From timber management to forest management: an initial discussion on forest management evolution

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ABSTRACT: Forests have been subject to human intervention since the inception of human civilization. With enhanced knowledge, understanding and capacity humans exert an increasing pressure and influence on forests. Forests in general have undergone different ownership patterns. The requirements for forests have changed over time. The objectives of forest management are shifting from timber production to biodiversity conservation and nature protection. On the other hand, in many places the forests are dwindling due to the anthropic pressure. The management paradigms are changing in response to these triggering mechanisms. In this paper an attempt has been made to summarize the evolution of forest management practices and discuss some recent trends in forest management.

Keywords: biodiversity conservation; deforestation; forest management; forest ownership; silvicultural system; timber production

Like other natural resources, management of forests has always been subject to a few phenomena such as exploitation of selected goods or services (e.g. timber and non-timber products), modification of the natural system to make the forest less chaotic to extract the targeted output; economic profitability considered as the basis for determining anthropic activities (Lamb, Gilmour 2003). Under the principles of scientific management of forests till recently modern forestry has targeted to produce more timber in a cost effective way. But facing two different phenomena – a continuous forest decline in developing countries and a gradual shift in demand and perception in developed countries (Jeanrenaud 2001) – the forest management practices are changing. The paper has summarized the available information to answer two broad questions: what are the major objectives under which forests are managed and what are recent trends in forest management to form the platform for further discussion on forest management transformation theory.

GOAL OF FOREST MANAGEMENT

Forests are managed to get ecological and economic services. They provide a variety of socio-economic and ecological goods and services. At the ecosystem level, forests are coastline and hill stabilizer, retainer and builder of land, buffer against waves and storms and a reservoir in the tertiary assimilation of wastes and in the nitrogen, carbon and sulphur cycle. It is a habitat for wildlife and birds and a nursery ground for fish and shellfish. It is an environment with potentials for agriculture, aquaculture, and salt production. It is a place for human recreation. At the component level, forest products have been used as timber, railway sleepers, beams and poles, firewood, charcoal, scaffolds, mining props, fence posts, chipboards, in boat building, dock piling, flooring, panelling. Plants are sources of tannin, fibres, dye, sugar, alcohol, cooking oil, vinegar, fermented drinks, condiments, sweetmeats, vegetables, glue, hairdressing oil, fodder, etc. Fish/crustaceans, honey, wax, birds, mammals, reptiles, etc. are also obtained from forest ecosystem. Millions of people in the world earn their livings by exploiting forest resources and working in the industries that depend on forests for their raw material. Forests bear cultural, historical and archaeological values. The role and use of the forest and particular forest products can also be subject to cultural and mystic values, reflecting people's history, religion, art and other aspects of social functioning (Secretariat of the Convention of Biological Diversity 2002).

EVOLUTION OF FOREST OWNERSHIP PATTERN

The use of forest resources varies with the type and locations, ownership and status of the forest and through time. They also have implications for the wider environment at scales ranging from local to global. In defining the ownership pattern of the forests three distinct phases could be identified – common property resource management, state ownership and private ownership. While state ownership dominates the forest resource in general terms, the detailed pattern is complicated by conflicting trends and contrasting pattern. Overall, common property ownership has been largely displaced by state ownership, which in turn has partially given way to private ownership. The different phases of forest ownership are discussed below.

Phase 1 – The common property resource: Common property ownership by indigenous populations accounted for the most of the world forest area until recently. It survived in parts of Europe until modern or early modern times. In much of Asia, Africa and America this form of ownership survived until the nineteenth century, and in some areas it is still existent. In Africa and parts of the other developing countries, the arrival of European colonial powers marked a major turning point in common property ownership. In general terms, they considered any land under common property or group ownership to be unoccupied or ownerless, and in effect appropriated it. With this change in the status of the forest, there came a change in management. Under traditional common property ownership the use of forest products was self-regulated by an informal form of policy consisting of rules or guidelines handed down from generation to generation (Mather 1990).

Phase 2 – State ownership: Traditional indigenous ownership has now largely died out, and the ownership of forest resources is dominated by the state. State ownership dates back to the time of the Pharaohs in Egypt, and the royal forests of countries such as England, France and Prussia represented an extensive area of state ownership in the medieval and early modern periods (Jeanrenaud 2001). The prominence of the state ownership stems from the growth of the state in modern time. As has been indicated, the colonial period witnessed a tremendous expansion of the state ownership, while many states acquired or appropriated forestlands in their territories in the nineteenth and twentieth centuries. As a consequence of colonialism in many developing countries, forests belong to the state (Mather 1990). But facing the gradual decline of natural forests many of the countries have started social forestry or community forestry programs where joint ownership over the forests is admitted.

Phase 3 – Private ownership: In some parts of the world, private forest ownership developed directly from common property ownership, but elsewhere it arose from the alienation of land previously under state control (Mather 1990). Forest ownership patterns are shifting in some regions – notably in Central and Eastern Europe, the Commonwealth of Independent States and parts of Asia – from a large single owner (the state, the fairly uniform objectives) to literally hundreds of thousands of smaller owners with different objectives. In Central and Eastern Europe alone, more than 1 million new forest owners have emerged since 1990 (Anderson et al. 1998). Some countries have accorded increasing recognition to the historical land or territorial claims of local peoples. The rights of indigenous communities figure prominently in several Latin American laws. A number of other countries, including Australia, Canada, South Africa and several countries in Central and Eastern Europe, are engaged in restoring the lands of dispossessed communities and individuals which may include natural forests or plantations (FAO 1999).

Phase 4 – Joint ownership: In many countries, particularly in the developing countries with declining forests, social forestry or community forestry programs have been promulgated as an approach to improve the condition of the forests and the community dependent on the forests simultaneously. Under this approach through mutual agreements the ownership of forest dwellers over the forest products is admitted. It is expected that this type of joint ownership will increase gradually.

EVOLUTION OF MANAGEMENT OBJECTIVES

Forests are cultural as well as ecological spaces. Most of the surface area of the earth was covered with forests after ice age, today termed as 'wildwood'. These wildwoods were frequented by hunters and gatherers, with limited impact on forest cover. However with development of livestock rearing and settled agriculture man started to change the landscape through clearing large tracts of forests. In fact the history of human civilization is also a description of forest degradation (Jeanrenaud 2001). Four major stages of development of the forest resource,

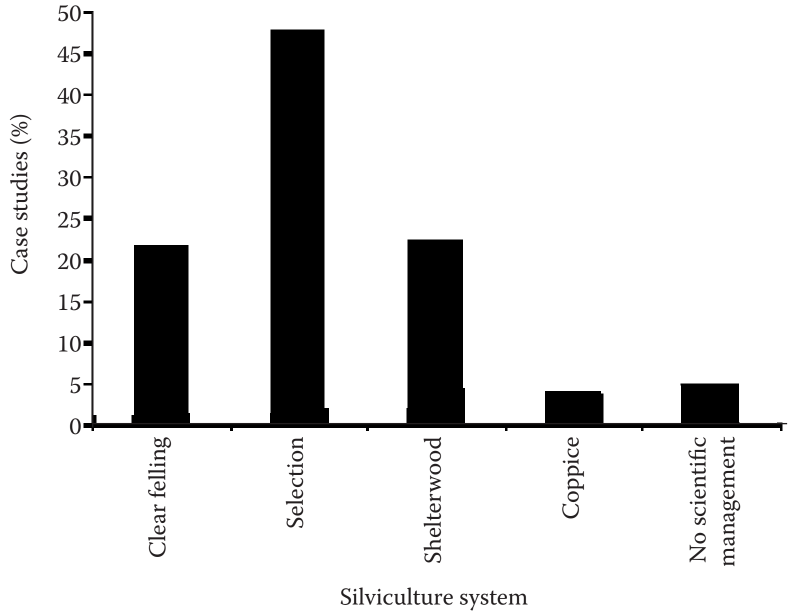

Fig. 1. Relative frequency of silvicultural systems adopted in different countries (based on Appendix)

in terms of its use, may be recognized. The common property ownership is typically characterized by the production of a wide range of products, timber and non-timber for subsistence and livelihood. The public or private forests are usually subject to management for production of narrow and simple product range. Priority is usually given to timber production. In the post-industrial forest, the provision of services such as conservation and recreation is accommodated alongside (or even to the exclusion) of timber production. The joint forest management usually recognizes the local people's or communities' demand on the forests, characterized by the production of timber and non-wood forest products. Thus nowadays the functions of forests worldwide belong to two main classes – production and protection. In the former, timber and a variety of other commodities are produced. In the latter, the emphasis is on the provision of ecological and environmental services such as watershed protection, carbon offsetting, pollution reduction and nature conservation. Forests are also protected and managed for cultural, social and religious values. Some of the major types of forest resource usage are described below.

Management of forests for timber production: Natural forest management for timber production is an age-old practice. It is practiced at various levels of intensity. As a minimum, it requires demarcation and protection, inventory, and regulation and control of exploitation of the forest. More intensive management involves silvicultural interventions such as the release of regenerating timber trees and cutting climbers (Sayer et al. 1992). In many countries a part of the state owned forest is used privately (at least for timber production) under various agreements usually known as forest utilization contracts or concessions. In the absence of the capability or will to utilize the forest resource themselves, governments use such arrangements as an alternative to alienating the state-owned forest to the private sector.

With some exceptions most countries have now adopted selection felling and clear felling as general practices (Fig. 1). Selection working is designed to conserve the trees of commercial species which are below the exploitation limit and because of the increment which these trees represent, to reduce the felling cycle approximately to one-half of the rotation. If selection fellings are to proceed to perpetuity in short felling cycles, and the yield truly sustained, it is essential that the putative residual stand before each felling contains sufficient stems of commercial species of good form, free from serious defects and with healthy crowns to provide a commercial felling at the end of the next cycle (Collins et al. 1991). However in some countries (e.g. Congo) a log and leave strategy still predominates.

Management of plantation for wood production: People have been planting trees for thousands of years for food, shelter, ceremonial or religious purposes. The present development of man-made forestry can be traced back to the sixteenth and seventeenth centuries when the exploration and expansion of European culture took place (Evans 1992). Following the introduction of planned forestry and the regular high forest system more than 250 years ago, forests in Central Europe became increasingly shaped by plantation silviculture. Many natural woodlands were replaced by planted forests, and the process is still continued (Koch et al. 1999). Factors favouring plantation developments are continued destruction of forest, difficult access to forest, inadequate natural regeneration, reduced availability of land and lack of management.

Nearly all plantations are transplanted rather than direct sown and, at maturity, clear-felled and replanted. Where practicable and where crops are grown on short rotations, regeneration from stump shoots (coppicing) is important. Other regeneration systems tried were mostly experimental, e.g. two-storey high forest or to accommodate special conditions, e.g. taungya. The dominance of clear-felling and replanting, is because it is simple and cheap as compared with the alternatives. Also, it is quick and reliable way of achieving uniform regeneration which is important for fast growing crops (Evans 1992). Plantations are basically managed for timber production. Whereas, forests are managed for many different purposes, including wood production, recreation, ecological, cultural, and amenity values, biodiversity, and soil and groundwater protection. This brings new challenges to forest management and silviculture (Koch et al. 1999).

Management of forests for non-wood forest products: Exploitation of non-wood forest products is an integral part of the survival and development strategy for humans. The role of forest managers is to maintain or increase the productivity of the forest resources while protecting them from overexploitation. The aim is to provide essential products and services while simultaneously allowing for the needs of the local rural people. For non-wood forest products the challenge is therefore to assist 'development' while simultaneously promoting the continued and possibly increased sustainable utilization of such products (Wickens 1994). Timber and non-timber products can be incorporated into multipurpose systems of natural forest management that both minimize the negative effects of timber extraction and capitalize on benefits provided by a range of forest products (Laird 1995). By decreasing clear-cutting with artificial regeneration, in favour of natural regeneration using advance growth or seed trees the total non-timber value of the forests can be considerably increased (Sunderlin, Ba 2005).

Both natural and planted forests are rich sources of non-wood forest products. Unfortunately, harvesting of wild products is sometimes inefficient and done using destructive methods (Sayer et al. 1992). The potential markets for some of these products have been replaced by cheaper, synthetic products. The need for a constant supply, as in the case of pharmaceutical products, has also led to synthesization. The few products that cannot be readily synthesized, such as natural rubber, have been taken into natural production or are undergoing domestication, for instance rattan (Wickens 1994). Southeast Asia has a long history of successful exploitation of non-timber forest products, e.g. rat-

Table 1. Number of countries producing non-wood forest tree products and forest animal products from their forests (FAO 2001)

Item	Country (as % of world total)	Africa	Asia	Oceania	Europe	North & Central America	South America	World (No.)
Non-wood forest tree products	Food	45	12	0	20	10	12	89
	Fodder	72	17	0	0	7	3	29
	Medicinal plants	47	15	0	15	12	12	60
	Perfumes	9	18	0	0	27	45	11
	Dyeing	19	25	0	0	19	38	16
	Utensils	32	8	0	8	27	24	37
	Ornamental	18	6	0	48	15	12	33
	Exudates	38	8	0	0	27	27	26
	Other	0	0	0	0	33	67	3
Forest animal products	Living animals	55	0	0	0	9	36	11
	Honey	35	15	0	22	13	15	46
	Bush meat	46	4	0	36	8	6	50
	Edible animals	100	0	0	0	0	0	4
	Hides	0	0	0	60	20	20	10
	Colour	0	0	0	0	0	100	2

tans and resins. However, African non-timber forest products (NTFP) have generally been important for subsistence and local economies (Sayer et al. 1992). Even in poverty-stricken areas the long-term trend of social and economic evolution towards improved living conditions will make the collection of NTFP in natural forests less attractive (Bruenig 1996). Table 1 shows the continentwise distribution of countries producing non-wood forest tree and animal products from their forests.

Management of forests for biodiversity conservation: The concept of sustainable forest management arose at the beginning of the 18th century in Central Europe and today constitutes a basis for forest management. The goal of this activity is that the sustainability of the forest as an ecosystem be maintained, and its development be balanced (Poznanski 1999). As the exploitation of forests accelerated, governments realized the importance of conservation of samples of relatively intact forests as a necessary part of balanced land use. Thus the idea of nature and biodiversity conservation arose in the 19th century in the USA, and its goal consists in conserving fragments of primordial nature. Now national parks and other forms of protected areas have become one of the most universally adopted mechanisms for nature conservation. Direct benefits of protected forests may be as follows: protection of renewable resources, support to tourism and recreation, and conservation of genetic resources. Indirect benefits may be watershed stabilization, maintenance of climatic stability, soil protection, additional biological services, provision of facilities for scientific research and education (Secretariat of the Convention of Biological Diversity 2004). But this is not to claim universal success; the great majority of protected areas are under a threat of encroachment or poaching, resulting from a conflict between the conservation of nationally or internationally important sites and the needs of local communities traditionally dependent on the resources of such areas. The level of conflict is intensified in many tropical countries where the population is increasing, and will continue to do so in decades to come (Myers 1999).

Management of forests for multipurpose functions: Foresters have traditionally managed forests with silvicultural systems that prescribe stand homogeneity for optimized tree growth. The primacy of timber production as the dominant objective is giving way to broader objectives such as sustaining the function and dynamics of ecosystems, and maintaining ecosystem diversity and resilience or protecting sensitive species, while providing for a variety of ecosystem services of value to humanity (Coates, Burton 1997). When the goal of natural forest management is to maintain the biodiversity and ecological integrity along with timber production, the employed silvicultural systems must promote timber production and reduce negative impacts on non-timber resources. A silvicultural system that includes even-aged groups of trees within an uneven-aged matrix appears more suitable to the multiple goals of management than either an even-aged or uneven-aged management system (Pinard et al. 1999). Protection and production of more diverse forest values demand the consideration of fine-scale variability found within forest stands and understanding of the spatial and temporal response of forest ecosystems to manipulation (Coates, Burton 1997). Applying the principle of biological rationalization (the use of natural ecosystem processes as far as possible in pursuit of forestry or silvicultural ends), the only silvicultural interventions that are considered are those that fulfil the aim of high-quality (or high value) production (Schutz 1996).

Virtually, the whole of Europe subscribes to the principle of multipurpose management, but some countries are more explicit than others are. At the same time it is apparent that management objectives are becoming increasingly specialized. Management is also very heavily weighted in a particular direction in forests with extensive leisure facilities, in forests dedicated to various aspects of nature and landscape conservation, and in commercial monocultures of fast-growing tree species. Many countries recognized these aspects by formally differentiating between forests with economic objectives and forests with special objectives such as protection, health and recreation, greenbelts, reserves of natural ecosystems, national parks and historic sites. In other countries the trend towards specialization seems to stem from case by case responses to particular circumstances rather than from any deliberate policy (FAO 1989).

Forest management for the sustainable livelihood of forest dwellers: In many areas of the world, forests are of immense importance for rural people, especially in remote or otherwise underdeveloped areas. Forest products often provide food and other basic needs, and represent a source of income and inputs into an agricultural system. Furthermore, they help households to check exposure to risks of various kinds, and are an integral component of their habitat and their social and cultural structure within such environment. Forest-dwelling shifting cultivators may number as many as 500 million, and are believed to use around one fifth of the tropical area. In addition to providing land for cultivation, the forest offers to these cultivators and other forest dwellers grazing and fodder, as well as fuelwood and direct sources of food such as nuts, berries and fruits (Mather 1990). Small-scale farmers seek livelihoods at the forest margins. This practice does not create too many disturbances when the population is sparse and the product is used only for their own needs. However, when the population pressure becomes greater and when profit is the motive for extraction, then the disturbance becomes serious and creates environmental problems.

FACTORS AFFECTING FOREST MANAGEMENT EVOLUTION

From the utilitarian aspect of man as the supreme user of natural resources (including forests), changes in the human condition (over space and time and their interaction) are the ultimate determinants of the forest management courses. Humans convert the natural capital into other forms of capital (financial, human and manufactured) for their livelihood (Andersson et al. 2004). Thus forest management encompasses administrative, economic, legal, social and technical measures involved in the conservation and use of natural forests and plantation (Hayens 2005; Andersson et al. 2004). It is ridden with multiple complexities and dynamism. It is characterized by multi-level and multi-scale management, varying in: 1. spatial scales (from local to global); 2. temporal scales (from a single event to long-term trends); 3. socio-economic scale of interests (from a specific policy to general issues). The underlying causes of forest management changes are numerous and inter-linked (for review see Rudel et al. 2005; Andersson et al. 2004; Oksanen et al. 2002; Dasgupta 2001).

The state of forest is also a major determinant of forest management paradigm. Though there have been worldwide efforts to conserve forests and forest resource for the future of mankind, unfortunately, deforestation is carried out at an alarming rate (0.2% per year) all over the world. Deforestation has been the highest in African countries, followed by countries of South America, Oceania and Asia. Asia has a less surviving forest than Africa and America and a higher relative rate of logging. At regional and national levels, however, the rates of forest loss vary enormously (FAO 2003). Deforestation results in land degradation, this leads to agricultural stagnation and even a lowering of productivity, which in turn promotes further deforestation and thus completes the vicious cycle of degradation (Iftekhar 2001). There are multiple direct agents of deforestation, like agricultural activity, grazing, fuelwood gathering, infrastructure building and urbanization. The population pressure is a major indirect factor determining the pace of deforestation. In addition, inappropriate land tenure systems, poverty, political instability, and market failure are important indirect factors and they are interlinked. Deforestation in the developing regions of Latin America and the Caribbean, Africa and Asia is a part of structural transformation determined in part by North-South relations through global markets. Besides domestic factors, the global pressures of demand for wood from the tropics also explain the pattern and rate of deforestation (Wardle et al. 2003). However, in some regions (especially in the European region) countries are experiencing forest transition and forest recovery (Walker 2004).

RECENT DEVELOPMENT IN FOREST MANAGEMENT

A sustainable yield principle has been the tradition of forest management until now (FAO 2003). Recently it was stated that these objectives of management could hardly be attained without the management of the ecosystem (Holvoet, Muys 2004). It is to note that an emphasis on timber production has resulted in the loss of other commodities from the forest and sometimes caused social conflicts. Presently there is a global commitment to make the forest management sustainable. This improvement entails a rebalancing of forest management objectives over time and space (FAO 1999).

Changes in management objectives

The approaches to forest management are changing. With the growing scientific knowledge ecological services of the forests are recognized while the demand for economic products and services is intensifying with increasing population and per capita consumption. Albeit the dominance of timber and non-timber production objectives emphasis are gradually laid on the role of forestry in poverty alleviation (Sunderlin, Ba 2005); sustainable rural development; urban forestry and environmental amelioration; mitigation of natural hazards, climate change and desertification (Iftekhar, Islam 2004); role of forests in water yield and quality maintenance, etc. (FAO 2003). The concept of sustainable forest management (SFM), which includes ecological, social and economic aspects, rapidly aroused interest after the UNCED Conference in Rio de Janeiro

(1992) where international forest principles were formulated primarily (Holvoet, Muys 2004).

Proliferation of pluralistic adaptive management

Decentralization and devolution of forest management is promoted in many countries, most pronouncedly in countries with the traditional federal structure such as Belgium, Germany, and Switzerland or where regionalization was introduced or reintroduced like in Italy and Spain (FAO 1989). Along with these in many other countries, an increasing number of local political and administrative powers are emerging that are less dependent on the central control (Anderson et al. 1998). Collaborative bodies of forest owners are formed. In the form of social forestry/participatory forestry/community forestry the desire and aspirations of local people are appreciated (FAO 2003), though sometimes claimed to be at a very narrow scale (Mayers, Bass 1999). The role of forestry sector in the overall national poverty reduction strategies is recognized in many countries (Oksanen et al. 2003).

Promulgation of ecosystem level management

As forestry must balance the short-term needs and desires of today's human population, the anticipated needs of future generations, and the maintenance of long-term forest ecosystem conditions, functions and organisms the use of the paradigm of forest ecosystem management (FEM) as the template of the forestry is considered as the most effective way to satisfy the obligations (Kimmins 2003). Sustainable forest management, ecologically sustainable forest management, forest ecosystem management, ecosystem approach to forest management and systematic forest management are some of the concepts related to this (Korn et al. 2003; Wilkie 2003).

Recent developments in silviculture

The previous tendency of forest management was to achieve uniformity by rigid silvicultural schedules. The dogma of maximizing the functions of production and protection, adapted and ethically fitting to the Europe of the eighteenth and nineteenth century, led to trials with silvicultural systems such as the African Uniformization par I'Haute, various forms of shelterwood systems and the former Malayan Uniform System, which aimed at a more uniform structure of the growing stock. Trials, errors and failures, and better understanding of the natural and economic systems gave prominence to tree species mixtures and biodiversity again, first in Europe and subsequently in tropical forests. The growing understanding of system dynamics helped to overcome a dogmatic opposition to more rational, flexible and adaptable approaches of traditional naturalistic silviculture. The failure of the positivistic ideologies prevailing in the nineteenth century that human beings could manipulate nature and humanity and overcome all natural obstacles opened the way to more holistically conceived, system-oriented silvicultural management systems that neither force nor copy, but mimic nature (Bruenig 1996). To accommodate the changes in the forest management objectives changes in silvicultural systems are occurring in all types of forests. Recent silvicultural management in many countries (e.g. USA, UK, Canada, Australia) adopted the concept of sustainable forestry, ecological integrity, mimicking natural disturbances and ecosystem management. The corresponding silvicultural systems are identified with another set of terms such as new forestry, reduced impact logging, variable retention silvicultural system and improvement cutting (FAO 1999).

Efforts to improve forest harvesting practices

Various efforts are underway to develop methods of timber harvesting that maintain both the potentials for future production and the environmental services provided by forests. At the international level, several initiatives are ongoing, namely Helsinki Process (1993), Montreal Process (1995), ITTO (1992), ATO (1993), The Tarapoto Agreement (1995), Dry Zone Africa (1995), the Near East Process (1996), Lepaterique Process for Central America (1999) and Bhopal – India Process (1999) to work on codes and guidelines for environmentally sound forest harvesting (FAO 1999; Hickey 2004). In a large number of countries and regions standards with Principles, Criteria and Indicators of Sustainable Forest Management have been developed. Several international initiatives started their search for methods potentially useful to define and assess SFM, such as Criteria and Indicators (C&I), Life Cycle Assessment, Cost Benefit Analysis, Knowledge Based Systems and Environmental Impact Assessment (Holvoet, Muys 2004). Silvicultural manipulations of an individual tree canopy or the live crown, that means of the growth of trees, have only recently been expanded to include wildlife and other non-timber objectives. Landscape level distribution of habitat structure and composition is achieved by retention of various amounts and patterns of forest. The updating and adaptation of management to either achieve set goals in a more appropriate way or modify expectations is a continuous process. There are clear indicators of gradual changes towards silvicultural practices that better reflect the multiple goals of sustainable forest management.

Forest managers are increasingly supported by decision support tools and models (Berg et al. 1996). The Decision Support Tools fall into three broad categories – experience based, empirical (historical bioassay (HB) models; e.g. growth and yield models), knowledge based (process simulation (PS) models) and hybrid simulation (HS) models that combine both experience and knowledge in hybrid historical bioassay process-simulation systems (Kimmins 2003).

CONCLUDING REMARKS

To achieve sustainable management of forest ecosystem is a major challenge for the forest managers. In many countries timber production no longer holds primacy and other forest values, such as the conservation of biodiversity and the production of water, are gradually becoming important. The maintenance of these values demands a change in the general philosophy associated with silvicultural practices from simply growing and cutting crops of trees to the perpetuation of key components of the ecosystem. This has required a shift from conventional logging methods to the development of new and more complex silvicultural systems. On the other hand, many countries are facing deforestation and degradation. To bring the barren land under forest cover social forestry or community forestry practices have been developed. This requires effective integration of all direct and indirect stakeholders in forest management. So, increasing the complexity of forest management should be viewed as a normal part of modern forestry and not a constraint on the profession. Indeed, these challenges represent an important opportunity to take forestry forward within a more holistic approach to environmental and forest resource management.

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Od pěstování dřeva k pěstování lesa: vývoj cílů hospodaření v lesích

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ABSTRAKT: Lesy byly vystaveny lidským vlivům od prvopočátku lidské civilizace. S rozšířeným poznáním, porozuměním a schopnostmi lidé stále více ovlivňují lesy a stupňují na ně tlak. Lesy mají různé typy vlastnictví. Lidské požadavky se během času měnily. Cíle hospodářské úpravy lesů se přesunují od produkce požadovaného objemu dřeva ke snaze o zachování biodiverzity a k ochraně přírody. Na druhé straně však lesy na mnoha místech trpí pod tlakem lidské populace. Cíle a způsoby hospodaření v lesích se mění v reakci na tyto spouštěcí mechanismy. Práce se pokouší shrnout vývoj praxe hospodaření s lesy a diskutovat jeho některé nedávné trendy.

Klíčová slova: zachování biodiverzity; odlesňování; hospodaření v lesích; vlastnictví lesů; hospodářský způsob; produkce dřeva

Appendix. Silvicultural systems practiced in different countries

Country	Place/Forest type	System	Reference
Albania		Clear felling with artificial regeneration mainly with conifers (75%) on unproductive and deforested area	FAO 1988a
Angola		Selective system	Sayer et al. 1992
Australia	Wet eucalypt forests on the Forestier Peninsula, SE Tasmania	Group selection	Neyland et al. 1999
	Mixed eucalypt forests in Victoria	Shelterwood system	Tolhurst and Turvey 1992
	Mountain ash (*Eucalyptus regnans*) stands in Victoria, SE Australia	Clear felling system with a rotation of 50 to 80 years	McCarthy and Lindenmayer 1998
	Native mountain *Eucalyptus regnans* forests of SE Australia	Clear felling managed for multiple use, including wood production	Dignan et al. 1998
	Dry eucalypt forest in eastern Tasmania	Clear felling and partial logging	Duncan 1995
	Wet eucalypt forest in southern Tasmania	Clear felling	Duncan 1995
	Mountain ash (*Eucalyptus regnans*) in SE and *Eucalyptus marginata* in SW Australia	Clear felling, followed by burning to give stand-replacing conditions	Attiwill 1994
	Tasmania's dry sclerophyll forests	(1) overstorey removal, (2) seed tree retention, (3) potential sawlog retention, (4) mixed age regrowth retention, (5) shelterwood felling and (6) canopy retention (essentially a thinning treatment used where it is desirable to avoid clear felling)	McCormick and Cunningham 1989
	Production forest	Selection system with a 30–40 year felling cycle	Collins et al. 1991
	Radiata pine (*Pinus radiata*) plantations and native eucalypt (*Eucalyptus* spp.) forests in Victoria	Clear felling, retention of seed trees, shelterwood and selection felling	Squire et al. 1991
Austria	Norway spruce stand	Clear felling with artificial reforestation	Hafner et al. 1983
Bangladesh	Hill forest	Clear felling and artificial regeneration of valuable species	FAO 1993
	Mangrove forest	Selection system with a 20-year felling cycle	FAO 1993
	Sal forest	Coppice system with a rotation of 40 years	FAO 1993
	Unclassed state forest	Under no scientific management	FAO 1993
Belgium	Broadleaved (ash, sycamore [*Acer pseudoplatanus*]), wild cherry (*Prunus avium*), black walnut, alder, oak, and large-leaved linden (*Tilia platyphyllos*) forest	Group selection with an 8-year cycle (optional intervention at 4 yr.). Natural regeneration is supplemented by planting genetically selected stock	Thill and Mathy 1980
	Walloon region	Timber production is the main objective. Silviculture aims at maintaining mixed forest of conifers and broadleaved species, both in sufficiently large groups or stands to permit economic management	FAO 1988a
Benin		Single tree selection	Sayer et al. 1992
Bhutan	Coniferous zone in western Bhutan	Group selection system	Klassen 1992

Country	Place/Forest type	System	Reference
Bolivia	Seasonally dry forests in Lomerio	Even-aged groups of trees within an uneven-aged matrix	Pinard et al. 1999
Cambodia	Dense evergreen and semi-evergreen forest	Selective felling, cycle 25–30 yr.; only 30% of the exploitable dbh ≥ 45 cm may be felled and a sustainable cutting rate at 25 yr. is 3.44% (for the average growth class)	Nophea et al. 1999
	Dry deciduous forest	Selective felling cycle of 12–15 yr., and a sustainable felling rate at 12 yr. is 3.76% (for an average growth class)	Nophea et al. 1999
Cameroon	Savannas	No management system is carried out in Savannas planted with fast-growing exotic species	Sayer et al. 1992
Canada	Algonquin Provincial Park, Ontario	Selection system	Anderson and Rice 1996
	Montane old-growth forests of coastal British Columbia	Shelterwood	Beese et al. 1999
	Red pine and white pine (*Pinus resinosa*, *P. strobus*) stands in the Algonquin Provincial Park	Uniform shelterwood system	Beese et al. 1999
	The Great Lakes-St. Lawrence forest region of Canada	Shelterwood	Burgess et al. 1995
	The interior cedar-hemlock (*Thuja plicata/Tsuga heterophylla*) zone contains some of the most productive forest sites in interior British Columbia	Clear felling	Smith et al. 1994
	The montane old-growth forests of coastal British Columbia	Shelterwood, patch clearcut and green tree retention	Beese et al. 1999
	High-elevation old-growth conifer (*Abies amabilis*/*Tsuga heterophylla*, with *Thuja plicata* and *Chamaecyparis nootkatensis*) forests on Vancouver Island, British Columbia	Uniform shelterwood (SW), green tree retention (GT) and patch cuttings (PC)	Arnott and Beese 1997
	Forests of British Columbia	Variable retention harvesting	Thompson and Pitt 2004
	Forests of Ontario	Careful logging around advanced growth	Thompson and Pitt 2004
	Forests of Quebec	Cutting with protection of regeneration and soil	Thompson and Pitt 2004
	Montane forest of western hemlock (*Tsuga heterophylla*) and amabilis fir (*Abies amabilis*) on Vancouver Island, with overstorey trees 200–800 years old	Green tree retention system	Prescott 1997
	Old-growth forests of Vancouver Island, British Columbia	Shelterwood, patch clear felling, dispersed green tree retention	Beese et al. 1999
	Interior Douglas fir (*Pseudotsuga menziesii* var. *glauca*) winter ranges in central interior British Columbia	Single-tree selection, low-volume removal (20%), to integrate timber harvesting with the needs of mule deer (*Odocoileus hemionus hemionus*)	Smith et al. 1994
Central African Republic		Selection system, exploitable dbh ≥ 60 cm	Sayer et al. 1992

Country	Place/Forest type	System	Reference
Chile	*F. cupressoides* forests	Uniform selection felling	Donoso et al. 1990
China	Uneven-aged forest	Selective felling, annual increment 9.6 m³/ha	Yu Zheng et al. 1996
	Plantation	Clear felling system	Yu Zheng et al. 1996
Congo		Selection system, 25-year cutting cycle, exploitable dbh ≥ 60 cm	Sayer et al. 1992
Cote d'Ivoire		Clear felling and artificial regeneration	Sayer et al. 1992
Czech Republic	Český kras	Selection felling is used at sites of higher class and in favourable moisture conditions group shelterwood for protection and environmental purposes	Poleno 1999
Eastern Africa	Until 1960 selective logging in natural forest. Later converted to plantations of exotics (*Pinus patula* and *Cupressus lusitanica* were common choices)	Clear felling followed by artificial regeneration	Sayer et al. 1992
Ecuador	Mangrove forest	Clear felling followed by natural regeneration. Felling in stands with more than 25 cm dbh. Seed trees are retained	Blanchard and Prado 1995
Equatorial Guinea		Selection system	Sayer et al. 1992
Fiji		Selection system	Collins et al. 1991
Finland	Park stands, and marginal sites such as peat bogs and near treelines	Selection system	Mikola 1984
France	Uneven-aged stands in the region of E. central France. Most of them are coniferous (*Picea abies*) or mixed coniferous forests	Coppice or coppice with standards	Badre and Demolis 1997
	State forests of Normandy (mostly monocultures without an understorey)	Selection systems	Gamblin et al. 1986
	Val de Saone area	Coppice with standards	Parde 1999
	Oak (*Quercus* sp.) stands of NE France	Coppice with standards	Degron 1998; Laporte 1998
	Beech (*Fagus sylvatica*) forests	Coppice with standards	Bastien 1997
	High forests	Classic French selection (high forest) system	Sevrin 1997
	Broadleaved and coniferous forests	Selection system, for strong environmental protection and/or conservation objectives	Dubourdieu 1990
Gabon	Forest rich in stand dynamics	Improvement of stand dynamics	Sayer et al. 1992
Germany	Beech (*Fagus sylvatica)* stands in the Spessart region	Shelterwood/group-selection system of regeneration	Franz et al. 1989
Ghana		In production forest long-term sustained yield management practice is followed with 40-year felling cycle. In protection forest logging is supposedly prohibited. In plantation very little systematic management is followed	Sayer et al. 1992
	Bobiri Forest Reserve	Shelterwood system	Sayer et al. 1992

Country	Place/Forest type	System	Reference
Guinea-Bissau	Production forests	Selection system with major emphasis on nine commercially exploitable species	Sayer et al. 1992
India	The mangrove vegetation of Andaman and Nicobar Islands	Previously clear felling with artificial regeneration, later strip felling with natural regeneration, presently shelterwood system	Banerji 1957; Balachandra 1988; Satish et al. 1998
	Spruce (*Picea smithiana*) and silver fir (*Abies pindrow*) forests in the Western Himalayas (Rajgarh Forest Division, Himachal Pradesh)	Selection system with an exploitable dbh ≥ 60 cm and a felling cycle of 15 yr.	Shrivastava 1997
	Tropical wet evergreen forests of Karnataka	About 38% of these forests are under a selection or selection-cum-improvement system	Kushalapa 1988
	Cedrus deodara and *Pinus wallichiana* forests in the temperate mountain forests of the Western Himalayas	Regular shelterwood system with fixed periodic blocks. Presently understocked	Shrivastava and Siaguru 1997
	Natural forest	Clear felling followed by artificial regeneration with valuable species	FAO 1993
Indonesia	Mangrove forest	Clear felling with artificial and natural regeneration	Sukardjo and Yamada 1992
	Lowland rain forest of Sarwak	Selection system with a cutting cycle of 25–30 years	Collins et al. 1991
Japan	Sugi (*Cryptomeria japonica*) and hinoki (*Chamaecyparis obtusa*) plantations	Shelterwood system	Ota et al. 1994
Laos	Moist forest	Selection (based on diameter and species) felling	Collins et al. 1991
Liberia		Selection system with 25-year felling cycle	Sayer et al. 1992
Malaysia	The dipterocarp forests in Malaysia	Malayan Uniform System (a tropical shelterwood system) and the Selective Management System (a selective felling)	Appanah et al. 1990
	Peninsular Malaysia	Malayan Uniform system	FAO 1993
	Mangrove forest	Clearfelling, artificial regeneration after two years of logging. Seven seed trees are retained	Ong 1982
	Peninsular Malaysia	Selection management system (SMS) which includes polycyclic logging as one of its option	Chin 1989; Collins et al. 1991
Mauritius		Any tree ≥ 18 cm diameter is used as timber and others as fuelwood	Sayer et al. 1992
Myanmar	*T. grandis* forest	Selection system	Bunvong et al. 1976
	Monsoon forest	Burma selection system, a polycyclic system in which a low volume of mature trees of stipulated minimum girth is harvested in a 25–40 year felling cycle	Collins et al. 1991
	Mangrove forest	Clear-felling system with rotation 15 years	Han 1992
Netherlands	Old Scots pine stands (60- to 140-years old) in Het Loo forest	Selection felling with natural regeneration	Kuper 1997

Country	Place/Forest type	System	Reference
Nigeria		Selection felling with 100-year felling cycle, exploitable girth ≥ 60–90 cm	Sayer et al. 1992
		Tropical shelterwood system, for enhanced natural regeneration of valuable tree species	Sayer et al. 1992
Pakistan	Hill forests	Single tree selection with reforestation depending on natural regeneration	FAO 1993
	Mangrove forest	Selection-cum-improvement system	Rahman and Sheikh 1988
Panama	Changuinola	Modified selection system, removing individual old trees and exposing only about one-quarter of the forest-floor area	Kapp 1993
Papua New Guinea	Production forest	Shelterwood system	Collins et al. 1991
		No formal application of sustained yield management	Collins et al. 1991
Philippines	Hill dipterocarp forests	Selective Management System (SMS)	Appanah et al. 1990
		Selective harvesting	Bruenig et al. 1991
	Mangrove forest	Selection system with rotation 20 years	Santos and Siapno 1968
Poland	Forest sub-district of Limanowa	Group shelterwood system	Poznanski and Rutkowska 1995
	The Sihle fir (*Abies alba*) forests of the Beskid Sadecki Mts.	Sequential selection felling with a long-term regeneration (40–60 years) period	Poznanski 1999
Reunion		Clear felling of native tamarind (*Acacia heterophylla*)	Sayer et al. 1992
Senegal		Selection system. Vast areas of palm plantations are underplanted with cash crops	Sayer et al. 1992
Sierra Leone		Most of the timber extraction takes place without any form of management. Exploitable dbh ≥ 60 cm, rarely enforced. More than 60 species are logged but the nine most important spp. account for over 70% of the production	Sayer et al. 1992
Slovenia		Selection system	Krajcic 1996
Solomon Island		Selection system (exploitable dbh previously ≥ 60 cm, now ≥ 35 cm)	Collins et al. 1991
South Africa	Southern Cape indigenous forests	Selection system	Geldenhuys 1980
Sri Lanka		Selective felling with enrichment plantation. In some places clear felling with artificial regeneration	Collins et al. 1991
Surinam	Tropical lowland forests	A polycyclic system, about 20 m^3/ha of quality timber is felled in 20-yr. cycles; well controlled. Arboricides used to release commercial species	Graaf 1986
	Rain forest	Regular selection forest management	Graaf et al. 1999
Sweden	Boreal Norway spruce (*Picea abies*) stands	Shelterwood system	Holgen 1999
	Even-aged stands of Norway spruce (*Picea abies*)	Selection method	Lindhagen 1996
	Boreal forests of northern, central, and southern Sweden	Shelterwood system	Holgen 1999

Country	Place/Forest type	System	Reference
Switzerland		Group-selection and selection system	Leibundgut 1981; Rotach 1994
Thailand		Clear felling with artificial regeneration. Now logging is banned	Collins et al. 1991
	Mangrove forest	Clear felling in alternate strips with 30-year rotation	Aksornkoae et al. 1989
Uganda		In production forest monocyclic system is followed and in protection forest felling is prohibited	Sayer et al. 1992
United Kingdom	Upland conifer forest in southern Scotland	Group selection, with group size of 0.1 to 0.2 ha	Wilson et al. 1999
	Plantation forests	Large-scale modification of silvicultural system for biodiversity conservation	Kerr 1999
	High forest	Clear felling system	Hart 1995
USA	Giant sequoia regeneration in the southern Sierra Nevada	Group selection	Stephens et al. 1999
	Floodplain and terrace of the Tombigbee River and adjacent hills and ravines in north-eastern Choctaw County, Alabama	Group selection system	Crouch and Golden 1997
	The interior cedar-hemlock (*Thuja plicata/Tsuga heterophylla*) zone of interior British Columbia	Group selection	Smith et al. 1994
	Cedar-hemlock-white pine (*Thuja plicata/Tsuga heterophylla/Pinus monticola*) stands in northern Idaho	Uneven-age management, selection cuts in fully-stocked stands	Monserud et al. 1994
	Commercial compartments of Kaskaskia Experimental Forest, Illinois	Intensive group selection silviculture, including improvement fellings and killing of cull trees	Minckler and Budelsky 1989
	Second growth Appalachian broadleaved stands, 75–80 yr. old, in Monongahela National Forest, West Virginia	'Deferment cutting', a shelterwood silvicultural system in which residual (reserve) trees are retained until the end of the rotation of the new stand	Smith et al. 1989
	Mixed-conifer stands in the Northern Rocky Mountains	Uneven-aged shelterwood system	Haight and Monserud 1990
	Floodplains – alluvial or red water forests SE USA	Clear felling with natural regeneration	Lockaby et al. 1997
	Pinus contorta forest	Clear felling with natural regeneration	Lotan 1973
		Clearcut, shelterwood, group selection, single-tree selection, and late-rotation, unharvested forest stands	Perry et al. 1999
	Forest in SE Alaska	Clear felling and subsequent natural regeneration	Harris 1974
Venezuela	Mangrove forest	Clear felling in alternate strips of 50-meter width	Aksornkoae 1993
Zaire		No regular management	Sayer et al. 1992
Zimbabwe		Community land, no forest management	Sayer et al. 1992

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