

Review

Indigenous exploitation and management of tropical forest resources: an evolutionary continuum in forest–people interactions

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Abstract

Since the early 1980s several new approaches towards forest management, which include active participation of local communities, have been tried out in many tropical regions. As a result of these efforts recognition has increased about the various ways in which many local communities are already actively managing their forest resources. The planning of development interventions to stimulate more efficient community involvement in forest management can often be based on such indigenous forest management systems. This paper aims to improve the understanding about the diversity and dynamics of indigenous forest management. The analysis consists of three parts. First an overview of the various types of indigenous forest management and their dynamics is presented. Subsequently, the basic principles of forest management are discussed. Forest management is characterized as involving a set of both technical activities and social arrangements for the protection and utilization of forest resources and the distribution of forest products. Three major categories of forest management practices are identified, e.g. controlled utilization of forest products, protection and maintenance of forest stands, and purposeful regeneration. The practices in the first category are both socially and biologically oriented, whereas the activities of the last two categories are biologically oriented. These principles are then used to develop a classification model of the various evolutionary phases in forest management. Along the lines of a similar model developed for exploitation of agricultural crops, various stages of forest management are distinguished along a gradient of increasing input of human energy per unit of exploited forest. This gradient represents a continuum of forest–people interactions; it illustrates how the various manifestations of indigenous forest management may be arranged along a nature–culture continuum. © 1997 Elsevier Science B.V.

Keywords: Community forestry; Forest management; Forest use dynamics; Domestication of landscapes

1. Introduction

Since the early 1980s various new approaches towards forest management, in which local communities are more actively involved, have been tried out

in several tropical countries. These efforts reflect a growing interest in the scope of community participation in forest management. This interest has emerged in response to concerns that have arisen relatively independently in the fields of forestry, nature conservation and development of tribal people (e.g. Allegratti, 1990; Poffenberger, 1990; Arnold, 1991; Nepstad and Schwartzman, 1992; Redford and

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Padoch, 1992; Colchester and Lohmann, 1993; Wells and Brandon, 1993). Although the scope for community involvement in forest management has only recently been recognized by foresters, ecologists and rural development experts, various types of community forest management have been in existence for centuries. In the past these management systems were rarely taken seriously by scientists and professionals. However, the growing interest in the scope for community forest management has led to an increased interest for indigenous forest management. Several recent studies have indicated that local people living in or near forests should not a priori be considered as mere gatherers of forest products and/or as people who are transforming forests into agriculture. In many cases they are active forest managers who are involved in purposeful activities to safeguard the continuous availability of the valuable forest resources.

The various publications describing a wide variety of indigenous forest management types provide a good empirical data base for further analysis of the characteristics of these systems. This paper will review the existing information. It aims at making a comparative analysis of the various types of indigenous forest management, and at developing a conceptual model for classification of the evolutionary stages of these forest management types. It will focus particularly on the management of vegetation resources and does not include management of livestock and wildlife resources. First, an overview is given of the various types of indigenous forest management, with examples of their dynamics. Secondly, a theoretical framework is developed for systematic, comparative characterization of these different management systems. For this purpose the basic principles of forest management are reviewed. These principles are then applied to adapt an existing model of agricultural development into a conceptual model, in which various phases of indigenous forest management are arranged along a continuum of forest–people interactions.

2. Indigenous forest management by tropical people

2.1. History

There is a long tradition of humans influencing forests in order to increase the benefits they derive

from them. For instance, paleobotanical research has shown that in New Guinea even as long ago as the late Pleistocene, some 30 000–40 000 years ago, people were manipulating the forest by trimming, thinning and ring-barking in order to increase the natural stands of taro, bananas and yams (Hladik et al., 1993).

This example demonstrates that the early activities to manipulate the forests for human benefits were directed primarily at products for local consumption such as fruits and other edible plant products (Hladik et al., 1993). It has been postulated (Sauer, 1969) that cultivating wild food trees can be considered as the first step in the evolution of a domesticated landscape. Such cultivation probably began when the act of collection caused changes in micro-environment which favored rejuvenation of the collected species and the spontaneous growth of plants from leftovers of products which the collectors brought to their camps. Gradually such unconscious manipulation was replaced by more conscious activities such as the deliberate planting of certain species at camp sites to facilitate future collection. Initially the cultivation was probably based on vegetative propagation techniques, later also cultivation by seeding was developed (Sauer, 1969; Boerboom and Wiersum, 1983).

There also exists a long history of forest manipulation by local people to obtain commercial products. For instance, already in the fifth century AD certain forest products, such as gums and resins, were traded in Southeast Asia, and forest management practices were being carried out to regulate their production (Dunn, 1975; Dove, 1994). In addition to forest management practices to secure material needs, in many societies conscious efforts have also been undertaken since time immemorial to protect certain, sacred, forest areas for cultural and religious reasons (Doornewaard, 1992).

These examples indicate that when considering the rural landscapes it is often not appropriate to assume a dichotomy between a natural forest area and a domesticated landscape characterized by agricultural cultivation. Rather, historically many forests have been used and manipulated by local people which resulted in the original forest being transformed into an environment which is enriched by resources useful to the local societies. Such indigenous forest utilization and manipulation has many manifestations with the habitats of the forest commu-

nities gradually evolving along a nature–culture continuum (McKey et al., 1993; Dove, 1994). The protection and purposeful regeneration of useful species does not necessarily involve the transformation into an agricultural landscape, but may result in a domesticated landscape (Chase, 1989) characterized by a mosaic of managed forests and agroforestry systems (Posey, 1985; Leach and Fairhead, 1993; McKey et al., 1993; De Jong, 1995).

2.2. *Types of indigenous forest management*

Several authors have attempted to categorize the types of indigenous forest management, e.g. on the basis of structural characteristics of the vegetation. For instance, Anderson (1990) differentiated two basic management strategies of local people:

- ‘Tolerant’ forest management in which the native vegetation is largely conserved or reconstituted through successional processes.
- ‘Intrusive’ forest management in which the native vegetation is replaced by mixed tree plantations that are maintained by long-term care.

A more refined classification of ‘alternative forest-like structures’ in insular South-east Asia (Olofson, 1983) includes the following types: sacred groves, enriched fallows, forest groves composed of domesticated tree species, and home gardens. In Mexico a distinction was made between managed fallow successions, forest gardens, kitchen (i.e. home) gardens, and semi-managed forests (Gomez-Pompa and Kaus, 1990). And in Africa a differentiation was made between reservations and sacred groves, conserved bushland resources, long and short swidden-fallow systems, and woodlands with selectively maintained and promoted useful species (Shepherd, 1992). The diverse and intricate nature of indigenous forest management is excellently demonstrated by the Kayapó indians in the Brazilian Amazon, who recognize forest islands in savanna areas as well as nine different management zones within the secondary forest (Posey, 1985).

Indigenous forest management types may also be differentiated on the basis of the objectives for manipulating the forest. For instance, the following types of community managed forests have been indicated for Asia (Messerschmidt, 1993):

- Fallow forest managed in relation with swidden cultivation

- Native forest in mountainous and semi-arid regions managed for their role in integrated forest–livestock–agriculture systems
- Natural forest managed for protecting village water sources
- Natural or planted forest maintained as sacred groves or temple forest.

This classification emphasizes that indigenous forest management should not be considered as an isolated activity, but as forming either a utilitarian or cultural component (Weidelt, 1993) of the local livelihood system. In many cases indigenous forest management consists of practices for modifying the forests within the framework of an integrated system of resource utilization; these practices augment crop cultivation and/or livestock management (cf. Padoch and Vayda, 1983).

A major example of the integrated nature of indigenous forest management and crop cultivation is the system of swidden cultivation coupled with fallow management. In many traditional swidden-fallow systems swiddens are not abandoned after agricultural use, but rather people actively manage and exploit the fallow vegetation by selectively sparing valuable tree species. Also valuable tree species such as fruit or gum producing trees or other valuable forest plants such as rattans may actually be planted with the crops or at the end of the cropping period (e.g. Clarke, 1966; Olofson, 1983; Weinstock, 1983; Denevan and Padoch, 1987; Hecht et al., 1988; Posey and Balée, 1989). Consequently, when the swidden is abandoned a nucleus of a valuable forest is present. In this way, swiddens may be gradually converted into a forest garden (or ‘reconstructed’ forest). Swiddens may thus form a logical and rational phase between natural and reconstructed forests (Olofson, 1980; Denevan et al., 1984; Mary and Michon, 1987; De Foresta and Michon, 1993; Dove, 1994). Useful trees may be protected not only in fallows but also in old growth forests, e.g. by marking them and/or clearing around them as an indication of exclusive use rights (Persoon and Wiersum, 1991). Or certain parts of the forest may be protected because of the abundance of useful species, e.g. fruit trees or trees which are a preferred habitat for bees (De Jong, 1995). In such cases less desirable competitors may be removed by weeding and thinning. In addition, valued species may be propagated selec-

tively by sowing seedlings or through propagation from discarded seeds and/or vegetative materials (Anderson, 1990).

Another example of integration of indigenous forest management with other land-use activities is the integrated forest–livestock–manure–agriculture land-use systems. In such systems forests form an important source of inputs for agriculture providing green manure as well as grazing and bedding for livestock. Both brown and green manure is used to fertilize the agricultural fields. These land-use systems are widespread in mountainous and semi-arid regions; between 1–9 ha of forest land is needed to support one hectare of cropland (Messerschmidt, 1993). These systems have been extensively described for the Himalaya region (e.g. Fisher, 1989; Gilmour, 1990; Messerschmidt, 1993), but are also common in the semi-arid zones of Asia and Africa (Niamir, 1990; Messerschmidt, 1993). The management practices in these systems are often less intensive than those in the fallow management systems, with less attention being given to purposeful regeneration. In most cases the management practices are primarily directed at various conservation measures, e.g. by rotational grazing and harvesting, or by controlling the amounts harvested (Niamir, 1990; Shepherd, 1992; Messerschmidt, 1993; Thomson and Coulibaly, 1995). For instance, the Turkana in Kenya actively maintain the riparian woodlands as an essential source of dry season fodder for livestock (Barrow, 1988).

As illustrated by these examples, indigenous management practices are often primarily directed at specific components of forests which are considered particularly useful, e.g. fruits, cash crops or fodder species. But indigenous forest practices may also be directed at the forest in a more integrated way. This is notably the case when forests are purposefully preserved as sacred forests or to protect water-springs. Sacred forests usually consist of patches of forest up to 10 ha in size which serve as a place of worship and/or meditation, e.g. Buddhist or Hindu temple forests in Asia (Doornewaard, 1992) sacred ceremonial forests in Africa (Shepherd, 1992), or as a dwelling place of (ancestral) spirits (Doornewaard, 1992). In many cases the sacred groves are located near mountain tops or near springs. In such cases they may serve also as de facto watershed protection

forests (Olofson, 1980). Another example of forest conservation for both religious and hydrological functions is displayed in the South and East African forests which are used for rain-making ceremonies (Sorensen, 1993; Campbell et al., 1993). In other cases, forests are specifically protected in order to preserve springs (Kajembe, 1994) or protect river-banks (e.g. Lian, 1988).

From the above examples it is clear that there is a wide range of indigenous forest management types. The various types and examples of their occurrence are summarized in Table 1. In this table four categories of indigenous forest management types have been distinguished¹:

Protected native forests: Native forests which are protected because of their religious/cultural significance, their role for protecting village water sources or their value for providing useful materials. In the first two instances the total forest is usually protected. In the last case either specific forest areas or specific tree species within the forests are actively protected.

Resource-enriched native forests: Native forests, either old-growth or fallow vegetations, whose composition has been altered by selective protection and incidental or purposeful propagule dispersion of food and/or commercial species.

Reconstructed native forests: Wholly or semi cultivated forest stands with several planted useful species, tolerated or encouraged wild species of lesser value and non-tree plants (herbs, lianas) composed of mainly wild species (cf. Gomez-Pompa and Kaus, 1990).

Mixed arboriculture: Cultivated mixed stands, almost exclusively of planted, and often domesticated, tree species.

These different categories are not discrete and gradations from one category to another occur.

¹ Often there is a continuum from forest management to tree management on farmlands (Shepherd, 1992). The growing of scattered trees on farmlands (Olofson, 1983) could therefore be considered as a 5th category of indigenous forest management. However, as these activities primarily involve the cultivation of individual trees in a non-forest environment, these practices will not be further discussed here. For recent reviews of the nature and dynamics of these tree management systems, see Warner (1993) and Arnold and Dewees (1995).

Table 1
Examples of different types of indigenous forest management

Main types	Examples
<i>Protected natural forests</i>	
Sacred forests	
sacred groves	Abodes of (ancestral) spirits Asia (Doornewaard, 1992), Africa (Shepherd, 1992; Sorensen, 1993) Ceremonial and rainmaking forests, Africa (Campbell et al., 1993)
shrine/temple forests	S. Asia (Gadgil and Vartak, 1976; Doornewaard, 1992; Dove, 1995)
Water protection forests	
spring forests	Tanzania (Kajembe, 1994)
riverine vegetation	Borneo (Lian, 1988); Kenya (Barrow, 1988).
Clan/village forests	
clan forests	Borneo (Lian, 1988; De Jong, 1995)
village forests	Himalaya region (Fisher, 1989; Gilmour, 1990)
grazed woodlands	Tribe/clan/lineage grazing woodlands Africa (Niamir, 1990; Shepherd, 1992)
Forest belts	T'Olche, Mexico (Remmers and de Koeijer, 1992)
Protected tree species	Taboo trees, pantropical (Doornewaard, 1992; Shepherd, 1992)
<i>Resource-enriched native forests</i>	
Individually claimed trees	Tree marking, S.E. Asia (Persoon and Wiersum, 1991)
Enriched natural forests	Enriched and expanded forest islands and gallery forests, Guinea (Leach and Fairhead, 1993); enriched rainforest groves Borneo (De Jong, 1995)
Enriched fallows	Casuarina fallows, New Guinea (Clarke, 1966) Rattan fallow cultivation (Weinstock, 1983) Fallow enriched with fruit/tree crops: S.E. Asia (De Foresta and Michon, 1993; Dove, 1994; Salafsky, 1995), Amazon (Denevan and Padoch, 1987; Posey and Balée, 1989) Palm fallows Amazon (Hecht et al., 1988), W. Africa (Sautter and Mondjannagni, 1978), East Indonesia (Fox, 1977)
<i>Reconstructed (native) forests</i>	
Forest gardens	
	Ifugao woodlots, Philippines (Olofson, 1980) Mixed damar gardens, Sumatra (Torquebiau, 1984; Mary and Michon, 1987) Mixed fruit and rubber gardens, Borneo/Sumatra (Gouyou et al., 1993; Salafsky, 1995)
Planted temple forests	India, Thailand (Doornewaard, 1992)
Fortification forests	Defense forests around human habitations in the Sahel (Seignebos, 1980) Village fortresses, Guinea (Leach and Fairhead, 1993)
<i>Mixed arboriculture</i>	
Home gardens	Pantropical (Landauer and Brazil, 1990)
Smallholder plantations	Pre-Hispanic cacao plantations Mexico (Gomez-Pompa and Kaus, 1990) Mixed damar/coffee gardens, Sumatra (Mary and Michon, 1987) Mixed rubber gardens, Indonesia (Dove, 1994)

Nonetheless, this classification provides a first approximation of the varied and often complex ways in which different local communities have been actively engaged in maintaining the forest vegetation and manipulating it to suit their needs.

2.3. Dynamics

The term 'indigenous forest management' refers to activities that were generated by internal initia-

tives within a local community; it should not be equated with 'traditional' which implies customary or antiquity (Fisher, 1989). Indigenous forest management practices should therefore not be considered to necessarily date from the past. They are often historically and situationally dynamic rather than static, as they have gradually evolved in response to changing conditions. Such changes may involve a variety of factors (Gilmour, 1990; Schmink et al.,

1992; Shepherd, 1992; Messerschmidt, 1993; Arnold and Dewees, 1995), which can be categorized as follows:

- Changed ecological conditions, such as resource depletion or land degradation.
- Changed technological conditions caused by the introduction of new agricultural and forest harvesting technologies.
- Changed economic conditions such as development of new markets and increased commercialization, changed demands for forest products and changed opportunities for off-farm employment.
- Changed socio-political conditions, e.g. population growth and migration, increased interaction with other (ethnic) groups, changed tenure conditions including gradual privatization or nationalization of forest lands, new state organizations for forest management and rural development.

These changes increase pressure on forest and tree resources. In many cases this has resulted in deforestation and forest degradation. But in other cases farmers have reacted by modifying their management strategies accordingly (Messerschmidt, 1993; Ghimire, 1994; Arnold and Dewees, 1995).

Such adaptive strategies have in particular been reported with respect to the fallow management systems in rainforest areas (e.g. Eder, 1981; Raintree and Warner, 1986; Balée, 1992; Dove, 1994). For instance, Clarke (1966) described a succession of fallow management in New Guinea from extensive forest-fallow rotations under conditions of low population density to planted *Casuarina* fallows under conditions of relatively high population density. More recently, more insights have also been obtained about the dynamic nature of the forest management regimes

in mountainous and semi-arid regions (e.g. Fisher, 1989; Messerschmidt, 1993; Thomson and Coulibaly, 1995). The types of adaptations that develop depend on the perceived needs of the local communities for specific forest products. As indicated by Gilmour (1990) with respect to Nepal, and Shepherd (1992) with respect to semi-arid Africa, a perceived change in the accessibility of resource availability may trigger a gradual intensification of management practices (Table 2). Similar induced innovations in response to changing socio-economic conditions and resource availability have been noted with respect to tree growing on agricultural land (Arnold and Dewees, 1995). All these examples indicate that the rich variety in indigenous forest management types can only be properly understood if these types are viewed in their historical context. The history of forest utilization and management has ecological implications and clarifies the people's relations with current forests (Dove, 1994; Fairhead and Leach, 1994).

2.4. Conclusion

A large variety of often complex indigenous forest management types does exist in tropical countries. They demonstrate the multi-resource character of forest vegetation and the creative role of human culture in regulating these resources for human use (cf. Hladik et al., 1993). The different forest management practices vary in intensity. They evolved in a process of co-evolution between human society and nature. As a consequence of the combined processes of natural and cultural selection a great diversity of human-influenced forest types has been created (Mc-

Table 2
Accessibility of forest resources and probable types of community forest management (Gilmour, 1990)

Resource	Local interest	Management system
Ample forest in or adjacent to village	No interest forest in protection or tree planting	Indigenous management systems exist, confined to defining use rights only. Few trees on private land
Forest becoming depleted or access restricted	Emerging interest in forest development activities	Indigenous management systems exist to define rights of use and in some cases have biological objectives. Few trees on private land, but incipient interest
Severe shortage of forest products	Genuine interest in forest development activities.	Indigenous management systems well developed, defining both rights of use and biological objectives. Extensive private tree planting and protection likely

Key et al., 1993; Leach and Fairhead, 1993; Dove, 1994, 1995). The different indigenous forest management types are often dynamic, they gradually evolve in response to changes in both ecological, cultural and socio-economic conditions. Because of the divers and dynamic nature of indigenous forest management systems, it would be useful to have a classification system which can be used for systematic, comparative characterization of the different management systems, and which can assist in assessing their scope for further development under different conditions of resource availability and socio-economic development. As a basis for such a classification system, it is useful to consider the principles of forest management in more detail.

3. Characteristics of forest management

3.1. Professional and indigenous forest management

Forest management has been defined as the practical application of scientific, economic and social principles to the administration and working of any area used for forestry for specific objectives (Ford-Robertson and Winters, 1983). This definition illustrates how in western societies forest management has traditionally been equated with professional activities based on scientific principles. These activities were primarily directed at manipulating forests to favour timber production or to provide environmental benefits. Not surprisingly, this normative grounding of the concept of forest management meant that for a long time the forest management practices of local communities were ignored. In order to understand local management regimes, it is therefore necessary to look beyond professional activities and to identify universal features of forest management.

Some authors have equated forest management with silvicultural management. For instance, Anderson (1990) defined forest management as the conscious manipulation of the environment to promote the maintenance and/or productivity of forest resources. According to this interpretation forest management is characterized by purposeful manipulation of the vegetation; extraction of forest products without silvicultural treatment of the forest is not considered as a management system. However, at a low

rate of extraction forest may be able to recover from such exploitation. The first question to be asked with respect to maintaining forests is whether forest extraction is controlled in order to maintain its productivity. Forest management should therefore be considered to involve not only silvicultural practices, but all conscious human activities directed at maintaining its production capacity. It can best be defined as the process of making and implementing decisions about the use and maintenance of forest resources and the organization of the related activities (Duerr et al., 1979). It refers to the total set of technical and social arrangements involved in the protection and maintenance of forest resources for specific purposes, and the harvesting and distribution of forest products. **Indigenous or community forest management** may then be defined as the process of making and effectuating decisions about the use and conservation of forest resources within a local territory, with the organization of these activities being based on social interactions and the shared norms and interests of the people living within this territory (Fisher, 1989; Wiersum, 1993). Indigenous management often consists of biologically-oriented practices aimed at protecting and modifying a forest ecosystem with a specific utilitarian goal in mind. But it may also consist of human interventions in the forest that are based on cultural customs which are associated with group identity (cf. Schmink et al., 1992). For instance, the protection of sacred forests is primarily based on religious values rather than biological concerns. These practices may nevertheless function as a de facto forest conservation strategy.

Although forests are defined in scientific terms as ecosystems in which trees play a dominant role, forest management should not be considered to be always ecosystem-oriented. In many cases management practices are primarily directed at forest resources: those attributes of a forest which are considered relevant for fulfilling human needs. These needs are often of material nature, but cultural and religious needs may also be involved. Forest resources may consist either of a forest as a functioning ecosystem or of specific forest components (specific successional stages, specific useful species, endangered species, etc). In professional forestry, the ecological value of forests is currently increasingly appreciated with the forest ecosystem being considered

as a major resource. It has been argued that tribal people also view forest management in such a holistic way (e.g. Posey, 1985). But as illustrated above, many indigenous forest management systems involve 'a selective respect towards a culturally conceived nature' (Persoon, 1991). In such cases the management practices are directed at selected forest resources rather than at the integral forest ecosystem (e.g. Sow and Anderson, 1996).

Local communities often value forests in a rather different way than professional foresters and state organizations do. For such communities forest management is not a specialized resource management activity as is mostly the case in professional forestry. Rather it forms a part of the local livelihood strategy. Depending on the strategies of resource use of local farmers (Padoch and Vayda, 1983; Gerritsen, 1995) forests may be integrated in the local resource utilization system because they have one or more of the following functions (Falconer, 1990; Messerschmidt, 1993):

- Production of valuable products for household consumption (construction material, foods, medicines).
- Production of materials for generating income and employment through possible local manufacturing and sale (selected foods, resins/gums, construction material).
- Provision of inputs (farm implements, litter, mulching material, erosion control, fodder, bedding material) for agricultural and livestock production.
- Protection of water resources and provision of shelter.
- Cultural functions, such as conservation of tribal lands or role in religious beliefs (sacred forests).

As a result of the discrepancy in perception between local communities and professional forestry organizations on the roles of forests, the management objectives of these two categories of forest managers may be at variance. Often, the professional organizations do not even recognize the presence and nature of indigenous forest management systems. For instance, in Guinea a forest reserve established for biodiversity conservation actually consisted of man-made and old secondary forests. This origin of the forest had, however, not been recognized by the professional conservation agencies (Fairhead and

Leach, 1994). While in Sumatra local people invaded a nature reserve by extending their highly profitable mixed forest gardens (Mary and Michon, 1987). In both cases discrepancies arose between the desire of local communities to maintain their traditional claims on the 'domesticated' forests and the state's objective of biodiversity conservation.

3.2. *Management practices*

To date most studies on indigenous forest–people relations have concentrated on describing how the local people actually use forests. Only limited attention has been given to whether and how local people control such utilization and/or manipulate forests by purposeful practices so as to optimize the benefits from the forests. Nonetheless, various studies have indicated that in many cases indigenous people carry out a variety of management practices such as conserving certain patches of forest, sparing or planting desirable species, introducing new species, eliminating competing species, thinning, protecting forests from fire, mulching, stimulating fruit production, etc. (Posey, 1985; Anderson, 1990; Gomez-Pompa, 1991; Gomez-Pompa and Kaus, 1990; Campbell et al., 1993).

It is often contended that the first step in forest management consists of tree planting. Although this is true when bare land has to be reforested, it is clearly not the case for existing natural forests. As indicated above, in natural forests the first phase of management consists of practices to maintain the rate of extraction below the production capacity. This may be accomplished by limiting the rights to use forest products to certain people. Thus, if ample forest resources are present, there is often no interest in forest protection or tree planting and indigenous management practices are confined to defining use rights. Only if forest resources become scarcer, interest in actually manipulating the forests by biologically-oriented management practices may develop (Gilmour, 1990). In these cases management practices characterized by a combination of defined rights of use and biological objectives will develop (Table 2). Recent studies in Nepal (Arnold and Campbell, 1986) have indicated the wide variety of such biologically-oriented control practices in indigenous forest management, e.g. only harvesting selected prod-

ucts and species, harvesting according to condition of products (stage of growth, size, plant density, season, specific plant parts), or limiting the amount of harvested products (by time, quantity, use of tools or area).

If notwithstanding such practices for controlling extraction forest resources are becoming scarce, the biologically-oriented management practices may be further intensified by carrying out measures aimed at increasing the presence and/or productivity of the desired species. Measures may also be taken to favour the useful species indirectly by removing less desirable competitors. Thus, in its widest sense, the technical arrangements in forest management concern a group of deliberate activities for (a) controlled utilization; (b) protection and maintenance of forest stands; and (c) purposeful propagation with either wild or domesticated tree species.

The kind and intensity of forest management practices may vary considerably depending on the kind of resources being considered. Indigenous practices may involve silvicultural practices, as well as management practices scientifically denoted as horticultural practices. The management practices with respect to fruit production may evolve from collecting wild fruits in the forest to fruit cultivation in enriched fallows and home gardens to fruit production in orchards (Verheij, 1991). A similar progression of practices may occur with respect to other products such as gums or resins, bark products, or timber. During this progression valuable tree species are gradually segregated from the natural forest and cultivated in increasingly specialized agro-ecosystems. The controlled utilization shifts from priority rights on marked and planted trees to private ownership of land and trees. Concomitantly, the vegetation structure becomes increasingly systematized, with randomly spaced trees of random age giving way to even spacing of even-aged trees. Furthermore, the propagation methods change from using seeds to using clonal material, and the location of planting changes gradually from a forest environment to open-field conditions. In professionally managed tree crop systems, this process of domestication has resulted in a differentiation between fruit orchards, cash-crop plantations and forest plantations. But as indicated by the earlier examples, in many indigenous forest management systems various tree species

are cultivated in combination, and no specialization in specific categories of tree crops has taken place. The professional categorization for specialized tree-crop systems does therefore not reflect the diversity of indigenous forest resource management.

3.3. *Organization of forest management*

Forest management not only involves the carrying out of resource management practices, but also the process of making decisions about (a) the objectives of forest management; (b) the kind of activities to be carried out by various persons; and (c) the distribution of forest products. In addition, management also requires the existence of a control system which ensures that the proposed activities are carried out as planned.

In conventional forestry thinking, it has been assumed that professional organizations, mostly under state or corporate control, were needed for effective forest management (Fairfax and Fortmann, 1990; Kartasubrata and Wiersum, 1993). Consequently, little attention was given to the nature and functioning of community-level organizations for forest management. It was generally assumed that the forest utilization practices of local people were governed by the principle of 'the tragedy of the commons' resulting in the overexploitation and degradation of the forest resources. It is now recognized, that a differentiation between 'open access' and 'common property' forests should be made (e.g. Gibbs and Bromley, 1989; Messerschmidt, 1993). Whereas open-access forests are prone to degradation, the common property forests are often actively maintained. These forests are subject to individual use, but not to private ownership. The utilization of these forests is governed by a set of regulations on independent user rights of members of a specific user group (Messerschmidt, 1993). For such common property forest management regimes to function properly, there should exist an indigenous institution for forest management with the following characteristics (Gibbs and Bromley, 1989):

- A structure for group members to make decisions on the required resource management practices;
- Group control over the behavior of the group members, which ensures that the planned management practices are carried out;

- Control over the distribution of collected forest products;
- Ability to exclude outsiders.

Such an institution need not be a formal forest management organization. A cultural/religious institution may ensure a similar effect. For instance sacred forests may be protected religious taboos. Or a village priest, who can 'communicate with gods', may therefore designate various forest zones for different kinds of use (Kunstadter, 1988).

Indigenous forest practices may be organized not only on the basis of common property regimes, but also on a private basis (Fortmann and Nihra, 1992). In many cultures it is usual that private forest utilization rights are created by investing labour in the establishment of agricultural or tree crops (Shepherd, 1992). However, the differentiation between common property and private forest management regimes is anything but straightforward. Many intermediate situations exist because of the differentiation between land and tree tenure as well as the variety of local rules for using different types of forest resources (Messerschmidt, 1993). For instance, in several tribal societies valuable tree species may be claimed for individual use by marking them, while the remainder of the forest remains common property (Persoon and Wiersum, 1991).

4. Classification of forest management as a continuum in forest–people interaction

On the basis of the characteristics of forest management, indigenous forest management may involve the following practices: (a) restricting access to or forbidding exploitation of (parts of) the forests because of their cultural and religious values; (b) carrying out technical measures to ensure controlled utilization and/or possible enhancement of specific forest products. There has been a general evolution from protection and extraction of products from the natural forests to the cultivation of domesticated tree crops. This evolutionary process included institutional changes as well as technical and ecological changes. To date the systematic comparison and classification of these various stages of indigenous forest management has received little attention. More

attention has been given to the evolution of people–plant interactions within agriculture. It seems worthwhile to attempt to apply the principles employed in such studies to clarify people–forest interactions.

A major attempt at understanding the processes involved in the emergence of agriculture was made by Harris (1989). He developed a model of agricultural development on the basis of ecological and evolutionary assumptions. The model postulates a series of plant-exploiting activities and associated ecological effects arranged sequentially along a gradient of increasing input of human energy per unit of exploited land. Along this continuum of plant–people interactions a gradual transformation of the natural ecosystem into an agro-ecosystem takes place, and the human intervention in the reproductive biology of foodplants intensifies. Three major thresholds in people–plant interactions are postulated. The first is between 'procurement of wild-food (foraging)' and 'production of wild-food', the second between 'production of wild-food with minimal tillage' and 'cultivation of wild food plants with systematic tillage', and the third between 'cultivation of wild food plants' and 'production with domesticated plants'².

By analogy with the Harris model, also forest resource exploitation and management activities can be arranged along a gradient of increasing input of human energy per unit of exploited forest. On basis of the three major categories of forest management practices, which were identified earlier, three major thresholds may be postulated between the various phases of forest–people interactions (Table 3). The first is between uncontrolled and controlled procurement of wild tree products in the natural forests. As indicated above, the control of forest utilization primarily involves the definition and control of use rights; this requires social transaction costs, e.g. in respect to time spent on mobilization and decision making and control. Control measures with a biological objective are developed in the second instance.

² Such plant domestication refers to the modification of the genetic constitution of an individual plant species and should not be confused with the concept mentioned earlier of domestication of the landscape (McKey et al., 1993).

Table 3
Major categories of indigenous forest/tree utilization and management practices

Threshold	Utilization system	Plant-exploiting practices	Ecological effects
	Uncontrolled procurement of wild tree products	Casual gathering/collecting	Incidental dispersal of propagules, no transformation of natural vegetation composition and structure
<i>Controlled utilization</i>			
	Controlled procurement of wild tree products	More or less systematic gathering/collecting	- ditto -
		Systematic collection with protective tending of valuable tree species	Reduction of competition, limited transformation of forest structure/composition
<i>Purposeful regeneration</i>			
	Cultivation of wild trees	Selective cultivation by transplanting of wildlings and/or dispersal of seeds/vegetative propagules in forest environment Tree crop cultivation (possibly in combination with annual crops)	Purposeful dispersal of propagules to new habitats, partial transformation of forest structure/composition Land clearance, total or almost total transformation of forest structure/composition
<i>Domestication</i>			
	Production of domesticated trees	Cultivation of domesticated trees in tree crop plantations	Propagation of genotype and phenotype variants, land clearance and soil modification inputs of fertilizer and pesticides

The second threshold is between controlled procurement of wild products and purposeful regeneration of valuable tree species. And the third threshold is between the cultivation of wild trees and the production of domesticated trees; the domesticated trees may be propagated through genotype or phenotype variants.

In comparison with the Harris model, the second and third thresholds are analogous to the thresholds separating 'wild plant food procurement' from 'wild plant food production', and 'cultivation of wild food plants' from 'production with domesticated crops' respectively. But a new threshold separating 'uncontrolled' from 'controlled' gathering was introduced. This threshold replaces the Harris threshold separating 'wild plant food production with minimal tillage' from 'cultivation with systematic tillage'. This modification was made to stress the important factor of social control in forest exploitation. Furthermore, soil tillage is less important in tree growing than in crop growing systems.

Concomitantly with the increasing input of human energy per unit of exploited forest land, a gradual transformation of the natural forest into an agro-ecosystem occurs. Also the human intervention in the reproductive biology of tree species intensifies (Table 3). This process of progressively closer interaction between people and the forest resources is also associated with various socio-economic trends (cf. Harris, 1989). In the first place the socio-economic conditions relating to forest utilization change: increasing sedentarization, increasing population density, and a gradual shift from a subsistence economy to commercialization. In the second place the complexity of the indigenous rules and regulations change, with common property rights gradually becoming changed into private land and tree tenure rights (Table 4).

The conceptual model for classification of the various evolutionary stages of forest utilization and management and their main characteristics is a descriptive one. It should not be regarded as an ex-

Table 4
Institutional arrangements in indigenous forest/tree management and utilization systems

Plant-exploiting practices	Socio-economic conditions	Indigenous institutions with respect to utilization
Uncontrolled, casual collection of wild tree products	Segmented societies, low population density, subsistence economy	Open access
Systematic, controlled collection of wild tree products	Low population density, incipient social stratification at community level (often coupled with formal state regulations and dual economic system)	Common property rights, sometimes priority rights to valuable tree species
Systematic collection of wild tree products and protective tending of valuable tree species	Increased social stratification and incipient commercialization at local level (often coupled with formal state regulations and dual economic system)	Combined common property rights on forests and private priority rights on claimed trees
Selective cultivation of wild trees	Increased population density and socio-economic stratification	Priority rights to forest plots for tree planters
Tree crop cultivation	Medium-high population density, increased incorporation in market economy	Private land and tree rights
Cultivation of domesticated trees in plantations	High population density, fully commercialized resource use	Private land and tree rights

planatory model indicating unidirectional and deterministic trends in which the various phases represent pre-ordained steps on a ladder of increasingly 'advanced' stages of general societal development (cf. Harris, 1989). Firstly, in many areas different forest management types may co-exist, with each type occupying a specific landscape (e.g. Posey, 1985) and/or tenurial niche (Fortmann and Nihra, 1992). Secondly, although the model indicates general evolutionary trends, the transitions from one phase to another are not always irreversible. For instance, Balée (1992) describes a 'regression' from shifting cultivation to forest gathering of several Amerindian tribes in the tropical lowlands of South America. Also for some areas of West Africa it has been reported that there has been a process of de-intensification rather than intensification in forest management (Fairhead and Leach, 1994). In both cases the local attitudes to forests have been influenced more by historical processes of land alienation as a result of tribal warfare and colonial land expropriation than by a tradition of gradual intensification of the utilization and management of forest resources. Thirdly, most indigenous forest management systems are mostly a component of an integrated farming system. The evolutionary trends in forest management practices are therefore often related to development trends

in agriculture. They may either be intensified or de-intensified in response to agricultural intensification, depending on their role in the local farming systems (Belsky, 1993).

5. Conclusion

The existence of a large variety of indigenous forest management systems indicates that the traditional view of equating forest management with professional forest management practices is untenable. To obtain a proper understanding of the full scope of forest management one should proceed from an empirical analysis of how different groups of local people define and value the various components of the forests and how they interact with the forests, rather than from an biological, legal or professional definitions of forests and forestry. In order to clarify the characteristics of various types of indigenous community forest management and their relation to ecological and socio-economic conditions, this paper began with an overview of the variety in indigenous forest management types and their major features. This information formed the basis for a re-evaluation of the basic principles of forest management. Com-

binning the theoretical and empirical bases yielded a conceptual model which illustrates the co-evolution of society and the forest environment (cf. McKey et al., 1993; Dove, 1995).

The model was primarily developed with the aim to contribute to a better understanding of the diversity of indigenous forest management systems and to clarify the different phases in the process of domestication of forested landscapes. It might also be useful for assessing under which kind of conditions indigenous forest management shows promise for incorporation in programmes to stimulate participatory forest management. As discussed above, the management objectives, practices and organizational framework of indigenous forest management systems are often at variance with the characteristics of professional management systems. Such discrepancies should be taken into account when planning for increased involvement of local communities in forest management. Attention should also be given to the fact that whereas in professional systems forest management is conceptualized as an activity taking place in a legally delineated and specialized land-use system, indigenous forest management practices are mostly directed at forests and/or trees as a component within an integrated land-use system. The stimulation of increased community involvement in forest conservation and management activities should therefore not only be based on general forest policy objectives, but on socially differentiated goals in which the different perspectives and priorities of local communities and professional (state) organizations must be balanced (cf. Fairhead and Leach, 1994; Wiersum and Lekanne dit Deprez, 1995). Development efforts to stimulate more active local involvement in forest management can best be considered as the start of a new phase in the long evolution of indigenous forest exploitation and management. They should not be conceived as always involving a radical switch from exploitive to conservative practices. The model may assist in characterizing the nature of still existing indigenous forest management systems and in identifying what further adaptations might be stimulated by development projects in order that they can function optimally under location-specific land-use conditions (cf. Kajembe, 1994; Raintree and Warner, 1986). For to be successful, the development efforts should go with the grain of

the historical process of co-evolution of human society and nature.

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