Forest Biological Diversity Interactions with Resource Utilization[1]

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Abstract: The most important forest resources of the Asia-Pacific region are the highly diverse rain forests. Utilization of the resource is a natural and inevitable consequence of the region's socio-economic development. The sustainable management and development of forest resources in the region can be achieved by implementing conservational forestry, which is based on blending Eastern wisdom and philosophy with Western expertise and technology. The most urgently needed technology in the region are cost-effective, integrated forest inventory and monitoring systems, information management and decision-support systems, and non-wood forest resources assessment and valuation systems. The conservational approach to forest management can have major beneficial effects in conserving resources and maintaining biological diversity.

Forests have served humankind beneficially since time immemorial. They are renewable natural resources. Natural forests are vital sources of food, fuel, medicine, and a host of other products essential for livelihood and welfare in all developing countries. They provide fertile land for agriculture and primary commodities for trade and industries which promote socio-economic progress. Besides producing tangible products, forests have heritage, socio-cultural, aesthetic, recreational, and other intrinsic values which enhance the quality of life. They play a critical role in the management of soil and water resources, maintenance of environmental quality, and conservation of biological diversity—all of which are essential for sustainable development.

In the Asia-Pacific region, forests constitute an integral part of the people's diverse cultures, religions, and socio-economic activities. Living in harmony with nature is a way of life in the region. Prudent use of forests contributed significantly to the rapid progress of civilization and socio-economic development. The region is home to more than half of the world's population, and is projected to increase to nearly 3,200 million by the year 2000 (Anon. 1987). It has a dynamic economy and is expected to become the economic growth center of the world in the 21st century. The growing population will inevitably increase pressure on the forests in the region, but socio-economic advancement will have a profound influence on the nature of these demands.

With increasing demands from a growing population, both regionally and globally, it is inevitable that the forests will continue to decline. According to the World Resources Institute (Anon. 1990a), the world's forests have declined by one-fifth, from 5 to 4 billion hectares, since pre-agricultural times. Temperate forests have lost the highest percentage of their area (32 to 35 percent), followed by subtropical woody savannas and deciduous forests (24 to 25 percent). Tropical evergreen forests have lost the least area (4 to 6 percent). However, the present highest rates of deforestation are in South America (1.3 percent) and Asia (0.9 percent). According to the Food and Agriculture Organization (FAO) of the United Nations, the rate of deforestation of 0.6 percent in 1980 has doubled to 1.2 percent, or almost 17 million hectares a year (Anon. 1990b). The rate of annual deforestation in the Asia-Pacific region during 1981-90 was close to 4.7 million hectares, compared with some 2 million hectares during 1976-80.

The impacts of rapidly growing world and regional populations, changing socio-economic circumstances, and declining forest resources, particularly on biological diversity, present major challenges to forest managers. The increasing awareness of the vital non-wood values, especially of tropical forests, makes the social and environmental aspects of forestry particularly important and the conservation of forests in general and forest biological diversity, in particular, imperative. Before these challenges can be met realistically and effectively, however, forest managers must have (a) timely, relevant, and reliable information on forest resources and biological diversity, (b) pragmatic policies and strategies for sustainable forestry development, (c) effective managerial expertise and operational skills, and (d) appropriate forest resources assessment, management and development technologies.

Forest Biological Diversity

The Asia-Pacific region has been well endowed with rich natural forests containing great biological diversity. However, the precise extent of forest areas is debatable due to a lack of consensus in definition and the rapid changes brought about by shifting cultivation, commercial timber harvesting, and conversion to other uses. The extent of closed forests has been estimated by the Asian Development Bank at 407.9 million hectares (Anon. 1987) and by the World Resources Institute at 495.7 million hectares (Anon. 1990a). According to the Asian Development Bank, broadleaved forests accounted for 376 million hectares or 92 percent of the natural closed forests in the region. More than half of the closed forests were found in insular Southeast Asia (144.4 million ha), continental Southeast Asia (95.9 million ha), and tropical Oceania (37.9 million ha). Closed forests covered more than 50 percent of the total land area of Indonesia, Malaysia, Papua New Guinea, and the Solomon Islands. Countries with the most extensive areas of closed forests are Indonesia (113.9 million ha), People's Republic of China (92 million ha), India (51.8 million ha), Papua New Guinea (34.2 million ha), Myanmar (31.9 million ha), and Malaysia (21 million ha). Substantial areas of non-forest land, especially in Southeast Asia, are actually under perennial tree crops such as rubber, oil palm, and cocoa.

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The most important forest resources of the Asia-Pacific region are the tropical rain/moist forests of Southeast Asia and Oceania, which cover some 1,000,000 square kilometer (Anon. 1989). The region has a great diversity of plant and animal species of economic importance and is one of the cradles of agriculture where many of the world's major crop plants originated or have their center of diversity. Many plants and animals from these forests are important sources of fruits, drugs, oils, beverages, gums, vegetables, spices, medicine, ornaments, fibres, and rattan. Nevertheless, the precise extent, location, and value of these forests' biological diversity is generally very poorly known.

Indonesia, with forests spread over more than 13,000 islands encompassing three major vegetation regions from Asia to Oceania, probably has the highest biological diversity in the Asia-Pacific region. The country is estimated to have 25,000 to 30,000 species of flowering seed-bearing plants (4,000 trees), 750 species of mammals (100 endemic), 1,250 species of birds, and 12,000 species of arthropods/insects.

Malaysia's biologically rich tropical rain forests have some 14,500 species of flowering plants (890 reaching 45-cm d.b.h.), over 800 species of non-flowering plants, around 1,000 species of vertebrates, and 20 to 80 thousand invertebrate species. A high degree of endemism ranging from 30 percent of all tree species to 80 to 90 percent of some families has been observed.

The Philippines has a unique flora and fauna with high levels of endemism in both plants and animals. More than 950 terrestrial vertebrate species and some 8,000 species of flowering plants have been recorded. The forests support at least 12,000 species of plants, of which about 3,000 are endemic. The fauna is characterized by a high degree of endemism, with about 96 species of non-volant land mammals, of which at least 70 are found nowhere else in the world. The avifauna and herpetofauna, with some 860 species, also show a remarkable degree of endemism.

Thailand, which divides naturally into six geographical regions, has 10,000 to 15,000 species of plants, including 500 tree species and about 1,000 species of orchids; over 900 species of birds; 270 species of mammals; and 100 species of amphibians.

Papua New Guinea has an extraordinary diversity of ecosystems, ranging from mountain glaciers to humid rain forests, and some of the most remarkable wildlife on earth. The total number of vascular plants in the country is believed to be in the order of 11,000 species and about 2,000 species of ferns, with estimates of endemism ranging from 55 to 90 percent. The lowland forests are the richest with over 1,200 species of trees. The majority of the fauna is Indomalayan in origin, with a strong Australian influence in mammals, which have been estimated at almost 200 species. The avifauna is one of the richest and most varied in the world, as New Guinea is a major center of diversity for several species of birds. Approximately 740 species have been recognized (10 percent of them endemic), of which 445 dwell in the rain forests. There are some 90 species of snakes, 170 species of lizards, nearly 200 species of frogs, and 455 species of butterflies, over 80 percent of which are endemic.

Interactions with Resource Utilization

Resource utilization is a natural and inevitable consequence of the socio-economic development process. Forest utilization has been ongoing since the dawn of civilization and is a worldwide phenomenon which escalated with the advent of the agricultural and industrial revolutions. It has been sustained at a high level to satisfy the basic and socio-economic needs of growing populations in developing countries and to meet the insatiable demands for primary commodities in the developed world. As a consequence, extensive areas of land have been deforested or degraded throughout the world, causing widespread and serious losses of forest biological diversity.

In the Asia-Pacific region, which is environmentally, ecologically, and culturally very complex, forest biological diversity interactions with resource utilization are largely correlated with forest degradation and deforestation caused by a variety of traditional forestry and socio-economic development activities. The main activities which could degrade the forests, and, therefore, biological diversity, include hunting and gathering, shifting cultivation, fuelwood cutting, and commercial timber harvesting. Loss of forest biological diversity can result from burning and converting forests to continuous annual cropping, grazing, perennial food and primary commodity crops, and industrial forest plantations; and from construction of dams, settlements, highways, and infrastructures.

Forestry has been practiced traditionally but informally in the Asia-Pacific region from the time when people began to use natural forests to satisfy their basic needs. The forest people's pattern of land use, exemplified by nomadic hunting, gathering and traditional shifting cultivation, has evolved over thousands of years to take advantage of the regenerative capacity of natural forest ecosystems—a way of life both rational and sustainable so long as their populations remain low and their territories extensive (Anon. 1989). Some of the most technologically advanced cultures in the world in the period 13,000 B.C. to 4,000 B.C. flourished not in the Middle East or the adjacent Mediterranean, but in the northern reaches of mainland Southeast Asia, where cultures were based on traditional shifting cultivation (Anon. 1989). The system is considered to be well adapted to tropical rain forest management as it helps to maintain the biological diversity of forests and often provides significant benefits to wildlife populations.

However, shifting cultivation can become unsustainable, and thus impact adversely on forest biological diversity in at least three main ways: (a) by an increase in human population, which causes old plots to be recultivated too soon; (b) by inept agricultural practices such as prolonged cultivation of the land that allows persistent weeds to become established; and (c) by extension into an insufficiently humid environment such as deciduous forests, which have a much slower recovery rate (Anon. 1989).

The problem has been exacerbated in recent years by "shifted cultivators" from the lowland who lack the knowledge which generations of traditional shifting cultivators have accumulated.

The rapid growth of populations in the Asia-Pacific region in recent decades has compounded the problem as the increased pressure on the forests resulted in unsuitable areas being cultivated. Even in Southeast Asia, shifting cultivation is often no longer a viable option as the density of population is such that the practice will almost invariably lead to long-term degradation of the agricultural and forestry potential of the land (Anon. 1989). Non-traditional shifting cultivation or slash-and-burn farming by the landless and unemployed rural poor, who follow in the wake of logging, is a major cause of deforestation associated with commercial timber harvesting in most Asia-Pacific countries.

Fuelwood is a major source of energy in the Asia-Pacific region and accounts for the largest share of consumer products from forests and other wooded areas. It is usually collected locally for rural households and from areas surrounding the population centers for cooking, heating, and small-scale industries. Although the extent of fuelwood collection is virtually impossible to ascertain precisely, it is estimated that annual production generally accounts for about 80 percent of total wood removals in the Asia-Pacific region. Consequently, uncontrolled exploitation for fuelwood and charcoal often degrades open tree formations and sometimes closed forests, causing adverse interactions with forest biological diversity.

Commercial harvesting of permanent production forests in the Asia-Pacific region is not usually a direct cause of deforestation because it is mainly selective, and clear-cutting is rare (Anon. 1988). Selective logging usually removes 2 to 10 trees per hectare or 3 to 30 per cent of the total timber volume. The permanent forest estates in many countries of the Asia-Pacific region are legally constituted and protected by long-established forestry services. Most countries in the region have basically sound forestry policies and subscribe to the principles of sustained yield and sustainable development. However, few of them have adequate human, technical, and financial resources to ensure effective enforcement of forestry legislations and implementation of sustainable forest management and development, especially with respect to forest biological diversity. Consequently, commercial timber harvesting is often the precursor of serious degradation of forests in general and forest biological diversity in particular.

The increasing degradation of forest biological diversity is caused largely by the inflexible and inappropriate application of eurocentric conventional forestry ideals, concepts, principles and practices. As logging became more profitable than the extraction of non-wood forest products usually associated with traditional forestry, large-scale mechanization and the removal of maximum volumes were advocated on the grounds of full and efficient utilization, economy of scale, and maximum socio-economic benefits. Unlike temperate forests, however, intensive exploitation of tropical forests invariably brought about rapid resource depletion, excessive resource wastage, and, above all, adverse impacts on the forest resources, environment and biological diversity. The damage is often aggravated by the indiscriminate and systematic application of silviculture techniques, often without the necessary information on the residual stand or its ecological characteristics, to produce idealistic uniform and highly productive forests like those in Europe. Seemingly, there is a lack of realization that the highly complex forest ecosystems in the Asia-Pacific region, particularly those located in the tropical countries with intense population pressures, harsh climatic conditions, and fragile environments, are not amenable to such extreme treatments. Besides degrading the forests, conventional forestry has also been alleged to have contributed to inequitable distribution of the forest wealth and deprivation of indigenous people's rights to their forest resources.

Conserving Biological Diversity

The importance of forest biological diversity, especially the rich genetic resources in tropical moist/rain forests, has been gaining increased attention in recent years. Whatever the uncertainties of the economic value of tropical forests in terms of their included biodiversity, the certainty of irreversible loss of a significant quantity of existing genetic resources through current rates and patterns of deforestation and forest degradation is beyond question (Kemp1991). Consequently, action for the conservation of forest biological diversity has been initiated by various United Nations agencies, notably FAO, United Nations Environmental Program (UNEP), United Nations Education, Scientific, and Cultural Organization (UNESCO), and non-governmental organizations such as International Union for Conservation of Nature and Natural Resources (IUCN), and World Wildlife Fund (WWF). However, the action has tended to be conceptual, intellectual and conventional, although field activities have increased in recent years. Given the wide spectrum of scientific information that must be urgently gathered to guide the location and management of conservation programs, international research organizations such as International Union of Forestry Research Organizations (IUFRO) also have an important role, in concert with national research centers (Kemp 1991).

In the Asia-Pacific region, the people's awareness of forests' multiple functions and vital contributions to their welfare and quality of life prompted the countries to establish extensive reserves of protected areas for environmental protection and biological diversity conservation. According to IUCN (Anon. 1990c), the region has 2,303 protected areas covering about 139.2 million hectares of which 810 areas covering 66.2 million hectares are totally protected. Southeast Asia and Oceania account for about 74.5 million hectares or 53.5 percent of the protected areas. Protected tropical moist/rain forests cover about 28.1 million hectares in the Asia-Pacific region while approximately 23.3 million hectares have been proposed for protection. However, management of the protected areas ranges from nominal to non-existent, and knowledge of the extent, nature, and value of the forests' biological diversity is grossly inadequate. Given the complexity of the ecosystems and the lack of adequately trained taxonomists, ecologists, and other scientists in the countries concerned, the provision of technical cooperation as well as financial support is critically important (Kemp 1991).

Most of the countries in the Asia-Pacific region have less than 10 percent of their land under protection for biological diversity conservation. With ever increasing demands on the rapidly declining forests from geometrically growing popula-

tions, however, there seems to be very limited scope and extremely poor prospects for further expansion of the protected areas system in most of the countries in the Asia-Pacific region. Permanent production forests must be managed sustainably and conservationally to ensure that forest biological diversity interactions with resource utilization are minimized so that forest genetic resources can be protected objectively and effectively.

Conservational Forest Management

The principal measures required to achieve sustainable natural resources and biological diversity conservation in production forests must include pragmatic objectives and technically, socially, economically, ecologically, and environmentally sound forestry practices. Conservational forestry, based on integrated forest resources assessment, management with realistic forest resources and biological diversity conservation goals, and preventive or proactive rather than curative or reactive measures, offers the best practical prospects for both sustainable forest management and forest biological diversity conservation.

A conservational approach to sustainable forest resources and biological diversity conservation must be supported by the following policy directions:

(a) Manage and utilize the forest resources for maximum benefits based on the inherent capability of the forest and its optimal use
(b) Manage the utilization of the forest resources based on comprehensive forest land use and management plans
(c) Determine potential yield on the basis of systematic and in-depth appraisals of the forest resource base, its growth potential, and other relevant factors
(d) Harvest forest resources conservationally by selective felling and retention of adequate natural regeneration, consistent with economical harvesting, to ensure the sustainability of the forest resource base; and
(e) Apply optimal forest management regimes developed on the basis of information generated by systematic integrated forest management and operations research

The development strategy for conservational forest management should accord priority to the following:

(a) Conservational and sustainable use of natural forest resources and biological diversity
(b) Afforestation and reforestation of deforested and degraded lands
(c) Research to improve forest management and operations, optimal resource utilization, and conservation of forest biological diversity
(d) Education to create awareness of multiple values of forests and promote forest conservation

Conservational forestry, based on the proven concept of management by objectives, requires careful integrated pre-felling and post-felling assessments of the total forest resources and the application of technically, socially, economically, ecologically and environmentally sound forest management and development practices. The conceptual outline sequence of operations is as follows:

Year	Operations
F-2 to F-1	Pre-felling integrated forest inventory
	Determination of optimal forest management regime or option
F-1 to F	Tree marking for felling or retention, if necessary
	Climber cutting, if necessary
F	Directional felling of prescribed trees
F+1	Post-felling integrated residual forest inventory
	Determination of optimal silvicultural regime or option
	Silvicultural treatment, enrichment or plantation, as appropriate

The conservational approach to forest management recognizes social, political, economic, ecological, and environmental constraints and is based largely on technological, managerial, and operational considerations. It is expected to be practical and will have the following beneficial effects:

(a) conserve forest resources and biological diversity;
(b) ensure sustainable forest management and development;
(c) minimize investments required for reforestation;
(d) maintain environmental stability and quality; and
(e) reduce damage to the ecosystem and loss of biological diversity.

Conclusion

The sustainable management and development of forest resources in the Asia-Pacific region can be achieved by the implementation of conservational forestry based on a blending of Eastern wisdom and philosophy with Western expertise and technologies. The necessary expertise, particularly in policy and economic analysis, must be acquired and appropriate facilities established within the Asia-Pacific region as a matter of priority to enable the countries in the region to formulate realistic strategies and options for sustainable forest management and biological diversity conservation. There is also an urgent need to upgrade essential technological, managerial, and operational skills. This is not only to intensify integrated studies in forest management and operations to develop appropriate tools and needed management information, but more importantly, to apply appropriate technologies, expertise, and skills for sustainable management of forest resources and the conservation of the biological diversity. The most urgently required technologies and skills in the Asia-Pacific region seem to be efficient and cost-effective integrated forest inventory systems, change detection and monitoring systems; information management systems; operations management and decision support systems; and non-wood forest resources, especially biological diversity, assessment and valuation systems.

The formulation and implementation of realistic strategies and programs for sustainable forest management and development in general and for forest biological diversity conservation

in particular can only be accomplished successfully after the evolution of a tropical forestry culture which is compatible with local social, cultural, political, economic, ecological and environmental conditions. The conservational and sustainable management and development of natural forests, especially tropical moist/rain forests, of the Asia-Pacific region require highly competent, innovative, and motivated forest managers and operators with the relevant expertise and skills; appropriate technologies and techniques; timely and reliable information; and adequate financial and human resources. Forestry specialists will need to acquire or upgrade their expertise and skills to conduct policy and economic analysis for optimizing sustainable management and biological diversity conservation; and to develop or adapt appropriate technologies and methodologies for environmentally-safe and ecologically-sound forest utilization and timber harvesting which ensure sustainable forest management and biological diversity conservation. In addition, they need to conduct cost effective integrated forest inventories to generate information for integrated forest management; to monitor changes in both natural and regenerating forests; to assess and evaluate non-wood forest and biological resources; and to conduct integrated studies in forest management and operations to evaluate the physical and economic impacts of alternative forest management, harvesting and silvicultural options on forest resources and biological diversity conservation.

The evolution of a tropical forestry culture, the formulation of realistic strategies and program for sustainable forest management and forest biological diversity conservation, and the effective implementation of conservational and sustainable forest management and development activities will require immense technical and financial resources to acquire or upgrade local capabilities. As most countries in the Asia-Pacific region are unlikely to be able to mobilize these resources nationally, they should be encouraged to collaborate and support the establishment of the following with external technical assistance:

(a) An Asia-Pacific Forestry Centre/Institute to conduct policy and economic studies necessary for the evolution of a tropical forestry culture; formulation and evaluation of strategic options for sustainable forest management and effective biological diversity conservation, and transfer of expertise and skills to national forestry personnel.

(b) Regional and National Centres of Excellence for Sustainable Forest Management and Development to develop or adapt, package, and transfer appropriate technologies, methodologies and techniques for integrated forest inventory, resource assessment, evaluation and monitoring; timber harvesting and reforestation; information management; and integrated studies in forest management and operations.

(c) Regional forestry programs to provide technical advice, guidance, and support necessary to upgrade national managerial, technical, technological and operational expertise and skills to ensure sustainable forest management and biological diversity conservation.

(d) An Asia-Pacific Forestry Information Centre to promote greater awareness and appreciation of the multiple values of forests and to provide technical advice, guidance, and support for upgrading national capacities and capabilities.

(e) A Global Forest Convention which encompasses biological diversity to ensure sustainable forest management and development and effective conservation of biological diversity as an integral component of the forest ecosystem.

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