Forest biodiversity conservation in India and Germany: a comparative analysis

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SUMMARY

Biodiversity or biological diversity pertains to the diversity of biological organisms, both animals and plants in a region. In 1992, the Earth Summit at Rio (Brazil) laid stress on the biodiversity over the globe and the need to preserve it for posterity. Biodiversity conservation has drawn the attention of governments all over the world. Both developed and developing countries are engaged in conserving their biodiversity. This paper attempts to draw comparisons between the biodiversity conservation measures in India (a developing) and Germany (a developed country).

INDIA

Biological Diversity

India has a rich and varied assemblage of living organisms. There are over 40 000 plant species in India of which nearly 2 500 are trees (Negi 1994). This accounts for about 12% of the global plant wealth. Amongst the 21 000 species of flowering plants found in India, 5 000 are woody plants. Almost a third of plant species of India are endemic and not found anywhere else in the world (Tewari 1992). The faunal wealth of India is also equally rich. There are over 75 000 species of animals of which about 60 000 are insects; 1 693 fishes; 3 000 birds and 372 are mammals. In addition to this, the marine life in the shelf zone of over 45 million ha is very rich and varied.

Forest Wealth

According to the Forest Survey of India report (Anon 1993), India has a total natural forest area of 640 107 km^2 which is 19.47% of the total geographic area of the country. India's natural forests can broadly be grouped into the following :

Forest group/type	% of forest area
1. Tropical wet evergreen forest	8.0
2. Tropical semi evergreen forest	4.1
3. Tropical moist deciduous forest	37.0
4. Tropical littoral and swamp forest	0.6
5. Tropical dry deciduous forest	28.6
6. Tropical thorn forest	2.6

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(Cont'd)	Forest group/type	% of forest area
7.	Tropical dry evergreen forest	0.02
8.	Subtropical broadleaved hill forest	0.4
9.	Subtropical pine forest	6.6
10.	Subtropical dry evergreen forest	2.5
11.	Montane wet temperate forest	3.6
12.	Himalayan moist temperate forests	3.4
13.	Himalayan dry temperate forests	negligible
14.	Subalpine and alpine forest	2.9

Loss of biodiversity

Causes : The following are the causes of biodiversity loss in India over the past several centuries:

1. Heavy removals of fuelwood and fodder;
2. Clearance of forest areas for agriculture, human settlements and flooding by reservoirs;
3. Overexploitation of forest resources;

Consequences:

a) According to the Red Data book of IUCN, 27 mammals of India are rare and threatened with extinction.
b) Over 800 plant species of India are either extinct or threatened with extinction (BSI report).

Biodiversity conservation

India has 77 national parks and 480 wildlife sanctuaries in which biodiversity conservation is the main activity. These areas cover about 14.03 million ha or 4.2% of the total geographical area of the country. There are 309 preservation plots covering about 8 500 ha; 1 905 sample plots in different forest types and 537 protected trees for *in situ* conservation of plants. However, all forest ecosystems have not been covered. *Ex situ* conservation is being done in 55 botanical gardens and 109 zoological parks.

Introduced biodiversity

Extensive plantations, mainly of exotic species have been raised in India. These include eucalyptus, exotic poplars and Australian acacias. However, they form an insignificant proportion of the total forest area.

What needs to be done

In spite of the efforts in recent decades, much needs to be done for conserving India's biodiversity. Some measures are:

1. Creating a network of special reserves for conserving at least two representative areas of different ecosystems;
2. Generating public awareness and interest in biodiversity conservation;
3. A fool-proof system for monitoring biodiversity conservation;
4. Sustainable use of components of biodiversity;
5. Impact assessment and minimising adverse impacts;
6. No forest working in representative ecosystems;
7. Further development of the network of national parks, sanctuaries and biosphere reserves.

GERMANY

In comparison with India, Germany is characterized by a sparse assemblage of living organisms. There are about 2, 00 species of flowering plants (including approximately 50 tree species). This is only 1% of the global wealth on flowering plants. Faunistic accounts give an amount of 76 mammal species, 237 bird species, 32 species of reptiles and amphibians, and approximately 30 000 insect species (WCMC 1992).

Forest data

The total forest area of Germany is 104 330 km^2 which is 29.2% of the total geographic area (StBA 1995). The forests of Germany belong to the forest biome type of cool temperate deciduous forests. This characterization pretends a monotonous appearance. Despite this the potential natural forest types reconstructed by vegetation scientists show the variety as follows:

1.	Broadleaved (beech) hill forest	42.2%
2.	Broadleaved (beech) montane forest	23.5%
3.	Broadleaved (oak) forest	24.8%
4.	Riparian and swamp forest	8.0%
5.	Dry temperate pine forest	1.0%
6.	Subalpine (spruce) forest	0.5%

In view of the wide range of definitions and (detailed) classifications on “forest types” (e.g., “forest vegetation types”), which can lead to some confusions, the account mentioned above is very simplistic. Nevertheless it facilitates the intercomparison of data between the two countries. The data on potential natural forests indicate a predominance of broadleaved deciduous tree species, especially of beech. The overall contribution of broadleaved species to natural forests has been estimated at 90%, the contribution of coniferous species being 10%.

But, in fact, forests in Germany are the results of human impacts over thousands of years, especially from the Middle Ages onward, when large areas of natural forest ecosystems had been exploited, converted into agricultural land and forest plantations. Today forests exhibit a share of more than 70% of coniferous species in the composition of forests. This gives a small impression on the extent of human activities, including forestry, during the past centuries.

Sustainable forestry was developed during a very long period in middle Europe (mainly in German-speaking regions). The uncontrolled (over)exploitation of forests was already counteracted by regulations in the Middle Ages. In the beginning of the 18th century the term “sustainability” made its way as a tenet in the management of forests. At first “sustainability” referred only to the sustainability of wood production, but in the middle of the 19th century “sustainability” encompassed other functions, too, like the protection of soils, watersheds and other forest resources. Today sustainability means the preservation of forests as a natural system. Therefore sustainable forestry includes a conservation use of nature and integrating the conservation related objectives in German forestry is of growing importance. Thus, sustainable forestry seems to be on the way to a perfect management system.

Loss of biodiversity

Causes:

1. Conversion and fragmentation of large forested areas caused by human settlements, agriculture, and industrial facilities;
2. Impact of industrial pollution on forest ecosystems;
3. Extension of the distribution of conifer forests during the past three centuries, managed as high forest and characterized by even-aged and more or less uniform stands.

Consequences:

According to WCMC (1992) 2 mammals, 17 bird species and 49 plant species are threatened with extinction. However, it is worth mentioning that not all of them are linked with forest ecosystems.

Biodiversity conservation

Germany has 12 national parks and 5 171 nature reserves. These areas cover 13 762 km^2 or 3.8% of the total geographical area of the country. There are also 12 biosphere reserves (> 11 700 km^2, 3.2%), 85 natural parks (> 56 000 km^2, i.e. > 16%) with different levels of conservation intensity and 6 700 km^2 of marshlands of international significance (StBA 1995).

There are about 580 natural forest preservation plots covering more than 16 500 ha for *in situ* conservation of plants and animals (StBA 1995), but still not all forest ecosystems (forest vegetation types) are represented with sufficient coverage.

Ex situ conservation is being done in 73 botanical gardens and 40 zoological parks. Furthermore *ex situ* conservation of forest genetic resources takes place by means of seed orchards, clone collections and conservation of seeds, pollen, plants, and tissues in gene banks.

Introduced biodiversity

About 20 exotic tree species were introduced to forestry in Germany since the middle of the last century. With the exception of Douglas fir, which covers about 1.5% of the total forest area, most of them are of minor or negligible importance in forestry.

What needs to be done: some proposals for solutions in forestry:

1. An important goal of nature conservation is to protect various forest ecosystems. Biodiversity conservation in large scale could be realized in national parks with no management operations. But, only national parks could not avoid the loss of species and habitats due to their small areas.
2. Other areas are needed to conserve forest habitats. This could be done by preservation of nature forest reserves (special unmanaged areas) with a sufficient amount of representative areas of different ecosystems (forest vegetation types).
3. Sustainable use of forests outside protected areas has many advantages and should be able to maintain species richness and diversity. Nature oriented management systems, which are already practised to some extent by forest landowners and managers on several thousands of hectares turn away from homogenous, mostly coniferous, forest forms to site adapted mixed broadleaved forests, which are assumed to exhibit advantages in ecological stability under the ongoing changes in environmental and climatic conditions (e.g. global change). Those and related management concepts are characterized mostly by permanent forest forms without intensive forest operations at a large spatial scale, where natural regeneration is preferred and supported. Clearcuts, if still practised at all, are not larger than a few hectares. Artificial regeneration favours autochthonous tree species and adapted provenances, and an adapted tending takes place (support of species mixtures and variety in physical structure therein, leaving decaying and dead trees as microhabitats, single tree harvesting).

Improved methods for inventory of diversity on different levels should be developed and give the basis for ecologically sound management plans.

4. All the measures must take into account conservation of forest genetic resources, with preference for *in situ* conservation for the protection of adaptability. Identification and declaration of gene resources by means of forest genetic research must be enforced. In 1989 the German Working Group “Conservation of Forest Genetic Resources” presented a conceptual framework for the conservation of forest genetic resources in Germany (BLAG 1989) which is continuously put into action.

5. These and related concepts are applicable not only in state forests, but also in community and private forests, for the latter this progress should serve as a model for financial support or remuneration.
6. However, pluralism as a innovative factor in forest management is to be retained. This is ensured to some extent by several hundred thousands of forest landowners with differing ideas on, and practices of, forest utilization.

COMPARATIVE REVIEW

Biodiversity is a complex issue. Life is organized in different hierarchy levels, therefore diversity is represented on all these levels, e.g. genetic diversity (diversity within and between populations), species diversity (species richness and evenness), and habitat diversity (ecosystem diversity, landscape diversity). There are interactions between these levels. Biodiversity is not static, but is realized in dynamic systems with considerable variation in space and time.

The Ministerial Conference on the Protection of Forests in Europe, held in Helsinki, Finland, in 1993, proved that the European countries have the will to act in accordance with the decisions taken at the Earth Summit in Rio. Besides guidelines for the sustainable management of forests in Europe, *inter alia*, the Conference encouraged the conservation of biodiversity of European forests. In its resolution H2 the Conference (MAF 1993) emphasised the conservation and appropriate enhancement of biodiversity as an essential operational element in sustainable forest management, which should be adequately addressed in forest policy, operational guidelines and legislation. The need of appropriate biodiversity appraisal systems was stressed as well as of methods for evaluating the impact on biodiversity of forest development and management techniques. Forest management should conserve and manage the diversity of habitats and a variety of structure within stands should be favoured. Future actions focus on the conservation of forest genetic resources, the protection of threatened forest species and ecosystems.

Inter alia, the Signatory States and the EC agreed to the establishment of a coherent ecological network of representative climax, primary and other special forests. An educational and public awareness programme will be established as well as surveys and research programmes (with special attention on the improvement of methods for assessing biodiversity in forests). Furthermore the participating states (including Germany) and the EC agreed in developing national or regional guidelines to obtain sufficient knowledge about the ecosystem functions and services derived from European forests and of the status and requirements for management of threatened, rare or representative biotic elements. The impact of different silvicultural techniques on biodiversity will be investigated (MAF 1993).

As one of the signatory states of the Helsinki resolutions, Germany is willing to put the agreements, also the commitments made in Rio, into practical work. The German Bundestag's (the German parliament) Enquete Commission "Protecting the Earth's Atmosphere" (Deutschland/Enquete Kommission Schutz der Erdatmosphaere 1994) gives further recommendations for the conservation of temperate forest ecosystems. European forest ecosystems are subject to atmospheric pollution, which threatens their survival. Therefore the reduction of industrial emissions below critical loads is one of the major challenges for the future. In addition, proposals have been made for ecologically sound forestry. Nature-oriented management concepts are favoured. India too is a signatory to the Rio Conference and has begun the process of biodiversity conservation as per its guidelines.

Some general conclusions from these and related viewpoints could be summarized as follows: Based on current knowledge and on ongoing research, the properties and dynamics of forest ecosystems with a view to their protection, stability and sustainable use, integrate the main objectives of today's forestry, e.g. the different demands of various lobbies on forests and the dangers to which they are exposed by modern industrial society. Forestry must cover expenses in order to ensure the

future existence of forest landowners, enterprises and employees. Wisely managed forests are an infinitely renewable resource and supply us with our most important regrowing natural resource – wood. Management directed towards the growth and supply of timber and non-timber forest products must be aimed at the intelligent and efficient tending, harvesting and regeneration of forests. All the practices must simultaneously include the preservation of natural goods and the maintenance of site capacity. This presupposes good knowledge and continuous research, e.g. on the impacts of climate change on forest ecosystems and on the importance of woodlands and forests in the global carbon budget as well as to people, forestry and wood industry. Ecosystem management and associated concepts have increasingly dominated natural resource management discussions. Sustainable forestry and ecological soundness became keywords and although many people may support this, these terms are not well defined or are understood in different ways (with a view on, for example, genetic sustainability, ecological or economical sustainability).

Some general conclusions for both countries :

1. The major challenge is that international or national conventions need to be implemented into a practical approach. This means bridging the gap between policy, science, practice, as well as public, and presupposes a participation of the different lobbies (forest landowners, forest managers, nature conservationists, policy-makers, etc.) and an unprejudiced debate and willingness to negotiate.
2. Public awareness in biodiversity conservation needs to be generated and improved by means of continued eduction.
3. There is a strong need of ongoing scientific research and deepening our knowledge on ecosystems and their inherent natural (dynamic) processes (e.g., monitoring and measuring, as well as appraisal of biodiversity).
4. Biodiversity is a result of historic and evolutionary processes, the possibility for artificial enhancement of biodiversity, creation or reconstruction needs to be assessed.
5. Incorporation of biodiversity into sound ecological, well-adapted management concepts in forestry is an essential prerequisite for the sustainable conservation, stability and elasticity of one of the most area-extensive habitats on earth.
6. Frequent consultations and joint bio-diversity programmes between neighbouring countries.

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