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Tree Products in Agroecosystems:
Economy and Policy Issues

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TREE PRODUCTS IN AGROECOSYSTEMS: ECONOMY AND POLICY ISSUES

J.E.M. Arnold

Trees in agroecosystems occur in two distinct places: they are planted and managed in the farming system, and are managed in neighbouring common property resources (CPRs) to provide inputs needed in order to complement those available from on-farm resources. These non-forest sources of production are becoming increasingly important with the growing decline and degradation of nearby forests and the increase in demand for fuel, fodder, and other products. As expropriation by the state, privatisation and encroachment reduce common property resources and overuse degrades those that remain, so there is a general trend towards greater reliance on on-farm resources.

The paper does not deal with production systems that take place wholly within the forest - namely systems based on shifting cultivation on forest land, or forest land which is locally owned but operated for forest outputs rather than agricultural inputs - as these are influenced more by policies and practices related to the use of forest land and forest resources than by agricultural policies and practices. It does, however, review trends in the use of, and rural reliance on, forest products; examine the role of CPRs as a source of these products; and characterise trends in the growing and management of trees in farming systems. Throughout, the impact of national policies and of programme and project interventions on these two sectors is examined in the respective sections.

Forest Products and the Rural Household Economy

There are three broad categories of use of forest products: direct use by the household as fuel, food, etc; inputs into the agricultural system such as fodder and mulch; and sources of rural household income and employment.

Household Inputs

For most rural people foods derived from forests, or from trees they maintain in their farming system, add variety to diets, improve palatability, and provide essential vitamins, protein and calories (Falconer, 1989). The quantities of forest foods consumed may not be great in comparison to the main food staples, but they often form an essential part of otherwise bland and nutritionally poor diets (Table 1). Forest and farm tree food products are also widely used as snack foods between meals, eaten while working in fields, while herding and so on.

In addition to these supplemental roles, forest and farm tree foods are extensively used to help meet dietary shortfalls during particular seasons of the year; helping bridge 'hunger periods' when stored food supplies are dwindling and the next harvest is not yet available. Forest and farm tree produce are also valued during the peak agricultural labour period, when less time is available for cooking and people consume more snack foods.

Table 1: Some common nutrition problems and the potential role of forest food (Falconer and Arnold, 1988)

Nutrient-related problems	**Forest food with potential for combatting deficiencies**
Protein-energy malnutrition: due to inadequate food consumption causing reduced growth, susceptibility to infection changes in skin, hair, and mental facility	Energy rich food which is available during seasonal or emergency food shortages, especially nuts, seeds, oil-rich fruit and tubers: eg. the seeds of *Geoffroea decorticans*, *Ricinodendron rautanenil*, and *Parkia spp*; oil *of Elacus guineensis*, babassu, palmyra and coconut palms; protein-rich leaves such as baobab (*Adansonia digitata*); as well as wild animals (eg. snails) incl. insects and larvae.
Vitamin A deficiency: in extreme cases causes blindness and death: responsible for blindness of 250,000 children/year.	Forest leaves and fruit are often good sources of Vitamin A; eg. leaves of *Pterocarpus* spp., *Moringa oleifera*, *Adansonia digitata*, the gum of *Sterculia* spp., palm oil of *Elaeus guineensis*, bee larvae and other animal food; in addition fats and oils are needed for the synthesis of Vitamin A.
Iron deficiency: in severe cases causes anaemia, weakness and susceptibility to disease: especially women and children.	Wild animals including insects such as tree ants, mushrooms (often consumed as meat substitutes), as well as forest leaves such as *Leptadenia hastata, Andansonia digitata*
Niacin deficiency: common in areas with a maize staple diet; can cause dementia, diarrhoea, and dermatitis.	Forest fruit and leaves rich in niacin such as *Adansonia digitata*, fruit of *Boscia senegalensis* and *Momordica balsamina*, seeds of *Parkia* spp*., Irvingia gabonensis* and *Acacia albida*.
Riboflavin deficiency: common throughout southeast Asia; among those with rice diets causes skin problems.	Forest leaves are especially high in riboflavin, notably *Anacardium* spp., *Sesbania grandiflora*, and *Cassia obtusifolia*, as well as wild animals, especially insects.
Vitamin C deficiency: common to those consuming monotonous diets; increases susceptibility to disease, weakness.	Forest fruit and leaves often supply the bulk of Vitamin C consumes, especially good sources include fruit of *Ziziphus mauritiana, Andansonia digitata* and *Sclerocarya caffra*, leaves such as *Cassia obtusifolia*, and the gum of *Sterculia* spp. are also good sources of this vitamin.

The third main role of forest foods in the overall nutritional system is in emergency periods such as floods, droughts, famines and wars. In famine periods energy rich foods such as roots, tubers, rhizomes and nuts can provide an important buffer.

Where people have had relatively unrestricted access to forests, forest food is often particularly important for poorer groups within the community. While forest gathering activities are not restricted to the poor, the latter depend on these activities to a greater extent. They are therefore most likely to be affected by a reduction in the availability of such foods as the forest resource is reduced, degraded or becomes inaccessible to them.

The role that forest food plays in household nutrition has also changed with penetration of rural markets by new food products and with changing tastes. Some studies indicate that emergency uses of forest resources are dwindling as people rely to a greater extent on food purchasing (Falconer, 1989). In many regions forest food is no longer consumed and knowledge about its use is vanishing. Elsewhere, markets for forest foods have grown rapidly – for example, that for bushmeat in West Africa. However, even where consumption is not declining the nutritional diversity of the gathered food may have decreased.

The impact of declining consumption of forest food varies. In some cases these changes have led to a poorer quality diet; most notably a greater reliance on purchased food reduces dietary diversity. Perhaps the worst impact is that poorer people's food options are being progressively reduced, especially during seasonal and emergency hardship periods.

Reduced availability of or access to forest resources may lead to problems with fuelwood supply. Yet decreasing availability of wood does not necessarily lead to shortages of fuel. People respond spontaneously to decreases in fuelwood supplies through a number of adjustments. For those with land the adjustment process may include using more of the woody material grown on their own land, and making changes in cropping patterns to include species such as pigeon pea (*Cajanus cajan*) which provide woody residues which can be used for fuel. For others, it may mean collecting fuelwood from resources further afield. Others may become more careful and economical in the use of available supplies, and shift to other readily available biomass fuels such as crop residues and dried dung (Dewees, 1989; Leach and Mearns, 1988).

Where rural fuel shortages do exist, the issue may be less one of physical scarcity than of labour shortages, constraints on access, or culturally determined patterns of behaviour (Dewees, 1989). Thus, the task of obtaining fuel may be becoming a greater burden because women have more to do, as is widely reflected in fluctuations in gathering seasonally which coincide with seasonal cycles in agricultural or other pressures on their time (Cecelski, 1987). This makes it no less a burden or problem, but alters the likelihood that tree planting will be a sufficient, or even appropriate, solution.

Agricultural Inputs

Many systems rely on tree cover to restore nutrients to the upper layers of the soil, either by intercropping suitable tree species with the farm crops or by gathering green mulch from trees off farm. Crop cultivation in the Himalayas, for example, is dependent on access to a substantial area of forest from which to cut and carry leaf mulch to maintain soil fertility. Increasing pressure on such systems can reach the point where the forest can no longer sustain the repeated offtake. In many agroecosystems, notably dryland systems where ploughing and sowing have to be compressed into a short rainy season, the numbers of animals needed are considerably higher than can be sustained from feed produced within the farm system, and can only be maintained if the farmer has access to grazing or fodder off-farm. Forests, woodland and areas of scrub are often the principal complementary source, and tree fodder is often the key source of livestock feed in the dry season and in periods of drought.

Numerous pressures have combined to reduce the availability of livestock feed. The irrigation of land previously under dryland crops or pasture, the shift to short stemmed low stover but high grain yielding grain crops, and shifts away from cereal crops are some of the changes occurring. At the same time, privatisation and land degradation have widely reduced feed availability on public lands. The available responses – irrigated fodder crops, stall feeding, substituting animals with tractors – tend to require more intensive use of capital or labour and therefore are not available to the poor.

Income and Employment

There is a wide range of forest products which rural people gather, produce and trade in order to derive income. Gathered products include fuelwood, rattan, bamboo, fibres, medicines, gums and wild foods (Falconer and Arnold, 1989; de Beer and McDermott, 1989). The main groups of traded products which are processed in the household or small enterprises are furniture and other products of wood, baskets and mats and other products of canes, reeds, grasses, etc, and handicrafts (Fisseha, 1986).

The extent of such small enterprise operations reflects the size of rural markets for forest products, and the dispersion of these markets across large areas with a relatively poor transport infrastructure. Small forest based gathering and processing enterprises provide one of the largest sources of non-agricultural employment and income to rural people – at a time when rural households are having to look to non-farm employment and income for a growing share of their total livelihood (Kilby and Liedholm, 1986).

Many people depend on sale of such products as fuelwood and rattan to supplement their farm income year around. Others engage in such activities seasonally, either to exploit raw materials or markets available only at particular periods, or the labour available in slack agricultural months, or to meet seasonally induced cash needs such as agricultural loan payments or school fees. Others resort to them during emergencies – for example, more people becoming involved in gathering and sale of fuelwood in years when agricultural conditions have worsened.

The seasonality of activities is often dictated by the availability of the product or raw material, or by the demands of other activities such as agriculture. For example, in northern Brazil, Babassu palm kernels are gathered and processed during the agricultural slack period. During this period the income earned from these activities represents more than a third of the family's overall budget (May et al, 1985). As the markets for many locally processed forest products are dependent on rural people's purchasing power, they too are tied to the cyclic nature of agricultural incomes. Tree based income and employment opportunities are particularly important to the poor – because of ease of access and very low thresholds of capital and skill needed to enter and engage in most of them. They also enable a high level of participation by poor women, who often dominate activities such as mat and basket making which may be performed in or near the home, thus allowing them to combine these income earning activities with other household tasks.

However, returns to labour from many forest-based activities are marginal, and markets for the products may be vulnerable to introduced substitutes. Moreover, diminishing forest stocks are a particular threat to small enterprises, as they are seldom able to create or conserve their own tree resources. Their forest raw material problems are often worsened by unfavourable harvesting controls, exclusive allocation to large users, complicated licensing or auctioning procedures, high prices due to state monopolies, and monopoly distribution systems. Thus, while forest based activities provide a means of income earning for a large number of rural poor, many may not be sustainable in the future (Falconer and Arnold, 1989).

Common Property Resources

Patterns of CPR Use

Rural people draw much of their forest products from areas of forest, woodland and 'waste' land to which they have access as common property resources (CPRs). These outputs often constitute a major component of the overall agricultural system – filling gaps in the resource and income flows from other resources, and providing complementary inputs often critical to the continued functioning of agricultural and household systems.

The nature and magnitude of the relationship varies with the characteristics of the surrounding ecological and agricultural systems. In India, for example, there are three broad categories (Arnold and Stewart, 1989):

- In the *arid and semi-arid regions*, land allocation and encroachment have steadily reduced the area of CPR lands, which are commonly heavily degraded and under effectively open access usage. A large proportion of the dryland draught animals are maintained on these CPRs, and fodder and fuel are the two most important outputs. The relative importance of CPRs varies significantly between households, with the poor being much more dependent on them and the rich more interested in privatisation. Most of the CPR lands not yet privatised exhibit soil erosion or fertility problems, and cannot sustain low input annual agriculture.

- In the *hills*, CPRs can comprise 60 to 80% of the area, predominantly in the form of forests under the control of forest departments. In contrast to the dry plain regions, CPR areas per household can be substantial, and all households have similar patterns of CPR use. Green mulch and fodder are the main outputs. Increased commercialisation of CPR products has led to heavy use in many areas. However, many forests, though degraded in terms of timber content, are still capable of producing sustained supplies of other CPR products.
- In the *forest belt* across central India, common property resource management traditionally covered most of the land. The major use by the indigenous people is collection of minor forest products as a source of income. Expropriation of local rights by the state, and rapid and continued privatisation, much of it by outsiders, has seriously weakened traditional institutions and practices.

The poor are usually more heavily dependent on common property resources than others. In a major study of common property resources in 82 villages of dryland India it was found that the poor obtained the bulk of their fodder and fuelwood and some 15– 23% of their income, from CPRs (Jodha, 1990). The poor also benefit considerably from the employment created by CPR management activities.

The trends in CPR availability have been steadily worsening. Nearly everywhere privatisation, encroachment and government appropriation have taken resources out of common use. Increasing pressures on what is left have frequently led to progressive degradation. This process is now so heavily entrenched in policy and practice as to make further privatisation or appropriation seem either inevitable or desirable, or both.

The result has been the widespread undermining of the self-regulating capabilities of groups of users of the resources. In India, of the communities that in 1950 had exercised controls such as rotational grazing, seasonal restrictions and watchmen, only 10% still had such controls by the early 1980s, whilst the use of fines, taxes and fees had ceased altogether. As a result most CPRs have become open access resources (Jodha, 1990).

In forest communities in Southeast Asia, traditional methods of access control, usufruct allocation, and conflict resolution have widely become ineffective or have disappeared, undermined by political, economic and social changes within the village and nation. State assertion of control first over the resource then over the land reduced access and rights of usage. Differentiation within the community, and in-migration of outsiders asserting claims to use the resource, have widely thwarted efforts to maintain or re-establish local control systems (Poffenberger, 1990).

And in Africa, large areas of land have been transferred from communal to state control. Management has changed from use-rights based on clan-membership to the exercise of state-granted privileges and management by restriction and exclusion. The authority of the traditional kin-group has been undermined, allowing an increasingly unregulated exploitation of land. With government legislation having become necessary for any change to established practice, groups are discouraged from organising to manage their local resources (Shepherd, 1990).

Interventions in Management

Social Forestry Woodlots

One of the largest interventions designed both to increase the productivity of forest product CPRs and to strengthen local management institutions, has been the programme of communal woodlots established under the Social Forestry programmes and projects in India. Most of the woodlots have been established in the dryland areas of the country, and therefore have been introduced into the situation of shrinking CPR availability and breakdown of local control summarised above. Productivity was to be increased by raising woodlots on uncultivable public land, and control was to be exercised through the *panchayat* system – the lowest level of the state administrative structure.

Planting has been on village lands or uncultivated revenue lands temporarily transferred to the forest department for this purpose. The *panchayat*, or some other designated community level body, was to take over responsibility for management from the forest department after the latter had established the woodlot. Initiated in most States in the early 1980s, the programme has expanded very rapidly. In the State of Orissa alone, woodlots were established in about 3200 villages during the first four years of the project (SIDA, 1987).

Under forest department management the projects have created primarily tree stocks and wood products, with little in the way of the intermediate products such as fuelwood and grass which were previously locally valued harvest products. Use of the common resource is in this way being shifted from products for local use to higher valued wood products for sale outside the community. Benefits are consequently in practice being transferred from those who earlier used the common land to those who will gain from the income accruing to and spent by the community as a whole.

In addition, the planned transfer of responsibility for management of woodlots on common land to the community is seldom taking place. A combination of forest management prescriptions more closely tailored to foresters' rather than villagers' skills and experience, use rules set by government which are not always compatible with local needs and possibilities (and are not open to change locally), and planning and control systems centered in local government bodies rather than user groups, has meant a widespread lack of local confidence in the outcome. Because of these institutional weaknesses, the programmes run the risk that they are unwittingly converting common property resources into state controlled resources (Blaikie et al, 1986; Chambers et al, 1989; Arnold and Stewart, 1989). Though successful in increasing the productivity of the sites used, the interventions have been poorly adapted to the institutional situation of the region (Jodha, 1990).

Joint Management on Forest Land

A number of interventions in hill and other forested areas in India and Nepal have resulted in potentially more sustainable management systems. In each, the forest department has reversed the trend of increasing control over forest areas and given specific powers to local institutions. In all cases the forest department had legal control over large tracts of degraded forests, but was unable to increase productivity. Villagers, on the other hand, had great difficulty in securing the forest products they needed for direct consumption and to support their agriculture. In order to resolve these problems, local control was increased under agreements whereby villagers would get a much larger share of future produce if they managed present use to allow for regeneration. In some, but not all, cases external funds and assistance were also provided to assist the regeneration process.

The institutions, practices and other features of each vary quite widely, but they have a number of features in common which appear to explain their relative success (Arnold and Stewart, 1989):

- management by the user group, or groups, rather than by the village or *panchayat* as a whole;
- security of tenure to the user group, with the state playing an active role in defining and protecting boundaries against outside use and encroachment;
- use regulations which are evolved and enforced locally, and marked by simplicity of individ ual rules and an ability to change these rules to meet new challenges;
- benefit allocation managed by the community, and reflecting the interests of the elite and the powerful as well as those dependent on the CPRs; and
- management focused on low value products of local importance.

The most successful examples seem to occur in areas where the technical knowledge already existed at the village level, and the missing ingredient was an effective agreement between village level institutions and local representatives of the government. Experience suggests that such institutions and working arrangements can mature in a relatively short period.

However, success with joint management is still the exception rather than the rule. A survey of experience in Southeast Asia (Seymour and Rutherford, 1990) reports two main impediments to progress. One is the reluctance, or inability, of forest departments to proceed with or implement devolution of responsibility to local level, particularly where they perceive that this will threaten their control over a timber resource. Improved access to use of forest products therefore tends to be concentrated on degraded forest. The other constraint arises from pressures from within the community that undermine or overwhelm agreed systems of local control.

Problems tend to be more pronounced where access to forest products is to be combined with rights to cultivate land – such as on tree *pattas* (leases) in India, stewardship contracts

in the Philippines, STK land entitlement certificates in Thailand, and the forest management agreements between the State Forest Corporation and groups of farmers practicing *taungya* (tumpang sari) on forest land in Java, Indonesia. Additional problems with these arrangements include concern on the part of governments, or government departments, that a concession that allows temporary use of forest land for cultivation will lead to permanent alienation of the land from forest to agriculture. Such schemes may also founder because participants lack the resources to bring the degraded land assigned to them in to productive use. Allocation to individuals of land which previously was available for common use also tends to raise problems of choice and exclusion among the previous users.

It is therefore necessary to recognise when CPR management is unlikely to succeed. When local institutions have broken down under the pressures of change, it is not to be expected that new village institutions capable of controlling resource allocation and use can be created easily. Interventions which increase the productivity and value of a CPR may attract interest in its privatisation, which could undermine the present level of control. The low returns and high social cost associated with trying to control CPRs may prove unacceptable to users, to the point at which they prefer to leave it to the state to manage them.

Where local management is feasible, one of the main roles of the state is likely be to legitimise and empower the local controlling institution. Many existing CPR management initiatives are threatened by weaknesses and impediments in related land use and forest legislation. Interventions may be at variance with existing legislation, or the implementation of enabling legislation, where it exists, is being neglected.

Trees in Farming Systems

Patterns of Farmer Tree Management

As common property resources disappear or are degraded, farmers everywhere have sought to shift the production of outputs of value on to their own land by protecting, planting and managing trees of selected species. In many situations farmers now depend on their own tree stocks for some products, and on common property resource sources for others. In recent times the process of adding trees to farming systems has been accelerated or transformed by the growing commoditisation of fuelwood and other tree products, and the consequent emergence of the growing of trees as a cash crop.

Some of the changes in agricultural land use may be such as to result in the elimination of trees from farming systems rather than their retention or establishment. Prominent among such pressures are competition with crops for light, water and nutrients on intensively used crop land; new agricultural techniques (e.g. use of tractors); broader land use practices (burning, free grazing); changes in control of the land (privatisation, nationalisation); and reduction in the rotational cycle to the point at which desirable trees are no longer able to re-establish.

Table 2: Contexts in which woodland management and tree planting occur in the **semi-arid regions of Africa (Shepard ,1990)**

Area-type 1	**Area-type 2**	**Area-type 3**	**Area-type 4**
General			
low rainfall……..high rainfall far from town…..…….…..….near to town low population density…..……..…...high population density extensive……..……..**Type of Land use**……...Intensive			
• Pastoralism, or • Settled home base + migrant animals, or • Shifting cultivation, long fallows • Labour the key constraint: so polygyny often found in this type of area.	• Settled agriculture, some on registered land. Some open land between farms. Fallows shortening. • Animals important but grazing pressure increasing. Kept on nearby commons.	• More intensive agriculture. Most land is demarcated as permanent registered plots. Dung or other fertiliser bought. • Animals fewer, kept on farms.	• Highly intensive agriculture; with all farms contiguous. • Increasing land prices + plot fragmentation. • Landlessness. • Off-farm employment increases. • Animals stall-fed or sold off.
Extent of common property resource (CPRs)			
Lots of common land; traditional management rules still extant.	Common land getting scarcer. Management rules causing conflict.	All common land gone except for hilltops, etc. CPR rules no longer thought workable.	Scraps of waste land may still exist. Management forgotten. Open access only.
LIKELY VILLAGER INTERESTS : PROMISING TREE PROJECT INTERVENTIONS			
• Only homestead planting: shade, fruit, hedges. • Only small nos. of trees wanted. • Tree-related cash from bush products such as browse, honey, charcoal, etc. • Only here is woodland management with villagers worth investigation.	• Mostly homestead planting, for shade, fruit hedging and some interest in poles. • Animal damage to planted trees a common problem. • Cash from farm-grown fruit, CPR-gathered fuel wood.	• Interest in field-boundary planting of poles, timber and maybe fuel. • Interest in all the homestead options. • Cash sales of fruit and poles; also farm-grown fuelwood if no competition from remoter CPRs.	• All tree-needs farm grown except high quality timber. • Good markets for high-value farm tree products. • Fodder for stall-fed animals? • Alley-cropping and mulching? • Put whole farm under trees and work off-farm?

Other changes tend to reduce, or even eliminate, the need for trees. Irrigation of dryland, for example, is likely to reduce the need for draught animals, and hence for fodder, and is also likely to create new and more productive sources of the latter than could be provided by fodder trees. Alternatives may be available which present a lower opportunity cost to the farmer than creating supplies of tree products – hence the widespread use of dung and crop residues in place of fuelwood. Other economic options available to the farm household – off the farm as well as on it – may offer a better use of its resources than adding or intensifying tree management.

The balance between supplies from tree stocks off-farm and from those managed and planted on-farm varies widely with agroecosystem (Table 2). Within a continuum from low rainfall, low population and considerable common resources to higher rainfall, high population and very little remaining common land, supply of forest products in semi-arid Africa shifts steadily towards dependence on farmer managed tree resources (Shepherd, 1990).

Similar patterns are found in other regions. In parts of the middle hills of Nepal where population growth has put existing resources under increasing pressure, there has been a major increase in tree cover on private land over a 24-year period; trees being added first to stream beds and banks, then to uncultivated land and the walls of rainfed terraces (Carter and Gilmour, 1989). In very arid areas in Rajastan, India, where fodder and fuel resources on common land have been severely depleted over 30 years, there has been an increase in the density of some of the woody shrubs intercropped on farm land (Jodha, 1988). Similarly in much of the humid tropics, there has been an increase in the proportion of farm land cultivated as tree bearing home gardens (Arnold, 1990).

Factors Influencing Change in Farmer Tree Management

Within a particular agroecosystem, farmer involvement in tree growing appears to be largely related to changes in the availability and employment of land, labour and capital, and to the progressive commoditisation of tree products such as fuelwood and poles. Variations in tree growing patterns seem to reflect variations in the efficiency of operation of factor markets, different stages in the process of agrarian transition, and different patterns of tenure.

Factor availability and use

It is generally argued that as land holding declines, its more intensive use for the cultivation of food crops will preclude the growing of trees. However, in situations where agroecological conditions favour vertically structured joint tree/crop/livestock systems as the most productive use of the site, farmers may respond to declining land availability through more intensive intercropping of trees and other perennial and annual crops. Such an evolution has been quite widely observed in the humid tropic belt in Asia and Africa within which home gardens feature as an important part of farming systems (Arnold, 1990).
Where labour resources are limited, as farm households are forced to turn increasingly to off-farm employment, low input tree crops may be employed as a way of keeping land in

productive use. This is more likely to happen where poorly functioning labour markets prevent more productive labour intensive uses being adopted, and where leasing out the land is not attractive to farmers.

Tree growing may also be adopted where lack of access to capital prevents farmers adopting more capital intensive crops. In highland areas in Kenya, for example, this appears to be one of the factors determining fanner choice between tea and woodlots (Dewees, 1990). In areas where farmers' livestock are not used for this purpose, they may also grow trees as a way of maintaining a reserve of capital. Farmers also use trees to help manage risk where repeated drought threatens other crops. Trees are also grown to help diversify farm production, to provide products and income in the period between the main harvests, and to help bridge the peaks and troughs in seasonal demands for labour (Chambers and Leach, 1987).

Commoditisation

Growth in the markets for short rotation wood products has often stimulated substantial farmer tree growing. This response has been most pronounced in wood short areas, where site and tenure conditions are favourable for tree growing, where low labour input land uses are favoured, and where there has been transition from predominantly subsistence oriented agriculture towards greater involvement in commodity markets.

The expansion of the growing of trees as field cash crops has attracted concern, notably in India, that it is diverting land from production of essential foods, and is reducing rural employment (CSE, 1985). This tends to overlook factors which are causing farmers to withdraw land from low value crop production, and to find less labour intensive forms of land use, and the features of tree growing which make it a logical response to these pressures (Saxena, 1990).

Trees such as eucalyptus can be unsuitable where they put household food security at risk. Producing only a single product, they are potentially vulnerable to market fluctuations, and thus to income fluctuations. They provide income in 'lumps' followed by periods with little or no income. Multi-purpose trees and multi-species systems such as home gardens are more likely to contribute to a sound mixed subsistence/cash crop household economy. Tree monocropping is likely to be an appropriate option only if the household has access to other sources of income or food, and if there are reasonably stable markets for the tree products (Falconer and Arnold, 1989).

Tenure

Security of tenure has obvious implications for tree growing decisions. Leasing, sharecropping and other forms of tenancy, systems of customary tenure under which land is a common pool resource, and customary and legal rights associated with the presence of trees, have all been assumed to inhibit tree growing.
However, the relative importance of tenure may have been overstated. In customary land use systems in Africa, rights, in particularly grazing rights, appear to be more important than tenure. Customary tenure may already provide the necessary assurances of returns to

capital and labour, so that tree growing decisions are determined more by considerations of profitability (Cook and Grut, 1989; Shepherd, 1990). Individualisation of holdings tends to result in an increase in tree planting, but this could be as much a reflection of the loss of access to common pool resources as of a perception of increased tenure security.

In upland Java, Indonesia, where tree cover plays an important conservation role, the principal factors influencing farmer tree management decisions were the productive potential of the land, size of total landholding, the presence or absence of good local markets for perennial crops, and of off-farm employment opportunities. While share-cropping and leasing arrangements may slow the rate of tree planting "tenure status per se is probably less important than related factors such as access to credit and the fragmentation, isolation and minute size of landholdings of many rural households" (Mackie, 1989).

The tendency to emphasise increased security of tenure for the individual so as to encourage investment in a relatively long gestation tree crops is therefore often misplaced. Changes in both formal and customary tenure are usually difficult to accomplish, so that it can be unrealistic to design project interventions which require such changes. Indeed, attempts to change tenure can be counterproductive. Past changes stemming from the colonial era have often engendered a strong distrust of government intervention in this area. Moves to individualise common pool resources can disenfranchise large segments of the local population. The prospect of change introduces uncertainty, and so may inhibit investments in long term activities such as tree growing.

Interventions in Private Tree Management

In the first generation of efforts designed to stimulate and support private tree growing by farmers, there was a widespread tendency to develop projects as though they were effectively isolated from many of the key influences on them – in particular economic forces. The assumption that farmers plant trees to meet subsistence or environmental needs, and that these are not bought or sold in the market place, was reflected in projects designed as though they were divorced from and immune to market forces. Some even tried to prevent participants from selling their produce on the grounds that this was contrary to the service function assumed to be the goal of community or social forestry. This reflected the priority that was given in the late seventies and early eighties to increasing supplies of fuelwood, in response to what was perceived to be a 'woodfuel crisis' (Arnold 1991).

The emphasis on meeting assumed subsistence needs has been accompanied by an underestimate of the influence of market demands for wood products – including urban demands for wood fuels. As forest products such as fuelwood, fodder and fruits become progressively commoditised, and with the growing dependence of farm households on income to meet at least part of their needs, the distinction between production for subsistence or sale has progressively less meaning. Not only will a producer sell what is surplus to her or his subsistence needs, but will sell a commodity needed in the household if the opportunity cost of doing so is advantageous – hence the widespread phenomenon of households short of fuelwood selling wood.

One result of promoting tree growing as though it were outside the forces of the market system has been the failure to match production to market possibilities. The collapse in pole prices in northwest India as large quantities of farmer grown material entered the market in the late eighties, as a consequence of Social Forestry support programmes, reflected lack of market information, and a lack of attention to the functioning of this emerging market. Most states still have in place restrictions on harvesting and sale of wood products by private producers which severely hinder the efficient functioning of these markets (Chambers et al, 1989; Saxena, 1990). In addition, farmers had to compete with fuelwood supplied to urban markets from state forests at subsidised prices. Many farmers are now withdrawing from tree growing in the areas affected (Saxena, 1990).

Similarly, projects have generally neglected to put producers in touch with sources of higher level inputs, such as credit, available to those seeking to produce for the market. Indeed, provision of credit, which has featured prominently in government programmes to encourage tree crop cultivation, has been notable by its absence in farm forestry projects, an exception being the PICOP smallholder tree growing project in the Philippines (Hyman, 1983).

Project interventions have centred on provision of subsidised planting stock, and/or cash payments to offset establishment and maintenance costs. Originally intended to encourage pursuit of essentially social and environmental goals, in practice they are generally supporting production for the market. Recent evaluations of projects in India suggest that there is a danger that this type of intervention is encouraging tree cash crops in situations where it is unlikely to be profitable. In Bihar, farmers appeared to be planting in response solely to the short term returns from the cash payments provided, rather than the longer term returns from investment in trees. This has lead to undesirable distortions in land use – such as displacement of sharecroppers and reduction in small farmer subsistence production and in areas available for grazing (SIDA, 1990).

Another weakness in early farm forestry projects has been in their technical prescriptions. A recent review paper reported that "the project record abounds with examples of projects that have foundered because of inappropriate species choice", and that "few social forestry project documents ever provide any systematic rationale whatsoever for the matching of tree species to the needs of the target community!" (Raintree and Hoskins, 1988). This is partly due to the lag in applied research, and the relative neglect of on-farm work. Thus, even with alley cropping, which has benefited from one of the most intensive and thorough research efforts of any innovation in the field of agroforestry, it is still unclear to what extent farmers will find it appropriate.

Another factor contributing to poor technical prescriptions and practices, has been the pressures often placed upon forest services to achieve planting or seedling distribution targets – pressures which all too often result in priority being accorded to quantity rather than quality (or appropriateness). The other main reason for the frequent mismatch between intervention and needs, is poor communication with farmers and their families due to shortage of people trained in communication and extension skills. This has meant that even projects which are now vigorously trying to remedy this weakness are burdened with

project objectives and designs which were developed without the benefit of involvement of the target population.

Implications for Policy

The large proportion of total developing country forest product use which occurs at the rural household level is increasingly met from production managed as part of agroecosystems. In many of these systems, common property resources managed to complement farm resources form critical parts of the total. The implications for future policy are considerable.

- Interventions have been too heavily biased towards creation of new resources through planting. Most of the forest products harvested from agroecosystems are still obtained from existing
- CPR tree stocks, and trees retained on fallow land and as intercrops within farming systems.
- Collective management of CPRs by local groups is possible given an appropriate policy and implementation environment and more accurate targeting and design of interventions. But many government policies undermine these structures through support to privatisation, encroachment and government appropriation, and legislation which gives greater support to private property.
- Interventions in favour of sustainable collective management need to be targeted to resources and institutional situations where this form of control and use has clear cut advantages; e.g. where privatisation or appropriation are inferior options.
- On-farm tree stocks will become progressively more important with the deterioration in forest and CPR resources. Lack of information about the role of trees in particular farming systems, and about present constraints to tree growing, can still hamper the definition and formulation of appropriate interventions.
- Interventions in support of collective management and private tree growing need to be based on fuller involvement of the beneficiaries than has been the case so far. Effective local control is usually based on user group rather than official institutions, and farm forestry is likely to succeed only when it is tailored to the particular features of the farming system within which it is inserted.
- Economic and legal incentives within the forest sector need to be overhauled to remove measures or practices that discriminate against or undermine local production. Private producers often face subsidised state wood supplies and impediments to their access to markets. Even the most progressive collective management initiatives tend to be threatened by their uncertain legal status, or by the failure of forest services to honour their own obligations or to enforce those of rightholders.

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