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Dynamics in Nontimber Forest Resource Management

The use of nontimber forest products (NTFPs) in tropical forest management is currently receiving greater attention. Use of NTFPs starts with extraction from natural forests but may gradually be intensified to cultivation of domesticated trees. In order to enhance understanding of the evolutionary processes in NTFP production, this article analyzes the different management systems of timur (Zanthoxylum armatum) production in Nepalese forests. Products of this medicinal plant are regularly traded with India. Four different management regimes on open-access state lands, two different types of community-controlled lands, and private lands are described, each being characterized by a specific set of access regimes, organizational rules for collecting and managing timur, and management practices. A gradual increase in management intensity takes place from public lands to private lands as a result of various socioeconomic and politico-legislative factors. In contrast to earlier Nepalese studies, increased market price rather than increased scarcity was found to be the most important factor inducing intensification. It is concluded that the effects of supply and demand factors on management intensity of NTFPs cannot be generalized; these effects depend on both the management and marketing characteristics of specific NTFPs.

Keywords: *Community forestry; agroforestry;* Zanthoxylum armatum *(Timur); indigenous knowledge; resource management; domestication; intensification; Nepal.*

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Introduction

Since the early 1990s, increased attention has been given to the extraction of nontimber forest products (NTFPs) from natural forests as a means of reconciling rural development and environmental conservation. Consequently, evaluation of the socioeconomic characteristics of NTFP production and assessment of the potential of NTFP extraction for sustained management of natural forests has become an important focus of research (Ros-Tonen et al 1995; Ruiz Pérez and Arnold 1996). Several authors have suggested that extraction of NTFPs from natural forests should not be conceived as a discrete activity but rather as the first stage in a process of gradual domestication of valuable NTFP species (Homma 1992; Wiersum 1996). During this process, a gradual transition from collection of NTFPs from natural forests to the purposeful cultivation of trees providing NTFPs in plantations takes place. In a recent review, such gradual intensification in managing tree resources was described as follows:

> Tree growing is likely to evolve through a number of definable common stages. Where forest cover is locally abundant and population densities are low, tree management exists, but is usually passive. The offtake of tree-based products is usually offset by natural regeneration and tree growth. As population pressures increase, farmers may respond by leaving more trees during land clearance and by more intensively managing the remaining tree cover by practices such as coppicing, pollarding and pruning, which result in higher total production. As tree resources become increasingly scarce, farmers may take measures to stimulate tree regeneration. (Arnold 1995)

In addition to actual scarcity, intensification of forest management may also result from decreased access to resources as a result of loss of communal lands or restrictions on forest access (Gilmour 1990; Shepherd 1992; Arnold 1995), increased demands for tree products resulting from population growth, or demands from new markets (Homma 1992; Scherr 1995; Filius 1997). Although it is known that induced innovations in forest management may occur, for most NTFP species, it is not yet clear whether such changes are taking place, and if so, what the precise nature of those changes is and which factors influence them. To enhance understanding of the evolutionary processes in NTFP production and the factors that contribute to intensification in managing NTFP species, a case study of the dynamics in the production of timur (*Zanthoxylum armatum*) in Nepal is presented here. The different management systems for timur production are described, and the factors that influenced changes in management intensity are explained.

Research methods

The data reported here were obtained as part of a study on the effects of different types of access to land and social networks concerned with the collection and trade of timur in Nepal (Den Hertog 1997). The study was carried out in the western part of the Salyan district in the midwestern region of Nepal (Figure 1). The study area is located in an area with an average altitude of 2000 m, but altitudes vary from 700 m in river valleys to

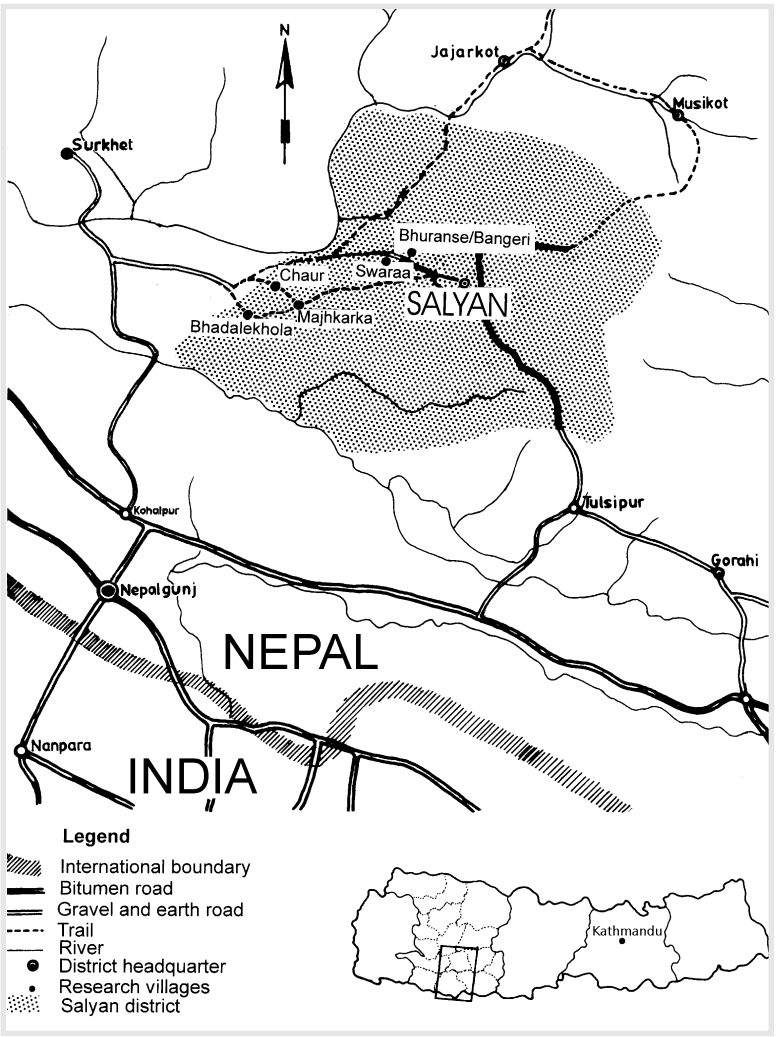

FIGURE 1 Location of the study site.

4000 m on nearby mountain ridges. It is situated at the northern side of the Mahabarat mountain range, which acts as a barrier to the monsoon and is responsible for relatively low precipitation in the area. The forests in the lower altitudes are dominated by *Pinus roxburghii,* which sometimes have an understory of *Aesculus indica* and *Bassia latifolia*. In the upper parts, the pine forests usually merge with oak forests. Two oak species are characteristic of this zone, *Quercus incana* and *Q lanuginosa*. In the second story, they may be associated with species such as *Rhododendron arboreum* and *Lyonia ovalifolia*. In both pine and oak forests, timur (*Zanthoxylum armatum*) grows naturally as an understory species.

Within the study area, five communities with a total population of approximately 2100 persons were selected on the basis of different property regimes and access situations with regard to collection of timur. The communities were defined on the basis of common use rights to a particular patch of communal (forest)land rather than on the basis of administrative criteria such as wards or village development committees. In each community, both qualitative and quantitative data were collected on the importance of timur production at both household and community levels and on the way in which timur production is organized. For this purpose, both group discussions and individual interviews were held. The group discussions concerned the social organization of groups of people involved in forest management and the collection and trade of timur. They were held with the members of two indigenous forest users groups (FUGs), one state-sponsored FUG, and two communities of forest users whose rights of use are based on residence in a ward. The aim of the interviews was to obtain information on the location and amounts of timur production, the collecting periods, and the contribution of timur to the collectors' house-

hold economies. Approximately 200 structured interviews with local timur collectors were conducted with the help of a standard questionnaire. The discussions and interviews were complemented with semistructured interviews of key informants who had specific knowledge of timur production and trade, such as members of forest user committees, traders, forest service personnel, and political leaders.

Forest management conditions in east Salyan

The forest management situation in Salyan is rather complex, as there are several types of property and access to forests. There are three *de jure* forms and four *de facto* forms of property regimes for forests (Gilmour and Fisher 1991; Den Hertog 1997):

1. Government-owned forest.
   - Where no claims are made by local people *(sarkari ban)*.
   - Where traditional claims to use are made by local people *(hamro ban)*.
2. Community forest.
3. Trees growing on private property.

The government-owned forests consist of national forests that are legally controlled by the forest service. With regard to the *de facto* control of these forests, two categories can be distinguished. The first category consists of forests over which local people claim no rights, even though they may use them, often on the basis of open access. Local people refer to such forests as *sarkari ban* (government forests). *Sarkari ban* is viewed as the property of the government by both Forest Department staff and local people. These forests are usually located at a greater distance from settlements than other forests. The main management objectives formulated by the Forest Department for these forests are protection and production of timber and other commercial products. No management practices for noncommercial products (eg, fodder, litter) have been formulated, although the local villagers may collect these products. Normally, management activities are restricted to occasional policing and licensing of timber harvests by contractors under the direction of the District Forest Office.

The second category of government-owned forests is controlled *de facto* by local FUGs. Regardless of their legal title, these forests are treated by local people as a common property resource and are referred to as *hamro ban* (our forests). Forest officials and villagers have two opposing (and sometimes conflicting) views of access rights to these forests. On the one hand, forest officials claim authority over the land and frequently take action against unauthorized collection of forest products, while accepting (within limitations) that local villagers are breaching the law. On the other hand, indigenous FUGs make their own decisions about forest use, while acknowledging that the Forest Department does impose controls. The *hamro ban* forests are mostly located near settlements so that control of compliance with community rules is relatively easy.

A community forest is a national forest handed over to a user group for its conservation, development, and utilization for collective benefit (Gilmour and Fisher 1991). A prerequisite for this is an operational plan approved by the District Forest Officer, which serves as a contract between the Forest Department and local users. This plan is prepared by the forest users in collaboration with forest officials. An important feature is the establishment of a village-level forest user committee, which is authorized to implement forest management and to distribute or sell forest products. The main contrast with indigenous FUGs is that the forest user committee of a community forest is recognized and sponsored by the state. Furthermore, income from sales of forest products can be used for the implementation of small community development projects in the vicinity of the community FUG.

In the community forests, villagers only have access to forest products, but the forestland remains state owned. Thus, the villagers' access to forest resources is not total. In the case of trees growing on private land, however, farmers own both the land and the tree products. This gives them the legally and socially sanctioned right to exclude others and effectively to resist unwanted intrusions, backed by the power of the state (Cernea 1989).

Timur production and management

Characteristics of timur plant and products

In Nepal, there is a long tradition of collecting nontimber forest products as a source of income. Every year, thousands of tonnes of NTFPs are collected in the Middle Hills of Nepal and traded with India (Malla et al 1993; Sinha et al 1993; Edwards 1996; Den Hertog 1997; Olsen 1997), including the fruits of timur (*Zanthoxylum armatum*). Timur is a branched, scandent, or erect shrub or a small tree, 6 m tall or more, with dense foliage (Figure 2). The branches are armed with thorns of up to 2 cm. The species naturally occurs as an understory species in forests and on open sites at altitudes between 1000 and 2100 m. According to farmers, timur grows best on sites with deep, moist soils that are also exposed to the sun. This is reflected in the occurrence of many timur shrubs or small trees around cultivated farmland. Farmers mention that the trees are mainly disseminated by birds, who like the fruits. During digestion, seeds are scarified, which stimulates

FIGURE 2 Cultivation of timur on terrace risers on private lands. (Photo by W.H. den Hertog)

germination. Timur can also be propagated vegetatively from branch cuttings or seeds. Timur flowers regularly around April to May and produces constant fruit yields over the years. However, hailstorms in spring can destroy the flowers.

Due to their carminative, stomachic, and anthelmintic properties (CSIR 1985), the fruits, seeds, and bark of timur are extensively used in indigenous medicines. The fruits and seeds are used as an aromatic tonic for fever and dyspepsia. An extract of the fruits is reported to be effective in expelling roundworms (CSIR 1985). Because of their deodorant, disinfectant, and antiseptic properties, the fruits are also used to treat dental problems, and their lotion is used against scabies. Steam distillation of dried fruits yields an essential oil that has deodorant and antiseptic properties; it is used in soaps and dental preparations. The oil obtained by steam distillation of the fresh plant shows antifungal activity. The bark is pungent and used to clean teeth.

Due to its appealing aroma and valuable perfume, timur is used in the manufacture of several health-care products. Most of this manufacturing takes place in India, which therefore has a well-established commercial outlet for dried timur fruits (Edwards 1996; Den Hertog 1997). During the last two decades, the market price of timur has been increasing considerably. In 1980, traders who settled at the border with India paid Nepalese collectors 1.8 Nepalese rupees (NRs) per kilogram for dried timur. This price has continuously increased from NRs 9/kg in 1985 to NRs 22/kg in 1993 and NRs 45/kg in 1995. This increase was much higher than the rate of inflation. According to Nepal Rastra Bank (1994), from 1980 to 1994, the price index for consumer goods increased from 74.6 to 287.4 (base year 1983–1984). Whereas in 1980 the income from the sale of 1 kg of timur could be used to buy 1 kg of rice, in 1995 it could buy 3 kg of rice.

The importance of timur collection in Salyan

In Salyan, there is a long tradition of collecting nontimber forest products; approximately 10,500 households (almost one third of all households) are involved in this activity. The most important nontimber forest products are listed in Table 1. The average annual con-

TABLE 1 Estimates of values (in 100s of Nepalese rupees) of NTFPs collected and traded in the Salyan district.

Scientific name	Average price/kg for collectors	Turnover estimated by collectors			Percentage of total turnover value
		Minimum value	Maximum value	Average value	
Zanthoxylum armatum	30	12,000	18,000	15,000	70
Sapindus mukorossi	12	3600	6000	4800	23
Asperagus racemosus	38	304	760	532	2
Berginia ciliata	4	320	720	520	2
Valeriana jatamansi	45	270	450	360	2
Cinnamomum tamala	34	204	340	272	1
Pistacia integerrima	80	24	40	32	0
Acorus calamus	16	16	22	18	0
Total		16,738	26,332	21,534	100

Source: Interviews with traders based in Salyan district, 1991–1996.

tribution of NTFPs to the household economies of collectors is more than 2000 NRs per household (in January 1994, US$ 1.0 was equivalent to NRs 49.0), or 40% of the average gross income of 5000 NRs/household (KMTNC 1991).

With 400–600 tonnes collected annually, timur is the main nontimber forest product in the Salyan district. Approximately 70% of the total value of the NTFPs collected is attributed to the fruits of this species (Table 1). Assuming that 1 working day is needed for the collection of 4 kilos of timur, more than 120,000 (wo)man days per year (an average of 12 working days per household) are required in the Salyan district to pick the fruit during the collecting season. (Collectors reported that, if timur shrubs are easily accessible, as is the case on private land, 1 adult can collect a quantity equivalent to 5 kilos after drying. Timur shrubs in the forest are more dispersed and collection here takes much more time.) Additional labor is needed for drying, sorting, packaging, and transportation. The average revenue generated is over one quarter of the average annual household income.

Collection and management practices

In the Salyan district, timur is collected from state, community, and private lands. These lands have different forms of tenure and are under different access regimes, resulting in different ways of exploiting and managing timur.

Sarkari ban: According to the Forest Act of 1993, a license from the Forest Department is needed to collect timur on state forestlands, and a royalty payment is to be paid prior to collection. However, since issuing permits to individual collectors is administratively cumbersome, licenses are normally issued to traders rather than to individual collectors. Thus, villagers are free to collect timur fruit in *sarkari ban* without licenses, and the collection is normally open access. Usually villagers start to collect timur in July when the fruit is immature. They often lop the branches in order to facilitate collection; such unregulated lopping decreases subsequent fruit production. Timur collection often takes place alongside other work in the forest, such as fuelwood and fodder collection. Each time, only a small quantity of timur is collected, and consequently the collection season for timur in *sarkari ban* may last up to 5 months.

Hamro ban: In contrast to the *sarkari ban* forests, in the *hamro ban* forests, local people have often initiated management practices for timur collection. These indigenous management practices mostly consist of controlling timur collection through the definition and control of user rights. In such cases, only the members of a forest user group are allowed to extract timur from the forests. These rights are regarded as legitimate by other people living in the area. The user groups may also decide that the forest is closed for timur collection until the fruit is mature. In this case, the forest user committee fixes the opening date. In addition, regulations on collection techniques may be formulated in order to enhance regeneration and production of timur, for example, by prohibiting felling or branch lopping of timur bushes or using sickles for fruit collection. The collection season in indigenous managed forests is short, as the largest quantity is collected on the opening day.

Farmers whose lands border *hamro ban* forests may claim usufruct rights of these forests up to a distance of 20 *gauj* (approximately 18 m) from their own land. The boundaries of such appropriated *hamro ban* lands often coincide with landmarks such as trails, streams, or

TABLE 2 Major timur collection and management practices under different types of tenure.

Main approach to timur exploitation	Type of tenure			
	Sarkari ban	***Hamro ban***	**Community forest**	**Private land**
Uncontrolled utilization	Open-access procurement of wild timur products	Same		
Controlled utilization		Access limited by dividing forests between subgroups of forest users	Same	
		Collection of timur limited to specific periods of time	Same	
		Prescription of collection techniques	Same	
			Number of users limited by admission fee	
				Rights to postharvest collection (*shila charnu*) of timur on private land
Maintenance and protection				Natural regeneration of timur spaced around *bari* land
				Mulching
				Pruning
Purposeful regeneration		Enriched forest stands (in case of private ownership of timur on claimed forestland)		Transplanting of wildlings
				Seeding

rocks. Landowners without formal titles on *hamro ban* land may enforce their claims by (trans)planting timur seedlings on the appropriated land. The claim entails exclusive and private usufruct rights, but regulations for collecting timur are similar to those in the rest of the *hamro ban* forest. For example, to harvest trees, the landowner needs the permission of the forest user committee, and payment of a royalty may be involved.

Community forests: In the community forests, management practices for timur production are formulated by the officially sanctioned FUGs. Like the *hamro ban*, these management practices mainly involve the regulation of timur harvesting, for example, by setting a date for opening the forest for collection. In these state-sponsored community forests, only one member of each household can gain admission to the forest after paying a fee to the committee. Generally, collectors prefer to pay for a permit from the forest user committee for collection of timur in community forests rather than collect timur in the *sarkari ban* free of charge. This is because *sarkari ban* forests are located at a greater distance from the villages, making specific collection trips unattractive and limiting harvests to small quantities collected in addition to other activities. In contrast, as a result of the harvesting rules, collection of timur in community forests is more efficient and yields are higher. Thus, the rules on timur harvesting in community- and indigenous-managed forests allow equity in the distribution of resource benefits and efficiency in investment of labor as well as in maintenance of production.

Private lands: In the study area, there is no clear-cut dichotomy between community and private property. Private landowners may claim exclusive individual usufruct rights on forests bordering their cropland. Villagers may also have a collective right to collect products from private farmland that remain after the owners

have harvested the fields. This right of *shila charnu* (literally, going for partial search) allows villagers to collect the remaining timur fruits on the lands of other villagers once the main harvest is over.

On private lands, timur is sometimes actively propagated by transplanting naturally regenerated seedlings or by seeding, especially on terrace risers (Figure 2). An important reason for growing timur on these lands is that its private ownership allows for optimal management. Private owners actively maintain their timur trees, especially in communities where the income from timur contributes considerably to farmers' income. They optimize the condition of the young seedlings from natural regrowth by thinning and transplanting. The mature timur trees are pruned and manured with leaflitter. Moreover, the productivity of the timur trees is high due to the fertile soil conditions. The private owners can effectively plan the supply of family labor for the collection of timur. In contrast to the collection of timur in *hamro ban* and community forests, collection on private land may span a period of months. The timur fruit is carefully collected by hand. As a result of these practices on private lands, the yield per hour of harvesting is higher than in forests managed by user groups.

The different collection and management practices for timur under various access regimes are summarized in Table 2. The various management practices have their own rationales, which are related to the nature and degree of control over access to timur trees (Table 3). In community-controlled natural forests, management usually consists of controlling utilization through the definition and control of user rights. Many of these practices are socially oriented and ensure distribution of forest products to local user groups as well as control of outsiders. The application of biologically oriented management practices, such as stimulation of regeneration and production, is more likely to occur on privately controlled lands.

The dynamics of timur production

Several studies have indicated that NTFP resources are diminishing in Nepal (Malla et al 1993; Sinha et al 1993; Edwards 1996), although others (Olsen 1997) indicate that utilization is generally sustainable. According to the Salyan farmers, during the last decade, the presence of timur in the area has increased considerably on both community-managed and private lands. Its use has changed as well. In the past, villagers cut the shrubs of timur around their cropland for local use as fuelwood. At present, timur is no longer used this way. Instead, it is purposely protected and even increasingly cultivated to provide commercial products.

The main reason for farmers to intensify the management of timur is a financial one (Table 4). The local market price of timur has increased considerably in the last 2 decades. In order to benefit from the initial increase in value on the *hamro ban* and community forestlands, farmers began to protect timur from exploitation by outsiders. Timur shrubs were also increasingly tolerated on private lands. When prices continued to increase, farmers also began to transplant timur seedlings from the forests onto their own farmland. The reason for doing so was not because timur was becoming scarce in the user-group managed forests. On the contrary, the presence of timur is increasing because its regeneration has been favored by the opening up of forests due to earlier overexploitation for timber and fodder. And the shrubs are hardly disturbed because animals do not usually browse the thorny shrubs, while timur collection for fuelwood has stopped.

Besides this financial aspect, farmers also indicated several other factors that contributed to the intensification of timur management. On croplands, timur is usually grown on terrace risers, where it has minimal impact on agricultural yields. In theory, other trees yielding edible fruits could also be cultivated on these terraces. However, timur has several advantages over other fruit trees. It requires less fertile soil than most other fruit trees. Farmers can already begin harvesting 3 years after planting, while many other fruit trees take longer. And as timur is only grown for sale and not for household consumption, there are no social obligations for timur growers to share their yield with relatives or fellow villagers, as is the case with edible fruits used for household consumption.

The third factor influencing the gradual intensification of timur production is the changing labor situation. Villagers are increasingly involved in seasonal wage labor in the study area. Their growing dependence on off-farm income reduces the amount of time they have available for collecting NTFPs and raises the labor cost for timur collection. Some timur owners who lack sufficient family labor make a kind of sharecropping arrangement with marginal farmers to collect timur on their lands. The collectors receive 50% of the collected products. Such arrangements for timur collection are an attractive alternative to off-farm employment for marginal farmers. For timur owners, such a collection arrangement is only lucrative if timur is present in relatively high densities. As it is fairly easy to grow timur, it is worthwhile to invest some labor in establishing denser stands.

The fourth factor contributing to increased timur cultivation on private lands is the fact that farmers can use their future yields as collateral for loans and commodity advances from village shopkeepers. Such credits are not provided to collectors who depend on the production of timur in forests managed by user groups.

Thus, several factors contributed to gradual intensi-

TABLE 3 Rationale for different timur production practices.

Management practice	Result/rationale
Limiting access by dividing forests between subgroups of forest users	Decrease use pressure by denying access to outsiders
Limiting collection of timur to specific periods of time or prescribing restrictive collection techniques	Equal opportunity for each FUG member to collect Equity in distribution of benefits Efficiency in labor investment Easy control of extraction
Limiting number of users by admission fee	Decrease use pressure by limiting number of collectors
Collective right of postharvesting (*shila charnu*) of timur on private land	Beneficial for marginal and landless farmers of a community
Spacing natural regeneration	Reduction of competition and increased fruit production
Mulching	Improved growth
Pruning	Stimulation of fruit production
Planting wildlings on claimed forestland	Strengthen claim on land Exclusive usufructuary right to timur
Transplanting wildlings or seedlings on private land	Optimization of growing conditions Exclusive usufructuary rights Increase in cash income

TABLE 4 Influence of the economic value of timur on timur collection and management practices (NA, not applicable; FUG, forest user group).[a]

Economic value of timur	*Sarkari ban*	*Hamro ban*	Community forest	Private land
Very low economic value	Open access; not much interest in timur collection	Nonmembers of FUG are allowed to collect timur	NA	Timur bushes are cut for fuelwood
Low economic value	Open access; not much interest in timur collection	Nonmembers of FUG are allowed to collect timur	Nonmembers of FUG are allowed to collect timur	Timur bushes are tolerated around *bari* land
Moderate economic value	Timur bushes are heavily lopped; collection of immature fruit	Timur collection exclusively by FUG members; opening date	Timur collection exclusively by FUG members; opening date	Timur bushes are maintained; spacing of timur; seedlings
Relatively high value	Timur bushes are heavily lopped; collection of immature fruit	Exclusion of outsiders; opening date; prescription of collection technique	Exclusion of outsiders; opening date; prescription on collection technique; admission fee to limit number of collectors	Replanting wildlings from forest; spacing of timur seedlings; supply of leaflitter; pruning

[a]The first community forests in Nepal were established at the end of the 1980s when timur had a low to moderate market value.

fication in the management of timur. After an initial stage of open-access extraction of timur from natural forests, the first attempt to maintain timur resources consisted of controlling utilization of resources through the definition and control of user rights. Collection of timur in the forest was restricted to the members of a forest user group living in a specific community. Gradually, these access and control measures were augmented by biologically oriented practices such as purposeful protection, stimulation of tree growth and production, and propagation. This gradual intensification enhanced timur production. The control of collection techniques

ensured a sustainable future supply, while the setting of an opening date for collection allowed efficient labor investment, higher yield, better product quality, and a fair distribution of benefits among the forest users. Cultivation of timur on private lands further increased production efficiency.

Discussion and conclusion

Villagers can collect timur on open-access state lands, community-controlled lands, or private lands. Factors that influence the selection of collection areas include distance to and density of the resource, access rules, labor efficiency in collecting and managing timur, and market price. The variety of collection and management practices for timur demonstrates that it is incorrect to assume that the production of nontimber forest products only takes place in the form of extraction from natural forests. Rather, both NTFP and wood resources may be more or less intensively managed and even cultivated (Gilmour 1990; Shepherd 1992; Wiersum 1996). The process of gradual intensification in managing timur resources is in agreement with the model of evolutionary people–tree interactions developed by Wiersum (1997). In this model, different phases of people–plant interaction are arranged along a gradient of increasing input of human energy per unit of exploited land, from uncontrolled utilization through controlled utilization to protection and maintenance to purposeful regeneration. Concomitant with this process of management intensification, a gradual transformation of the natural ecosystem into a domesticated agroecosystem takes place. As indicated by the example of timur, these different phases are not discrete. There is not a clear boundary between natural and cultivated timur stocks but rather a gradual transition from collection of timur from wild resources through increased management of naturally occurring timur stocks and enrichment planting by landowners who claim use rights in forests bordering their croplands to transplanting timur seedlings on private land. Furthermore, usufruct rights to timur are not rigid and are neither exclusively private or community or government controlled. Access to timur resources varies depending on the season, land tenure, location of private property, and type of timur use. This demonstrates that, in general, it is not correct to assume a dichotomy between the extraction of NTFP from wild trees in a natural forest under either open-access or common property regimes and the private cultivation of NTFP species in an agroforestry system (Wiersum 1996).

Earlier studies in Nepal have suggested that the main economic trend inducing gradual intensification in tree growing is the increasing scarcity of tree resources (Gilmour 1990). In the study area, however, it was not the growing shortage of timur that triggered intensification but its increasing economic value. Only when ample timur resources were present were villagers interested in defining access rights in order to assure local benefits from the commercial value of timur. With increasing timur prices, the rules for timur collection became gradually more rigorous. This difference in factors inducing intensification may be explained by the characteristics of the tree products involved. A study by Gilmour (1990) mainly concerned tree species used for household needs, for example, fuelwood and fodder. Since such products are not very species specific, it is easy to shift from one species to another. In view of these characteristics, the degree of management intensity is primarily influenced by supply factors. In contrast, timur products have a high commercial value and they are not easily substituted. In this case, market demand rather than supply factors is the dominating influence in developing management practices.

In addition to the increasing market prices for timur, other socioeconomic changes also stimulated intensification of timur management. The gradual shift from a subsistence economy to commercialization, together with increasing opportunities for wage labor, stimulated a more efficient input of labor for timur collection on both private and community-controlled land. Timur cultivation was also stimulated by the possibility of using timur as collateral for loans. Finally, ease of cultivation, which included free seedlings from the forests, also contributed to intensification.

The process of gradual intensification in timur production is also associated with political and legislative changes. These are important in creating conditions that allow forest users to back up local forest management institutions so they function properly. For instance, official recognition of forest user groups allows the strengthening of control measures, for example, by requiring a payment for collection permits. Cultivation of timur on private lands only became an attractive proposition after the legalization of private land ownership.

In conclusion, our data show that NTFP production is not limited to extraction from natural forests but that different types of production systems may exist. It was also shown that a variety of factors influence the type and intensity of NTFP production (cf Homma 1992; Arnold 1995; Scherr 1995; Filius 1997). Whether intensification takes place depends on both supply and demand factors. Supply includes ecological factors, such as natural occurrence and ease of cultivation of the species concerned, as well as socioeconomic factors including land and tree tenure and access to labor and capital. The demand factors

include marketing conditions, prices, and degree of substitutability. The effects of these various factors on the intensity and dynamics of NTFP collection and management cannot be generalized but vary between specific categories of NTFPs, such as subsistence versus cash products or easy-to-substitute versus difficult-to-substitute products.

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