Economic Factors in Farmer Adoption of Forest Product Activities

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ABSTRACT
The adoption of commercial NTFPs within an agroforestry system is influenced by a number of different economic factors. Income from NTFP activities helps a substantial proportion of rural households meet seasonal and other needs. The relevance of particular activities in different situations is often changing rapidly, and care needs to be taken to focus attention on those with continuing development potential. Rising raw material costs are being accompanied by a shift towards supplies available on or adjacent to farms, but this is largely an adaptation to raw materials available in fallow and farm bush. Commercial activities based on planted stocks are often a by-product of trees established primarily to meet subsistence or other needs, or a response to changing availability of the factors of production (land, labour and capital). Growing exposure to markets may increase commercial opportunities for tree crops and may also improve access to inputs that could substitute for goods and services presently provided by trees.

INTRODUCTION
Very large numbers of third world rural households generate some of their income from selling non-timber forest products (NTFPs). As pressures on the agricultural land base increase, leading to progressive fragmentation of farm holdings and overuse of arable land, the ability of farm households to achieve food self-sufficiency from their land has been declining widely. Rural populations are becoming increasingly reliant on farm and non-farm income in order to meet their food and other needs. Forest product activities have repeatedly been found to provide one of the main sources of non-farm income to rural households (Fisseha 1987, Iedholm & Mead 1993). Products of farm trees can also be important sources of farm income (Arnold & Dewees 1995).

There is a great deal of descriptive information about local uses of NTFPs, but this is generally concentrated in situation-specific ethnobotanical, anthropological or geographical studies. There are few analytical studies that have attempted to synthesize the information available in economic terms (Falconer & Arnold 1989, Beer & McDermott 1989, Falconer 1990). However, more studies with an economic focus have been carried out recently, and a number of household and activity surveys have begun to shed light on broader economic patterns of NTFP production and use.

This paper draws primarily upon two areas of recent economic research related to farmer involvement in tree-product activities. One is concerned with economic factors that enter into farm household participation in harvesting, processing and selling forest products (Townson 1995a). The other relates to economic considerations that influence farmer decisions about management of trees and tree crops (Arnold & Dewees 1995).

Because some of the products that people produce and sell from trees and forests are wood products, it can be difficult to separate out information about those that relate only to non-timber products, from all the information generated by studies designed to look at relationships between people and the forest and tree resources they depend upon. Where necessary, therefore, some of the analysis in this paper takes account of all products that are important in understanding these relationships and not just those defined as non-timber forest products.

A related boundary problem arises because many marketed tree products are also used within the household. For many producers there are no clear distinctions between activities to meet their subsistence needs and those involved in producing for the market. They sell what is surplus to their needs or in response to the opportunity to generate needed cash income. Analysis of commercial decisions and actions at this level, therefore, need to take account of such subsistence (and cultural and spiritual) factors that determine the values that households place on different forest products.
Another definitional problem that arises in considering the process of domestication is that there is not a clear boundary between natural and domesticated tree stocks. Rather there exists a continuum from gathering from wild resources, through increasing intensities of management of naturally occurring stocks and the encouragement and protection of natural regeneration, to planted trees and other woody plants. Many NTFPs are also coproducts or byproducts of other forestry or agricultural products.

Within this framework of limited information and multiple uses and joint supply, the present review focuses on the factors influencing farm household commercial activities involving NTFP activities. The focus throughout is on products that serve local and other domestic markets, rather than on those destined for industrial processing overseas, as the former account for the bulk of what is traded.

The first part of the paper examines the main features of production and trade in such products, focusing on their magnitude and importance as sources of rural household income, and on the structure and dynamics of such activities. The second part looks in more detail at the sources of the main types of product and at shifts in the supply base that suggest which components are more likely to become domesticated. The third part reviews the main factors that determine the extent to which farmers are likely to adopt trees in different situations. The concluding section highlights a number of issues that may help in targeting interventions in support of domestication of products that can contribute to farm household incomes.

**PATTERNS OF NTFP ACTIVITY**

**Magnitude of involvement**

Density of involvement in NTFP selling varies widely. Recent countrywide surveys by the GEMINI Programme (Liedholm & Mead 1993) in six countries in eastern and southern Africa (Botswana, Kenya, Lesotho, Malawi, Swaziland and Zimbabwe), disclosed that on average 2.3% of rural populations and 0.8% of urban populations were selling more than half the wood products and the grass, cane and bamboo products that they were gathering or producing. A similar survey, but covering a wider range of products and users, in the forest zone of southern Ghana found 10% of rural people and 38% of households selling forest products (Townson 1995b). Studies in forest-rich areas adjacent to large urban markets show even higher levels of involvement—e.g., 68% of households surveyed in villages around the large market centre of Kumasi in Ghana (Falconer 1994) and all households in surveyed villages supplying the Amazon city of Iquitos (Padoch 1988).

A large component of forest product activities in the rural sector reflects the presence of raw materials, the size of rural markets for forest products, and the dispersion of these markets across large areas with a relatively poor transport infrastructure, so that they are more effectively supplied locally. They provide many of the products that farm households require at lower cost than can be achieved with supplies from the modern sector (FAO 1987).

As they are tied to the rate of change in agricultural activity and incomes, rural markets for most forest products, though very large, in aggregate tend to grow only slowly. More rapid growth in market demand is usually associated with expansion of urban use of wood fuels, certain foods, medicinal products, building materials and furniture, leaf and fibre packaging, and other forest products, which people continue to consumed as they move to the towns. Most of such forest products are usually characterized as goods used primarily by low-income consumers. However, expenditure data from the 1991-92 Ghana living standards survey indicates that in that country forest products are in fact bought by the bulk of the population, with about three-quarters of households in both rural and urban areas purchasing some of their forest product needs. Total household expenditure on just nine forest products, in the country as a whole in that year, was estimated to amount to the equivalent of more than USD 200 million. Although average household expenditures were low, rural markets accounted for the largest share of money spent on purchasing *akpeteshie* (spirit distilled from palm wine), bushmeat and furniture. Urban markets dominated expenditure on palm wine, bushmeat, snails, honey, firewood and charcoal (Townson 1995b).

**NTFP income and household livelihoods**

Many studies have indicated that, where people have had relatively unrestricted access to forests, the income from forest foods and forest products is often particularly important for poorer groups within the community. Thus dependence on income from NTFPs has been shown to be inversely related to size of landholdings in Orissa, India (Fernandes & Menon 1987), and in Brazil (Hecht et al. 1988), to family incomes in dryland India (Jodha 1990) and Sri Lanka (Gunatilake et al. 1993), and to levels of household rice self-sufficiency in the Philippines (Siebert & Belsky, 1985).
Income from forest products seldom appears to account for a large share of a household’s total income, but it is often important in filling seasonal or other cash flow gaps, and in helping to cope with particular expenses or to respond to unusual opportunities. Among persons generating some income from forest products activities in households surveyed in southern Ghana, 72% identified this income as being important either in absolute terms, or in meeting particular needs, or because of its timing (Townson 1995b). But only 10% of these respondents identified this as their sole source of income, and for only a minority was it the main source. For 66% of these households, half or more of their income came from agriculture. This is consistent with evidence from case studies from a variety of other situations (e.g., May et al. 1985, Falconer 1990 and 1994, Madge 1990, Davies & Richards 1991, Hopkins et al. 1994, Leach & Fairhead 1994).

Income-earning activities based on marketable forest products may be seasonal or year-round, or they may be occasional when supplementary cash income is needed. There are several dimensions to the seasonality of forest-based income-generating activities. Some are governed by seasonally induced cash needs, such as the need for income to buy food during the ‘hunger period’ between harvests, or to purchase farm inputs. Other activities are seasonal, largely because the crop or material can be gathered only at certain times of year. The fluctuation in timing of other forest product activities is dictated by the seasonality of other activities, such as demand for baskets needed at harvest time and the surge in demand for many items as agricultural incomes peak. Some activities are also linked to fluctuations in availability of labour and to decline in agricultural and planting seasons, or they are phased to take advantage of slack periods.

Often these pressures work in conjunction one with another. A study in Sierra Leone found that fuelwood sales provided the first cash income from land cleared for rice production. Subsequently fuelwood collection for the market was concentrated during the off-peak agriculture period, providing cash income in a period when food supplies are generally at their lowest (Kamara 1986). A study in the forest-savanna zone of Guinea showed that farmers link their wild plant collection and trading incomes to seasonally timed needs—e.g., to purchase seeds, hire labour for cultivation, and buy food at harvest to be processed and sold during the dry season. Many women traders generated their working capital from cropping, gathering and processing, within sequences in which one activity’s output becomes another’s input (Leach and Fairhead 1994).

The role of forest-based activities as a source of income that people can fall back on in times of crop failure or shortfall, or to cope with some other form of emergency, has also been shown to be very important. Numerous case studies document how the numbers involved in the selling of forest products rise in such times. In addition, some forest-product activities may be opportunistic, taking advantage of unexpected or periodic surges in availability of a product to generate additional income or savings (Beer & McDermott 1989, Falconer 1990).

The high incidence of women’s involvement in NTFP activities in most situations (e.g., 40-50% in Ghana and the six countries of eastern and southern Africa) appears to reflect easy access to the resource and low thresholds of skill and capital. As forest-product processing may often be performed at or near home, women are often able to combine these income-earning activities with other household chores (e.g., child care). In addition, as women traditionally use forest products to meet some of their household’s basic needs (e.g., fuelwood, medicines and foods), gathering of forest products for the market can often be accomplished in conjunction with other collecting activities (Falconer 1990). Income from forest products can be more important to women than to men. In western Niger, for example, income from products of the commons was found to represent 27% of women’s local non-farm income, as compared with 10% for men (Hopkins et al. 1994).

Patterns of change

Even a cursory examination of the information available demonstrates that the pattern and frequently the magnitude of NTFP activity are changing substantially (some activities expanding and some declining) and often rapidly. In some situations users are becoming more dependent on tree-product activities, in others they are moving away from dependence on them. If interventions to foster development of sustainable forest-product activities are to be effective, it is evidently important to be able to understand which categories are likely to continue to prove viable and important in the future, and which are destined to decline and disappear.

At least three sources of the marked differences observed in the performances of different types of forest product activity can be identified:

- **Product and market characteristics:** the level of output in some activities is changing because of characteristics such as rapidly growing demand, absence of competitive alternatives, sustainable raw material, or a technology with no diseconomies of scale that encourage growth.
- **Production or distribution process characteristics:** these can enable or prevent the component enterprises to increase in size, or to add extra value by diversifying into additional stages of the process, or to organize the process more efficiently (or to exploit more than one of these avenues).

Features of individual enterprise: entrepreneurial and managerial talent, location, constraints and opportunities in the local agricultural economy, etc., can also be reasons for growth or decline of NTFP performance.

Performance is therefore likely to reflect a combination of factors related to the product, the way it can be produced and marketed, and the circumstances within which a particular enterprise is operating. In economically stagnant regions, much growth in non-farm activity comes about as people who cannot find employment in agriculture (or urban activities) try to move into the non-farm economy, being absorbed principally in creation of labour-intensive, low-return micro-enterprise activities. In contrast, in regions where rural incomes are growing rapidly, growth in enterprise activities is predominantly demand driven, reflecting the increased need for services and the diversification of consumption into more non-food items, many of which will be produced in the rural areas. As wages rise, the structure of small enterprise activity is likely to shift from low return into higher return activities. With improvements in rural infrastructure and incomes, manufacturing tends to become more concentrated in somewhat larger workshop scale enterprises located mainly in rural settlements and towns (Haggblade & Hazell 1989, Haggblade & Liedholm 1991).

The progress of NTFP activities tends to reflect these broader trends. Of the two largest activities recorded in the surveys in eastern and southern Africa, employment in woodworking was growing 10 times as fast (30.6% per year) as employment in grass, cane and bamboo activities (3.1%). The latter are low input and output processes tied to agricultural demand, based on a simple technology, primarily single-person production units, and subject to competition from alternative products. It could be argued that they thus show many of the characteristics of activities that grow when the lack of alternatives forces more people to engage in them but that are unlikely to prosper as the economy grows. Many woodworking units, though, seem better able to respond to growing demand, as they are relatively high-input and -output activities confronting growing urban as well as rural demand, and employing flexible technologies that facilitate expansion of individual enterprises. This seems to be borne out by the observation that, at the time of the surveys, about 80% of jobs existing in grass, cane and bamboo activities came from new start-ups. In woodworking, in contrast, 55% of jobs came from expansion of existing enterprises (Arnold et al. 1994).

Comparable analysis of the range of NTFP activities found in southern Ghana (table 1) suggests that many forest product activities are 'activities of last resort'. Most are characterized by ease of access and low capital or skill thresholds needed to enter. Participants in such activities are consequently likely to find themselves in oversaturated markets that offer very low returns to labour. Few are able to expand beyond the single-person (or at best family-based) operation, operating from the homestead. They are thus activities that are likely to be abandoned by those involved in them if more attractive options become available. If correct, this interpretation clearly has important implications for the selection of NTFP options to promote.

<table>
<thead>
<tr>
<th>Product</th>
<th>Change (a/b)</th>
<th>Demand (a/b/c)</th>
<th>Features (a/b/c)</th>
<th>Problems (a/b/c)</th>
<th>Viability (a/b)</th>
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<td><img src="image55" alt="Image" /></td>
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<tr>
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<td>++[+]</td>
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<td><img src="image58" alt="Image" /></td>
<td><img src="image59" alt="Image" /></td>
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CHANGES IN THE RAW MATERIAL BASE

The progressive domestication of a naturally occurring commercial product usually reflects pressures to bring the source of supply under closer control. This response may be to rising costs, irregularity of supply from wild sources, problems of quality, etc. In this section these issues are examined as they relate to NTFPs and the balance between forest and non-forest sources of supply that is emerging.

Raw material 'shortages'

Reports of worsening NTFP supply situations have been widespread. Complaints about raw material supply problems feature prominently, for example, among forest product producers included in small enterprise surveys. More of these producers report supply as their main problem now rather than at start-up (Fisseha 1987, Arnold et al. 1994). Much of this can be attributed to rising costs rather than, or as well as, physical depletion.

The increasing dependence of rural people on wage labour reduces the amount of time they have available for other activities and raises the opportunity cost of labour. Recent studies have revealed that the poor are often unable to devote as much labour to gathering or trading NTFPs as in the past. This was found, for example, in Orissa, India (Fernandes et al. 1988), parts of Indonesia (Peluso 1989), the Gambia (Madge 1990) and Vietnam (Nguyen Thi Yen et al. 1994).

The opening up of rural areas itself expands the range of employment options open to rural people, encouraging a move away from some of the more marginal and often isolated and arduous forest-product activities on which they previously depended. For example, improved links between producer and market areas in the Amazon have made agriculture more attractive, contributing to the decline in the numbers engaged in collecting and selling forest products (Browder 1992, Richards 1993).

Changes that reduce physical or economic supplies of particular products may thus be part of broader changes that cause or encourage a shift away from the products altogether, rather than a move to producing them in a more controlled and less costly manner. Some of these trends are evident even where supply remains abundant. A recent study in West Malaysia, for instance, found 279 species present that had been used as foods, medicines, etc., in the past. Of these, only 71 were still being used by local people, and only 11 (10 of them fruits and vegetables) were being sold in nearby markets (Lim & Jamaluddin 1994).

In addition to rising costs that reduce economic access to a resource, many gatherers and producers of NTFPs face other restrictions on their access. As growing commercial demand increases the value of particular forest products, the poor may find themselves excluded from access to the resource. In the Orissa case referred to above, for example, use of trees on village common land was progressively monopolized by the rich and powerful as market demand for NTFPs grew, forcing the poor to collect from further afield (Fernandes et al. 1988).
Producers often face forest policies and practices that focus on conserving the forest resource and on protecting the rights of those licensed to harvest timber. This commonly results in policy prescriptions relating to use of non-timber products that are generally restrictive rather than enabling. Such policies are typically pursued through systems of licensing, fees and other measures designed to limit rather than encourage production and sale of such products (Dewees & Scherr 1996).

**Non-forest sources of supply**

Rising costs and increasing constraints on access to supplies off-farm are reflected in a marked concentration of production on or close to the farm. A study in a forested area in Sierra Leone, for instance, found that only 14% of all hunted or collected foodstuffs and 32% of the medicinal plants came from the forest; the rest came from fallow and farm bush areas (Davies & Richards 1991).

Similarly, in southern Ghana nearly half of those surveyed reported the farm bush as being their most important source of NTFPs, and a quarter stated their main source to be the farm. Though these magnitudes need to be viewed with some caution, as people are sometimes reluctant to report what they harvest from reserved forests, it does appear that the most important activities draw on forests for little, if any, of their supplies (table 2). A large part of the NTFP activity in the area is thus presently based on farm resources. These resources are, however, mainly naturally occurring stocks, retained during clearance or regenerating on fallow areas. Only some of the oil palm is of planted origin. The forests are a major source of raw materials for some of the smaller activities such as canes, chewspunge and sponge, and for particular forest products such as snails, mushrooms and wrapping leaves.

### Table 2: Number and share of participants dependent on reserved forests as their most important source of raw materials, Ghana forest zone

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of participants dependent on reserved forests as their most important source of raw materials</th>
<th>Proportion (%) of participants dependent on reserved forests as their most important source of raw materials</th>
<th>Ranking of activity by number of participants (all sources of raw materials)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushmeat</td>
<td>8343</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Wrapping leaves</td>
<td>8328</td>
<td>31</td>
<td>4</td>
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<tr>
<td>Snails</td>
<td>6688</td>
<td>35</td>
<td>7</td>
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<tr>
<td>Chewspunge</td>
<td>4719</td>
<td>47</td>
<td>10</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>3721</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Baskets</td>
<td>3247</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Medicines</td>
<td>2994</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Sponge</td>
<td>2935</td>
<td>38</td>
<td>12</td>
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<tr>
<td>Akpeteshie</td>
<td>2832</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Pestles</td>
<td>1463</td>
<td>39</td>
<td>15</td>
</tr>
<tr>
<td>Canes</td>
<td>1425</td>
<td>39</td>
<td>16</td>
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<tr>
<td>Carving</td>
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<td>51</td>
<td>18</td>
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<tr>
<td>Raffia thatch</td>
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<td>Mats</td>
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<td>Honey</td>
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<td>14</td>
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<tr>
<td>Firewood</td>
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<tr>
<td>Charcoal</td>
<td>0</td>
<td>0</td>
<td>17</td>
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</tbody>
</table>

Source: derived from Townson 1995b

The structure of NTFP activity is also strongly influenced by the demand for labour in agriculture and its relative attraction as a source of income. A number of products, for instance, are dominated by groups and individuals who have migrated into the area and therefore have only limited access to land. Similarly, some activities are dominated by young men who still do not have their own farms, while other activities (e.g., charcoal production) are concentrated in areas where new farms are being cleared (Townson 1995b).
There are also many situations where people have actively manipulated a naturally occurring resource in order to encourage and maintain components of particular value. The babaçu palm in northeast Brazil has long been integrated into local farmers' shifting cultivation system (May et al. 1985). Farmers in the floodplain forests of the Amazon area manage them to favour the economically more valuable species they contain (Anderson & Ioris 1992). In West Kalimantan, forest areas adjacent to communities with improved access to markets have been managed in favour of 'orchards' of the wild fruit tree durian (Padoch 1995, Peluso 1994).

However, the West African evidence suggests that, in at least some situations, the choice by farm households of what farm-based NTFP activities they concentrate upon is largely dictated by the availability of labour and what activities can be based on and integrated with their agricultural activities. It is therefore likely that the tree products most in demand from off-farm sources will provide only limited guidance to which trees farmers wish to establish on-farm. In selecting trees to be grown on-farm as a source of commercial products, it will therefore be important to understand how each responds to the range of needs that farmers usually try to meet through tree management.

**TREE CROPS AND FARMER MANAGEMENT DECISIONS**

As off-farm tree production declines, farmers may maintain or grow trees to maintain supplies of tree products to meet the growing demand for tree products, to help maintain agricultural productivity, or to contribute to risk reduction and management (Arnold & Dewees 1995). In most farm systems, trees are present for a combination of more than one of these purposes. Multistrata home gardens, for example, incorporate a variety of woody perennials that contribute to nutrient recycling and soil protection and yield produce that supplements output from other parts of the farm system. Reliance on home gardens also helps to spread farm work, output and income more evenly throughout the year (Ninez 1984).

Three factors in particular may influence farmer decisions about tree management to produce saleable products:

- the influence of market opportunities and constraints
- the relationship between tree crops and different factor endowments and needs
- the roles of trees in risk management

**Market opportunities and constraints**

Research suggests that most farm-level tree management is primarily to meet household needs. Trading in tree products usually develops as local markets emerge for fruits, fuel and other tree products or shortages. Alternatively, trading can develop as increasing demands on the time of household members leave less time for gathering what is needed to meet household needs. In addition, rising cash incomes allow some households the option of purchasing rather than gathering or growing tree products. Households that are managing tree stocks to provide themselves with such products will sell what is surplus to their needs, or will sell more of their output, to generate additional income (Arnold & Dewees 1995).

Markets for tree products can be important to small-scale, resource-poor farmers at this stage in their integration into a market economy when the costs and risks involved are low (e.g., there are low costs of entry, early returns, market channels that serve small-scale as well as large-scale producers), and production systems can be developed incrementally without putting other parts of the farm system at risk. For example, farmers in an area studied in western Kenya, who had increasingly been growing trees to meet their household needs for poles, fruit and fuelwood, expanded their production of these products for sale to local markets as these markets developed. This has become an important part of overall cash strategies of many households, with sales within communities or between neighbours still predominating (Scherr 1995).

Production for urban and industrial markets is more likely to be practised by farmers in areas where the process of agrarian transition has evolved further towards greater involvement in commodity markets and where there has been an evolution towards an entrepreneurial approach to agriculture based on cash crops. Farmers are likely to enter the market for tree products where they lack other income opportunities, as was the case with black wattle in central Kenya (Dewees 1993) or where returns from tree crops appear to be more attractive or stable than from alternative crops, as was the case during the phase when farmers were adopting eucalypts in north India (Saxena 1992).

In these markets, however, farmers can encounter forms of competition, and policy constraints that can make it difficult for them to compete. In many situations urban markets for most NTFPs are still being supplied by
mining natural stocks, with producers paying little if anything for the raw material, so that the cost of the product delivered to the market consists mainly of labour and transport. In addition, in many countries supplies of some products come from state forests and plantations and are sold at administered prices. Private producers are also frequently subjected to controls on harvesting, transport and sale, designed to protect against illegal felling for sale from state forests. Resulting cumbersome and costly bureaucratic procedures lead to private producers having to depend on intermediaries to market their produce.

Different combinations of market factors affect farmer development of tree stocks to supply urban wood fuel markets in different ways (table 3). In the Sudan, production by farmers is simply not practical in competition with the low-cost supplies from wood generated through agricultural land clearing. In both central Kenya and northern India, on the other hand, the cultivation of trees as wood cash crops did emerge but then was curtailed in the face of competitive and policy constraints (Dewees and Saxena 1994a). Unless such impediments can be reduced or removed, urban and industrial markets are likely to be less important than local rural markets in most tree-growing situations.

Factor availability and allocation

The varying role of trees in different situations often reflects differences in the availability of the different factors of production—land, labour and capital. Where the amount of arable land is the limiting resource, trees, as a land use that produces low returns per unit of area, are generally restricted to homesteads, boundaries and other niches where they do not compete with the agricultural crops. However, in some agroforestry systems tree outputs complement or supplement crop outputs, thereby increasing total returns per unit of area. Home gardens, with their vertically layered structure of trees, shrubs and ground cover crops making effective use of space above and below the soil surface, provide a notable example of this.

As farm households have increasingly come to depend on income earned from employment off-farm, labour rather than land is widely becoming the main resource limitation determining farmer options. As the growing of trees requires lower inputs of labour to establish and maintain than most other crops, such shifts in the ratio of labour to land may encourage greater reliance on tree crops (table 4). Thus, in central Kenya a study found that it was households with fewest resident adult males that were most likely to retain or establish black wattle woodlots, in preference to using the sites for the growing of the much more labour (and capital) intensive crop of tea (Dewees 1993). In north India it was the more asset-rich households (with significant off-farm income) seeking to minimize labour supervision requirements that were most likely to grow eucalyptus as a crop (Saxena 1992).

Table 3: Comparison of wood product markets, and their operation and impact in providing incentives for farmers to cultivate and manage trees

<table>
<thead>
<tr>
<th>Characteristics of markets and systems of production</th>
<th>Country case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sudan</td>
</tr>
<tr>
<td>Type of wood and tree product markets</td>
<td>charcoal</td>
</tr>
<tr>
<td>Sources of supply which meet market demands</td>
<td>agricultural land clearance</td>
</tr>
<tr>
<td>Competing sources of supply</td>
<td>none</td>
</tr>
<tr>
<td>Time scale and impact of markets on farmer tree growing</td>
<td>never provided any incentive for tree growing</td>
</tr>
<tr>
<td>Other incentives not directly linked to markets</td>
<td>none of relevance; some irrigation is made available for eucalyptus and Acacia nilotica, but it is not economic to grow these species for charcoal on any scale</td>
</tr>
</tbody>
</table>
### Table 4: Trees and land and labour allocation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Earliest adopters of tree growing innovations</th>
<th>Comparative advantage of sustainable production systems</th>
<th>Bioeconomic constraints to the adoption of tree growing innovations</th>
<th>Policy constraints to the adoption of tree growing innovations</th>
<th>Characteristics of the ways markets operate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited by legislation</td>
<td>earliest adopters were landed and wealthy, though later adopters included small-scale farmers as well</td>
<td>land-tenure constraints before independence encouraged households to plant trees to establish land rights; trees also favoured by households with labour supervision problems or with low demands for income</td>
<td>low opportunity costs for land (tea and coffee more lucrative than trees)</td>
<td>movement controls on charcoal, price controls, paraffin subsidies</td>
<td>more segmented market operation, with transporters providing the crucial link between rural producers and urban markets</td>
</tr>
<tr>
<td>Source: Dewees and Saxena 1994a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tree planting may be seen as a feasible land-use option when the opportunity costs of using household labour on-farm are high because there are good wage opportunities in other labour markets.

Where household labour resources are constrained, problems with supervising and hiring in labour to cultivate annual crops more intensively can act as incentives for households to plant or to maintain trees instead of other crops.

Labour-to-land ratios are often determined by demographic changes in household composition, with older households having a smaller resident labour force on which to draw. The outcome can be the adoption of less labour-intensive forms of land-use, such as tree growing.

The need to intensively cultivate a holding may be less amongst older households with fewer residents, which may instead be more dependent on savings or on wage remittances from non-resident children for their support. Trees may be planted to maintain a productive crop on land that will eventually comprise the household's inheritance.

The quality of land within a holding, as well as across holdings in a given agroecological zone, may be highly heterogeneous. This, in turn, may mean that some holdings, or some parts of some holdings, require much more labour to cultivate than others. Trees may be planted in these areas to even out labour demands.

The sale of land that is in surplus of the household's immediate needs may be undesirable because of intergenerational concerns and the need to retain resources that can be passed on to the next generation. Tenting out surplus land may be undesirable because it might jeopardize the tenure holder's long-term rights of ownership. In these circumstances, trees may be planted and maintained, as an alternative to letting the land lie fallow.
Although trees require less capital than most crops to establish and maintain, they can lock up this capital (and the underlying land) for periods of several years, with little if any intermediate return. The experience of farm forestry in north India demonstrated that tree crops may therefore be an option mainly for those who do not rely on that land for household self-sufficiency—such as large-scale farmers or those with sufficient off-farm income (Saxena 1992).

A tree crop that can be appropriate in one set of factor circumstances could therefore be unsuitable in another. Furthermore, these circumstances are often changing, sometimes quite rapidly. Thus, better functioning factor markets, giving increased access to capital and other inputs, could trigger a move away from extensive and site-enhancing uses of tree cover towards the adoption of more valuable crops and intensive land uses.

**Containment of exposure to risk**

Trees can contribute to risk containment in a number of ways. Trees are widely included in farm systems because they help to even out seasonal peaks and troughs in flows of produce and income and in demands on farm labour. In systems where trees form a substantial part of farm output (e.g., where home gardens are well developed), tree products are also important in diversifying farm output, thus reducing the exposure of the farm household to price falls or failure on the part of individual crops (Ninez 1984). Farmers also tend to favour trees with multiple uses, as these provide them with more flexibility in responding to changing household needs and market conditions, over single-product species such as eucalypts.

In agricultural systems where other forms of accumulating and holding capital, such as livestock herds, are not available, trees may serve this purpose. As they can be harvested and sold whenever the owner chooses, they are particularly appropriate as a flexible reserve that can be called down in times of emergency, or to fund exceptional financial outlays, such as weddings or the purchase of land (Chambers & Leach 1987). Farmers in arid areas also exploit the resistance of certain trees and woody shrubs to drought to create a buffer to be drawn on in periods of low rainfall. Trees may also be present in part because they help protect crops and contribute to maintaining soil fertility.

Farmers will use trees that complement or supplement existing crops in different ways and plant them in locations where they do not compete with crops. Trees and tree formations that help protect crops and farm land are likely to be favoured in the allocation of land. Thus the cultivation of *Prosopis cineraria* as an intercrop in Rajasthan reflects its value in enriching the soil and protecting the adjacent pearl millet against wind, as well as its value as a source of fodder (Jodha 1995). In contrast, the fact that the eucalypts planted around fields caused substantial reduction in the yield of nearby crops was a factor in the decision of farmers in Uttar Pradesh to discontinue cultivation of these trees on their cropland (Saxena 1991).

It is important to recognize the above distinctions in the role of trees in farm strategies. Farmers apparently use lower implicit discount rates in making decisions about activities that can contribute to risk minimization—or to meeting self-sufficiency needs—than they do to income-generating activities. In other words, farmers may accept low yields from trees that enable them to reduce their exposure to risk but expect much higher yields from trees they grow as cash crops.

The adoption or non-adoption of tree crops may also be determined by whether or not they contribute to the farmer's security of tenure. When rights to use of land may be established or secured by planting trees on or around the property, this may encourage people to plant trees (or lead landowners to prohibit their tenants from doing so). Where the state is empowered to appropriate forest or woodland areas, people are frequently unsure about their rights to grow trees—and are likely to be reluctant to do so.

The most important factor affecting tree growing in many systems appears to be the existence or absence of rights of exclusion—in particular, exclusion of grazing on the household's fallow fields. Where this is discouraged (e.g., because livestock management is important) or where it cannot be enforced, tree growing is unlikely to take place. Where farmers can exercise this degree of control, economic factors are probably more important than land tenure in determining decisions about growing trees (Cook & Grut 1989, Godoy 1992, Shepherd 1992, Warner 1993).

**CONCLUSIONS**

The adoption of a commercial NTFP activity within an agroforestry system is conditioned by a range of...
economic as well as physical factors. For some, the scale or nature of the product or process may not lend itself to domestication at the farm level. For others, farm-level production may not be practical or competitive or will not be compatible with other aspects of multiple-objective systems for the livelihood of the farm household. Conversely, some species that are adopted primarily for other reasons may provide commercially exploitable NTFPs as a by-product (e.g., the oils distilled from leaves of eucalypts grown to produce wood).

One aspect likely to require close attention in the process of identification of viable products and activities is the extensive and often rapid change that is occurring in NTFP use. Production and use of many products will decline in face of adverse market or cost developments. There is a danger of focusing on 'sunset' products just because they are important to many people at present. Doing so may adversely affect the producers' ability to respond to more favourable market and appropriate options as they arise. At the same time, shifts in broader economic parameters will open up potentials for other products, which may not be recognized in good time if attention focuses just on the present and the past.

A second important aspect is the dual impact that increasing exposure to market forces can have on the place of tree crops within farming systems. Access to markets can mean not only expanded commercial opportunities for tree products but also increased access to fertilizers and other inputs that could permit more intensive land uses. It needs to be kept in mind, therefore, that increased wealth, or improved functioning of land, labour and capital markets that would enable farmers to respond more efficiently to imbalances in factor availability, could be accompanied by a reversal of some of the current shifts towards more tree cover on farms.

A third key aspect is that farmer responses to NTFP market opportunities are often distorted by policy barriers. Higher priority should be given to changing policies and practices that presently constrain farmers' access to markets and that depress market prices for their tree products. These commonly include lack of market information, poorly functioning trading systems serving small producers, competition from subsidized supplies from state forests and plantations, fuelwood prices depressed by subsidies to alternative fuels, and restrictions on private harvesting and trading of some tree products. Removing or reducing such barriers could often be more effective and efficient than subsidies to induce tree planting and husbandry (Dewees & Scherr 1996).

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