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Keep Asia Green

Volume III "South Asia"

Edited by Don Koo Lee

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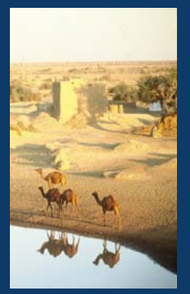

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FOREWORD

The forests of South Asia are highly diverse ranging from alpine and temperate ecosystems in the Himalayas to tropical and subtropical zones located in the lower mountain ranges and flood plains to littoral mangrove forests stretching along the vast coastal areas. All of these ecosystems have been affected in the past by human activities causing significant deforestation and degradation. Despite considerable efforts by governments over the last three decades or so the forests of the region are not free from the problems of degradation resulting in the loss of vital goods and services for society. The problems and underlying causes of forest degradation are not far from the experiences gained in other regions in Asia, particularly in Southeast Asia.

The social and economic transformations taking place in the region during the last decades have changed the way people and institutions perceive and value their forests. Redefining traditional roles of forests and increasing people's participation in sustainably managing forest resources have become the new paradigms embraced by governmental and non-governmental institutions alike. However, under the prevailing conditions of increasing population and accelerated economic development, the demand for land and exploitation of forests (e.g. fuelwood) beyond sustainable levels remain a major concern in the region. Therefore, efforts towards sustainable forest management need to focus on poverty reduction, economic development in rural areas and creating an enabling policy environment.

The countries in the region share a wide range of common problems related to rural development, forest land degradation as well as afforestation and forest rehabilitation. However, individual countries pursue different approaches to address some of the issues depending on governance systems, existing institutions, history of land tenure and resource allocations and the evolution of policies and their implementation. Hence, it is a great challenge for South Asian countries to promote economic development while conserving the environment and sustainably managing forest resources.

The "Keep Asia Green" book series aims to understand national capacities in terms of forest rehabilitation and existing education programs, and to analyze the need for further strengthening of forest landscape restoration efforts in each country and region in Asia.

This publication series was made possible through an initiative by the ASEAN-Korea Environmental Cooperation Project (AKECOP) in cooperation with the International Union of Forest Research Organization - Special Programme for the Developing Countries (IUFRO-SPDC). I am really honored to be a part of this noble undertaking that will provide a substantial contribution to the rehabilitation of degraded forest areas in various regions of Asia.

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The third volume of the book provides information about the forests of five countries in the South Asian region, namely Bangladesh, Bhutan, India, Nepal, and Sri Lanka. It includes historical perspectives of land use change and forest degradation in South Asia, the current stage of forest rehabilitation, the capacities for forest rehabilitation, and innovative approaches to promote forest rehabilitation. Given the importance of globally emerging issues such as climate change, carbon sequestration, invasive species and others, some of these are addressed in this book in the context of forest rehabilitation. Some case studies are also included reflecting past failures and success stories of forest rehabilitation on the ground.

The lessons learned from the many reforestation and rehabilitation projects allow for the formulation of recommendations for future actions. These actions aim to further enhance the approaches to forest rehabilitation so that investments in trees and forests can achieve an even greater impact, thus providing enhanced environmental services and economic benefits for the well being of present and future generations.

This book is the first of its kind in South Asia and it is an essential reading material for practitioners and decision makers involved in forest restoration. It is hoped that this book will contribute to the enhancement of forest restoration or rehabilitation in the region.

Finally, please allow me to thank AKECOP and its staff for initiating this wonderful deed; to all forest scientists in the different countries of the South Asian region for sharing the necessary information to come up with this book; to Dr. Michael Kleine (Coordinator of IUFRO-SPDC) for his dedicated effort and great contribution to this project; and to Yuhan-Kimberly, Ltd. for substantial financial support to this publication. The assistance of Mag. Eva Maria Schimpf and Mag. Margareta Khorchidi of IUFRO-SPDC in language editing as well as Ms. Jin-a Kim and Ms. Marilyn S. Combalicer of the IUFRO President's office in preparing the final book lay-out is much appreciated. To all of you, thank you and let us continue to work towards keeping Asia green.

Prof. Don Koo Lee
IUFRO President

REHABILITATING FORESTS AND EXTENDING TREE COVER IN SOUTH ASIA

A Synthesis

by
Promode Kant[1], Michael Kleine[2], Krishna Prasad Acharya[3], Mohammed Kamal Hossain[4], and
Don Koo Lee[5]

1. South Asian Landscapes and Cultures

South Asia[6] covers a vast stretch of about 368 million ha of land from the highest of mountain peaks in the north to sea coasts in the south, from the deserts with little rainfall in the west to the wettest rainforests in the east and from near equatorial climate in the south to the cold deserts high in the Himalaya mountains. It is a confluence of many streams of cultures and races that have made the region a land of many races, cultures, faiths, ethnicities, languages and traditions. The defining geographical feature of the region is the Himalayan mountain range. The main land extends from 5 to 37^{o} N latitude and from 68 to 97^{o} E longitude comprising four broad geographical areas: the Northern Mountains with the Great Himalayas flanked towards the south by the Siwalik Hills, the vast plains formed by alluvial deposits carried by great rivers like Indus, Ganges and Brahamputra, the Southern Deccan Peninsula bounded by the Western and the Eastern Ghats, and the coastal plains and islands.

The region is crisscrossed by a large number of major and minor rivers originating in the glaciers of the Himalayas and the rain-fed rivers of the southern peninsula and the coastal rivers. On account of different precipitations in the catchments of these rivers, the availability of renewable freshwater varies enormously in different river basins and in different seasons.
The monsoon is the defining climatic feature of South Asia with a narrow window of rainfall. More than 80% of rainfall occurs over just three months which makes floods a very common occurrence. The climate of the region can be described as tropical-monsoon over most parts and montane temperate in the higher reaches. The southwest or the summer monsoon is the main source of rainfall in the country providing about 80% of the precipitation. The temperatures range from the highs of more than 50^{o} C in the hinterlands to freezing cold in the higher reaches of northern latitudes. Coastal regions, particularly in the Bay of Bengal are subjected to a large number of cyclonic events causing large scale damages.

The region is one of the most heavily populated regions of the world supporting approximately 18% of world's population over barely 2.5% of the global land surface. The total regional population is about 1.2 billion of which the share of rural population is between 60 and 70%. The current annual growth rate of population ranges from 1.4% in India and Bhutan to an estimated 2.25% in Nepal. The average density of population is approximately 350 per km^2 (highest in Bangladesh with over 900 per km^2) the majority of which is very young. There is a rapid migration of rural population to urban centres and from high mountain areas to the lower plains.

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[6] Countries represented in this book: Bangladesh, Bhutan, India, Nepal, and Sri Lanka

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The entire region has faced low levels of economic development over the past one hundred years and more and has the largest concentration of people below the poverty line in the world. All the countries of the region show a low Human Development Index (HDI) and are ranked in the lowest quartet. Income disparities between rich and poor, measured by the Gini Index, are also high for most counties of the region. A large proportion of children are under-nourished or under-weight and unemployment and underemployment are widespread.

But there has been considerable progress in economic development in the past one decade in most countries of the region. India is presently the second fastest growing economy in the world and fourth largest economy in the world in terms of purchasing power parity. Agriculture has been the mainstay of these economies for long but now the situation is changing and today, in India, agriculture contributes 16.6% to GDP, compared to 28.4% by the industry and 55% by the service sector. Similar, though slower, shifts in other regional economies are also occurring in favour of industrial and service sectors. The economic surge provided by higher rates of growth in GDP has led to increasing demand for services and natural resources placing land and water under increasing stress from both overuse and pollution.

A large proportion of the geographical area of South Asia is degraded affecting its most valuable resource base resulting in loss of agricultural productivity, forests and biodiversity, as well as increasing economic losses. Excessive grazing is rampant on account of the fact that the countries of the region, particularly India and Nepal, support a livestock population that is one of the largest in the world. This is one of the major causes of degradation of lands, particularly in the forests affecting both the standing growth as well as regeneration.

2. Forests of South Asia

The South Asian region could be divided into four distinct parts on the basis of average reigning temperatures, namely, tropical with mild winters and no frosts; sub-tropical with definite but not very severe winters; temperate with pronounced winters and some snow; and alpine with severe winters and much snow. Combined with unique topographical features, distance from the seas and location with regard to the monsoon winds, these four broad temperature zones create a unique floristic composition across the region making it one of the most bio-diverse zones that contributes to about 10% to the world's biodiversity in terms of total number of species. Out of 18 unique biodiversity 'hot-spots' on the earth, which are storehouses of nearly 50,000 plant species or about 20% of the world's flora, three are located in the region (Himalaya; Western Ghats; and Sri Lanka).

The floral compositions have been enriched by migration from the Malayan, Chinese, Australian regions and also from the Caucuses over millions of years. The north-western parts of the region have floristic compositions that have considerable Mediterranean elements while in the eastern parts there is a clear transition towards the Malayan flora. Almost half of the dicotyledons of the region are endemic with the higher portion being in the Himalayan region having long been isolated by orogenesis and glaciers.

More recently, however, invasives species like eupatoreum and lantana have severely affected the floral composition of many parts of the region, lowering productivity and delaying natural succession. But there have been other types of inward migration that have become naturalized and could even be seen as having reached a kind of transitional climax in ecosystems they helped create themselves. *Prosopis juliflora* is a prime example of such a naturalization process.

Tropical forests constitute the bulk of forests of the region which cover a wide range of ecosystems ranging from tropical wet evergreen forests with rainfall exceeding 2,000 mm (up to 9,000 mm) moist tropical forests in localities of rainfall between 1,000 – 2,000 mm and tropical dry forests with rainfall lower than 1,000 mm. Tropical thorn forests occur in near desert conditions. Mangroves dot the entire length of the sea coast of the region. Overall the tropical forests of the South Asian region can be classified under the categories of wet evergreen forests with dense tall trees almost entirely evergreen; tropical semi-evergreen forests where evergreen tree species dominate but include a good

percentage of deciduous species; tropical moist deciduous forests with pre-dominantly deciduous upper-canopy trees and a good mix of evergreens among the sub-dominants; littoral and swamp forests mostly evergreen along the coastline and some fresh water bodies; dry deciduous forests with trees of moderate height and light canopy cover; tropical thorn forests with xerophytes predominating and tropical dry evergreen forests along the south-eastern coast of India and Sri Lanka with hard leaved evergreen trees of modest height.

Among the sub tropical forests, in regions of well defined winters, three broad categories can be recognized as subtropical broadleaved forests, subtropical pine forests and subtropical dry evergreen forests. Higher up in the mountain there are montane wet temperate forests both in the Himalayas and in the southern hill ranges, the moist temperate forests in the northern hills, dry temperate forests mostly on the western side of the Himalayas, the subalpine forests of fir, spruce and birch above 2,750 m elevation in both the Eastern and the Western Himalayas and the alpine scrubs just below the snow line.

One of the main regional ecosystems in the subtropical region is the sal (*Shorea robusta*) forest formation spread across India, Bangladesh, and Nepal. These forests are bounded by high temperatures in the south, extreme winter cold and frost in the north, dry conditions in the west and excessive rainfall in the east. In the tropics one of the most productive forest ecosystems are the teak forests that occur mostly in the southern half of the region. Main forest ecosystems in the temperate region are dominated by Chir Pine (*Pinus roxburghii*) of drier lower zones, oak on the wetter sides, and Kail (*Pinus wallichiana*) around 2000 m altitude (mixed in the western parts with Deodar (*Cedrus deodara*), fir and spruce stands above the Kail forests and below the alpine grasslands that reach up to the snowline.

The salt tolerant evergreen mangrove forests of the inter-tidal regions of the coast that perform a number of vital ecological functions of protecting coastal regions against the physical force of storms, in nutrient cycling and in maintaining the hydrological regime of the fresh waters from the rivers and the salt water of the seas, are found in all the countries of the region that have a maritime boundary. The biggest mangroves, known as the habitat of the Royal Bengal Tiger, are in the Sunderbans shared between India and Bangladesh. The total area of mangrove forests in the South Asian region is more than 6,000 km^2 of which 4,500 km^2 are located in India, followed by 1,500 km^2 in Bangladesh and about 90 km^2 in Sri Lanka.

3. Forest Degradation

3.1 Historical Perspectives

During pre-colonial times the degradation of forests in South Asia was driven by the need for agricultural expansion and demand for timber for laying railway tracks across this vast continent and for military reasons. In India, for example, large areas in the western coastal tracts were exploited for teak and other hardwoods used in the ship building industry while sal (*Shorea robusta*) timber from central and northern part of India was extensively used for railway tracks. Mainly common property forests were utilised to meet the immediate needs of the people for wood and non-wood forest products without any considerations of conservation or protection.

Colonial rule in most parts of South Asia introduced systematic management of forests by establishing a permanent forest estate for sustainable management and also created a forestry profession through organised education and training. The process of bringing all forests under sustainable forest management was interrupted by World War I and II resulting in significant losses of forest areas cleared to meet the needs for domestic energy and raw material for the war machinery.

In the second half of the 20th Century after independence from colonial rule, South Asia experienced a period of continued large-scale degradation of forest because of economic development. This post-independence phenomenon was driven by expansion of agriculture land to feed growing populations and infrastructure development such as roads, dams, urban areas and industrial sites. In addition,

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nationalisation of forest land (e.g. Nepal) taking away ownership of forests from local villagers accompanied by continued demand for forest products led to further degradation. With the emergence of the environmental movement and international debate on environment and development in the 1980s and 1990s new forest policies were formulated that amongst others also provided guidelines of a minimum forest cover that should be maintained in a country. Based thereon, many different projects and initiatives were implemented to halt deforestation and forest degradation. Despite of these efforts forest degradation turned out to be a persistent phenomenon and continued to take place in many forms all over South Asia.

3.2 Direct Causes of Forest Degradation

The direct causes of deforestation have been analysed extensively and include further expansion of agricultural land to grow more food, construction of hydro-electric dams, infrastructure such as roads and power-lines, and mining activities. While these activities resulted in a complete change in land use, more gradual degradation of the remaining forests also took place through grazing of livestock, forest fire as well as over-exploitation for wood and non-wood forest products. In this context, the extraction and collection of fire wood continues to play a key role in forest degradation. The negative effects in many forest areas were compounded by inappropriate silviculture practices.

3.3 Underlying Causes of Forest Degradation

In order to develop approaches for successful forest rehabilitation, the underlying causes of forest degradation have been extensively analysed in each of the South Asian countries and include:

- Population pressure: The increasing number of people in both rural and urban areas significantly increased the demand for goods and services from forests leading not only to unsustainable uses by timber extraction and livestock grazing but also to conversion of forest land for settlement and re-settlement programmes.

- Poverty: At the same time, most of the people remained poor and were forced to utilise the forests for fuelwood collection and extraction of forest products for subsistence purposes.

- Unintended effects of policy interventions: Policies put in place by governments sometimes had negative effects on forests. In India for example bamboo forests were allowed to be harvested by the pulp and paper industry without obligation to rehabilitate the exploited areas. Policies commonly regulate harvesting rights only but do not provide for long-term stakes of the industry in forest management. Privatisation of common land mainly for settlements resulted in increasing use of adjacent remaining forest areas for grazing of livestock. Illegal occupation and use of forest land has frequently been legalised thus leading to permanent deforestation and degradation.

- Insecure land tenure rights: Local customary rights existed for hundreds of years in many parts of South Asia regulating access to forest resources. Frequently, these *de facto* land tenure rights have not been recognised by governments, thus creating opposition and suspicion among local communities preventing genuine participation in restoration and protection of degraded forests. As a consequence perverse incentives were created such as felling of trees (e.g. India) and dismantling fences for livestock grazing in newly planted areas (e.g. Bhutan) as the communities fear that they may not benefit from forest rehabilitation activities. Nationalisation of forests as has been taking place in Nepal lead to accelerated degradation because of increasing demand and economic development.

- Market failures: As timber and firewood markets are still largely controlled by Forest Departments, the real costs of production are not captured and do not allow for adequate investments into forest rehabilitation.

- Poor sector policy coordination between sectors: Forest areas have also been degraded because of lack of coordination between departments for agriculture, forestry, land & survey, irrigation, and tribal welfare. In India, for example, the energy producing sector prefers forest areas for new power stations as approval is easier to obtain. Similarly, expansion of agriculture land in Sri Lanka and Bangladesh took place almost entirely at the expense of forests.

3.4 Scope for Forest Rehabilitation in South Asia

Over the past decades, forest rehabilitation has been addressed in all countries of South Asia with varying success. As demonstrated by new environmental and land-use policies, countries have identified a minimum forest cover that should be maintained in order to provide ecological stability, reverse the decline of the region's rich biodiversity as well as ensure the provision of essential forest goods and services for society. Based on these targets the magnitude of the task ahead for forest rehabilitation and reforestation has been estimated and provided in Table 1.

Table 1: ***Proportion of Degraded Forest Area in Relation to Total Forest Area in South Asia***

Country	Existing Forest Cover (% of Total Land)	Targeted Forest Cover (As per Forest Policy)	Degraded Forest Area (As of 2008; % of Total Forest Area)	Land Available for Reforestation & Afforestation
	(million ha (%))	(%)	%	(million ha)
Bangladesh	2.53 (17.5%)	20.0%	67%	1.00
Bhutan	2.82 (73.0%)	73.0%	17%	0.30
India	67.71 (20.6%)	33.0%	43%	50.00
Nepal	5.83 (39.60%)	39.6%	10%	1.50
Sri Lanka	2.04 (30%)	33%	5%	0.25
Total	80.93	-	-	53.05

According to current forest policy directions in Bangladesh and India forest cover needs to be increased, while in the other countries with sufficient existing forest cover the current extent of forest areas should remain unchanged. However, in each country a substantial proportion of the existing forests (between 5 and 67% of the total forest area) has been degraded to varying degrees, leaving forest stands that require some form of rehabilitation and/or reforestation. Based on these estimations the total degraded forest area in South Asia is in the range of 30 to 35 million ha. In addition, an attempt was made to estimate the size of currently unproductive land (e.g. wasteland) that might be available for re-forestation and/or afforestation. The extent of such wasteland is in the range of 50 and 55 million ha. All in all, a total area of 80 to 90 million ha in South Asia would require investments into forest rehabilitation.

4. Current Stage of Forest Rehabilitation

The history and current practice of rehabilitating forests in South Asia is inseparably linked to community-based forestry. Involving local communities and private land owners in re-forestation and sustainable utilisation of forest resources has evolved as successful alternative to "state-implemented" forest management. However, in addition to community-based forest management, rehabilitation of forests is also taking place through private company initiatives in the form of industrial tree plantations and government-driven forest conservation through the creation of national parks or other forms of fully protected areas. Protected area management, re-forestation to combat desertification as well as coastal area rehabilitation are also important components of forest rehabilitation in the region.

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4.1 Forest Protection and Land-Use Policy

Forests in the region have been administered and protected by rulers and governments through policies and legislation for at least two millennia. These efforts were motivated not only to secure rights over assets not claimed by specific rural communities but also to follow religious piety for the protection of animals or ensure provision of goods and services to society. With the advent of industrialisation accompanied by population growth and rapidly increasing natural resources consumption, particularly in the second half of the 20th Century, policies and regulations for the conservation and sustainable use of forests have been formulated and continuously updated and revised according to changing societal requirements. Today in each country of South Asia a wide range of policies and legislation exist that address managerial, administrative, organisational, social and economic aspects of forests and trees.

In India, for example, policies have been created and implemented dealing not only with social forestry concepts, wildlife protection and timber harvesting but also tenure issues and institutional arrangements such as the creation of forest state corporations, re-organisation of ministries and the establishment of new research entities. In Bhutan and Nepal new forest policies emphasise the conservation of mountain ecosystems and the protection of forests against natural hazards such as soil erosion. Decentralisation of forest management and a substantial improvement of access rights and management responsibilities for local communities have been important components of these new policies. In Bangladesh with its high population density, forest-related land-use policies focus on increasing tree cover within agricultural land and urban environments. Similarly, also Sri Lanka's forestry sector policy is directed towards conserving remaining natural forests, empowering people to protect and manage multiple-use forests, and to expand and enhance the productivity of traditional homegardens, agroforestry and forest plantations to meet the people's basic needs. In all countries, the maintenance of existing forest cover and its expansion is central to forest policy directions. Comprehensive exercises to draw up forest sector master plans have also been undertaken to address forest tenure, benefit sharing between government and people, inter-sectoral coordination and other managerial and fiscal issues.

Over the years the policy framework and legislation in each country of the region significantly changed in favour of decentralised forest management, allowing rural communities and private landowners to invest in forest rehabilitation and to manage tree resources for long-term benefits. This represented a major shift in the approach to forest governance from a traditional custodian role of the forest department to a participatory management concept involving different stakeholders.

4.2 Community-Based Forest Management

Implementation of community-based forest management in South Asia

The concept of managing forests through people developed over time and took many different forms, starting with farm forestry in the 1960s, leading to broader social forestry projects in the 1970s and joint forest management of present days. In farm forestry and social forestry, assistance by national governments and external donors has been provided to help land-owners and communities to invest in forest rehabilitation (e.g. free seedling distribution, tax exemption, grant and loan facilities, etc.). Decentralisation of forest management has been taken to a higher level through joint forest management whereby partial control of the forest on government land has been transferred to local communities. The principal objectives of community-based forest management in all countries in the region include:

- To meet local people's need for fuelwood, small timber and non-wood forest products such as medicines and food on a sustainable basis;
- To effectively conserve soil and water resources and in this way contribute to improved agriculture production and livelihood;
- To provide employment opportunities;
- To promote self-reliance and social equity among local people; and

- To improve the aesthetic value of the landscape and provide for recreational needs of an increasingly urban population.

A wide range of examples have been presented in the country papers of this book describing community-based forest rehabilitation initiatives and projects.

In India, for example, the largest portion of government-owned land today is under joint forest management arrangements. The concept is based on the realisation that forests serve multiple purposes for many different groups within a society ranging from forest dwelling people to safeguard their basic material needs and rural farmers to protect soil and water resources to an urban population favouring recreational and scenic values. The new forest policy enacted in the late 1980s therefore gives high priority to environmental services and direct economic benefits were subordinated to this principal goal. Numerous initiatives for rehabilitation of forest resources involving either reforestation of barren land or improvement of existing forests were established in India on the basis of community participation. These initiatives include rehabilitation of hill forests in cooperation with villagers and the Indian Army; watershed management with focus on slope stabilisation through tree planting and enhancement of grass productivity; forest restoration in tropical rainforest through community organisation and regulation of extractive activities. There are also successful examples where land productivity could be improved through the resolution of social conflict followed by joint efforts of all community members in reforestation and acceptance of new regulations for harvesting and collection of forest products.

Similarly, Nepal is well known for its successes in community-based forest management whereby part of the national forests is managed by traditional resource users organised as so-called community forest user groups. Over the past 30 years about 1.2 million ha of forest have been handed over to more than 14,000 community forest user groups, thus this approach is being implemented on a large scale throughout the country. In addition, the management of conservation areas and buffer zones around protection forests is based on the participatory approach involving rural communities and local NGOs. Numerous examples exist in Nepal where NGOs and local people are the main actors in eco-tourism, wildlife management and other conservation activities. Particularly the buffer zone management approach around national parks and wildlife reserves has been very effective as 30-50% of the park revenue is shared with the local communities. More recently, renewed initiatives were taken to improve tree cover of public land through involvement of people living in extreme poverty. One of the approaches is through leasehold forestry aiming at poverty reduction and environmental rehabilitation.

Systematic forest rehabilitation efforts in Bhutan started later as the country has an extensive forest cover and a rather low population density. Most of the reforestation projects are an integral component of watershed management programmes. The involvement of rural people is limited to participatory planning to organise grazing and fodder collection in the forests, provision of labour force for replanting and management interventions. Main focus of forest rehabilitation is the stabilisation of the ecosystem in water catchments, notably soils, improvement of aesthetic values of the landscape along roads and overall enhancement of the environment. Plantation establishment by the private sector for timber production has also taken place, though on a much smaller scale.

The main focus of social forestry activities in Bangladesh is to increase tree cover on about 31% of the total land area. In order to achieve this, several approaches are used and include agroforestry; participatory management of sal forests; homestead plantations, participatory buffer zone plantations; plantations for the production of various high value products such as neem, coconut, agar; as well as urban greening in and around major cities. Motivating rural people to plant trees on agricultural land has been a major focus and resulted in massive increase in tree cover outside traditional forest areas. Given the high population density and scarcity of land, accommodating trees in intensive agriculture land uses serves both the production of various timber and non-timber products and for mitigation of recurring catastrophic flood events.

Extensive forest rehabilitation programmes have also been implemented in Sri Lanka with different roles assigned to governmental and non-governmental stakeholders. Typical forms of forest protection and rehabilitation include protected area management, multiple-use of natural forests, home gardens, and forest plantations for both local consumption and industrial processing.

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Reasons for the success of community-based forest management

Throughout the South Asian Region community-based forest management has become a common practice and today most of the forest areas are being managed according to this concept. Experiences with implementation show a number of reasons for the success of this approach and include the following main points:

- Effective and acceptable leadership through local institutions: Local leadership with a vision for a more sustainable and prosperous future of the community proved to be indispensable for successful community-led forest management. Likewise leadership was also found to be essential in government-driven programmes with a competent officer in-charge.

- Access to resources: Availability of land and/or forest resources in the vicinity of the community is necessary in order to manage the transition to a future where forests and trees play a greater role.

- Freedom to decide and act: One of the pre-conditions for success has also been the fact that laws and policies either enabled local leadership to take the initiative or at least did oppose their action strongly enough.

- Locally held knowledge and beliefs: Recalling the relative prosperity enjoyed in the past when forest resources were in a much better shape significantly contributed to enhance community participation. Considerations of local dominant religious beliefs were also motivating factors to mobilise participation.

- Long-term assurance of returns: Arrangements to secure returns and benefits from forest rehabilitation for local communities proved to be a pre-requisite to maintain the communities' interest beyond initial enthusiasm.

- Project results far beyond forest regeneration: The outcomes of forest rehabilitation projects have had significant impacts beyond a more productive use of land and forests and included improvement of the social capital in terms of enhanced gender and caste equity, literacy and health besides strengthening of village institutions. And the economic regeneration has also been significant with better access to financing for micro enterprises at reasonable rates of interest.

Although there is no blue-print (or one-fits-all) approach to community-based forest management, the above list of issues when properly addressed and resolved in the local context will increase the chances for successful implementation. Overall, the introduction of community-based forest governance at a larger scale became a reality because governments gradually amended laws and regulations that enabled this type of participatory management of forest resources.

4.3 Protected Area Establishment and Management

With its diversity of landscapes ranging from high mountain ecosystems of alpine climate to coastal lowlands in tropical and sub-tropical realm, the diversity of flora and fauna in South Asia is extremely varied. Bhutan, for example, which is home to 7,500 species of vascular plants, 700 species of bird and 165 species of mammals, is recognised as one of the biodiversity hotspots in the world. Approximately 34% of the land area of Bhutan has therefore been set aside for full protection. Likewise, Sri Lanka which is equally diverse in floral and faunal composition has brought 45% of its forest area under protected area management. The figures for Bangladesh, India, and Nepal are 1.7%, 23%, and 19.7%, respectively.

In the context of establishment and management of protected areas in South Asia it is important to emphasise that in most cases success was only possible because of adequate involvement of local people in the planning and implementation of such conservation areas. This also includes attractive

benefit sharing arrangements in order to motivate local decision-makers to engage in the project and maintain the momentum over longer periods.

4.4 Special Rehabilitation Projects

Besides community-based forest rehabilitation projects, also special initiatives to combat desertification (e.g. Thar Dessert) and reforestation of coastal areas (e.g. mangrove ecosystems in Bangladesh) are part of the activities to enhance the environment. These initiatives are mostly financed and implemented by governmental departments and in some cases external aid is used to provide additional financial resources and technical expertise. However, community involvement is also important in order to ensure sustainability of the newly established forests.

4.5 Problems and Failures

Although a large number of successful examples of forest rehabilitation exist on the ground and some of them have been extended to other areas or became common practice within a state or country, there are still unresolved issues and challenges that require renewed efforts. Some of the major prevailing problems in forest rehabilitation include:

- Low priority for the government: In many situations governments (both at state and national levels) are confronted with pressing problems such as food shortage, public health issues, infrastructure development and labour markets. These and other issues frequently take precedence over long-term investments into the rehabilitation of forests. As a result, inadequate funding and support through government agencies can be observed which negatively affect forest rehabilitation initiatives. Intensive lobbying and mobilising support from various sections of society are needed to achieve the necessary political support. Under certain conditions, external donor funding can be a useful addition to national or local efforts, but needs careful planning in order to be truly complementary.

- Ecological services not internalised: Currently, environmental services from forests such as clean water, soil protection, flood mitigation, and recreational and scenic values, or carbon sequestration cannot easily be marketed and thus are provided free-of-charge. The higher costs involved in environmental sound management safeguarding these services are incurred by those responsible for the management of these forests. It is therefore extremely difficult to finance sustainable management and conservation of forests on a long-term basis.

- Tenure systems not fully clarified: Another cause of failed forest rehabilitation is related to unresolved tenure issues. In many regions both customary rights exist that are poorly documented or understood. More often than not these rights are in conflict with state and national laws and regulations. Before actual forest rehabilitation work can commence, these tenure issues need to be clarified. This may take some time and will result in a delay in project implementation.

- Community-based approaches do not work everywhere: As has been demonstrated in this book, each locality requires its own development path towards improved forest management and rehabilitation, particularly with respect to social capital such as local institutions, leadership, equity among different community members, as well as new roles in participatory decision-making. As shown with the help of cases in Nepal, community-based forest management works well in the mid-hill areas, but has significant lower success rates in the Terai and high mountain areas. Likewise, joint forest management in India is not attractive to every rural community because of natural resource conditions, alternative types of income or customary access rights to forest resources.

- The poor did not always benefit: Although benefit sharing systems had been established, in some cases it did not provide sufficient incentives to keep community participation high.

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The failures and problems experienced with forest rehabilitation in South Asia are the starting point for developing innovative initiatives and new ideas. Following a brief summary about current capacities for rehabilitation in the region, emerging opportunities for additional support of forest rehabilitation in the region are presented.

5. Capacities for Forest Rehabilitation

All countries in the region have built considerable capacity in forest management over the past four decades. Lessons learnt from the many projects on reforestation and forest rehabilitation have been used to improve the practices of forest management, governance and supervision. For the analysis of existing capacities for forest rehabilitation, a three-tiered approach is used to distinguish between executing agencies (Level 1); educators (Level 2), and researchers (Level 3).

At the level of executing agencies (Level 1) such as forest departments and community organisations considerable expertise is available. In the case of forest department staff a significant shift in acceptability towards multi-stakeholder involvement in forest governance away from trying to continue policing the forests could be observed. However, monitoring systems of forests of both forest departments and community institutions require improvement, particularly in the application of state-of-the-art survey, assessment methods and trained personnel.

At the implementation level it is also important to produce quality planting material adapted to the various site conditions. Over the years the standard has been significantly raised and today, quality planting material is widely distributed by forest departments to encourage local communities and private planters to engage in reforestation.

All countries in South Asia have in place a system for forestry education (Level 2), both at the technical and professional levels. Numerous institutions such as universities and research organisations offer different programmes to study forest and tree-related subjects including traditional forestry, agroforestry, ecosystem and environmental management, rural development and others.

With the shift towards sustainable development and participatory mode of forest management, however, forestry has been undergoing fundamental changes in recent times. Emphasis on conservation practices and collaborative management involving the local stakeholder communities and individuals is required. Lack of financial resources and adequately trained teaching personnel and effective teaching aids and material is a key bottleneck in achieving this objective. The course content is focused excessively on technical aspects of forestry and other social science subjects like rural sociology, traditional ecological knowledge, rural economy and political ecology are not adequately covered. The financial and infrastructural resources available to support forestry training are generally insufficient in all countries in South Asia.

At Level 3, forest-related research aims to provide the scientific background and innovation for forest management and rehabilitation. In Bangladesh, India and Sri Lanka research on forests has been conducted over the past one hundred years. In comparison, forest science is rather young in Bhutan and Nepal where systematic research has only started in the later 20th Century.

Today, most of the forest research institutions in South Asia are faced with problems related to poor funding, insufficient qualified academic staff and thus low research output. There are many cases where excellent scientists move to other sectors such as agriculture or biotechnology because of more attractive career prospects. This contributes to a rather slow extension and implementation of research results in the field.

In order to awaken research from this state of inertia several aspects would need to be considered:

- Broadening forest research beyond the traditional specialisations should be in the centre of any strategic research planning. Research needs to reorient its focus from traditional silviculture and management to the current needs in the areas of community-based forestry,

environmental ethics, political ecology, environmental history and ecological economics, urban forestry as well as mitigation of and adaptation to climate change. There is a need to develop institutions for integrative and multi-disciplinary research to overcome the current disciplinary fragmentation of the forest science community located in forestry research institutes and universities.

- Research needs to be made more attractive for young scientists so that they are able to follow a career path comparable with other sectors.

- Important for forest rehabilitation is also a better interaction between research and implementers, whereby research projects are conducted in close cooperation with stakeholders, right from the start of the research. Involvement of practitioners, farmers and decision-makers will allow to direct research towards topics that are most relevant to stakeholders, thus scientific work becomes demand-driven and is therefore attractive and will be better funded.

Overall, more innovation in research is needed to support forest rehabilitation, particularly in non-traditional fields of knowledge that address the constraints of successfully re-building forest resources that provide the goods and services needed by society.

6. Innovative Approaches to Promote Forest Rehabilitation

From the experiences gained and especially the problems encountered in reforestation and forest rehabilitation initiatives in South Asia, a number of issues are described in this section that – when properly addressed - have the potential to further enhance the success rate of land rehabilitation in the region.

6.1 Landscape Management Planning Approach

Given the complex mix of environmental, social and economic issues associated with forest rehabilitation, renewed efforts are needed to better integrate forest rehabilitation into overall land-use planning. This requires extensive consultation and negotiation processes with all stakeholders, consuming considerable resources before the first tree can be planted. Sufficient time needs to be allocated to these consultations, in order to reach consensus and reconcile the many existing conflicts over land and access to resources. In view of the increasing population in many parts of South Asia, community-based programmes should be given highest priority.

6.2 Tenure Systems

One of the most prominent reasons why forest rehabilitation initiatives were not successful is related to tenure issues. Throughout South Asia, experiences show that aspects of tenure have not always sufficiently been addressed. In principle, forest rehabilitation managers are confronted with the following three main situations:

- Rights and privileges of local communities have not officially been recognised;
- Rights claimed by communities did not exist; and
- Many different communities or sections of the same community claimed rights over the same area or commodity.

Reasonably, the settlement of land tenure rights is a pre-condition for successful rehabilitation projects, including clarification of long-term benefits and harvest rights of forest products.

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6.3 Policies Revisited

Although considerable revisions of laws and policies took place in support of sustainable management and conservation of forest resources, still certain elements of existing policies need to be revisited and amended to better support forest rehabilitation. Some of the issues include:

- Indian forest policy, for example, calls for the replacement of wood by non-wood products such as steel and concrete. This led to depression of demand for wood products and kept prices low.

- There are still in place certain harvesting, transportation and sale restrictions that need to be lifted. In the case of Nepal, the sale of certain timber species grown on private land is still banned, thus discouraging investments in forest rehabilitation.

- Present fiscal policies need to be amended or newly introduced. For example, in India, investments in tree planting are exempted from income tax, but this provision does not exist in other countries in the region. Forest products which are taxed in Nepal have a clear disadvantage over non-taxable agricultural production.

6.4 Payment for Environmental Services

This approach to finance forest conservation is already being implemented in several projects throughout South Asia. For example, local communities are compensated for maintaining and enhancing forest cover in watershed areas by hydroelectric power generating companies. Other forms of such payments for environmental services include conservation fees that certain hotels benefiting from national parks pay to conservation funds. These funds are used to improve the livelihood of rural people living within the buffer zones of nature conservation or protection areas. In the context of forest rehabilitation, it would be desirable to further expand systems of payments for environmental services, in order to more fully capture and market benefits from forests.

6.5 Conservation-Based Economic Activities

Several examples exist in South Asia where nature conservation activities have been made attractive to local people. Such approaches are essential in order to mobilise local expertise and manpower to implement sound conservation mechanisms on the ground. Investments into buffer zone management, particularly to promote broad economic activities and employment for local people provide the foundation for successful participatory conservation management. Although important, eco-tourism with wildlife/bird watching activities is considered only part of the range of options to be considered to increase the level of income of rural people.

6.6 Private Sector Companies' Involvement in Forest Rehabilitation

There is increasing interest by the private sector to invest into forest plantations for the production of wood fibre and timber. As experience shows, such investments require careful planning in terms of land allocation, tenure arrangements and organisation. In addition, the possibility of encroachment by the company of the rights of locals needs to be carefully considered. Strict monitoring and control of all operations implemented by the company is essential in order to ensure long-term sustainability in terms of social, economic and ecological benefits from forest rehabilitation.

6.7 Climate Change Mitigation

Carbon storage through reforestation is another environmental service that has attracted much attention because of the international debate on global climate change. Under the Kyoto Protocol,

carbon credits can be sold by those investing in reforestation. With the Bali Action Plan categorically placing reduced emissions from degradation and deforestation (REDD) activities on the agenda of future climate change negotiations, there is now a strong possibility that policy approaches and incentives relating to enhancement of carbon stocks in low biomass forests will be successfully negotiated and accepted as a legitimate greenhouse gas mitigation option in the upcoming post-2012 climate change regime. There have been only limited attempts in the region, thus far, to set-up forest and carbon-related projects. However, initial assessments suggest that there is a significant potential for carbon storage in the largely under-stocked forests of South Asia. In order to make these mechanisms work on the ground, appropriate governance structures at various scales (local, district, state and national levels) are required. Developing adequate institutions for assessment, implementation and supervision will be the main task in capacity building so that additional financial resources can be mobilised in support of forest rehabilitation.

6.8 Forest Sector Funding

An increase in forest sector funding at the national level in all countries in South Asia is needed to expedite efforts in reforestation and forest rehabilitation. However, increased public funding requires to be invested into projects that generate their own income at a later stage. Options to be considered are mostly a mix of various functions such as serving carbon markets or other paid environmental services, timber and/or fuel wood production, agroforestry systems, eco-tourism, and others. Along with improved funding for the forestry sector, the proportion for forest- and tree-related research also needs to be increased. This is essential as focussed research can assist in generating the scientific knowledge needed to find innovative solutions for forest rehabilitation on the ground.

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FOREST RESTORATION AND REHABILITATION IN BANGLADESH

Mohammed Kamal Hossain[7], M. Khairul Alam[8], and Md. Danesh Miah[9]

1. General Information

Bangladesh is a Unitary and Sovereign Republic known as the People's Republic of Bangladesh. Bangladesh, extending over 14.83 million ha in the north-eastern part of South Asia, lies between $20^0$34' and $26^0$38' N latitude and $88^0$01' and $92^0$41' E longitude (Rashid, 2001). It shares boundary on the west, the north and the north-east side with India, in the Southeast with Myanmar, and the Bay of Bengal in the South.

The country was under different Indian rulers till 1757. The British ruled over the country as part of Bengal under "British India" for about two centuries (1757 to 1947 AD). During 1947-1971, Pakistan governed the country as East Pakistan and it became an independent and a sovereign state in December 1971 with Dhaka as capital city. The official language spoken by all Bangladeshi is Bangla.

1.1 Geographic Information

1.1.1 Physiography

Most of the country is located in the delta of three of the world's major rivers. A few small tracts of higher land occur in Sylhet, Mymensingh, Chittagong and Chittagong Hill Tracts regions. Maximum elevation is 1300 m on the Bangladesh-Myanmar border. The south-western region consists of a large number of dead and cutoff rivers, the coastal part of which includes the famous Sundarbans mangrove forest. Within greater Sylhet and Mymensingh districts lie a number of depressed basins that get inundated by fresh water during the monsoon season and gradually dry out during the dry winter months.

Except for small higher areas of old alluvium, rising to about 30 m, in the Northwest (Barind tract) and North Centre (Madhupur tract), the Ganges-Brahmaputra deltaic plain region is a flat surface of recent alluvium, having a gentle slope and generally with an elevation of less than 10 m above mean sea level (asl). In the Northeast (Sylhet) and Southeast (Chittagong hills) region, the hilly ridges run mainly north-south and form part of the mountain divide between Myanmar and India. It encompasses the southern and southwestern parts of the Sylhet area (including the valley plain of the Surma River) and the northern part of the Mymensingh area and has large number of lakes. The far north-east region has Sylhet hills that consist of a number of hillocks and hills ranging from 30 to 40 m in height. Similarly, the Southeast is dominated by the Chittagong Hills Tracts (CHTs) that has many hills, hillocks, valleys, and forests and is quite different in many aspects from other parts of the country. The coastal plain region of Bangladesh is partly sandy and saline. It varies in width from 1 to 15 km. The region has a number of offshore islands and one coral reef, St. Martin's Island.

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1.1.2. Soils

Bangladesh has three broad types of soil, namely, Flood Plain Soils (79%), Brown Hill Soils (13%), and Terrace Soils (8%). Soil scientists further classify "Flood Plain Soils" of Bangladesh into 14 sub-types varying from calcareous to non-calcareous, acid basin to acid sulphate, grey to brown Piedmont, peat and Terai soils. The "Brown Hill Soils" are located in the hilly regions of Chittagong, CHTs, and Dhaka and Sylhet districts and vary from brown sandy loam to clay loam. The "Terrace Soils" exist in the "Barind" and "Madhupur" tracts of Bangladesh and consist of brown to grey clays and loams (Rashid, 2001).

1.1.3 River system

The country has five major river systems: the Ganges or Padma and its deltaic streams, the Meghna and the Surma river systems, the Jamuna and its adjoining channels, the North Bengal rivers, and the rivers of the Chittagong Hill Tracts and the adjoining plains. The Ganges River system is divided into two segments, the Ganges and the Padma. The Meghna River is the union of the Sylhet-Surma and Kusiyara rivers. The Jamuna and its adjoining channels span a large area from North Central Bangladesh to the Meghna River in the Southeast. The Tista is the most important water carrier of Northwestern Bangladesh that meets the Jamuna. The Feni, the Karnaphuli, the Sangu, and the Matamuhari are the four main rivers that constitute the river system of the CHTs and the adjoining plains of Bangladesh (Rashid, 1991).

1.1.4. Climate

Bangladesh has a tropical monsoon climate. There are basically four seasons in a year: winter (December-February), summer (March-May), monsoon (June-September) and autumn (October-November). The average temperature across the country usually ranges between 11^0C and 29^0C in winter months and between 21^0C and 34^0C during summer months. Annual rainfall varies from 160 cm to 200 cm in the west, 200 cm to 400 cm in the Southeast and 250 cm to 400 cm in the Northeast (Rashid, 1991).

1.2 Demography

Bangladesh, a small coastal country of South Asia, is the eighth most populous country in the world with an estimated population of about 140 million with a growth rate of 1.43%. The population density of Bangladesh is 941 per km^2 (Bangladesh Economic Review, 2006) which is one of the highest in the world. In 1947, the density was only 306 per km^2 and the demand for forest produces as well as land for settlement was very little. In 1971, the density increased to 510 per km^2 and the demand for forest products as well as land for settlement increased by 67%. At present, the density is 941 per km^2 and compared to the 1947 baseline, the demand for forest products as well as land for settlement increased by 189%. There is also an estimation that the population will reach to 177.3 million by 2025 and 210.8 million by 2050 (Davidson, 2000). Around 75% of the people live in rural areas of which 60% depend on agriculture for their livelihood.

1.3 Economic and Livelihood Situation

Bangladesh has an agrarian economy with 21.77% of GDP coming from the agriculture, forestry and fisheries sectors (Bangladesh Bureau of Statistics, 2004). Major agricultural products are rice, jute, wheat, potato, pulses, tobacco, tea, and sugarcane. The country is the largest exporter of jute and jute products in the world. Readymade garments occupy the topmost position among the exportable items. Tea, frozen shrimps, fish, leather goods, flowers and vegetables, ceramic-ware and handicrafts are also major export commodities.

Bangladesh has undergone a major shift in its economic philosophy and management in recent years. The government is working towards upgrading the living standard of the people by meeting their basic

needs and is determined to ensure health for all within the shortest possible time. Considerable progress has been achieved in Bangladesh in the fields of health and family welfare. Primary health care has been expanded throughout the country. Infant mortality rates have come down dramatically.

The annual GDP (Gross Domestic Product) growth rate of the country is 5.33 and per capita GDP is US$ 410. The GDP growth in the agriculture and forestry sectors is Tk 4600.3 million (1 US$= 68 Taka) (Bangladesh Bureau of Statistics, 2004).

Contribution of Forestry to the National Economy

Forestry has manifold contributions towards the welfare of mankind. The multiple use of forest resources has been recognized from the advent of civilization. The forestry sector contributes about 1.79% of the total GDP of Bangladesh. This does not reflect the true contribution of this sector. The rural population uses fuelwood and other minor forest products practically free of cost. Forest and tree resources also play an important role in protecting watersheds, irrigation and hydraulic structures, also in keeping the rivers and ports navigable. They also play key roles in protecting the coastal areas from natural calamities. The role of forest in protecting the environment from pollution and its contribution towards biodiversity is immense (www.bforests.gov.bd).

The participatory social forestry contributes towards rural poverty reduction significantly. In the last 3 years, out of total sale proceeds of timber and fuelwood about 308 million taka (1US$ = 68 Taka) has been distributed to 23,561 participants. Social Forestry Rules have been framed to provide the legal basis for a benefit sharing system. Tree farming funds have been created from the 10% of the sale proceeds to create new resources on the same pieces of land involving the same participants, to ensure sustainability. TFF operating committees have been established involving local government and Local Community Organizations (LCO). Apart from the sale proceeds, participants also get money from the Forest Department for their labor input into plantation activities. They also get periodic income from agriculture crops grown between trees both in forest and marginal land. The participants also enjoy the thinning and pruning outputs in many areas which also contribute to improving the livelihoods of the participants (PFN, 2005).

Employment Generation

In 2001-2002, about 2% of the total manpower of the country was engaged in the forestry sector. Many people benefited directly from forestry-related activities e.g. in the wood based industry, saw milling, furniture making, establishing and operating private nurseries, logging, and in afforestation programs. Besides this, in the Sundarban region, millions of people depend on the mangrove forest for their livelihood (e.g. mawali, bawali, fishermen, etc.).

Fuelood and Non-wood Forest Products

Fuelwood is the major wood product required today in Bangladesh. The country needs over 8.0 million m^3 of fuel wood every year. Domestic cooking uses an estimated 63%, which is 5.1 million m^3 annually. Industrial and commercial use is also significant, which is 2.9 million m^3 annually. According to the Forestry Master Plan, village households supply about 75% of the fuelwood in the country, whereas government forests provide the remaining 25% (FMP, 1993). Due to limited alternative sources of energy, rural people are mainly dependant on fuelwood for cooking and other household activities. Of the total fuelwood, nearly 85% is used in rural areas and 15% in urban areas (Banglapedia, 2003). The Government of Bangladesh took many initiatives to provide the consumer an additional supply of fuelwood for the future. In addition, some of the non-wood forest products are also significantly contributing to the economy and livelihood of the poor, and include (www.bforests.gov.bd):

- Bamboo (*Melocanna baccifera, Bambusa tulda,* etc.) plays a very crucial role in the rural economy and is a singular essential material for house construction, cottage industry, shelter for rural people, especially for tribal communities living in hilly areas.

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- Sungrass (*Imperata cylindrica*) is the most common thatching material for low-cost housing in the villages of Bangladesh.
- Cane (*Calamus viminalis, Calamus guruba*) used by rural people for domestic purposes, but also for making sophisticated furniture and luxury souvenir articles.
- Pati Pata, Murta (*Clinogynae dichotoma*) is an excellent material for floor-mats (Pati), which is extensively used by poor villagers and also as a luxury item for rich people. This is also exported by the cottage industry as a finished product.
- Gol-Pata (*Nypa fruticans*) is a very popular and essential thatching material for poor people in Khulna, Bagerhat and Satkhira districts and fetches revenue for the Forest Department.
- Horitaki (*Terminalia chebula*), Amlaki (*Phyllanthus emblica*), and Bohera (*Terminalia belerica*) popularly called "Trifala" (Myrabolum) are used as medicine.
- Honey is used as food, drink, beverage, and also as a medicine.
- Considerable quantity of shells and oysters are collected by local people, as means of livelihood in the coastal forest belts, like Cox's Bazar, Teknaf, Moheshkhali, Barisal, Patuakhali, Sundarbans, etc. These are highly priced by tourists as souvenir articles.
- Rivers flowing inside forest areas like Sundarbans, Chittagong Hill Tracts and Sylhet (as well as in the coastal belts and offshore islands) are rich in fish resources of different types, in both freshwater and saline environments.

1.4 Environmental Status

Bangladesh has only recently created institutional mechanisms for environmental management through the Ministry of Environment and Forests and the Department of Environment. A major issue is how to build the institutional capacity and use existing national level expertise efficiently in environmental impact assessment, monitoring, and evaluation of the forest sector. Environmental issues in Bangladesh differ depending on ecosystems, habitats, and type of land uses. Major environmental issues in urban and industrial areas are air pollution of smokes from industries and motor vehicles. Effluents of industries are also regarded as a serious environmental problem. Erosion of hill soils, silting up of water bodies, drying up of streams coming from hills, and flush floods are some of the environmental hazards arising from degradation of forested lands in the hills (Hossain, 1998; Salam et al., 1999). Indiscriminate use of chemical fertilizers and insecticides is another environmental issue and threat to water bodies. Drying up of water bodies, downing of ground water tables and erratic behavior of monsoons are some of the indicators of change in climate with likely impact on the environment.

An experience with environmental impact assessment is limited in Bangladesh, and legislation and policy are weak. Significant training and national capacity building is needed, within both the Forest and Environment Departments. Effective policy, legislation, and implementation mechanisms for conservation, protected area management, wildlife management and biodiversity are poorly developed in the country. Owing to large population and limited resources, Bangladesh can not afford not to fully utilize its limited resources. The problem is how to manage renewable resources without depleting them or their productive capacities. Past and present forest resource use and exploitation patterns, if allowed to continue, will result in further severe depletion of the growing stock and reduce flora and faunal resources. These past exploitation patterns are not sustainable. The remaining natural forests in the country may be exploited without causing irreversible and permanent damage to the natural heritage of the country (Ali, 1994).

1.5 Agricultural Situation

Bangladesh has primarily an agrarian economy. Agriculture remained the driving force behind the economic growth of Bangladesh during the 20th Century and would continue to remain for years in the 21st Century (Badruddoza, 2001). Agriculture is the single largest producing sector of the economy since it generates about 30% of the country's GDP and employing around 60% of the total labour force. The performance of this sector has an overwhelming impact on major macroeconomic objectives like employment generation, poverty alleviation, human resources development and food

security. Meeting the nation's food requirements remains the key-objective of the government and in recent years there has been substantial increase in grain production. However, due to calamities like flood, loss of food and cash crops is a recurring phenomenon which disrupts the continuing progress of the entire economy.

Agricultural holdings in Bangladesh are generally small. Through cooperatives the use of modern machinery is gradually gaining popularity. Rice, jute, sugarcane, potato, pulses, wheat, tea and tobacco are the principal crops. The crop sub-sector dominates the agriculture sector contributing about 72% of the total production. Fisheries, livestock and forestry sub-sectors have a share of 10.33%, 10.11% and 7.33%, respectively.

The area under agricultural use is subdivided into three categories, namely the net cropped area, current fallow, and cultivable waste which is a fallow for more than a year. Agriculture land use has been able to maintain its share at about 66% of the total area of the country during the 1970s and 1980s but its share has fallen to about 59% during the 1990s. The share of land under "other uses" like settlements, homestead, rivers, etc. has consistently risen over the past period (Rashid, 2001).
Bangladesh is the world's largest producer of jute. Rice being the principle staple food, its production is of major importance. Rice production stood at 20.3 million tons in the 1996-97 fiscal years. Crop diversification programs, credit, extension and research, and input distribution policies pursued by the government are yielding positive results. The country is now at the threshold of attaining self-sufficiency in food grain production.

2. Forest Information

2.1 Forest Area

Forest areas of Bangladesh vary considerably from one source to another, and there is a general need of reliable information in this regard, e.g. the total forest area is 2.56 million ha (FMP, 1993), 2.25 million ha (BBS, 1999) and 1.47 million ha (World Bank, 1997. However, in Bangladesh, of the total area agricultural land makes up 65% of the geographic surface, forest lands account for almost 17.5% (2.53 million ha) (FD, 2004), while urban areas cover 8% of the land. Water and other land uses account for the remaining 10%. The total forestland includes classified and unclassified state lands, homestead forests and tea and rubber gardens. Of the 2.53 million ha of forest land, the Forest Department manages 1.53 million ha including hill, Sal and Sunderban forests (FAO, 2006). The remaining 0.73 million ha of land designated as Unclassed State Forest (USF) are under the control of Deputy Commissioners (Table 1). Village forests (homesteads) form the most productive tree and bamboo resources in the country and account for 0.27 million ha. Much of the forest lands do not have satisfactory tree cover (World Bank, 1997; Chowdhury, 1999; Ahmed, 2003) and only 0.84 million ha (about 5.8%) of the state forest land has good forest cover (FSP, 2004).

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Table 1: ***Total Forest Land and Forest Area Managed by Forest Department of Bangladesh***

Category of Forests	Area (Million ha)	Percentage
Forest Department managed forests	1.53	10.54
Unclassed state forests	0.73	5.07
Village forests	0.27	1.88
Total	2.53	17.49

Category of Forests	Area (Million ha)	Percentage
Hill forests	0.67	4.65
Natural mangrove forests	0.60	4.09
Mangrove plantations	0.14	0.97
Plain land sal forests	0.12	0.83
Total	1.53	10.54

2.2 Forest Distribution

Hill Forests: The hill forests of Bangladesh are situated at the eastern border of the country. The relatively high altitude hills are found in Chittagong Hill Tracts. Hill forests of Bangladesh are ecologically divided into two classes: (a) Tropical wet evergreen forests, and (b) Tropical semi-evergreen forests (Das, 1990).

Tropical Wet Evergreen Forests: The tropical wet evergreen forests are an important class of forests in Bangladesh in terms of biodiversity, forest assets and environmental concerns. These are magnificent dense evergreen forests, rich in floral and faunal composition. The trees in the top canopy reach a height of 46-61 m. A few semi-evergreen or deciduous species may occur but they do not really change the evergreen character of the forests. The forests floral diversity is rich with epiphytes, orchids, woody and non-woody climbers, ferns, mosses, aroids, and palms, particularly in northern shady moist places. Herbs and grasses are abundant and the undergrowth is a tangle mass of shrubs, bamboo and cane. These forests occur usually in hills and moist shady areas in Chittagong Hill Tracts (Khagrachari, Rangamati and Bandarban), Sylhet, Habigonj, Moulvibazer, Sunamganj, Cox's Bazar and Chittagong (Das, 1990).

Tropical Semi-evergreen Forests: This type of forests occurs in Cox's Bazar, Chittagong, CHTs and Sylhet, in more exposed dry locations. The top canopy species of the tropical semi-evergreen forests reach a height of 25-57 m. In this group, the evergreen species predominate but there are also many deciduous species. Many of the species of evergreen forests also occur in this type of forests.

Tropical Moist Deciduous Plain Land Forests: The tropical moist deciduous forests are popularly known as sal forests. These occur in Dhaka, Gazipur, Tangail, Mymensingh, Sherpur, Jamalpur, Netrokona, Dinajpur, Rangpur, Naugaon, and in degraded form in Comilla (Chowdhury, 1994). In these forests, the predominant species is sal (*Shorea robusta*). The trees are 10-25 m high and mostly deciduous. Associate species are palas (*Butea monosperma*), Haldu (*Adina cordifolia*), Sidha Jarul (*Lagerstroemia paviflora*), Kumbi or Gadila (*Careya arborea*), Hargaza or Ajuli (*Dillenia pentagyna*), Bhela or Beola (*Semecarpus anacardium*), Koroi (*Albizia* spp.), Gandhi Gazari (*Miliusa velutina*), Menda (*Litsea polyantha*), Kusum (*Schleichera oleosa*), Chapalish (*Artocarpus chaplasha*), Udal (*Sterculia* Spp.), Depha jam (*Cleistocalyx operculatus*), Bahera (*Terminalia bellirica*), Kurchi (*Holarrhena antidysenterica*), Horitiki (*Terminalia chebula*), Kapila (*Garuga pinnanta*), Raina or Pitraj (*Aphanamixis polystachya*), Sheora (*Streblus asper*), Sonalu (*Cassia fistula*), Assar (*Microcos paniculata*), and Amloki (*Phyllanthus emblica*).

Mangrove Forests: Mangrove forests, both natural and plantation, are very important forest resources in Bangladesh. These are also called littoral swamp forests and are mainly evergreen forests of varying density and height, always associated with wet soils. The mangrove forests are well developed in the Sundarbans on the Ganges- Brahmaputra Delta, but very poorly developed in the Chokaria Sundarbans (Siddiqi, 2001).

The Sundarbans mangrove area is now a World Heritage Site. Sundari (*Heritera fomes*) is the dominant tree species from which it derives its name. The total area of the Sundarbans is 6,017 km^2, which is the single largest natural mangrove tract in the world. It is about 4.2% of the total land area of Bangladesh and about 44% of the forest land (FMP, 1993). Other associate species are *Excoecaria agallocha*, *Avicennia officinalis, Rhizophora mucronata, Bruguiera sexangula* and *Ceriops decandra* and many others constitute the tidal or mangrove vegetation.

The Sundarbans Reserve forest has been managed as a productive forest since 1879. The Sundarbans are a very vital natural resource providing a large number of products, such as timber, fuelwood, fish, thatching materials, honey, bee wax and shells. In addition, it supports a very rich and diverse flora and fauna (Das and Siddiqi, 1985; Siddiqi, 2001). It is the largest remaining habitat for the Royal Bengal Tiger. Some 600,000 people are directly dependent on these resources for their livelihood. The mangrove forest acts as a natural barrier to cyclones and tidal bores, and protects the densely populated agricultural areas to its north. The Sundarbans also act as the world's largest mangrove carbon sink. These are also an important spawning ground for fishes and harboring a very rich biodiversity.

Homestead Forests: Planting trees near homesteads is a traditional land use system in Bangladesh. Homestead forests develop as small groves scattered around homesteads through ecological and anthropogenic selections (Alam and Masum, 2005). Multi-layered vertical stratification, species diversity, and diversity of economic plants rather than number of individuals per species are characteristic features of Bangladesh homestead forests. The homestead flora of Bangladesh ranges from annual herbs to woody perennials; including indigenous and exotic species of multiple uses (Khan and Alam, 1996). The homestead vegetation can broadly be stratified into three strata. Trees are the dominant and common feature of the homestead flora.

Common trees of the upper stratum are: *Albizia procera, Aphanamixis polystachya, Artocapus heterophyllus, A. lacucha, Polyalthia longifolia, Alstonia scholaris, Azadirachta indica, Dillenia indica, Mangifera indica, Cordia dichotoma, Elaeocarpus floribundus, Bombax ceiba, Syzygium cumini; Albizia saman, Swietenia macrophylla, Tamarindus indica, Toona ciliata, Acacia nilotica, Lagerstroemia speciosa, Ficus benghalensis, F. religiosa, F. racemosa, Anthocephalus chinensis, Eucalyptus camaldulensis, Areca catechu, Borassus flabellifer, Cocos nucifera, Gmelina arborea, Erythrina orientalis, Lannea coromandelica,* and *Litsea monopetala.*

The mid stratum is dominated by medium-size trees, small trees, and bamboos. Common among them are *Holarrhena pubescence, Microcos paniculata, Citrus grandis, Ehretia serratam, Mallotus philippensis, Cassia fistula, Pithecellobium dulce,* and *Phoenix sylvestris*. *Bambusa balcooa, B. cacharensis, B. comillensis, B.nutans, B. salarkanii, B. tulda* and *B. vulgaris* are common bamboo species. *Adhatoda zeylanica, Cajanus cajan, Glycosmis arborea, Citrus* spp. *Duranta repens, Pithecellobium dulce, Euphorbia antiquorum, Opumia dillenii, Sesbania* spp*., Lawsomia alba, Calotropis procera, Murraya spp,* and *Grewia* spp. are common shrubs. Many of them are of medicinal value and some of them are used as hedge plants. *Barringtonia acutangula, Crataeva magna, Erythrina fusca, Pongamia pinnata,* and *Trewia nudifolra are* common trees that grow along water edges in low-lying areas (Alam et al., 1991). *Calamus tenuis* is a common rattan palm of the villages.

2.3 History of Forest Management (Forest Tenure System)

No scientific attempt was made anywhere in the sub-continent to conserve the forests before the advent of British rule. Even in the early days of British rule, there was much wasteful exploitation of forests to meet the requirements of the people. In 1862, on his way to Delhi from Myanmar (Burma),

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Brandis inspected parts of the forests of Bengal and made a note of the state of the forest resources of this region. This marked the beginning of forest management of Bangladesh (Banglapedia, 2003). In 1864, Anderson, Superintendent of the Calcutta Botanical Garden was appointed as the First Conservator of Forests of the lower provinces of Bengal Assam. Preliminary investigations and enquiries started by him led to the reservation of forest areas. In 1871, about 14,685 km^2 of hill forests were declared Government forests. In 1875, the first forest reserves were declared in Sitapahar (present CHTs South Forest Division) and in the Sundarbans. The Sundarbans were declared as a Reserved Forest in 1879 and the first management plan for the Sundarbans was adopted in 1892. The prime objective of this plan was to collect revenue from the export of forest products. The management plans for the hill forests were adopted at the beginning of the 20^{th} Century. The management plan of sal forests was prepared much later.

With the partition of India in 1947, the eastern and northeastern hill forests and unclassed state forests of Bengal, some parts of Assam, plain land sal forests and most of the Sundarban forests fell within the then East Pakistan. Plantation of valuable species, preferably teak and extraction of timber were the main objectives of forest management practices. The Forest Industries Development Corporation (FIDC) was set up in the early 60s in an effort to extract timber from remote forest areas. Plantations were raised from a few hundred hectares to 4,000 ha in the mid sixties. Commercial crops like rubber, cashew nut were also introduced (FMP, 1993).

Hill Forests: The hill forests were managed under the clear-felling system followed by artificial regeneration with valuable species with a rotation of 60 years (long rotation) and 30 years (short rotation).

Plain Land Sal Forests: The inland sal (*Shorea robusta*) forests were managed under a coppicing system with a rotation of 25 years. Areas where sal trees are comparatively fewer are managed under a clear-felling system followed by artificial regeneration mostly with sal and other suitable species.

Tidal Forests: The tidal forests were managed under the selection system followed by natural regeneration with a felling cycle of 20 years.

Systematic management of forests started in the 1860s after the establishment of a Forest Department in the Province of Bengal. The National Forest Policy of 1894 provided the basic guidelines for the formulation of acts and rules for the management of forests in the country. After partition of India in 1947, the forest policy of 1894 was not relevant for the new state of Pakistan which inherited poor forest coverage. Considering the necessity, a new Forest Policy was announced in 1955 (Banglapedia, 2003).

The Forest Policy of 1955 was further revised and the Forest Policy of 1962 was introduced. The forest policies of 1955 and 1962 laid emphasis on the exploitation of forest produce, particularly from East Pakistan. The policies did not help the development of forestry in Bangladesh. In addition, the increase in population and increased demand for food and other essential products resulted in heavy pressure on forestland. Even though Bangladesh became independent in 1971, its new National Forest Policy was not announced until 1979.

The policy statement of 1979 is very general and vague. It did not address some of the crucial issues such as functional classification and use of land, role of forests as the ecological foundation of sustainable productivity, or community participation. Consequently, the Policy of 1979 was later amended and known as Forest Policy 1994. In the early 1990s, a 20-year Forestry Sector Master Plan (1993-2012) was developed, which aims to bring 20% of the country's land area under tree cover.

Similarly, forest legislation in Bangladesh dates back to 1865, when the first Indian Forest Act was enacted. Until a comprehensive Indian Forest Act was formulated in 1927, several other regulations and amendments were created. The Forest Act of 1927, as amended with its related rules and regulations, is still the basic law governing forests in Bangladesh. An amendment of the Forest Act of 1927 was drafted in 1987 and approved in 1989, as the Forest (Amendment) Ordinance 1989. The Forest Act was further amended in 2000 and renamed as the Forest (Amendment) Act 2000. Under this amendment some major changes have been included.

Present Forest Management

Forest management today is almost totally different from the past in respect of its objectives and philosophy. Present-day forest management objectives are not only to produce timber but also to provide clean air, clean water, and a healthy habitat for wildlife and to act as a major harbor of biodiversity and nature based tourism. The present philosophy is to involve people in the management of forest resources and create an environment so that people can feel that they have also a share on trees growing on forestland as well as to improve the living standard of people residing in the vicinity of the forest.

Present-day forest management is primarily guided by the Forestry Master Plan (FMP) completed in 1993 with the assistance of ADB, UNDP and FAO. The objectives of present-day forest management are adopted following the FMP and include:

- Enhancing environmental preservation and conservation;
- Introducing rational forest land use;
- Increasing public participation and benefit from the forest;
- Creating forests on marginal and private lands;
- Institutional strengthening;
- Improving management practices; and
- Improving the efficiency of resource utilization.

Recent Improvement in Management Practices

Inventories were carried out of all major forest formations in the country except the forests in Chittagong Hill Tracts (NFA, 2007). This has provided the necessary database for using quantitative information for preparing more comprehensive management plans for different forests. Small units of uniform tree crops have been identified and information on these units was recorded and processed by the Forest Department with the help of a computer based Resources Information Management System (RIMS).

The inventory and associated activities have made long desired information on the status, growth and yield of forests available in the country. It has been possible to develop volume and yield functions for all major plantation species and volume functions for major species in natural forests. Based on these data long-term yield forecasts were made possible. A new working plan format has been devised in order to incorporate available information in the future management plans. An annual plan of operation is included as part of the management plan. This is basically a detailed plan of operations within the forest division and is prepared by the Divisional Forest Officer. In recent years, there has been a substantial shift in emphasis in forestry and forest management from maximizing yield towards maximizing sustainability through increased participation of local population, conserving biodiversity and maintaining forest services (www.bforests.gov.bd).

Present management systems have evolved from the past ones through various modifications in order to incorporate present objectives into forest management. Some new forest management systems have also been added to address new concepts in forest management such as agroforestry, homestead plantation, strip plantation, participatory forestry on encroached forest land, mangrove afforestation on newly accreted land in the coastal areas, and conservation area management to preserve wildlife habitat and biodiversity.

Resource Information Management System

The Bangladesh Forest Department initiated the establishment of the Resource Information Management System (RIMS) during 1984-85 under the auspices of the IDA funded Second Forestry Project. The main objective of the RIMS was to produce reports and maps relevant to all aspects of the management plan, silvicultural prescriptions and to provide information on present and predicted yields from relevant operations. This was designed as an aid to intensive forest resource management of all Forest Divisions through management plans and long-term planning in forestry.

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2.4 Degradation of Forests of Bangladesh

There are many forces responsible for forest degradation, collectively and individually and the trends of these forces are very complex. The major causes of forest degradation in Bangladesh are agricultural expansion, over-extraction of wood and non-wood resources, infrastructure development, population growth, deforestation, settlement, urbanization and wrong management practices (Hossain, 1998; Salam et al., 1999; Hasan and Alam, 2006). The state of forest degradation in Bangladesh and their causes are described below.

Deforestation

Forest cover losses in Bangladesh remain unsurveyed or unmapped and their exact size and location are not conclusively determined, except for periodic visual observations (FMP, 1993). These estimates indicate that damage affects one eighth of the country's land area (Fig. 1). The different estimates of deforestation reported in various sources are not consistent (Khan et al., 2004). In the absence of survey and demarcation of areas classified as forests, it is not possible to improve the information base. About half of the land area controlled by the Forest Department lacks tree cover. According to the major classes, forest coverage in the hill forests (including Unclassed State Forests) is 54%, in the Sundarbans is 99% and in the sal forests is 32%.

Deforestation results mainly from agriculture land clearing, principally shifting cultivation. Other causes include land use changes, encroachments, grazing, fire, uncontrolled and unscientific commercial logging, and clear felling for plantations, illegal felling and fuel wood collection, erection of brick fields and expansion of tobacco cultivation in the vicinity of forests in some hill district. The direct causes are the symptoms or effects of a wide malaise – poverty, landlessness, economic underdevelopment, implementation of regulations, lack of land use planning, uncertainties in land tenure system and socio-political instability. The annual deforestation rate is estimated to be 3.3% (Khan *et al*., 2004). Consequently, per capita forest land is declining. The impacts and manifestations of such alarming rates of deforestation are multifaceted. The costs of these impacts on the economy were estimated to be 1% of GDP in 1990 (BBS, 1999).

Shifting (Jhum) Cultivation

Shifting cultivation goes with primitive economies and isolated cultural communities. Shifting cultivation is characterized by a rotation of fields rather than by crops, accompanied by slashing and burning (Kerkhoff and Sharma, 2006). In a situation of little or no population or market pressure, shifting cultivation is environmentally acceptable. There were stable cases of integrated land use, and good agroforestry. However, with a developing market economy and the inevitable population pressure on land, the once elegant system of shifting cultivation collapsed into degradation and retrogression, influenced by factors both internal and external to the system. Control or regulation of jhuming is not effective and vast tracts in the hill regions became denuded (Fig. 2). About 60,000 families engaged in shifting cultivation covering an area of about 85,000 ha of the hill forests reserves. The extent of soil losses due to shifting cultivation in the hilly areas is shown in Table 2 (Farid et al., 1992).

Table 2: ***Land Degradation (Soil Loss) Due to Shifting Cultivation***

Location	Predominant Slope	Soil Loss (t ha^{-1} yr^{-1})
Khagrachari	60% area under 60% slope	10.10 - 67.00
Manikchari	46% area under 40% slope	12.00 – 120.00
Ramgarh	48% area under 40% slope	7.00 – 27.00
Rangamati	53% area under 40% slope	26.00 – 68.00
Raikhali	49% area under 40% slope	13.00 – 27.00
Bandarban	58% area under 60% slope	8.00 – 107.00
Teknaf	56% area under 20% slope	-

Clearing of natural vegetation for cultivation of pineapple, ginger and turmeric along the slopes has a negative effect, which increases soil erosion in the hilly areas. After 5-7 years of cultivation, by this method, these lands totally degrade to an almost irreversible state. Rubber plantations on more than 70% of the slopes of Sylhet and Chittagong hills leads to severe landslides during heavy monsoon periods. Clearing of forestland for settlements and unscientific land management for agricultural use accelerate erosion of the topsoil through extensive surface runoff caused by heavy monsoon rain. In addition, the infertile heavily compacted clay is exposed to the surface as a result of topsoil removal.

Encroachment

Encroachment is a serious problem both in the plain land sal forests and in the hill forests. However, information available about encroachment is scarce (FMP, 1993). Encroached lands lack legal surveys and the exact area involved is unknown. Current data are the visual estimates of the Forest Department field staff. The encroachment problem in the forest areas of Chittagong, CHTs and Cox's Bazar is political and involves both the Ruhinga and cyclone refugees.

Encroached sal forests in Central and Northern Bangladesh result from tenurial uncertainties (Chowdhury, 1994). Organized encroachments carried out by `dummy encroachers' supported by politically powerful local groups also exist. The Forest Department is unable to control these encroachments. Lack of coordination between the Land Department and the Forest Department in land transfers and records adds to the problem. Some 77,000 ha of forest land involving 12,200 families are estimated to be encroached in this way (FMP, 1993).

Land Transfers to Other Uses

Land transfers have taken place where forested land got diverted for purposes of human settlement, development of industry, fishery, transport and communications, irrigation, energy and power, mining, tourism, educational institutions and defence. The extent of such transfers was about 61,000 ha.

Population Explosion

The population density of Bangladesh is 941 per km^2 (Bangladesh Economic Review, 2006) which is one of the highest in the world. In 1947, the density was only 306 per km^2 and the demand for forest products as well as land for settlement was very little. In 1971, the density increased to 510 per km^2 and the demand for forest products as well as land for settlement increased by 67%. At present, the density is 941 per km^2 and compared to the 1947 baseline, the demand for forest products as well as land for settlement increased by 189%. Thus, the population explosion is the single most important

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factor for destruction of forests. Unequal distribution of resources among the population is also contributing to the destruction of forests.

Settlement and Urbanization

Population growth is estimated at 1.43% per annum. Given this rate, land is needed to feed, homes to live, schools to educate, and hospitals to provide health care services. To meet all these demands, the only available land in this land-hungry country is the forestland. Conflict also arises from the settlers when CHTs were rehabilitated in 1980 (Roy, 1997). On the other hand, industrialization is also emerging at a rapid pace and engulfing our land.

Wrong Management Practices

In order to meet the increasing demand for forest products, in the 1980s, the Forest Department adopted a forest management called clear felling followed by artificial regeneration, which later on proved to be very detrimental to sustainable tropical rain forest management. Following this system, the forest was cleared by slush and burning all vegetation, and replanted with only one or two commercially important species. As a consequence, the rich biodiversity of the tropical rain forest ecosystem was destroyed as well as its soils exposed to erosion through torrential rains during the monsoon season. The opening up of forests also tempted some people to encroach the forest land.

Brick Fields

Brick fields in the vicinity of forests have been identified as one of the notorious causes of deforestation. Brick field owners who are the elites and patrons within existing power structures, have good liaison with political and government officials. They deploy local musclemen who instigate landless, job hungry people to illicitly harvest forest resources. Brick fields in the vicinity of forests have caused not only deforestation but also environmental degradation of the biological production systems. Farmers of many areas reported that their fruit production in the areas had declined because of smoke originating from the brick fields. Moreover, 50% of the energy used for firing bricks comes from woody biomass.

Saw Mills

Saw mills in the district and upazila headquarters and also along the borders in adjacent districts have created a demand for timber processing. This demand has caused an increase in harvesting forest resources both from public and private forests.

Tobacco Cultivation

Extension of tobacco cultivation in Lama, Ali Kadam and Naikhongchhari Upazila of Bandarban district has also contributed towards deforestation in two ways: through bringing fringe forest lands under tobacco cultivation and, supplying of fuel wood for tobacco curing from adjacent forests.

Patronage of Timber Traders

Patronage of traders in illicit harvesting of timbers is also a contributing factor towards deforestation. Generally, from April to November is the lean period of food production. At that time there is also little scope to sale labors. Many timber merchants take this opportunity and engage agents who instigate and encourage people to illicitly harvest bamboo and timbers.

Policy Conflict

Conflict over policies is one of the important and major causes of deforestation in the CHTs. Clear felling followed by monoculture of teak, introduction of recent exotics by the Forest Department; allotment of land for rubber plantations; upland settlement programs coupled with rubber plantations, loosely coordinated and integrated development programs have caused significant deforestation.

These have also been an important cause of biodiversity loss. Lack of integrity among some government officials, political and community leaders have influenced policies and local level decision making processes which ultimately added to the underlying causes of deforestation.

2.5 Forest Related Environmental Issues

In the hill forests the most common environmental problems are soil erosion, over exploitation and loss of soil fertility. In the mangrove forests environmental problems are related to poor water quality and pests while in the bamboo forests soil erosion and over exploitation are severe problems. Forest plantations are faced with problems such as loss of soil fertility, erosion and overgrazing (NFA, 2007). According to NFA (2007), the environmental problems in different forest land use classes are shown in Table 3.

Table 3: ***Environmental Problems in Different Forest Land Use Classes (%)***

Environmental Problems	Hill Forest	Mangrove Forest	Bamboo Forest	Long Rotation Plantation	Short Rotation Plantation
Not existing	2	10	--	50	--
Poor water	--	44	--	--	--
Pests	2	47	--	--	--
Erosion	87	--	83	39	--
Loss of soil fertility	35	--	11	34	46
Burning	8	--	7	--	--
Landslide	11	--	--	--	--
Wind throw	--	10	--	--	--
Over exploitation	47	--	31	--	--
Over grazing	--	--	--	--	46

2.6 Constraints of Forest Restoration and Rehabilitation

The major constraint of forest restoration and rehabilitation in Bangladesh is population pressure. The population pressure is so high that the land and man ratio is decreasing day by day. Most of the people are poor and are not conscious about natural resources. Though there is a strong political will for tree planting programs in Bangladesh, factors like land demand for homestead, shrimp cultivation, establishment of industries/factories, the Rohinga refugee problem, erosion, floods, natural calamities and encroachment of forest land by powerful people have made forest protections very difficult. Lack of coordination and cooperation among the relevant organizations, e.g. land, fisheries, agriculture, forestry are also responsible for the slow progress in rehabilitation programs. Another major problem in development and conservation of forest resources in Bangladesh is the absence of appropriate institutional frameworks in the forestry sector (Ahmed, 2001).

It is also important to overcome the image crisis of the Forest Department, so that people can trust them. The officials are required to be capable of efficiently managing increasingly emerging legal challenges for protecting forests of the country (Chowdhury, 2006). However, the Forest Department alone can not protect the forests. Their role should be to look after the national interest, coordinate, monitor, evaluate and enforce overall forest management and development policies.

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3. Forest Degradation Control Mechanisms to Date

3.1 Linkage to National and Regional Forest and Land Use Policies

The National Forest Policy reflects the objectives and strategies of the broad development goals of the country's forests. The current forest policy is the refined version of the forest policy of 1894. The forest policy of 1894 provided the basic guidelines for the formulation of subsequent Acts and Rules, for the management of forests in the country. Between 1947 and 1955, no new forest policy was promulgated. In 1955, the Government of the then Pakistan announced its first National Forest policy with the following salient features:

- Forestry should receive priority and increased allocation should be made available to increase forest cover,
- Intangible benefits of forest origin should be recognized,
- All forests should be scientifically managed under an approved working plan (management plan), and
- Sound management of private forests should be ensured through government legislation and support.

This policy also emphasized the enhancement of forest revenue. Thus, a practice of exploitation of forest and planting of the harvested areas under the National Development Program was initiated. Prior to this, no development fund was used for the activities of the Forest Department. In 1962, small revisions were incorporated into the policy without any major changes. Under this policy, for the first time, a thorough forest inventory of the Sundarbans was carried out by Forest and Engineering International of Canada in 1959 (FMP, 1993).

The first National Forest Policy of Bangladesh, which emerged as an independent nation in 1971, was announced in 1979. The salient features of the Forest Policy of 1979 were as follows:

- Government forests should not be used for non–forestry purposes,
- Timber resources should be increased by establishing large scale plantations,
- Modern technology should be employed for extraction and utilization of forest products,
- Forest based industries should be set up,
- A cadre of officers should be constituted for managing the forestry sector,
- Steps should be taken to conserve forests and wildlife and utilize the recreational potential of the forests, and
- Mass motivation should be initiated and technical assistance extended to those interested in forestry.

The forest policy was revised in 1994. This policy is extensive, versatile and dynamic in nature. The issues considered in formulating the Forest Policy of 1994 are as follows:

- People's welfare principles inscribed in the Constitution of the Peoples Republic of Bangladesh,
- Long-term and specific roles of the forest sector in the overall socio-economic development of the country including the environment,
- National policies for the development of agriculture, cottage industries and other related sectors,
- Decisions and recommendations taken in different international conferences and conventions,
- *The target of 20% of the country's land under forest cover by the year 2015*,
- The importance of urban forestry in reducing pollution in the cities,
- *The target of the country's protected area at 10% of the reserved forest by the year 2015,*
- The need to involve women in homestead and farm forestry and participatory afforestation programmes,
- The importance of ecotourism, related to forest and wildlife, and
- Promotion of Government, NGOs and local people working together in order to achieve self-reliance in forest products and maintenance of the ecological balance.

Hill Forest Planting: Plantation in hill forests has a history of more than 135 years (Table 4) and is a major afforestation program in Bangladesh. The magnitude of deforestation, soil erosion and degradation in the hill forest areas is quite acute. Immediate steps should therefore be taken to bring such denuded and degraded areas under vegetation cover in the shortest possible time in order to safeguard the area from utter ruination (Hossain, 1998). The main aims of the hill forest plantations are to control soil erosion, enhance watershed and biodiversity, as well as to supply industrial raw materials.

Table 4: ***Tree Species Introduction in the Plantation Forests of Bangladesh***

Year	Species Introduced in Plantation Programs
1871	- Introduction of teak in Chittagong Hill Tracts from Myanmar
1871-1920	- Plantations limited in Chittagong Hill Tracts with teak
1921	- Plantation extends to Chittagong, Cox's Bazar and Sylhet Forest Divisions - *Dipterocarpus turbinatus, Swietenia macrophylla, Lagerstroemia speciosa, Cedrella toona, Artocarpus chaplasha, Xylia kerrii* and *Syzygium grande* are included in the plantations
1923	- *Gmelina arborea* also included in the plantations
1950	- Till teak dominates
1950-1960	- *Shorea robusta* plantation in substantial areas but in many areas failed
1960	- Initiatives of experimental rubber plantation
1971	- Independence of Bangladesh
1974	- Large scale plantation of *G. arborea, Paraserianthes falcataria, Anthocephalus chinensis* in Chittagong, Chittagong Hill Tracts and Sylhet forest areas - Included oil palm, mulberry and cashew nut plantations - BFIDC started commercial rubber plantations
1977-78	- Initiation of species and provenance trials of *Eucalyptus* and *Acacia*
1980 onwards	- Long rotation (40 years) plantations of *T. grandis, D. turbinatus, S. grande, A. chaplasha, M. champaca, S. macrophylla, C. tabularis,* etc. - Medium – Short rotation (18, 12, 6 years): *E. camaldulensis, A. auriculiformis, A.* hybrid*, A. procera, G. arborea, C. siame*a, etc. - Presently teak, Acacia and Gamar are the priority species in large scale plantation programs

The soil in these hills varies from sandy-loam to coarse sand, acidic and has low base exchange and water holding capacities (Choudhury, 1982). Conspicuous retrogression of the ecosystem is the result of uncontrolled fellings, shifting cultivation and fire leading to large tracts of hills today covered with *Imperata* and *Eupatorium* and few trees distributed sporadically over the area. In such a situation, plantations of multipurpose tree species can play an important role in restoring productivity, ecosystem stability and biological diversity of the degraded hills. There is also increasing evidence that forest plantations can play an important role in harmonizing long-term forest ecosystem rehabilitation with socio-economic development objectives (Lamb and Tomlinson, 1994). About 210,162 ha plantations were raised in the hill forests (Table 5). Now, these plantations provide timber, poles, fuel wood and pulpwood and also help to conserve biodiversity and the environment (Hossain, 1998).

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Table 5: ***Forest Land (ha) Under Different Forest Types in Bangladesh***

Forest Type	Natural Forest	Plantation Forest	Total Forest	% of the Total Area of the Country
Hill forest	1,106,560	210,162	1,316,722	9.1
Littoral /coastal	616,589	134,700	751,289	5.2
Sal forest	87,213	36,013	123,226	0.9
Village forest	------	270,000	270,000	1.8
Total	1,810,362 (1.81 m ha)	650,875 (0.65 m ha)	2,461,237 (2.46 m ha)	17.0

3.2 People-oriented Forestry

In order to restore degraded forest lands of Bangladesh, people-oriented forestry was introduced as an alternative to traditional forest management. Active participation in the management of forest resources was encouraged through these programs. Participation was successfully created in different degraded forest zones. The Tangail Forest Division is one of them which belongs to about 49,748 ha or 42% of the moist deciduous forests of Bangladesh. Muhammed *et al*. (2008) analyzed the people-oriented forestry practice in Bangladesh with a case study in the Tangail Forest Division. An excerpt of this study is presented below.

3.3 Stabilization of Newly Accreted Land and Coastal Afforestation

The coastal belt of Bangladesh is about 710 km long, extending along the Bay of Bengal from the mouth of the Teknaf River in the Southeast to the mouth of the Raimongal River in the West (Siddiqi, 2001). Given the protective role of the natural mangroves, the Sundarbans led the Forest Department to try the establishment of mangrove plantations. Bangladesh is a pioneer country in coastal afforestation programs. Coastal plantations were started in 1961 by the Forest Department with a view to provide protection against natural calamities, such as cyclones and tidal surges. The Forest Department started intensive mangrove plantations in 1965 with the following purposes:

- Protection of coastal life and property from tidal surges and cyclones;
- Conservation and stabilization of newly accreted fragile coastal lands, and acceleration of further accretion with the ultimate aim of transferring a large part of this stable land to agriculture;
- Production of timber for fuel wood and industrial use;
- Creation of employment opportunities for isolated rural communities, and
- Development of a suitable environment for wildlife, fish and other estuarine and marine fauna.

Afforestation programs under different projects funded by ADB and World Bank were accelerated in 1974 and, by 2001; about 148,526 ha of plantation were established in four coastal forest divisions (Table 6). While the potential contribution of coastal plantations towards mitigating the damages from tidal and storm surges are not disputed, their financial success will depend on a viable program for utilizing wood products. The tree resources created under this massive mangrove afforestation amount to about Tk 5,330 million and are estimated to have contributed 1% to the increase of the country's land mass. These mangrove plantations are sources of timber, poles and firewood, as well as different intangible benefits. They are also acting as ideal filter of the coastal environment, disaster protector, habitat and breeding ground for fish and shrimps, pastureland for cattle, habitat for wildlife and locations for ecotourism.

Table 6: ***Coastal Plantations (ha) Raised between 1960-2001 by the Bangladesh Forest***

Forest Division	Coastal Afforestation Project 1960-80	Mangrove Afforestation Project 1980-85	Second Forestry Project 1985-92	Forest Resources Management Project 1992-2001	Total Plantation in ha (1960-2001)
Chittagong	10,392	11,437	10,057	4,958	36,844
Noakhali	11,200	14,615	15,314	18,400	59,529
Bhola	5,549	11,011	7,758	5,845	30,163
Patuakhali	5,379	6,114	5,932	4,565	21,990
Total	**32,520**	**43,177**	**39,061**	**33,768**	**148,526**

Case Study 1: Tangail Forest Division

"In the study area located in the Tangail Forest Division, a total of 11,854 ha of woodlot, 2,704 ha of agroforestry and 945 km of strip plantations have been raised in a benefit-sharing program that is inclusive of land encroachers and other economically disadvantaged people. Since 2000–2001, a total of 3,716 ha of woodlot, 890 ha of agroforestry and 163 km of strip plantations have been harvested to the benefit of 6,326 individuals. Investment analysis indicates that woodlot plantation is not financially viable but agroforestry is the most profitable. These results were somewhat unexpected since initial analysis suggested that the woodlot plantation profit would be greater than, or at least equal to, that of the agroforestry plantation, if the number of planted seedlings per unit area was taken into account. The per unit area net present value (NPV) was highest in the agroforestry plantation ($1,662) and negative in the woodlot plantation ($397). The benefit cost ratio (BCR) was also highest in the agroforestry plantation (1.64) and lowest in the woodlot plantation (0.86). This study also showed that some individuals who were formally classified as encroachers have now become vital forest stakeholders. On average, participants received $800, $1,866 and $1,327 over the course of 13 years from strip, agroforestry and woodlot plantations, respectively. Average annual return per participant was $62, $144 and $102, respectively, which was in addition to each individual's yearly income. This added income is a significant contribution to monetary resources and improves socio-economic conditions at the grass roots level. Overall, this program can be considered a financial success as a plantation raising strategy."

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Case Study 2: Nijhum Dweep

Nijhum Dweep is located within Hatiya Upazila in Noakhali District, at the confluence of the Meghna estuary on the Bay of Bengal. The total area is about 16,352 ha. Nijhum Dweep is a very precious island of Bangladesh and was concealed by water for many years. The island slowly started to surface, and since 1971 the Forest Department has been involved in the planting of trees like Keora, Baen and Gewa. About 18,900 acres of plantation were raised between the years 1971 and 2005 (Chowdhury, 2006). The forest, which is irrigated by the bay, has also attracted a great number of bird species. By 1978, wildlife was introduced to the island, and the eight spotted deer that were originally released on the island have grown to a healthy population of approximately six thousand individuals. Nijhum Dweep was declared a National Park in 2001.

The spotted deer share Nijhum Dweep with various other animals such as snakes, buffalo and monkeys, and it is estimated that almost 35 bird species are permanent residents of the island. Migratory birds also find the island the perfect resting destination as it is almost untouched and not threatened by human interaction. The beaches and sightings of crabs, sea snails and oysters create great excitement amongst tourists, as they are able to appreciate nature against the backdrop of the lush, green landscapes.

The authorities have made the island more attractive to tourists by erecting visitor facilities along the beaches. Viewing a sunset or sunrise from the shores of this tranquil and inspiring natural paradise is unforgettable. Bangladesh has realized how significant and important their wildlife and nature can be for the economy and tourism industry and is looking at creating more protected areas within the country. Nijhum Dweep is the perfect example of how conservation and forestry can not only assist and ensure the survival of animals, but enhance an industry and a country.

Keora (*Sonneratia apetala*) and Baen (*Avicennia officinalis*) are the two most common species used in the newly accreted char land plantations (Fig. 3). Some of the afforested mangrove islands are very densely stocked and look like natural forests, namely Nijhum Dweep, Dhal Chara and Char Kukrimukri islands. Spotted deer were released on these islands and their number has increased considerably over the years. Due to successful plantations and creation of an adequate habitat for wildlife, “Nijhum Dweep” was declared a National Park by the Government in 2001 (www.bforests.gov.bd).

Unfortunately, destruction and exploitation of mangroves have become an alarming concern in Bangladesh (Sajjaduzzaman et al., 2005). Many established plantations have been destroyed due to over exploitation, conversion to agricultural land, shrimp culture, salt pans, urbanization and other

human interventions and about 50,000 ha of successful plantations are reported to have been destroyed. Of the coastal plantations, 27% of the area has been eroded and 12% of the area has been encroached (Iftekhar and Islam, 2004).

3.4 National Level Degradation Control Measures

Trends in Rehabilitation of Degraded Forests through Social Forestry

Deforestation is an immense problem in Bangladesh. Over a long period of time, much of the state forests have been deforested and encroached by landless poor people. Prevailing socio-political condition does not allow eviction of these encroachers. Therefore, to solve this problem, instead of evicting the encroachers, they are actively involved in tree planting activities with a first right use in the designated forest areas.

Social Forestry is a forestry which aims at ensuring economic, ecological, and social benefits to the people, particularly to the rural masses and those living below the poverty line (Ahmed, 2001). The history of social forestry in Bangladesh is linked with the institutional approach to the introduction of forest extension services in the Forest Department. During 1962-63, two forest extension divisions, one at Rajshahi and another one at Dhaka were created and the tree planting day on 1st June was introduced. Since the creation of the forest extension division for raising and distributing of seedlings, a gradual expansion of activities took place. The activities, however, remained confined to the establishment of nurseries and ceremonial planting in the district headquarters and some important centers. Tree planting campaign initially was for a day which later extended to a week, then a month and subsequently to three months period. The program initially was small and it has limited impact on people. The activities failed to bring any change in the outlook of extension personnel or change in the mind of common people. No thought was given to the utilization of landless people and their involvement in forestry activities.

However, social forestry in the real sense started with the Asian Development Bank (ADB) financed community forestry project (Khan *et al*., 2004). ADB sanctioned a loan of 11 million US$ and United Nations Development Program allotted 2.0 million US$ through the Food and Agricultural Organization (FAO) as technical assistance. Project activities started in 1982 and were completed in 1987 in seven districts, namely Dinajpur, Rangpur, Pabna, Rajshahi, Bogra, Kushtia and Jessore. The objective of the project was to increase the supply of fuelwood, fodder, small timbers, fruits and other products. Bangladesh is a densely populated country where land is a scarce resource. Therefore, marginal land such as slopes of roads, embankments and railways, has also been brought under participatory forestry for raising strip plantations. Subsequently, two more participatory forestry projects were implemented, namely the Thana Afforestation and Nursery Development Project and the Coastal Greenbelt Project. A participatory forestry project captioned as the Extended Social Forestry Project was implemented during 1995-97. Under the above projects, 35,000 ha of woodlot plantations, 9,000 ha of agro-forestry and 45,000 km of strip plantations were created. Resources built up through these plantations are equivalent to Tk 100,000 million (www.bforests.gov.bd).

The Asian Development Bank was pleased with the overall performance of the community forestry project and sanctioned Upazila Afforestation and Nursery Development Project as a follow up. This was a countrywide project covering all parts of Bangladesh with the exception of the Sundarbans and greater CHTs districts.

Social Forestry Programs have been initiated with a view to meet the forest product requirements of the local population and to reverse the process of ecological and climatic degradation through proper soil and water conservation and to improve the socio-economic conditions of the rural people. More specifically, the Social Forestry Programs had the following objectives:

- To meet the needs for fuelwood, small timber, bamboo, fodder and other minor forest produces on a sustained basis;

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- To empower local communities by involving them in the planning, implementation and benefit distribution of forestry activities in order to cater for local needs;
- To promote self reliance and social equity among local people;
- To provide employment opportunities to the rural population;
- To develop the cottage industries in rural areas;
- To utilize the available land to the best advantage according to its production capacity;
- To provide efficient soil and water conservation; and
- To improve aesthetic value of the area and to meet the recreational needs of the population.

Over the last two decades there has been a gradual shift in the forest management approach adopted by the Forest Department i.e. from its traditional custodian role to a more participatory management approach. Accordingly, the provision of people's participation in protecting the natural forest and replanting degraded and encroached forest land with benefit sharing mechanism has been developed and people's participation has been ensured.

The ADB funded Community Forestry Project implemented in the seven northern districts from 1981 to 1987 paved the way for participatory forestry in Bangladesh. Following this project other ADB funded projects such as the 'Thana Afforestation and Nursery Development Project', and the 'Green Belt Project' was implemented. Currently, a country-wide 'Forestry Sector Project' is being implemented. Major components of this project are: woodlot, agroforestry and strip plantations. The physical achievement during 1981-2003 under the various social forestry programs are shown in Table 7.

Table 7: ***Achievements of the Social Forestry Program during 1981-2003***

Sl No.	Components	Achievements
1	Establishment of woodlot / block plantation	32,640 ha
2	Establishment of agroforestry plantation	8,778 ha
3	Establishment of Strip plantation	86,338 km (including WFP assisted part)
4	Rehabilitation of Jhumias	6,321 families
5	Village afforestation	7,282 villages
6	Institutional planting & seedling distribution / sale	168 million nos.
7	Establishment of SFNTC (Social Forestry Nursery and Training Center)	98 nos.
8	Establishment of SFPC (Social Forestry Plantation Center)	345 nos.
9	Training on social forestry	177,261 persons
10	In every upazila, there is a Forest Department's nursery center. In addition to that, 12,000 private nurseries have been established throughout the country.	

(Source: Bangladesh Forest Department)

Poverty is a major problem, particularly in rural areas of Bangladesh. Plantations raised earlier under the CFP and the TANDP are now being harvested to raise second rotation plantations under the Forestry Sector Project (FSP). During 1999-2003 nearly 5,080 ha of woodlots, 1,597 ha agroforestry, 2,897 km strip plantations and 40 ha Charland plantations were harvested and replanted under the FSP with the total sale proceeds of 704 million Taka. During this period, a total of 23,561 participants received Taka 308 million as their shares agreed in the participatory benefit sharing agreement (PBSA).

Under the World Food Program Assisted Strip Plantation Program, in the period from 1988 to 1998, about 45,682 km strip plantations have been raised and 38.524 million seedlings have been planted and maintained with the participation of 456,820 landless destitute families, of which about 365,456 are women. In total, 77,048 nos. of caretakers have been employed under this program. During 1999 to 2006, an amount of 15,174 ha woodlot, 3,468 ha of agroforestry, 7,414 km strip plantations and 219 ha Char land plantations have been harvested and replanted under the FSP with a total sale proceed of 2.37 billion Taka. In total, 68,372 participants received 1044.15 million Taka as their shares according to the participatory benefit sharing agreement (PBSA).

Sustainability of Participatory Forestry

Social Forestry Rules: The Forest Act of 1927 has been amended in 2000 to support and encourage social forestry/participatory forestry activities in the country. Social Forestry Rules have been formulated and are now waiting for vetting from the Ministry of Law, Justice and Parliamentary Affairs. The Forest Act and Social Forestry Rules will provide legal support to participatory forestry and will also ensure sustainability of this program.

The Tree Farming Fund (TFF): Participatory plantations are being raised from the development budget using both government and external loan money. Participatory forestry cannot be made sustainable using government funds only. The Tree Farming Fund (TFF) has been developed using a 10% share from the proceeds of final timber harvest in order to reduce dependency on government and donor funding. The Ministry of Finance has approved the TFF which will be operated by forest stakeholders and provide 50% of the replanting cost. The remaining 50% cost will be provided by the project. If TFF doesn't cover 50% of the replanting cost, the participant will contribute voluntary labour to cover the gap. TFF and participatory labour contribution will make participatory forestry sustainable.
Bangladesh has an immense scope of popularizing social forestry programs in different land components. In total, about 4.65 million ha of land is available for this purpose, which is about 31% of the country's total land surface (Table 8). Considering the size of Bangladesh and her forest area, the potential land available for social forestry production systems is quite significant (Khan et al., 2004).

Table 8: ***The Potential Land Available for Social Forestry Practices in Bangladesh***

Sl No.	Land Availability	Area (Million ha)
01	Degraded & denuded land of Unclassed State Forest Land	1.00
02	Khas lands	0.56
03	Degraded government forest land	0.27
04	Marginal strip land	0.08
05	Homestead marginal land	0.27
06	Degraded tea garden land	0.06
07	Degraded private forest land	0.05
08	Cropland agroforestry on private agricultural lands (29% of the total agricultural land is above normal flood level & suitable for cropland agroforestry)	2.36
Total		**4.65**

If all the available 4.65 million ha of land is brought under social forestry production systems, then 465,000 ha of land would be available for planting annually under the social forestry production system of 10 years rotation. The area will produce 46.5 million m^3 of timber and firewood annually (at the moderate rate of 10 $m^3 ha^{-1} yr^{-1}$ production). Moreover, the system will provide food, income and employment opportunities for the farmers.
The component-wise targets of the project were:

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- Raising of plantations in the depleted sal forest over an area of 16,194 ha involving local people;
- Establishment of agroforestry farms in the denuded and encroached sal forest over 3,289 ha following the participatory approach;
- Afforestation of 810 ha outside the area of the Water Development Board;
- Development of 8, upgrading of 32, and maintenance of 51 community forestry growth centres by renaming them as Forestry Extension Nursery and Training Centres (FENTC);
- Raising and distribution of 40-48 million seedlings during the project period;
- Imparting training to about 75,000 village leaders, block supervisors and upazila agriculture officers, plantation assistants, gardeners, staff, and officers of the Forest Department;
- Establishment of another 345 nurseries in the upazila complexes;
- Establishment of 17,760 km of strip plantation along road, railway, and canal embankments;
- Raising and distribution of 10.97 million seedlings from the newly established upazila nurseries; and
- Helping in establishing 100 private nurseries by encouraging entrepreneurs with training and financial assistance.

Another participatory social forestry project financed by the Asian Development Bank is the Coastal Green Belt Project started in 1994-95. It is based on the Asian Development Bank's Upazila Afforestation and Nursery Development Projects theme. The project area includes 10 districts of the coastal zone. The objective of the project is to reduce loss of life and damage to property caused by cyclones through increased vegetative cover in the project area. Increasing the vegetative cover will be realized by the promotion of coastal tree planting activities among the local population with the involvement of Non-Government Organizations (NGOs). Social forestry projects have contributed to employment generation, capacity building and institutional reform activities through benefit sharing arrangements, but with minimal or no external assistance. These achievements will be difficult to sustain (FMP, 1993; Khan, 1998, 2004).

Agroforestry

Agroforestry as a scientific and planned approach to land use has emerged recently. It is a sustainable management system for land that increases overall production, combines agricultural crops, tree crops and forest plants and/or animals simultaneously or sequentially, and applies management practices that are compatible with the cultural practices of the local population (Bene et *al.*, 1977). The potential land available for agroforestry in the country has been identified to be about 1.51 million ha including 0.27 million ha homesteads land (Bhuiyan, 1997).

Participatory Natural Sal Coppice Forest Management

Sal (*Shorea robusta*) is the key tree species of the plain land sal forests. It is locally called Gajari (having coppicing power) for which the sal forest is also known as the Gazari forest. This sal forest is now under heavy population pressure as it is easily convertible into agricultural land.

The Forest Department started participatory sal coppice management from 2001 under the Forestry Sector Project. An area of 5,850 ha of sal forest has been brought under coppice management through participatory social forestry. Division and year–wise distribution of participatory sal coppice forests is shown in Table 9 (PFN, 2005; Chowdhury, 2006).

Table 9: ***Participatory Natural Sal Coppice Management (ha) from 2000 to 2005***

Forest Division	2000-01	2001-02	2002-03	2003-04	2004-05	Total
Dhaka	60	-	600	710	500	1870
Tangail	-	60	1600	1350	500	3510
Mymensingh	80	-	100	200	50	430
Dinajpur	-	-	-	40	-	40
Total	140	60	2300	2300	1050	**5850**

Participatory Barind Ponds and Tanks Rehabilitation and Plantation

Ponds and tanks of the Barind Tract are important water sources for household purposes and irrigation. For this reason, the Forest Department has taken up re-excavation and plantation programs to conserve and develop these important water sources in collaboration with the local community. From 2002 to 2005, 29 ponds and tanks have been rehabilitated and planted with trees (Chowdhury, 2006).

Participatory Buffer Zone Plantation

The Forest Department has undertaken a program to conserve and develop about 8,288 ha of national parks, game reserves and wildlife sanctuaries with local community participation throughout the country. This program will help in conserving biodiversity, environment, soil, water and wildlife. The participatory buffer zone plantation is one of the major components of this program. These plantations will meet the local demand of forest products and also help to reduce poverty. Buffer zone plantations raised during the period 2002 to 2005 are summarized in Table 10.

Table 10. ***Buffer Zone Plantations (in ha) Established from 2002 to 2005***

Forest Division	2002-03	2003-04	2004-05	Total (ha)
Tangail	127.46	125	16	268.46
Sylhet	100.00	255	83	438.00
Chittagong (N)	300	400	150	850.00
Chittagong (S)	450	300	150	900.00
Cox'sBazar (N)	110	-	50	160.00
Cox'sBazar (S)	190	855	250	1295.00
Total				**3911.46**

Livelihood Improvement of Tribal People through Participatory Forestry in the Chittagong Hill Tracts

This is an ambitious program of the Forest Department in improving the livelihood of the tribal people. This is a new program and 124 families were involved under this program. Each household was provided with 2 ha of land where they developed silvi-agri-horticultural farms. In addition, 820 ha of block plantations were raised in highly degraded forest areas through people's participation in Lama and Bandarban Forest Division.

Homestead Plantation

The homestead plantation is an important afforestation program of the government. Under this afforestation program, seedlings of fruit and timber species are distributed at a subsidized rate to the

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rural households. This homestead afforestation program earned widespread popularity in the country. As a result, a huge amount of tree resources was created at the rural household level (Rahman et al., 2005). In addition to providing shelter for birds and environmental conservation, these are supplying families with food, necessary fuel wood and timber. The distributed seedlings include tree species like Mahogony, Sissoo, Akasmani, teak, etc. and fruit species like coconut, betel nut, date palm, mango, guava, and others (Khan and Alam, 1996). Homestead forests contribute to the rural economy of the country significantly (Salam et al., 2000; Momen et al., 2006; Rahman et al., 2006).

Institutional Plantation

The Government of Bangladesh has been implementing an institutional plantation program throughout the country with the objectives of re-greening public institutions and urban centers. Under this program, trees are planted in areas available within the various institutions, such as educational institutions, e.g. schools, colleges and universities, compounds of mosques, temples and churches, graveyards, office complexes and other institutions. Under this program trees of various fruit, timber and medicinal species are provided by the Forest Department free of cost and these are planted by concerned institutions with their own labour under technical guidance of the Forest Department and assistance of NGOs. This institutional plantation program will be very helpful for preserving and developing the environment and also to increase the scenic beauty in the respective areas.

Urban Plantation

The population in urban areas in Bangladesh increased tremendously in recent years, which is the major cause for disappearance of greenery in the cities and towns resulting in the degradation of the environment. For this reason, the government started city plantations from 1992 under the Nagar Banayan Project. Under this project extensive afforestation was undertaken in Dhaka, the capital of Bangladesh. Afforestaton was also carried out in 5 other metropolitan cities, such as Chittagong, Khulna, Rajshahi, Sylhet and Barishal. Roads, office compounds, islands and road dividers were also planted with ornamental plants.

Bamboo, Cane and Murta Plantation

Bamboo, cane and murta are important raw materials for the cottage industries in Bangladesh. For this reason, the government raised participatory bamboo, cane and murta plantations under a development project. About 2,010 ha of bamboo plantations, 3,992 ha of cane plantations and 784 ha of murta plantations were raised between 1989 and 2005 (PFN, 2005).

Plantation of Medicinal Plants

A majority of the people in Bangladesh use herbal medicines, manufactured by indigenous Ayurvedic and Unani institutions. The demand for herbal medicine has been increasing over the years, as it has very little side effects. As the country possesses a huge variety of medicinal plants, their conservation and promotion can contribute tremendously in meeting the future demand of herbal medicine. More than 500 medicinal plants are naturally found in forests (Yusuf et al., 1994; Khisa, 1996; Ghani, 1998). The Government of Bangladesh places much emphasis on the afforestation and conservation of medicinal plants. So far, more than 300 ha have been planted with medicinal plants. The wild source of such plants is also protected through definite policy guidelines. The medicinal plant marketing in Bangladesh reported that the total size of the medicinal plant market at wholesale prices was estimated at some $14 million per annum corresponding to 17,000 tons of products.

Neem Plantation

Neem (*Azadiracta indica*) is an environment friendly plant which has high medicinal and insecticidal values. It thrives in arid conditions. The government has taken up a program for Neem plantations. About 10 million neem trees were planted throughout the country to supply raw materials for herbal medicines and insecticides and also to improve the environment.

Coconut Plantation

The Coconut Plantation Program was initiated by the Prime Minister of Bangladesh in 2003 with the objective of achieving self-sufficiency in coconut oil and other products derived from coconut. The initial program was to plant 10 million coconut plants in the 26 coastal districts. So far, more than 7 million saplings have been planted involving people all over the country. This will also act as a shelter belt in the coastal areas to minimize wind erosion.

Agar Plantation

The agar (*Aquilqria qgallocha*) plant is the only raw material for perfume industries, and trade in agar-based products is growing rapidly due to their demand as an ingredient in the cosmetics and pharmaceuticals sectors (Uddin et al., 2008). It is one of the most promising non-timber forest products (NTFPs) of Bangladesh and earned Tk, 300 million through exports of attar (agar oil) in 2004 (Hayder et al., 2005). The government established 2,105 ha of agar plantations in Sylhet, Chittagong and Cox's Bazar hill forests areas to feed the local perfume industries.

Seedling Distribution

Seedling distribution at a subsidized rate is one of the major programs to accelerate homestead plantations in Bangladesh. The objective of this program is to create a forest resource base at the household level throughout the country in creating greenery and maintaining environmental equilibrium and boosting the rural economy. During a period of five years (2001-2005), 28.5 million seedlings were distributed to rural communities.

Tree Plantation Movement

Tree plantation has now become a social movement. The Government of Bangladesh started the Tree Planting Movement in 1991 with a huge awareness program consisting of leaflets and posters, massive print and electronic media campaigns, writing of general and species manuals, and other activities. In addition, banks were asked to establish credit lines for setting up nurseries. Since then, every year, tree planting is carried out nation–wide for three months from 1st June to 31st August. The tree planting season is inaugurated every year by the Prime Minister or Chief Adviser of the Caretaker Government of Bangladesh.

The popularity of the tree planting movement in Bangladesh can be understood by just two facts. First, the demand for seedlings/saplings increased by leaps and bounds between 1991 and 2006; as a result, the number of nurseries in the country also increased manifold during the same period. Second, in every market place of the country, urban or rural, tree seedlings/sapling has emerged as an important commodity to be bought and sold.

Tree Fair

Tree fair is now a popular national festival in Bangladesh. The Government of Bangladesh introduced the tree fair as a part of the "Tree Planting Movement in 1994." The main objectives of the tree fair are to disseminate new planting technology, to provide high yielding varieties, to create awareness about tree planting and preservation of the environment, to acquaint people with plant biodiversity and to facilitate education and research. Every year during the monsoon season, tree fairs are held in the capital and Divisions, Districts and Sub-Districts all over Bangladesh. Every year the Head of the States of Bangladesh inaugurate the National Tree Fair in Dhaka. The tree fair now acts as a congregation of nature and plant lovers in Bangladesh.

Tree Rally

A tree rally is an important event for creating awareness about the role of trees in enhancing the economy and environment. The Government of Bangladesh introduced a tree rally in 1991 as a part of the tree planting movement. It has gained immense popularity among the people. Teachers, students,

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tree lovers, nature conservationists, scouts, girl guides, etc. join the tree rally. Ministers and Members of the Parliament generally lead the tree rally.

National Award of the Prime Minister for Tree Planting

Considering the importance of tree planting for environmental and biodiversity conservation, the Government of Bangladesh introduced national awards of the Prime Minister for outstanding performance in tree planting in 1992. The award is given in 15 categories. Each category has three awards. Every year 45 persons or institutions are receiving these awards.

3.5 International Interventions for Degradation Control

The primary objective of these projects is to plant trees to enrich the forest resources for a better environment. The salient features of some of the important projects are discussed below:

Forestry Sector Project: The major donor of the project was ADB. The objectives of the project are to increase the overall tree resource base of the country through bringing all the available and fallow land (roadside, canal banks, and slopes of the rail line, degraded sal forests and USF) under vegetation cover and promote social forestry practices.

Afforestation in the denuded hill areas of Ramgarh – Sitakunda: The objectives of the project include planting of the denuded hill areas with indigenous species through participatory forestry; reducing soil erosion in the hill forests and protecting the agricultural land beneath as well as improving the environment.

Coastal Char Land Afforestation Project: The objectives of the project are to stabilize newly accreted Char land in the fragile coastal areas; to protect coastal habitat and resources from tidal bores, cyclones; to create employment for landless poor people.

Reed Land Integrated Social Forestry Project: The objectives of the project are to restore reed lands biodiversity through systematic plantations based on indigenous species; to increase socio-economic conditions of the local people through social forestry; to ensure supply of raw materials in small cottage industries by increasing cane and murta production and to establish a habitat for local and migratory birds as well as other wildlife.

Nishorgo Support Project: The objectives of the project are to develop a functional model to formalize co-management of the protected areas; to create alternative income generation opportunities for key local stakeholders associated with co-managed protected areas; to build or reinforce the infrastructure within the protected areas that will enable better management and provide services for visitors at co-managed sites and to design and implement a program for habitat restoration of the protected areas.

Arannayk Foundation Project: The Arannayk Foundation (AF), also known as the Bangladesh Tropical Forest Conservation Foundation, is a not for profit company (limited by guarantee and not having a share capital), established in 2003 by a joint initiative of the Governments of the People's Republic of Bangladesh and the United States of America based on the provisions of the US Tropical Forest Act of 1998, which seeks to contribute to the conservation of biodiversity assets of tropical forests. The mission of AF is to facilitate the conservation, protection, restoration and sustainable use of tropical forests in Bangladesh, which provide a wide range of benefits to mankind, by providing financial grants or other support to qualified organizations or entities.

International Conventions/Treaties Signed and Ratified by Bangladesh: The Bangladesh Government has signed on the following conventions/treaties (Table 11) for the conservation of biodiversity and amelioration of the environment (www.bforests.gov.bd).

Table 11: ***International Conventions/Treaties Signed and Ratified by Bangladesh***

No.	Convention/Treaty	Signed	Ratified	Authority/Implementing Agencies
1	Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES) Washington, 1973	20-11-1981	18-02-1982	i) Management Authority – Chief Conservator of Forest, Bangladesh. ii) Assistant Management Authority – Conservator of Forest, Wildlife and Nature Conservation Circle, Bangladesh. iii) Scientific Authority – Wildlife Advisory Board
2	Convention on Wetlands of International Importance especially as Water Fowl Habitat, Ramsar, 1971	20-04-1992		Focal point, Secretary, MOEF, Implementing Agency, Forest Department
3	Convention Concerning the Protection of the World Cultural & Natural Heritage, Paris, 1972. (World Heritage Convention)		03-08-1983	Ministry of Environment and Forests, Forest Department
4	Convention on the Conservation of Migratory Species (CMS) of Wild Animals Bonn. 1979.	MoU for turtle 23-10-2003		Ministry of Environment and Forests, Forest Department
5	Global Tiger Forum (GTF)	24-02-1999		Ministry of Environment and Forests, Forest Department
6	'MIKE' is a long term program for monitoring the illegal killing of elephants in the South Asia region.	Bangladesh joined 'MIKE' in 2003		Ministry of Environment and Forests, Forest Department
7	Convention on Biological Diversity	05-06-1992	20-03-1994	Ministry of Environment & Forests, Ministry of Agriculture
8	International Convention to Combat Desertification	21-06-1994		Ministry of Environment & Forests, Ministry of Agriculture
9	International Plant Protection Convention	01-09-1978		Ministry of Environment & Forests, Ministry of Agriculture
10	Vienna Convention for the Protection of Ozone Layer	31-10-1990		Ministry of Environment & Forests, Ministry of Agriculture

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Management of Protected Areas

There are 19 Protected Areas in Bangladesh (Table 12), covering 2,458 km^2 and representing 1.68% of the country's surface area (FD record as of July 2007). The Forest Department has the mandate for managing these Protected Areas which have been declared under the "Bangladesh Wildlife (Preservation) (Amendment) Act 1974". The Act recognizes three categories of Protected Areas (Table 12), namely National Park, Wildlife Sanctuary and Game Reserve. These are defined in the Act as follows:

- "*Game Reserve* means an area declared by the Government as such for the protection of wildlife and increase in population of important species where capturing of wild animals shall be unlawful".
- "*National Park* means comparatively large areas of outstanding scenic and natural beauty with the primary objective of protection and preservation of scenery, flora, and fauna in natural state to which access for public recreation; education and research may be allowed".
- "*Wildlife Sanctuary* means an area closed to hunting, shooting or trapping of wild animals and declared as such under Article 23 by the Government an undisturbed breeding ground primarily for the protection of wildlife inclusive of all natural resources, such as vegetation, soil and water".

Table 12: ***Protected Areas of Bangladesh with their Locations and Designated Area***

I. National Parks

Sl No.	Name of PA	Location	Area (ha)	Year of Notification
1	Bhawal National Park	Gazipur	5,022	1982
2	Himchari National Park	Cox's Bazar	1,729	1980
3	Lawachara National Park	Moulvibazar	1,250	1996
4	Madhupur National Park	Tangail/Mymensingh	8,436	1982
5	Kaptai National Park	Chittagong Hill Tracts	5,465	1999
6	Ramsagar National Park	Dinajpur	52	1974
7	Nijhum Dweep National Park	Noakhali	16,352	2001
8	Medha Kassapia National Park	Cox's Bazar	395.92	2004
9	Satchari NationalPark	Habigonj	242.91	2005
10	Khadeem Nagar National Park	Sylhet	678.80	2006
II. Wildlife Sanctuaries				
Sl No.	**Name of PA**	**Location**	**Area (ha)**	**Year of Notification**
11	Chunati Wildlife Sanctuary	Chittagong	7,761	1986
12	Pablakhali Wildlife Sanctuary	Chittagong Hill Tracts	42,087	1683

13	Rema-Kalenga Wildlife Sanctuary	Habigonj	1,795	1996
14	Sundarbans (East) Wildlife Sanctuary	Bagerhat	31,227	1996
15	Sundarbans (South) Wildlife Sanctuary	Khulna	36,970	1996
16	Sundarbans (West) Wildlife Sanctuary	Satkhira	71,502	1996
17	Char Kukri Mukri Wildlife Sanctuary	Bhola	40	1981
18	Fashiakhali Wildlife Sanctuary	Cox's Bazar	3,217	2007
III. Game Reserve				
Sl No.	**Name of PA**	**Location**	**Area (ha)**	**Year of Notification**
19	Teknaf Game Reserve	Cox's Bazar	11,615	1983

The conservation of biodiversity through Protected Area management only recently emerged as a major concern of the Forest Department. During the reorganization of the FD institutional structure in 2001, a new FD Circle; namely, the "Wildlife and Nature Conservation Circle" (WNCC) was established and headed by a Conservator of Forests under the direct control of the Chief Conservator of Forests (CCF). Internally, the FD has developed a vision of it's the future Protected Area management. The FD's "Vision 2010" proposes that the total PA system area should increase by 2010 and be managed by developing formal co-management systems through agreements for specific protected areas between the Department and stakeholders. FD with support from USAID through the Nishorgo Support Project has already started the co-management of the following five protected areas:

1. Lawachara National Park;
2. Rema-Kalenga Wildlife Sanctuary;
3. Satchari National Park;
4. Teknaf Game Reserve; and
5. Chunati Wildlife Sanctuary.

Ex situ Conservation

In addition to the Wildlife Act that recognized *in-situ* categories as National Park, Wildlife Sanctuary and Game Reserve, there are seven *ex-situ* conservation areas under the management of FD (Gani, 2003). These are Botanical Gardens, Eco-Parks and Safari Parks as shown in Table 13.

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Table 13: ***Ex situ Conservation under the Management of the Forest Department***

No.	Name of Protected Area	Location	Area (ha)	Year of establishment
1	National Botanical Garden	Dhaka	84	1961
2	Balda Garden	Dhaka	1.37	1909
3	Dulhazara Safari Park	Dulhazara Cox's Bazar	600	1999
4	Sitakundu Eco-Park and Botanical Garden	Sitakundu, Chittagong	1000	2000
5	Madhutila Ecopark	Sherpur	125	2000
6	Madhabkunda Ecopark	Moulvibazar	654	2001
7	Murai Chara Ecopark	Moulvibazar	830	2001

World Heritage Site

The World Heritage Committee of the UNESCO has declared three protected areas of the Sundarban Reserve Forest covering an area of about 1,400 km^2 (910 km^2 is land area and 490 km^2 is water area) as 522nd World Heritage Site for its scenic beauty and biological traits on the 6th December 1997. The Blue Flag of the World Heritage Site was hoisted on 4th February 1999. The three sanctuaries are intersected by a complex network of tidal waterways, mudflats and small islands of salt tolerant mangrove forests. The area has been recognized globally for its importance as a reservoir of biodiversity. This mangrove supports a unique assemblage of flora and fauna, including charismatic mega fauna like the Royal Bengal Tiger, estuarine crocodile and the Ganges river dolphin. The entire Sundarban has been declared as 560th Ramsar Site in 1992 due to covering all criteria of wetland as well as Ramsar Site.

Rehabilitation Techniques of the Degraded Forest Areas

Plantation Species: Attempts to raise plantations in Bangladesh started in 1871 with *Tectona grandis* but remained confined to the CHTs until 1920 (Fig. 4). In 1921, plantations were extended to the Cox´s Bazar and Sylhet Forest Divisions.

The total planted area until 1948 was 4,140 ha with an annual planting rate of 100 to 300 ha. *Tectona grandis* was the main species planted because of its high value (FMP, 1993). *Lagerstroemia speciosa, Swietenia macrophylla, A. chaplasha, Cedrela toona* and *Syzygium grande* were introduced several years later. The planted area gradually reached 72,000 ha in 1968. The Forest Department started planting fast-growing species, e.g. *Gmelina arborea, Paraserianthes falcataria* and *Anthocephalus chinensis* in 1974. The plantations were established on a large scale in the Chittagong Hill Tracts and Sylhet Division to produce fuelwood. Coastal afforestation was also accelerated by four divisions. Annual planting has continuously increased and reached a peak of 22,800 ha in 1985, of which coastal plantations were about 10,000 ha (FMP, 1993).

Teak (*Tectona grandis)* has dominated the plantations for industrial wood in the CHT, Cox´s Bazar and Sylhet (Table 14). More than 70% of the total plantation in hill forests is composed of teak (Rahman, 1982) and has always been the principal species in plantation programs of Bangladesh (Sajjaduzzaman et al., 2005). Though there are risks and uncertainties in long term forestry investment, studies showed that teak plantations in Bangladesh are profitable and can be found all

over the country both as public and private plantations (Muhammed et al., 2004, 2007). The total area of teak plantations in these three regions was about 144,000 ha. Besides teak, other long-rotation species planted for industrial purpose are *Dipterocarpus turbinatus, Swietenia macrophylla, Lagerstroemia speciosa, Cedrela toona, Artocarpus chaplasha,* and *Syzygium grande* (Hossain, 2008).

Table 14*: Major Plantation Species in Bangladesh*

Local / English Name	Scientific Name	Plantation Area (ha)
Segun, Teak	*Tectona grandis*	1,44,000
Akashmoni, Acacia	*Acacia auriculiformis*	32,000
Eucalyptus	*Eucalyptus camaldulensis*	37,000
Rubber	*Hevea brassiliensis*	92,000

Short-rotation species planted for fuelwood and pulp are *Acacia auriculiformis, A. mangium, Eucalyptus camaldulensis, Gmelina arborea, Paraserianthes falcataria* and *Anthocephalus chinensis.* Species used in coastal afforestation include *Sonneratia apetala, Aviccenia officinalis, Rhizophora gymnorhiza* and *Casuarina equisetifolia.*

The Forestry Master Plan (1993) suggested two scenarios. The first one proposed an annual planting target of about 18,000 ha during 1993-2002 and 21,000 ha during 2003-2012. Potential areas for industrial plantation totaling about 700,000 ha exist in the CHTs, Cox´s Bazaar and Sylhet Districts.

Pulpwood, veneer wood and fuel wood plantations have been established recently. A 1991 inventory of homestead plantations estimated a total of 520,000,000 trees, of which more than 60% are below 20 cm diameter. The estimated volume of wood is about 54,500,000 m^3, excluding trees below 20 cm diameter (FMP, 1993). The use of quality planting material, site preparation and post-establishment maintenance has not been given adequate attention. Due to budgetary and legal constraints adequate protection of plantations from fire, grazing, illegal removal and encroachment has not been provided. There is no clear policy to support homestead plantations.

Increasing Productivity: Unless productivity is dramatically improved, Bangladesh has little chance to retain its natural forest areas. The correct way to achieve this goal involves several processes:

- Increase forest productivity on existing and new plantations on barren land;
- Increase productivity by planting open and sparsely covered areas with multipurpose and non wood species, e.g. fodder, legumes and nitrogen-fixing species;
- Keep coastal areas and char lands in mangroves, creating plantations on accreting areas, rather than allowing conversion into agricultural land; and
- Prohibit low-technology shrimp farming from further expansion on forest lands.

4. Capacities to Address Degradation Problems

4.1 Research

Bangladesh Forest Research Institute (BFRI): The Bangladesh Forest Research Institute (BFRI) is the only National Institute of the country concerned with forestry research. The institute was established as a Forest Products Research Laboratory in 1955 at Chittagong with the objective of

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proper utilization of wood and wood products. Subsequently, considering the need of increasing forest resources, forest management research was initiated and BFRI was transformed into a full-fledged forest research institute in 1968. This Institute is under the direct administrative control of the Ministry of Environment and Forests.

BFRI's research activities aim at developing appropriate technologies to maintain sustainable productivity of forestland and of forest industries without resource depletion. It conducts research in 17 broad disciplines under two broad categories namely the Forest Management Branch and Forest Products Branch (Sattar, 2001).

BFRI's current major research program areas are:

- Production of quality planting materials
- Plantation technique and forest management
- Breeding and tree improvement
- Bamboo and non-timber economic crops
- Biodiversity and conservation
- Forest inventory growth and yield
- Social forestry and farming system research (FSR)
- Forest pest and diseases management
- Post harvest utilization: physical processing
- Post harvest utilization: chemical processing
- Training and transfer of technology

BFRI has more than 1,000 scientific publications in its credit and developed about 50 technologies. More than 20 technologies are in use by different clienteles. In addition to conducting forestry research, BFRI offers consultative advices and technical services to different organizations related to forest productions, management and utilizations.

In addition to BFRI, the Institute of Forestry and Environmental Sciences of Chittagong University (IFESCU), Forestry and Wood Technology Discipline of Khulna University and Department of Forestry and Environmental Sciences of Shahjalal University of Science and Technology are also contributing to forestry research activities of the country. Among the academic institutes, IFESCU is offering quality research in the M.S., M. Phil and PhD programs of both the forestry and environmental sciences. IFESCU is also publishing a research journal titled "Journal of Forestry and Environment", with main focus on forest-related research findings.

4.2 Education and Training

Bangladesh has eight institutions offering education and training services in forestry. University level education in professional forestry is given mainly in:

- Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU).
- Forestry and Wood Science Discipline, Khulna University, and
- Department of Forestry, Shahjalal University of Science and Technology, Sylhet.

Also the Bangladesh Agriculture University in Mymensingh and other agriculture universities have started a degree course in agroforestry.

The Bangladesh Forest Academy (former Forest College) at Chittagong provides:

- Orientation course for newly recruited forestry professionals; and
- Refresher officer courses for professionals.

The Sylhet Forest School and Rajshahi Forest School conduct 2-year Diploma courses for in-service sub-professionals. The Chittagong Forest School is conducting a 3-year diploma course in forestry with open admission.

The Kaptai Forest Development and Training Centre (FDTC) provides vocational level training on:

- Basic logging, timber harvesting and road construction
- Equipment and maintenance
- Saw doctoring and sawmilling maintenance
- Extension forestry for rural development

Unfortunately, the programs of FDTC have been suspended for years due to lack of funds.
Extension training centers, located at nursery sites under afforestation and nursery development provide extension training throughout the country for plantation assistants. Additionally, BFIDC runs a training centre for rubber tapers in Chittagong.

None of the above programmes are based on any long term training needs assessment, but are derived from arbitrary decisions. Facilities available are generally poor and there are none to meet the special training needs of forest industries or the large number of people involved in forestry activities in the unorganized or informal sector.

4.3 Institutional Capacity

Social Forestry Training and Human Resources Development

The Government started the Social Forestry Training Program in 1983. Under this program, participants of social forestry, unemployed youth, village leaders, religious leaders, NGOs, boys scouts, girl guides, teachers, members of the elite, nursery owners and VDP members were trained in nursery raising, plantation establishment and management. More than 20 million persons were trained in social forestry up to 2003-2004. The achievements of social forestry training in Bangladesh are as follows:

- Creation of awareness about the need for conservation and preservation of trees and forests;
- Assistance in the establishment of 15 thousand private nurseries producing about 50-60 million seedlings, and
- Facilitation of the development of many private forests and fruit gardens throughout the country.

4.4 NGO Activities

Several NGOs are involved in forestry activities which include planting trees along the marginal land, private land and even in the forest department lands. Notable NGOs are Proshika Manobik Unnayan Kendra, Bangladesh Rural Advancement Committee (BRAC), CARITAS, CARE, POUSH, RDRS, VFFP, etc. (Ahmed, 2001; Khan *et al*., 2004). In Bangladesh, the history of NGO involvement in the field of development is not very old. After liberation, NGOs started their activities through relief and rehabilitation of the war victims. During the mid-70s, NGOs switched over to the socio-economic development of the rural poor, and at present there are thousands of NGOs whose mandate is mostly to organize rural poor programs and provide awareness, education, skill training and various support services including credit to enhance participation of the landless poor in the development process towards self reliance. On the basis of networking throughout the country the NGOs can be classified into two levels; (i) local and (ii) national. At present, more than 100 NGOs both local and national are implementing social forestry programmes in Bangladesh. It is not possible to enlist activities of all the NGOs involved in the Social Forestry Program. However, the participatory forestry activities of some of the NGOs who are playing a pioneer role in this field are highlighted here.

BRAC

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The Bangladesh Rural Advancement Committee (BRAC) has been established in 1972 and is the largest NGO in Bangladesh. BRAC has six broad categories of projects/programmes among which social forestry falls within the rural development program. The Social/Participatory Forestry Programs have three components: (a) Nursery establishment; (b) Plantation and (c) Establishment of agroforestry. They claim that they have assisted their women members in raising more than 225 homestead nurseries and 100 large nurseries with a combined production capacity of one million fruits and forest seedlings. They have established 200 mulberry nurseries with the production capacity of 2 million seedlings. The social afforestation program of BRAC is assisted by WFP. This assistance commenced in 1989 and is still ongoing. Most of the plantations under this program have been established along strips. Up to this time about 33.72 million seedlings have been planted over an area of 33,700 km strips along roads, railways and embankments. This program involves about 670,000 participants, of which 80% are women.

PROSHIKA

Proshika: A center for human development is one of the largest NGO in Bangladesh. The Social Forestry Program of Proshika is a systematic intervention effort to enhance afforestation in the country and to make a case that the poor are the best managers and protectors of forest resources if they are granted usufruct rights on these resources. Proshika has introduced its group members in social forestry activities and provided them with credit and technical support, which contributed significantly to their self-sufficiency. The main components of Proshika's Social Forestry Program are: i) Homestead plantation; ii) Strip and block plantation; iii) Natural Forest protection, and iv) Nursery establishment. Proshika has planted 71 million seedlings on 8,887 km strips, and 37,662 areas of block plantation which included natural sal forest protection throughout the country. One of the most significant contributions of Proshika to the development arena is the introduction of the concept of participatory forest management for natural forest protection. Proshika has successfully involved forest dwellers in the sal forest areas of Kaliakoir, Mirzapur, Shakhipur and Shreepur thanas under the districts of Tangail and Gazipur for the protection of coppice sal forest by involving community group members organized by Proshika. It has already been proven that poor people depending on forest resources are organized, trained and granted usufruct rights, they present an enormous human potential for afforestation and forest protection.

RDRS

The Rangpur: Dinajpur Rural Services operating in 28 Upazilas of greater Rangpur and Dinajpur districts covering 28 thanas. It is the largest international integrated rural development NGO operating in Northern Bangladesh for more than two decades. Its entry point in forestry was through road side plantations in 1977. Initially, seedlings were protected with bamboo cages. The situation has been changed significantly nowadays and protection of seedlings with bamboo cage has become a part of history. Besides strip plantations, they also extend their tree plantation program in homestead, institutional grounds as well as raising of local nurseries. With the assistance of WFP they have planted about 10.66 million trees under their participatory afforestation program.

TMSS

TMSS stands for Thangamara Mohila Sabuj Sangha. It is an NGO exclusively directed towards women issues. This NGO believes in the concept of simple living and high thinking. TMSS was also involved in the Social Forestry Program, particularly in the northern districts of Bangladesh. The organization has been implementing both road side and farm forestry with assistance from the WFP and the Swiss Development Corporation (SDC), respectively.

POUSH

Another NGO has been engaged in planting on private lands also by persuading farmers in Baroibari, Kaliakoir thana assisted by food aid from the WFP. Its activities in forestry are limited to strip plantations and it plans to expand its program extensively. Target groups of POUSH are mostly landless destitutes, widows and divorced women. POUSH also happens to be the first of its kind to get

involved in participatory forestry in the hill district of Bandarban.

VFFP

The Swiss Development Cooperation (SDC) launched the Village and Farm Forestry Project (VFFP) in 1987 in Northwestern Bangladesh with a view to address the acute shortage of fuel, fodder and timber that affected the poor in the region. Trees were planted in croplands in collaboration with poor and marginal farmers and through the involvement of local NGOs. VFFP primarily concentrated on cropland agroforestry in 1987-1991. In 1991, VFFP launched a program to support the development of nurseries with the objective of ensuring sufficient supply of seedlings of wide varieties of species in high demand. The initiatives gave impetus to private entrepreneurs and developed a network of professional seedling producers (nursery owner) who could by its own right promote local development, generate income and operate on a self-sustaining basis (Khan *et al*., 2004).

5. Innovation Approaches to Address Forest Degradation

Innovative approaches to address forest degradation are the participatory forestry programs involving the local habitants to raise, maintain and take care of the plantations. The traditional forestry programs are not able to sufficiently protect forest resources. Examples of innovative Betagi-Pomora agroforestry experiences in degraded hill forests of Rangunia Thana of Chittagong district are well recognized. The Betagi-Pomora project aimed at achieving three goals:

- To regenerate denuded hills by planting trees;
- To improve the livelihood of landless farmers, and
- To protect the forest from illegal felling with the help of settlers.

The project began operating at Betagi with 82 landless families in 1979. In 1980 another 144 families settled at Pomora. The Betagi – Pomora Project has been widely recognized as a successful story of social forestry. The farmers selected for this project have no land at all, or possess a homestead only, pond or other land that together do not exceed 40 decimals. Within a short time the economic condition of the settlers has significantly improved since the inception of the project. Their income has increased three times which is very encouraging. More than half of the income is generated from agroforestry production (PFN, 2005).

5.1 Ecosystem Services, Carbon Sequestration & REDD

The ecosystem services & REDD programs in Bangladesh are not remarkably developed. However, there are potentials for carbon sequestration programs in the forestry sector of the country.

Potential of Carbon Sequestration of the Forestry Sector of Bangladesh

The Kyoto Protocol provides for the involvement of Bangladesh in an atmospheric greenhouse gas reduction regime under its Clean Development Mechanism (CDM). Through the CDM, carbon credits can be gained from afforestation and reforestation (A/R) activities in developing countries (UNFCCC, 2004). Bangladesh has a huge degraded forestland which can be reforested by CDM projects. To realize the potential of the forestry sector in developing countries for full-scale emission mitigation, the carbon sequestration potential of different species in different types of plantations should be integrated with the carbon trading system under the CDM of the Kyoto Protocol. Shin et al. (2007) analyzes the effects of reforestation projects on carbon sequestration in Bangladesh, in general, and in the hilly Chittagong region, in particular, and concluded by demonstrating the carbon trading opportunities. Results showed that tree tissue in the forests of Bangladesh stored 92 tons of carbon per hectare (tC/ha), on average. The results also revealed a gross stock of 190 tC/ha in the plantations of 13 tree species, ranging in age from 6 to 23 years. The study confirms the huge atmospheric CO_2 offset by the forests if the degraded forestlands are reforested by CDM projects, indicating the potential of Bangladesh to participate in carbon trading for both its economic and environmental benefits. To

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properly assign carbon credits within the forestry sector of Bangladesh, a number of important issues and uncertainties need to be examined and resolved (Shin et al., 2008). Afforestation and reforestation offers opportunities for carbon credits, which is subject to the end-use of the forest products. A/R may be the best option, as well as conserving the existing carbon sink offered by Bangladesh for mitigating global warming. Within the forestry sector itself, some constraints are identified; nevertheless, the results of the study can expedite policy decisions regarding Bangladesh's participation in carbon trading through the CDM.

5.2 Prospects for the Future and the Likely Countries Approach

Bangladesh has a prospect for future participatory forestry programmes like social forestry, agroforestry, and community forestry. The vast barren lands of the hill districts should be brought under forest cover immediately and the land tenurial conflicts between the tribal people and the Forest Department should be resolved immediately. Some of the successful project findings may be implemented in other areas, so that participants are encouraged to get involved in such activities.

5.3 Payment for Environmental Services

In Bangladesh payment for environmental services is not yet well developed.

6. Recommendations

The following actions are recommended to arrest deforestation and promote sustainable development of forest resources in the CHTs. The recommended actions also aim at strategic policy and legal reforms.

6.1 Raising Awareness

During the afforestation study respondents from all sectors of society stated that for sustainable natural resources management deforestation awareness campaigns must be implemented. Most of the people are now realizing the affects of deforestation and they understand the changes that are happening. However, their visions about remedies are limited. They have ideas about ecosystem functions but are not aware about the service values of ecosystems. Access to benefit sharing is ignored as there is no legal provision for it. Downstream people who enjoy the benefits of upland forests are quite ignorant of the production and service functions of hills and forests. Thus, nationwide awareness focusing on the values of forests, restoration needs, national, regional and international obligations, access to resources, benefit sharing from ecosystem services and, policy and legal reforms should be raised in all sectors of society.

6.2 Land Use Zoning

The need for zoning as planning tool for proper management of natural resources has been recognized in many policy documents of the country including the National Land Use Policy 2001. The country needs a total survey and inventory of land and natural resources. Success of forest development, settlement and rehabilitation will depend on proper zoning for specific purposes which need to be backed up by mass awareness and legal acts where necessary. Local level land use planning should be given priority in land use zoning following the concept of 'landscape mosaics'. A new land use policy needs to incorporate an obligatory land husbandry measures and regulatory interventions in matching crops.

6.3 Development of Private Forestry

Private forestry in the CHTs has got its momentum during the last three decades. Many lease holders for rubber plantations, settlers under rehabilitation programs and private land owners have gone for horticulture and tree farming. In most of the cases successful plantations have been raised. Major source of furniture timbers in the Rangamati and Bandarban furniture market is from local private plantations. In case of tree farming most of the entrepreneurs have gone for teak, *gamar* or *Acacia auriculiformis* monocultures. But most of the tree farmers are not aware about available forestry development technologies and services. Most of the plantations have been raised from poor stocks and lack of scientific and sustainable management approaches. Quality planting materials with adequate silvicultural knowledge can enhance the productivity of private forests.

6.4 Restoration and Enrichment Plantation

Islands or patches of secondary forests appear in many private lands in the Chittagong, Sylhet and CHTs. It appears that if a degraded forest or denuded land is left without any human interference natural regeneration is able to establish. Many of such patches have come to the shape of a forest by 8-10 years. Enrichment plantation and aided regeneration with indigenous 'niche' species plantation will help in early restoration of natural forest ecosystems in the CHTs and sal forests areas. Protecting secondary forests and habitats from fire by proper fire management (fire line) will also help in restoring the forest ecosystem. Many degraded forests in sal forest areas have regenerated through coppice management.

6.5 Linking Demand and Objective Oriented Planting

While developing forestry programs at public, private or participatory levels, emphasis on species selection should be linked up with local demands like furniture, brick field, rubber estates, tobacco curing, fodder and fuel wood production.

6.6 Strengthening of Institutional Capacities

The lack of quality planting stocks, access of people to national knowledge and information systems were identified as issues for natural resource management. Linking people with national and private sectors for access to information and knowledge systems will help to enhance capacity at individual and farm levels that will ultimately support reforestation. Along with strengthening of institutions both at national and local levels professional capacities at individual and institutional level need to be developed for addressing the afforestation/ reforestation Clean Development Mechanism (CDM) and negotiation for the ecosystem services.

6.7 Development and Promotion of Eco-Tourism

Eco-tourism only allows eco-friendly behaviour with nature during visiting the site. The landscape with diversified flora and fauna along with cultural diversity of different ethnic communities in the CHTs and sal forest area offers great opportunities for eco-tourism. The natural beauty of the Sundarbans is so attractive, captivating, fascinating and varied that hardly another region of the world can compete with its particular grace and beauty. There are several spots in the Sundarbans that can easily attract the tourists, e.g. Karamjal, Kotka, Kochikhali, Dublar char, NilKamal, Shekertek Temple, Mandarbaria, Notabekia etc. Integration and promotion of eco-tourism through community participation could be an approach to nature conservation and income generation. Similarly, the off-shore islands, e.g. St. Martins Island, Kutubdia, and coastal areas need improved eco-tourism facilities and adequate tree plantation programs.

6.8 Promotion of Alternative Income Generation Activities

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In order to reduce pressure on land and forest resources alternative income generation activities need to be promoted. Sporadic activities include bee keeping, floriculture, cow fattening, poultry, micro-fishing, handicrafts based on local resources as a source of income generation. Systematic approach on capacity building, small enterprise development and forward linking with markets on such alternative income generating activities will help reducing pressure on forest resources.

6.9 Involving Local People in Decision-making Processes

Local and community level participatory planning through assessment of the local resource base, potentials and constraints will provide a basis for developing a conservation plan with a focus on a legal reform. Massive forest extension activities could be a demanding strategy. The participants with training on improved homestead and agroforestry management practices and an adequate supply of seedlings and other inputs should be able to meet the domestic demand of timber and fuel wood.

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List of Acronyms and Abbreviations

ADB	Asian Development Bank
AF	Arannayk Foundation
BBS	Bangladesh Bureau of Statistics
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Forest Research Institute
BRAC	The Bangladesh Rural Advancement Committee
CCF	Chief Conservator of Forests
CDM	Clean Development Mechanism
CFP	Community Forestry Project
CHTs	Chittagong Hill Tracts
FAO	Food and Agriculture Organizations of the United Nations
FD	Forest Department
FDTC	Forest Development and Training Centre
FENTC	Forestry Extension Nursery and Training Centre
FMP	Forestry Master Plan
FSP	Forestry Sector Project
GDP	Gross Domestic Products
IFESCU	Institute of Forestry & Environmental Sciences
LCO	Local Community Organizations
NFA	National Forest and Tree Resources Assessment
PBSA	Participatory Benefit Sharing Agreement
PROSHIKA	The Proshika Manobik Unnayan Kendra
RDRS	The Rangpur Dinajpur Rural Service
RIMS	Resources Information Management System
TANDP	Thana Afforestation and Nursery Development Project
TFCF	Tropical Forest Conservation Foundation
TFF	Tree Farming Funds
TMSS	Thangamara Mohila Sabuj Sangha
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USF	Unclassed State Forests
VDP	Village Defense Party
VFFP	The Village and Farm Forestry Project
WFP	World Food program
WNCC	Wildlife and Nature Conservation Circle

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Deforestation in Hill Forest Areas of Bangladesh

Jhum (Shifting) Cultivation in Chittagong Hill Tracts Area

Coastal Mangrove Plantations

Successful Teak (*Tectona grandis*) Plantations in Kaptai, CHTs

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REFORESTATION IN BHUTAN – ACCOMPLISHMENTS AND PROSPECTS

Lungten Norbu[10], Dhan B. Dhital[11], and Pema Wangda[12]

1. General Information

1.1 Geographic Area

Bhutan is a small country located in the eastern part of the Himalayas. The total area of the country is 38,394 km^2 (PPD, 2008). The terrain is very rugged and the topography is characterized by steep precipitous slopes which descend rapidly into narrow river valleys. The elevation varies from 100 m above mean sea level (m.a.s.l) in the south to more than 7,500 m (m.a.s.l) in the north. As per the Atlas of Bhutan, the area under 3,000 m altitude is only 55.4% (RGoB, 1997). The distribution of land area by altitude is given in Table 1.

Table 1*: Distribution of Area by Altitude*

Altitude (m)	Below 600	600 – 1,800	1,800 – 3,000	3,000 – 4,200	4,200 – 5,400	5,400 – 6,600	Above 6,600
Land Area (%)	5.3	22.4	27.7	24.1	16.7	3.6	0.2

(Source: RGoB, 1997)

Only a small percentage of people live above 3,800 m. The large extent of steep slopes limits the potential for expansion of agriculture and increases the probability of landslides. However, such a rugged terrain provides has great potential for hydropower generation.

The geological conditions of the country are very fragile and there are significant differences between the northern and central regions and the southern fringes, which are younger and less stable. Folded and metamorphosed rocks of Precambrian and early Paleozoic age, largely quartzite and gneiss, cover most of the country.

In general, the soils have good permeability and moderate moisture retention capacity. Forest soils are of good tilth, although generally shallow. Exposed soils derived from sedimentary parent rock are generally leached by high rainfall and show low pH values and some tendency towards podsolization. The rugged terrain suggests that maintenance of vegetative cover and careful use of soils is necessary to check erosion and landslides. The topsoil in agricultural areas has a pH between 5 and 6 (at 1:1 soil – water ratio) and the textures are mostly loamy clay between 10 to 30%, and silt between 20 to 50% (MoA, 1991).

All rivers of Bhutan show marked characteristics of mountain streams. They flow between high rocky mountains confining the channel in a narrow valley. As the gradient of the rivers falls, the streams rush headlong over beds of huge boulders and rock masses. None of the rivers are navigable in the mountains or even when they enter the plains. There is no serious problem of floods in the mountain region. However, in the foot-hill regions there is a real threat of floods in almost all the rivers.

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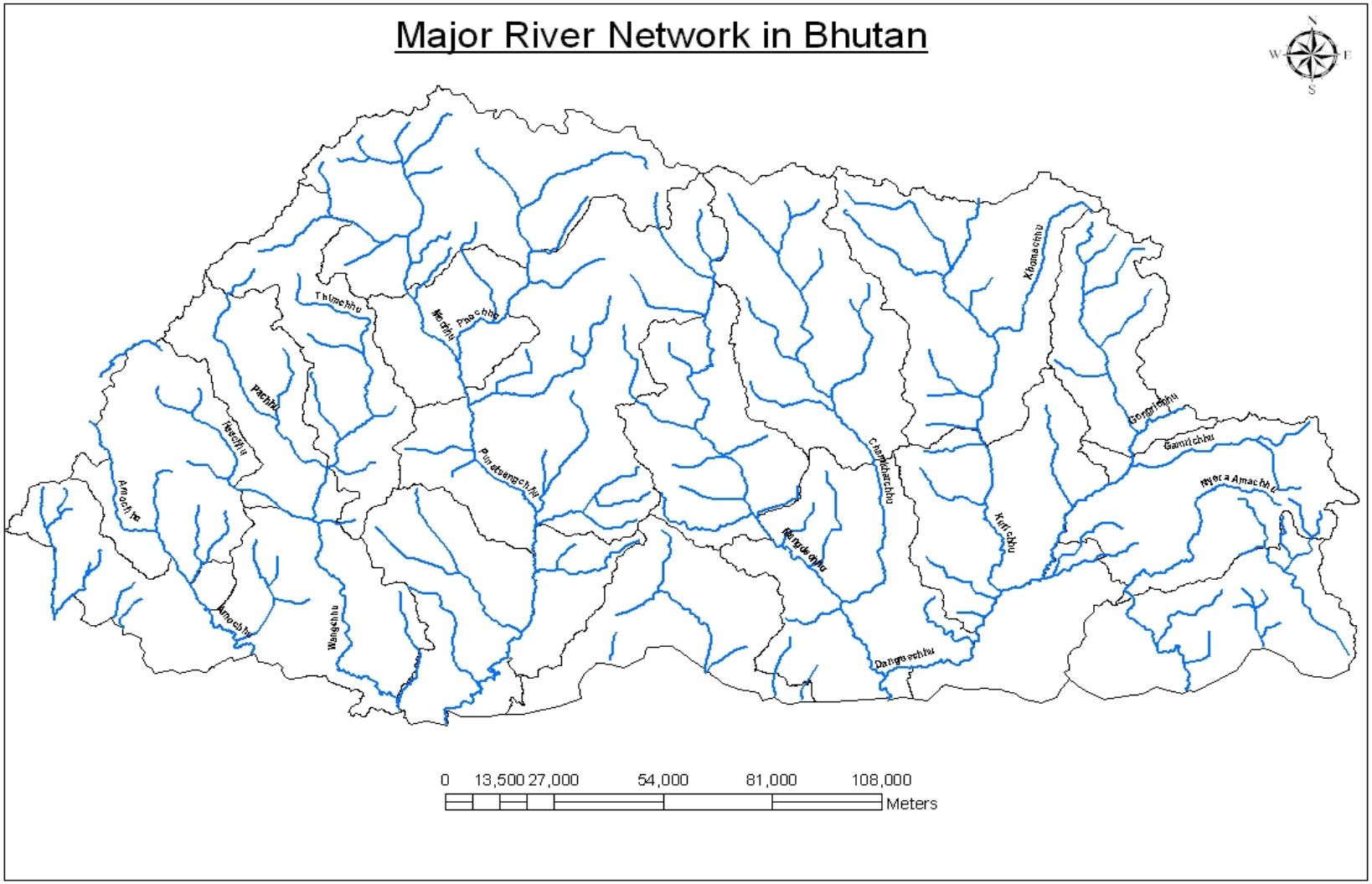
Map 1: Major River Network in Bhutan



The principal rivers of Bhutan are (i) the Amo Chu, (ii) the Wang Chu, (iii) the Mo Chu, and (iv) the Dangme Chu. A brief description of the river system as per the History of Bhutan of each river with their tributaries is given below (Hasrat, 1980).

(a) **Amo Chu:** This river originates in the high-peaked Tangla area in Tibet. It enters into Bhutan at Pasha and drains the Chumbu Valley. This is a fierce and very swift flowing river passing through a narrow and rocky valley. This river is not navigable and enters the low lying areas near Phuntsholing. It finally drains into the river Brahmaputra.

(b) **Wang Chu:** This river also originates from Tibet and is joined by Paro Chu and Haa Chu. This river is also a very swift flowing river and upon leaving Bhutan drains into West Bengal.

(c) **Puna-Tshang Chu:** The Puna Tsang Chu or the Sankosh River originates in the great Himalayan region above Gasa. Its main tributaries are the Pho Chu and Mo Chu which join at Punakha. This river drains into the Brahmaputra through Lhamiozingkha in the southern part of Bhutan.

(d) **Dangme Chu:** The Dangme Chu is the largest river in Bhutan crossing the eastern part of the country. Three rivers of Eastern Bhutan confluence to form the Dangme Chu including (a) the Mangde Chu, (b) the Kuri Chu, (c) and the Dangme Chu. The river enters Bhutan from the Indian frontier and flows towards the southwest. This river is very swift and unfordable in any part between Trashigang till reaching the Indian border.

1.2 Demographics

The total population of the country is estimated at 634,982 in 2005[13] (RGOB, 2006a), of which 333,595 persons are males and 301,387 are females. The urban population consists of 196,111 persons while 438,871 are residing in rural areas (RGoB, 2006).

Population growth is estimated at an average rate of 1.4% per annum. The density of the population is 16 people per km^2 and by 2020 the number of persons living per km^2 will increase from 16 persons (2005 estimate) to about 21 persons (RGoB, 2007a). This figure is projected to grow to around 809,397 in 2020, an increase of nearly 27% within 15 years. This will put enormous pressure on scarce resources and infrastructure. The details of population growth and gender are given in Table 2.

About 45% of the Bhutanese population is under the age of 20 which implies that the population growth rate is likely to increase in the near future as a result of the young age structure (RGoB, 2005).

Within the next 25 years the birth rate will decline from 26.1 (in 2005) to 14.5 because of the declining level of total fertility. Further, the death rate is expected to fall from 7.7 in 2005 to 6.8 within the same period (RGOB, 2007a). As per the same report the estimated life expectancy at birth for female is 66.8 years and 65.6 years for male. It is further estimated that life expectancy at birth will increase at a gradual rate of 0.5 years between 2005 and 2010 and life expectancy will gradually increase after 2010.

1.3 Economic Situation

The country's economic growth is very inspiring with the Gross Domestic Products (GDP) growth being at 6.5 percent in 2005 (RGOB, 2007a) and is expected to increase to 8.5% by 2008. However, before 2005 the GDP growth had to go through many ups and downs but in 2007 and 2008 it has been steadily increasing (RGOB, 2007a). The GDP was 7.5 in 2003 but decreased to 6.78 in 2004 and 6.50 in 2005.

[13] Population census was conducted in 2005

Table 2: ***Population Projection***

Years	Population	Percentage	
		Male	Female
2005	634,982	52.5	47.5
2008	671,083	52.3	47.7
2010	695,822	52.2	47.8
2012	720,679	52.1	47.9
2014	745,153	52.0	48.0
2016	768,577	51.9	48.1
2018	790,215	51.8	48.2
2020	809,397	51.7	48.3

(Source: RGoB, 2007a)

Table 3: ***Growth Pattern of GDP for Five Years***

	Years				
	2001	**2002**	**2003**	**2004**	**2005**
Gross Domestic Products (%)	7.17	9.99	7.55	6.78	6.50

(Source: RGOB, 2007a)

In Bhutan the tertiary sector is the main contributor to economic growth which accounts for 41.8%. The secondary sector is the second major contributor which accounted for 34.4% of the nominal GDP. The primary sector which consists of agriculture produce, livestock production, forestry, mining and quarrying accounted for only 23.8% of the nominal GDP. Table 4 provides information about the real GDP growth by sectors.

Table 4a: ***GDP Growth by Sectors***

Sectors	Years				
	2001	**2002**	**2003**	**2004**	**2005**
Primary Sector (Share of GDP in %)	27.9	27.9	26.9	25.8	23.8
Secondary Sector (Share of GDP in %)	34.8	35.5	35.6	34.5	34.4
Tertiary Sector (Share of GDP in %)	37.3	36.6	37.5	39.7	41.8

Table 4b*: Real GDP growth by Sectors (in %)*

Sectors	Years				
	2001	**2002**	**2003**	**2004**	**2005**
Primary Sector (Share of GDP in %)	27.9	27.9	26.9	25.8	23.8
Secondary Sector (Share of GDP in %)	34.8	35.5	35.6	34.5	34.4
Tertiary Sector (Share of GDP in %)	37.3	36.6	37.5	39.7	41.8

(Source: RGoB, 2007a)

The growth pattern indicates that in the coming decades the service and manufacturing sectors will be the major contributors to the GDP. The Royal Government is trying its best to create economic opportunities for young people in the rural areas, such as agricultural related activities or other activities like forestry and horticulture.

As per the Poverty Analysis Report, 2004 and the Poverty Analysis Report 2007, an estimated 31.7% of the population lives below the overall poverty line (i.e. Nu. 740 (USD 15) per person and month). Poverty is more a rural phenomenon with more than 97% of the poor people living in rural areas. Rural enterprises and other income generating activities are lacking in the villages (RGoB, 2007b).

With less employment opportunity for young school drop-outs in rural areas, there is a big exodus of young people from the rural areas to the urban centers seeking jobs in the industries and service sector. It is also observed that the horizontal expansion of agriculture is declining. As a result, agricultural fields turning increasingly into fallows.

1.4 Environmental Status

It is of utmost importance to Bhutan to keep a large proportion of the land under forest cover in order to protect its fragile environment, watersheds and farmlands, particularly for sustaining human livelihood and well-being. Realizing this, the government, in its policy, has given high priority to the conservation functions of forests dominating over its economic functions. About 34% of the country is set aside as protected areas represented by four national parks, four wildlife sanctuaries and one nature reserve located across the country (Table 5). Varied flora and fauna include 7500 species of vascular plants, 700 species of birds and 165 species of mammals (RGoB, 2003). Bhutan's forests are globally significant for their rich biodiversity and Bhutan has been recognized as one of the 10 "hotspots" in the world.

1.5 Agricultural Situation

Bhutan is a predominantly agrarian society with 69% of the population living in the rural areas depending on subsistence agriculture including livestock rearing and using of a wide range of non wood forest products. Therefore, sustainable management of natural renewable resources is very critical for rural economic development.

Table 5: ***Protected Area System in Bhutan***

Protected Areas	Area (km^2)	Ecosystem Representation
Royal Manas National Park	1, 000	Sub-tropical forest, habitat for tiger, elephant, leopard and golden langur
Jigmi Dorji National Park	4, 200	Habitat for taking, snow leopard, blue sheep, rare plant species
Jigmi Singye Wangchuck National Park	1,400	Pristine upland broadleaf forest, habitat for clouded leopard and tiger
Bomdeling Wildlife Sanctuary	1,300	Upland broadleaf forest, winter roosting area of black neck crane
Thrumsingla National Park	768	Old growth fir forest with rhododendron, habitat for red panda, tragopan and monal pheasant
Sakten Wildlife Sanctuary	650	Pristine mixed coniferous forests, highest number of rhododendron plant species
Phibsoo Wildlife Sanctuary	278	Natural sal forest, habitat for spotted deer
Toorsa Strict Nature Reserve	644	Pristine temperate forest
Khaling Wildlife Sanctuary	273	Temperate forests, only habitat for pigmy hog

(Source: RGoB 2003 Vision and Strategy for the Nature Conservation Division)

The Gross Domestic Product (GDP) share of the RNR[14] sector (in current prices) is given in Table 6. The agriculture sector (including livestock and forestry) is the single largest sector whose contribution is much higher than other sectors (RGOB, 2006b).

Table 6: Share of Agriculture Sector to GDP (in %)

Sectors	2001	2002	2003	2004	2005
Agriculture (including livestock and forestry)	26.4	26.2	24.9	24.4	22.4
Agriculture proper	11.7	11.4	10.9	10.8	10.0
Livestock	8.4	7.6	7.4	7.2	6.9
Forestry	6.2	7.1	6.6	6.4	5.5

(Source: RGoB, 2006b)

While the GDP share of the RNR sector in relative terms has diminished over the years, the GDP amount of the RNR sector has grown from Nu. 3,161 million in 1995 to Nu. 8,132 million in 2004.

[14] Renewable Natural Resources (RNR) Sector consists of agriculture, livestock and forestry.

The share of agriculture within the GDP has declined from 26.4% in 2001 to 22.4% in 2005 (RGoB, 2006b). Despite this, agriculture remains the primary source of livelihood of the majority of the Bhutanese people[15]. About 80% of the people of Bhutan are involved in agriculture.

About 7.8% of the geographical area is categorized as arable agricultural land (RGoB, n.d). Out of which 13% of the agricultural land is under wetland cultivation (irrigated) and about 32% is dry land, 29% is used as tseri (shifting cultivation), and another 27% as orchards and as kitchen garden (RGoB, n.d). The details are given in Table 7.

Table 7: ***Agricultural Land under Different Types of Cultivations***

Categories of Agricultural Land	Area (ha)	Total Agricultural Land (%)
Wetland Cultivation	38,800	13
Dry Land Cultivation	97,700	32
Tseri	88,300	29
Mixed Cultivation Land	84,000	27
Total	308,800	100

(Source: (RGoB, n.d.))

Major cereal crops cultivated in Bhutan are maize and rice. Maize accounts for 49% of the total domestic cereal cultivation and rice for about 43%. Rice is, however, the major staple crop. Paddy is the primary crop cultivated where irrigation facilities are available. Apart from cereal crops, also apple, orange, potato and different vegetables are cultivated. The total annual cereal production figures are given in Table 8.

Table 8: ***Cereal Production (000' tons) 1999-2007***

Cereals	1999	2000	2002	2003	2004	2005	2006	2007
Paddy	44.7	68.6	37.9	45.8	54.3	67.6	55.8	56.2
Maize	47.5	77.3	41.7	49.7	90.6	94.0	70.1	70.6
Wheat	5.7	4.4	4.6	4.7	4.2	11.2	6.1	6.1
Barley	3.0	1.7	1.4	1.0	1.4	4.6	2.3	2.3
Buckwheat	4.7	2.9	2.8	2.2	2.5	7.0	3.9	3.9
Millet	4.4	3.8	2.6	2.9	2.4	6.6	4.0	4.0
All	110	159	91	106	155	191	142.1	143.1

1.6 Cattle Population

Latest data on cattle population are lacking. However, the cattle population data from 1994 to 2005 shows that there is (a) an increasing trend on cattle including yaks, (b) equine and pigs population has decreased, and (c) poultry and goats populations have also increased over the years. The details are given in Table 9.

[15] http://en.wikipedia.org/wiki/Agriculture_in_Bhutan

Table 9: ***Cattle Population Data of 2000***

Year	Cattle	Yak	Equine	Pig	Poultry	Sheep	Goat
1994	299,807	36,761	27,209	45,968	157,663	26,667	18,432
1995	332,427	39,668	29,545	47,691	177,994	26,278	19,387
1996	315,884	37,871	28,995	61,010	169,208	22,857	22,044
1997	315,734	37,782	28,995	61,010	161,487	23,036	22,239
2000	320,510	34,928	21,222	42,271	184,114	19,811	23,467
2001	287,052	38,892	21,588	40,829	184,874	22,199	22,950
2002	294,787	31,223	21,511	40,088	191,931	20,099	24,071
2003	293,990	38,724	23,448	38,548	165,708	24,515	22,950
2004	295,922	41,628	24,692	35,255	195,286	20,803	23,850
2005	338,847	45,538	24,608	28,161	189,269	17,612	20,507

(Source: RGoB, 2007d)

As per the statistics maintained by the Department of Livestock it is seen that 77.5% of the households own cattle whereas buffalos are kept by only 0.8 percent of the households. Yaks are reared by 2.2% of the households (RGoB, 2007d). Quite a large percentage (23.8) of the households still keeps horses which are mainly used for transportation in the rural areas. The details are shown in Figure 1 and Table 10.

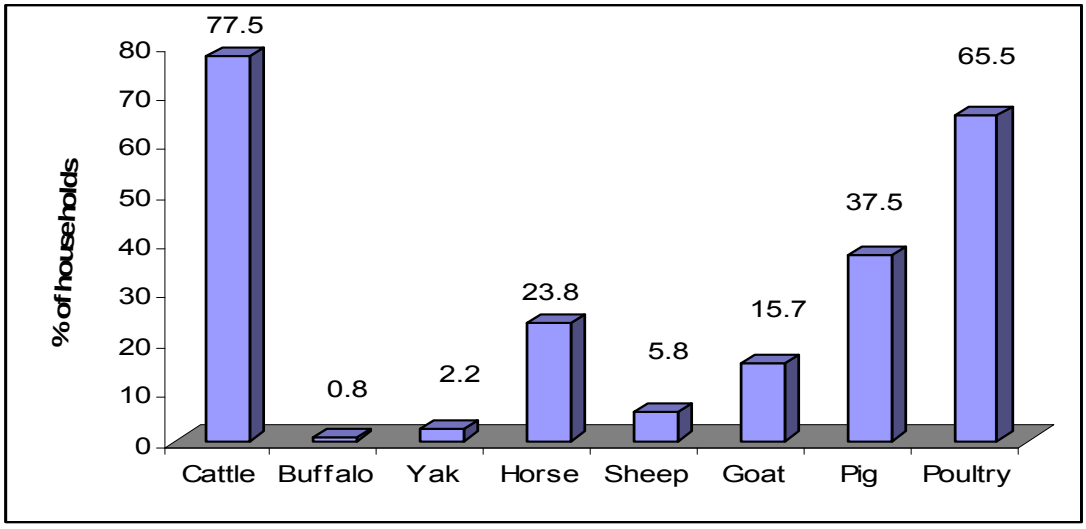


Figure 1: ***Percentage of Households Keeping Different Types of Animals (Source: RGoB, 2007d)***

1.7 National Policy and Legislation

Bhutan has in place several enabling policies and laws creating the legal environment to support rehabilitation of land and re-afforestion initiatives. These policies and laws include:

Policies

- The Constitution of the Kingdom of Bhutan 2008
- Gross National Happiness and Bhutan 2020 Vision
- National Environment Strategy
- National Forest Policy

Laws

- Forest and Nature Conservation Act 1995
- Mines and Mineral Management Act 1995
- Environment Assessment Act 2000
- Land Act of Bhutan 2007
- National Environment Protection Act 2007

Table 10: ***Livestock Products Sold in 2005***

Animal Products Sold per Year (Kg) (Amount is in Ngultrum)									
Milk		**Butter**		**Cheese**		**Chugo**		**Whey**	**Total Income**
Qnty	**Amount**	**Qnty**	**Amount**	**Qnty**	**Amount**	**Qnty**	**Amount**		
3,683	73,660	10,347	1,532,880	13,158	1,296,235				2,902,775
2,688	39,270	44,344	6,811,810	87,456	4,748,080			864	11,600,024
19,620	88,740	3,490	50,850	10,420	51,560	11,227	489,715		680,865
		25,226	3,784,920	40,422	1,616,880				5,401,800
4,933	99,398	5,742	9,924,600	131,646	1,802,102				11,826,100
137,304	357,750	9,906	285,841	17,036	48,200				691,791
8,365	167,300	16,091	4,022,750	183,585	1,835,850	-			6,025,900
15,904	239,143	2,705	562,683	2,463	25,810				827,636
457,465		12,493	1,873,950	103,623	5,181,150				7,055,100
69,934	1,049,010	22,392	3,138,318	27,349	1,496,020	-			5,683,348
315,712	5,380,631	102,329	11,047,320	517,746	15,899,602	5,657	236,050		32,563,603
22,066	411,915	51,730	8,979,140	2,129,504	7,472,980	6,284	1,077,920		17,941,955
110	2,750	22,065	4,413,000	33,115	3,226,360				7,642,110
87,364	1,297,380	69,969	1,815,816	152,566	7,912,989	-			11,026,185
556,431	11,119,915	61,325	14,714,820	14,111	1,620,984	73,739	14,495,029		41,950,748
2,888	57,760	935	158,950	8,348	584,360				801,070
103,900	2,062,671	83,396	10,919,477	78,020	4,537,283	56,401	6,768,120		24,287,550
17,182	355,430	31,690	4,722,170	65,497	4,072,978	1,800	223,296		9,373,874
871,491	10,457,892	16,257	2,438,505	26,933	1,615,978				14,512,375
110,405	1,367,320	8,738	1,046,030	223,687	2,177,580	160,860			4,590,930
2,807,445	34,627,935	601,168	92,243,829	3,866,685	67,222,980	315,968	23,290,130	864	217,385,738

(Source: RGOB, 2007d)

2. Forest Resources Information

2.1 Ecological Description

Bhutan's ecological zones can be categorized from altitude, watershed, ecology and agro-ecology which help to understand the distribution of natural resources. According to altitude Bhutan can be divided into three regions i.e. alpine, temperate and sub-Tropical regions. The alpine region is a distinct bio-geographic zone lying above 4,500 m altitude. The temperate region is located between 500 or 1,000 m and 4,500 m altitude. The sub-tropical region consists of southern foothills below 1,000 m and river valleys below 500 m altitude.

Bio-Geographic Ecological Zones: Bhutan is classified into eight bio-geographic ecological zones within the three altitudinal regions, i.e. (i) alpine, (ii) temperate and (iii) sub-tropical zones (MPFD, 1991). They are:

a. High Himalyan Zone
b. West Temperate Zone
c. Sankosh Temperate Zone
d. Mangde Temperate Zone
e. East Temperate Zone
f. West Sub-Tropical Zone
g. Central Sub-Tropical Zone
h. East Sub-Tropical Zone

The Himalayan Zone is located in the northern part of the country at an elevation of 4,500 m a.s.l. In the Temperate zone mountainous areas between the major valleys form alpine barriers between the temperate valleys which have resulted in east – west differences in faunal composition. Therefore, this zone can be divided into four sub-regions, namely west, west-central, east-central, and east covering the temperate altitudinal region. The Sub-Tropical Zone extends from the southern foot-hills up to an altitude of 1,000 m. This covers the Manas and Sankosh rivers within the sub-tropical altitudinal region creating three zones, one each in the eastern, central and western part of the country.

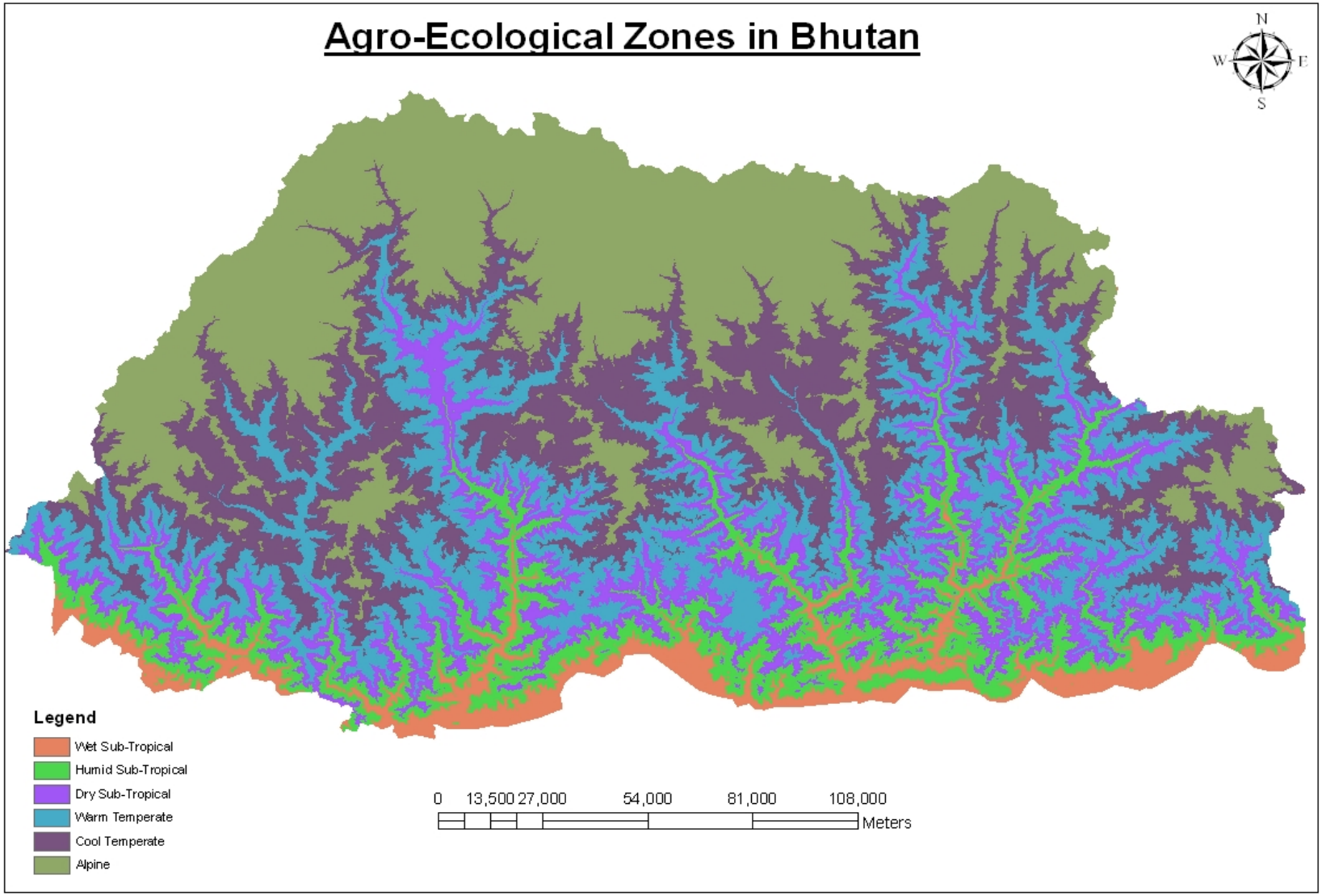
Agro-Ecological Zones: Bhutan has six agro-ecological zones (Gyamtsho, 1996; Tobgay, 2005). The wet sub-tropical zone extends from 150 to 600 m, followed by the humid sub-tropical zone to 1,200 m. The dry sub-tropical zone starts at 1,200 m and extends to 1,800 m, followed by the warm temperate zone, which reaches 2,600 m. The cool temperate zone lies between 2,600 and 3,600 m and, finally, the alpine zone at a height of 4,600 m and above. Table 11 presents the altitude range and climatic information of each agro-ecological zone, while Figure 2 shows the map of the agro-ecological zones.

Table 11: ***Agro-ecological Zones of Bhutan***

Agro-Ecological Zones	Altitude Range (m)	Annual Rainfall (mm)	Annual Mean Temp. (°C)
Alpine	3,600 – 4,600	< 650	5.5
Cool Temperate	2,600 – 3,600	650 - 850	9.9
Warm Temperate	1,800 – 2,600	650 - 850	12.5
Dry Sub-Tropical	1,200 – 1,800	1,200 – 1,800	17.2
Humid Sub-Tropical	600 – 1,200	1,200 – 2,500	19.5
Wet Sub-Tropical	150 - 600	2,500 – 5,500	23.6

(Source: Gyamtsho, 1996)

Map 2: Agro-ecological Zones in Bhutan



2.2 Forest Area

The total forest area of the country is 28,175.50 km^2. Forests with canopy density of more than 10% occupy about 63.84% of the forest area and the rest is occupied by scrub forest formations. Broadleaf forest is the principal forest type in Bhutan followed by mixed conifer forests. Blue pine and chir pine forests occupy 3.10% and 2.60%, respectively (RGoB, 2007c). Details of the forest types found in Bhutan are given in Table 12.

Table 12: *Major Forest Types of Bhutan*

Sl No.	Forest Types	Area (km2)	Land Area (%)
1	Blue pine	1,199.34	3.10
2	Fir	3,132.19	8.09
3	Mixed conifer	4,523.26	11.68
4	Chir pine	1,006.08	2.60
5	Broadleaf	13,259.61	34.25
6	Broadleaf + Conifer	1,597.67	4.13
7	Sub total	24,718.15	63.84
8	Scrub forest	3,457.35	8.93
9	Total	28,175.50	72.78

(Source: RGOB, 2007c)

2.3 Forest Types and Distribution

Broadleaf forest is the major forest formation in the country followed by mixed conifer which is mainly composed of hemlock, blue pine, spruce and fir. Wangduephodrang Dzongkahg has 10% of the country's forest followed by Sarpang, Samdrupjongkhar, Lhuntshe and Trashigang. Tsirang and Pema Gatshel have the lowest percentage of forest area.

Scrub forest covers about 8.93% of the forest area. Lhuntsi Dzongkhag has the highest percentage of scrub forest followed by Bumthang and Trashigang. The details are given in Table 13.

Map 3: Major Forest Types of Bhutan

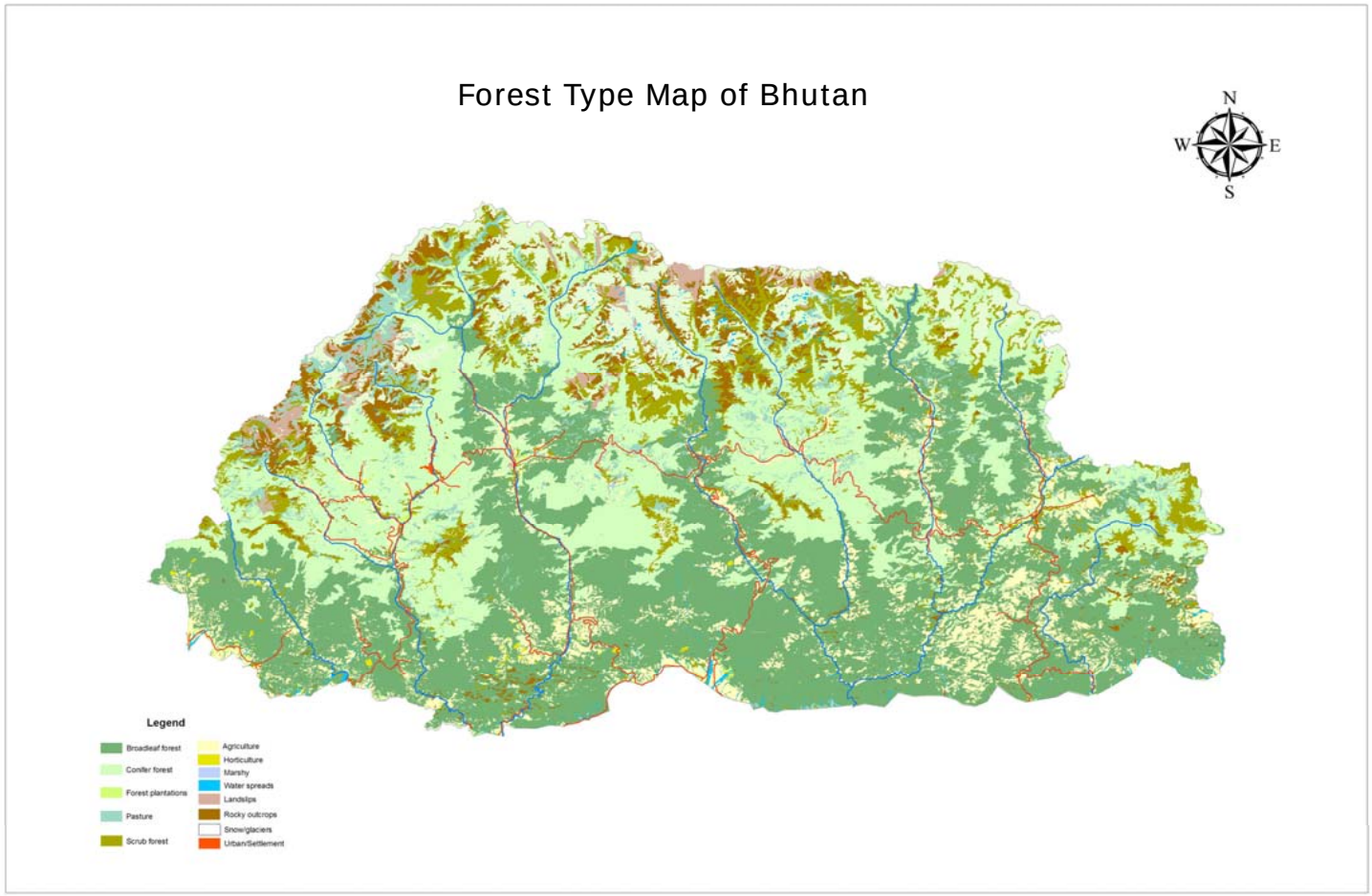


Table 13: ***Dzongkhag-wise Distribution of Forest***

Dzongkhags	Blue Pine	Broadleaf	Broadleaf + Conifer	Chir Pine	Fir	Mixed Conifer	Sub total	Scrub	Total
Bumthang	176.599	23.852	9.435	0.001	275.577	671.100	1,156.564	446.052	1,602.616
Chukha	51.988	599.218	257.563	53.020	136.224	319.821	1,417.834	62.831	1,480.665
Dagana	33.010	655.039	111.546	32.138	84.409	181.013	1,097.155	49.541	1,146.696
Gasa	0.004	103.011	1.162	0.022	448.192	124.252	676.643	362.862	1,039.505
Haa	47.213	232.632	58.101	--	177.332	460.238	975.516	217.871	1,193.387
Lhuntshe	0.002	705.103	107.521	83.359	290.865	228.502	1,415.352	537.262	1,952.614
Monggar	2.894	820.886	206.618	296.828	67.857	202.332	1,597.415	105.585	1,703.000
Paro	266.932	4.751	34.873	0.001	58.811	344.436	709.804	77.437	787.241
Pema Gatshel	0.001	291.982	24.752	10.704	2.818	5.961	336.218	130.100	466.318
Punakha	10.901	411.263	8.811	85.285	109.596	171.947	797.803	43.512	841.315
Samdrup jongkhar	14.623	1,675.431	28.562	4.193	46.354	59.166	1,828.329	153.649	1,981.978
Samtse	7.121	1,087.324	78.855	--	12.576	48.102	1,233.978	16.355	1,250.333
Sarpang	--	1,857.607	15.176	0.002	2.622	22.234	1,897.641	48.773	1,946.414
Thimphu	187.284	122.639	5.363	28.525	118.094	388.549	850.454	86.956	937.410
Trashigang	48.747	696.641	73.613	91.548	388.883	247.081	1,546.513	377.974	1,924.487
Trashiyangtse	19.540	441.013	62.464	18.945	350.914	71.118	963.994	192.897	1,156.891
Trongsa	11.168	704.232	247.982	23.973	110.322	261.913	1,359.590	161.373	1,520.963
Tsirang	--	416.079	19.864	28.628	0.005	5.565	470.141	26.158	496.299
Wangduephodrang	321.309	991.512	98.814	196.285	393.831	591.967	2,593.718	247.109	2,840.827
Zhemgang	0.001	1,419.390	146.593	52.622	56.910	117.964	1,793.480	113.051	1,906.531
Total	1,199.337	13,259.605	1,597.668	1,006.079	3,132.192	4,523.261	24,718.142	3,457.348	28,175.490

(Source: RGOB, 2007c)

2.4 Forest Policy, Planning and Management

The forest administration in Bhutan was institutionalized in the 1950s, with the establishment of the forest department in 1952 as one of the government institutions in the country (Box 1). The legal framework for forest management was established with the enactment of the Bhutan Forest Act in 1969. This Act brought all forests in the country under state control and emphasized the protection of forest resources. The foundation of scientific forest management was laid in 1970s with the start of a pre-investment survey (PIS) through assistance of the Indian Government that carried out a national inventory of forest resources. Following the promulgation of the National Forest Policy in 1974, the preparation of management plans for the forests started.

Box 1 Department of Forests

The Department of Forest (DoF) is under the Ministry of Agriculture (MoA) and organized according to the following hierarchical structure. The Department is headed by the Director who is supported at the headquarters level by functional divisions (i.e. Forest Resource Development Division, Forest Protection, Utilization Division, Nature Conservation Division and Social Forestry Division) and Chief Forest Officers (CFOs) in the field forest divisions as well as Dzongkhag Forest Officers (DFO) in the districts. The Forest Research Program operates under the Council for RNR Research of Bhutan (CoRRB) with a research agenda set through annual research planning meetings.

Re-afforestation, plantation and social forestry programs are coordinated and monitored by the Social Forestry Division of DoF.

Forest planning and management is guided by the National Forest Policy 1974. In order to include the changing needs, the forest policy 1974 was revised in 1991 and it is again under revision in 2008. In line with the changing policy, the Forest Act of 1969 was revised and newly enacted in 1995 as the Forest and Nature Conservation Act. The Forest Policy 1991 places more importance on conservation than on utilization and seeks to ensure that forest resources contribute to social justice and equity and that they are sustainably managed and used. The policy directs that the goal of environmental conservation should override the financial considerations from forests and sets out four main goals for the forestry sector (Revised Forest Policy 1991):

Goal 1: To protect the land, forests, soil, water resources and overall biodiversity against degradation, such as loss of soil fertility, soil erosion, landslides, floods and other ecological devastation and to improve degraded forests through management systems and practice.

Goal 2: To contribute to the production of food, water, energy and commodities by effectively coordinating the interaction between forestry and farming systems.

Goal 3: To meet long term needs of the people for wood and other forest products through sustained production forestry.

Goal 4: To contribute to the growth of national and local economies, including exploitation of export opportunities through fully developed forest-based industries, and to contribute to balanced human resources development through training and creation of employment opportunities.

The forest is basically classified into two categories: (a) protected forest areas (e.g. national parks) and (b) the balance of the forest areas. The balance of the forest area is further divided into (a) critical, fragile, and depleted forest areas for conservation and protection and (b) operable areas for production. The forest management units (FMU) or production units are then delineated within the operable areas for preparation and implementation of forest management plans, which are long-term silvicultural plans for a ten year period for the sustainable production of timber.

Total production forest area is approximately 982,362 ha and at present about 169,991 ha has been brought under management plans. However, timber production is technically and economically feasible under the FMUs system on about 409,564 ha only while the balance of 572,798 ha could be brought under systematic management with high inputs. The estimated annual allowable cut (AAC) is about 35 million ft^3 (1 million m^3). At present, in the production area under the FMU system about 5.8 million ft^3 of standing volume are prescribed for harvesting.

2.5 Forests in the Economy

Forests are an important resource playing an important role in providing goods and services for people's livelihood and the economy on a national and local scale. Forests contribute about 11% of the Gross Domestic Product (GDP) and generate 3% of the Government's revenues through royalty collection and through sale of wood and non-wood products. Logs, sawn timber, veneer and non-wood products account for 20% of all exports. A rough estimate of the total employment in the forestry sector is 25,000 people (MoA, 1991; World Bank, 1997). This includes about 20,000 person-years of employment from non-monetary fuelwood collection. The annual demand from the private sector to the forestry sector is about Nu. 300 million (US $ 14100). The economic linkage between forests and hydroelectric power generation is important as hydro-electricity is the highest revenue earner. Proper watershed management, including the conservation of biological diversity, contributes to the sustainability of this vital source of income for the country. The value of animal feed production in the forests is estimated to be around Nu. 300 million (MoA, 1991).

2.6 Forest Degradation

Forest degradation can be explained with the historical events of the country's development and its subsequent development in the forestry and environment sectors (Table 14).

Table 14: ***Chronology of Forest Degradation and Forest Management***

Period	Forest for What (Concept)	Forest Institutions/ Infrastructure	Forest Degradation Process
Before 1950	Forest for basic needs of people. All lands not private regarded as common property. Forests were also common properties (Wangchuck, 1998; Tshering, 2002).	Forest uses were administered by the community (*maang, reesups, meesups)* through village customs and traditions of ladam/ redumΦ (Wangchuck, 1998; Tshering, 2002)	Extensive forest fire damage due to fire escaping from Tseri* and Panshing+ cultivation

1950-1960	Forest as potential resource for revenue generation in the light of launching the country's development plans	Utilization started by the civil administration and Forest Department established in 1952. Leasing of forest areas to contractors	Accessible forests at the foothills degraded – felling by timber contractors
1960-1970	Forest for sustainable production of timber by professional foresters (Indian foresters on deputation)	Nationalization of Forest through the Bhutan Forest Act 1969. Systematic utilization through preparation of working schemes-creaming of forest in accessible areas. A few sawmills established at strategic locations.	Forests near roads degraded. Commercially important tree species selectively felled.
1970-1980	Forest for timber with emphasis on preparation of scientific management plans (i.e. silviculture). Bhutanese professional foresters joined the forest service.	Preparation of scientific management plans bringing into the country experiences of American, European and Indian foresters. The number of sawmills increased across the country.	Forest Management Units (FMU) established. Timber production conflicting with local rights (e.g. grazing, leaf litter collection) resulting to failure of regeneration in logged -over forests and plantations.
1980-1990	Forest for wood with orientation on wood based industry development	Forest management units established country-wide. Forest utilization agent, FDCL established. Wood based industries (Plywood, particle board) established. Forest Research Division established (1988)	A large chunk of forests leased for industrial plantation. Fast growing tree species for industrial purposes replaced the old growth slow growing indigenous species.
1990-2000	Forest for nature conservation and people	A network of Protected Areas established. RNR integrated concept established. Non-wood forest products given due importance in forest inventory and planning. Forest Act revised to Forest and Nature Conservation 1995 providing a legal avenue for local people to participate in management and use of forest resources.	Forests near settlements and critical watersheds degraded due to heavy pressure from use of wood and non-wood forest products. Population increasing (3.4% annually) and development expanding causing visible land degradation in many parts of the country.
2000-to date	Forest for integrated natural resources and environment services-(e.g. carbon sequestration)	Social forestry rules approved (2000) Social Forestry Division in DoF and participatory forestry field programs implemented. Watershed management and water resources projects started. Signatories for UNFCCC, UNCCD	Quality of forest in FMU, plantations and community forests decreasing.

Φ temporary closure of forests for use
* shifting cultivation in forest stands
\+ shifting cultivation in grassland system
(Source: *Norbu, 2002*)

2.6.1 State of Degradation

There is no recent comprehensive study on forest degradation in Bhutan. The last analysis of satellite imageries indicated that there is a loss of forest cover (Gupta, 1992) and forest cover at the national

level is declining mainly attributed to extensive expansion of agriculture. The study also indicates that the area of closed forest has declined while the area of open forest has increased over the entire period. In 1991 it has been estimated that a total of 231,000 ha of forests in the country is degraded with an annual rate of forest degradation estimated at 0.5% (MoA, 1991).

Forest degradation at local level is apparent. Bhutan's economy is a basic need-based economy with predominance of agriculture, livestock and forestry. Forest degradation is basically a biotic phenomenon, where man living in and around forests has taken short-term unsustainable measures, to survive and improve his well being. In some instances, forest degradations have led to land degradation causing loss of life, property and agricultural lands. The underlying causes of forest degradation are related to increasing population and economic development with their consequences presented as follows:

- Population growth

  - More forest areas brought under agricultural land;
  - Increasing pressure on forest pasture and forest grazing land;
  - Increasing use of fuel wood, construction timber and non-wood forest products; and
  - Frequent forest fire outbreaks in blue pine and chir pine forests.

- Economic development

  - Pressure on forest land for new house construction and industrial development;
  - Higher demand on wood and non-wood forest products from forests for development projects;
  - Improved export market is increasing the demand of additional land to raise commercial crops such as apples, oranges and cardamom and leading to acquisition and encroachment into forest areas; and
  - Increasing human development increases demands which put pressure on forest resources.

2.6.2 Constraints for Forest Restoration and Rehabilitation

A series of monitoring and evaluation exercises on forest plantations conducted by the Social Forestry Division (Chetri, 1995, 1997 and 1998; Phuntso, 2003) and the case studies presented in this report show that the success of reforestation and plantation programs has been constrained by a variety of factors:

Inadequate Budget

A lot of successful plantations have been raised in the southern and central part of the country in the 1950s and 1980s and many of these plantations now supply quality timber and other products for industrial as well as local use. The 1980s plantations were raised and managed with support of several World Bank projects (Davies, 1984).

As of now, there is no external support to the reforestation and plantation programs. As the funds allocated by RGoB are inadequate for establishment as well as maintenance, most young plantations are not performing well in terms of survival and quality.

Difficult Planting Areas and Biotic Interferences

In many areas forest restoration had to be carried out on dry, rocky and impoverished soils requiring high inputs and special planting techniques, thus many re-afforestation programs failed in such areas. In addition, biotic interferences also lead to failure of plantation establishment. Cattle grazing and browsing caused heavy damage to plantations and rehabilitation areas. Wild animals, particularly elephants and sambar deer caused extensive damage to newly established plantations.

Lack of Proper Planning

Re-afforestation and plantations were often done on larger areas to fulfill budget targets without proper planning and clear objectives. As a result, little consideration was given to the choice of species, plantation techniques and the timing of planting. These reasons coupled with lack of funds for plantation maintenance of large areas led to many failures.

Lack of Quality Nurseries

Nursery management is an essential component of any plantation program. The quality of seedling production is the basic foundation for successful rehabilitation of degraded and barren lands. The nursery management program had suffered heavily due to lack of adequate funding for employing sufficient nursery managers/caretakers. Increasing seedling demand had to be met either from low quality nurseries or by wildings affecting the success of reforestation and plantation programs.

Lack of Support from the General Public

Local people have an important role to play in the conservation and cultivation of trees both on agricultural land and within forest areas. However, experience till date indicates that people have shown very little support and co-operation in the re-afforestation and social forestry planting programs. This is due to the fact that people had been enjoying free grazing access in the state forests for decades and when the areas were enclosed for plantation, they deliberately dismantled the fencings and grazed their cattle in the plantation areas (Norbu, 2000). The other reason is related to a lack of incentives and long term returns from the planted forests.

3. Reforestation Mechanisms

3.1 Present Situation

Sound forest conservation and management policies have enabled Bhutan to maintain 72.8% of its land under forest. However, the increasing urbanization as the country pursues its development activities coupled with population growth are increasingly exerting pressure on the forest resources through continuous deforestation and conversion of forestland to other land use forms. Efforts to combat forest degradation in the country are therefore made through afforestation of barren and degraded lands and reforestion in cleared or logged-over forests. Accordingly, different categories of plantations are created to arrest the forest degradation process. Plantations are created by the Department of Forests (DoF) in blank and degraded forest lands; plantations are also established in the leased out forest lands by the wood-based industry; and plantations are created by communities around settlements in community land as well as leased forest lands. Planting in openings and glades in FMUs is done by the Forest Development Corporation Ltd (FDCL) to supplement natural regeneration. Reforestation is undertaken in watershed areas and also farmers are encouraged to plant trees in their private lands as part of agroforestry practices.

From the earliest times, the Department of Forest has always accorded priority to the reforestation program. This can be testified from the plantations created way back in the 1940's by civil authorities in the absence of a forest department. After the establishment of the Department of Forests in 1952, systematic plantations were raised in the southern Dzongkhags. Later in the late 1960's, with improvement in human resource capacity and infrastructure, the reforestation was expanded to other parts of the country. Accordingly, DoF had started reforestation programs systematically, targeting to reforest at least 2,000 acres per year in the 3rd FYP period (1971-1976) and 2,500 acres per year in the 4th FYP period (1976-1981). A total of 53,615 acres of barren and degraded areas and cleared forests have been brought under plantation as of June 2008 (Table 15). The majority of these established plantations are located in the southern parts of the country.

Table 15: ***Total Plantation Established in Bhutan till June 2008***

Sl. No	Plantation by Agency	Area (Acres)
1	Dzongkhag Forestry Sectors	4,077.88
2	Territorial Forest Divisions	39,440.5
3	Parks and Sanctuaries	40.0
4	Forest Development Corporation (FDCL)	3,141.0
5	Bhutan Boards Products Ltd (BBPL)	5,040.0
6	Bhutan Calcium Carbide Ltd (BCCL)	1,864.0
7	Ugyen Wangchuck Institute of Environment and Forest (UWIEF)	12.0
	Total	53,615.38

(Source: Plantation records, SFD, 2008)

Since the first plantation program started along the southern belt, it is likely that planting stocks were either imported from India or wildings were used during the initial plantation period. Later, forest nurseries were established in the southern region and subsequently in other parts of the country to supply planting stocks for the increasing areas of degraded forest brought under forest plantations.

In order to ensure availability of good planting stocks, the DoF had directed that all implementing agencies should have a minimum of one central nursery with adequate stock of quality seedlings for plantation. Besides DoF, there are a number of other agencies operating nurseries such as FDCL, BBPL, and BCCL. Private entrepreneurs or some individuals also manage nurseries on a commercial basis. However, many of them are small with low production capacity (Table 16).

Table 16: ***Nurseries Established in the Country till June 2007***

Sl. No	Agencies	Number of Nurseries
1	Dzongkhag Forestry Sectors	31
2	Territorial Forest Divisions	17
3	Protected Areas	8
4	FDCL	10
5	BBPL	2
6	Private individuals	27
	Total	95

3.2 National Policies, Strategy and Plans Supporting Reforestation

National Forest Policy 1974

The National Forest Policy promulgated by Royal Decree in 1974 declared that at least 60% of the country's land should be maintained under forest cover for all times to come. The National Forest Policy, besides conservation of the forest resources, stressed the need for strengthening the reforestation program, for maintaining the targeted forest cover, and for meeting the basic forest product needs of the people. The policy also states that a reforestation program is required not only to compensate for the loss of forests by natural processes and utilization, but also to improve the growing stock of inferior and degraded forests so that denuded and unproductive forest lands are covered by tree plantations with higher utility and aesthetic values.

Master Plan for Forestry Development 1991

The Master Plan for Forestry Development (MPFD) 1991 was elaborated to provide guidelines for long-term development of the forestry sector in the country. The MPFP notes the importance of combating forest degradation by reforestation of degraded forest areas estimated to be 231,000 ha. The MPFD highlights the following priority areas to be brought under the reforestation program:

- Areas surrounding human settlements, since there is a high pressure on the forest areas close to human settlements through wood extraction, cattle grazing and agricultural encroachment.
- Areas with south west aspect, since there are reasons to believe that natural regeneration will not succeed as well on south west slopes on north east slopes due to abiotic factors.
- Areas with slopes of more than 100%, since steep slopes are more susceptible to soil erosion.

National Re-Afforestation Strategy 2008

Despite the sound policies adopted by the Royal Government and the rules that have been enforced, forest degradation remained a major concern. In order to bring degraded areas under forest cover and to combat further degradation, the National Re-afforestation Strategy was adopted in 1996 and updated in 2008 to provide direction to the development and management of forest plantations. The long-term objectives of the Re-afforestation Strategy are:

- Protect, rehabilitate, and manage degraded watersheds within government-reserved forests as well as on private land;
- Make full use of the productive capacity of the degraded lands by planting economically viable species. This will result in more forest produce being available to the industry and local people generating employment and revenue;
- Protect farms and provide basic needs of farmers through social and community forestry programs;
- Combat soil erosion and land degradation;
- Contribute to bio-diversity conservation by supplying forest produce needs from planted forests;
- Contribute to the reduction of the green-house effect by greening the country; and
- Maintain a minimum of 60% of the country under forest cover.

3.3 Case Studies of Re-afforestation Activities

53,615 acres of forestland have been re-afforested across the country through participation of various stake-holders. Many plantations created by the Department of Forests are in bad conditions for want of proper care and maintenance (DoF, 2008). Proper care after plantation could not be given due to inadequate funds for maintenance and follow up operations.

Some plantations were raised on dry and degraded slopes that experience harsh climate. Such reforestations demanded high inputs and special planting techniques and involved international assistances. The success of these re-afforestation activities did not prove sustainable on phasing out of the external assistances. Local people's participation and response to re-afforestation and land restoration projects were lukewarm; protecting and barring domestic cattle from damaging plantations was difficult. Industries were interested in creating short-term returns from plantations for their use, compromising biodiversity and environment conservation.

Box 2: ***Industrial Plantation at Nangla Drang, Samtse, Southern Bhutan***

Summary of Analysis

100 ha of leased-out degraded natural forest were reforested with Alnus, Evodia, Cryptomeria and Macaranga in 1998 and 1999. The plantation activity was supported by Bhutan Boards and Particles Ltd (BBPL).

Objective of the Planting Activity

The main objective was to create commercial plantations of fast growing species for industrial use (BBPL).

Success and Performance of the Planting Activities

76% of the plantation has survived as per the Plantation Monitoring and Evaluation Report 2003 (Phuntso, 2003).

Factors Influencing Success/Failure of Plantation

Timely undercutting of weeds, shrubs and bamboo as the area receives high rainfall (120 inches per year). Protection of the plantation from grazing as 60% of the plantation areas is subjected to heavy domestic cattle grazing. Employing and involving local people including cow herders in nursery raising and taking care of the plantation.

Success and Performance of the Planting Activities

Industrial plantation of 100 ha established. Created employment for local people and improved transportation of agricultural produce as a new forest road was constructed.

Winter planting technology has been developed and proved successful as the areas receive moderate rain fall during winter (Wangdi, 2006.)

However, the monitoring and evaluation reports pointed out that there is a need to plant more slow-growing indigenous tree species to improve the species composition of the plantation. Planting of exotic trees such as Cryptomeria was discouraged.

Box 3: ***Afforestation at Chongdiri Catchments in Eastern Bhutan- A Component of an Integrated Watershed Management Program***

Summary of Analysis

80.8 ha of degraded forestlands were planted with Bluepine, Cypresses, Walnut, Michelia, Poplar and Maple and bamboos in degraded watershed (MoA, 2006). Different local stakeholders were involved - DoF, Dzongkhag forestry (extension), researchers, as well as the local school and community. The activity was financially and technically supported by RGoB (Research Centre, Wengkar) and SNV (The Netherlands).

The other components included livestock development, water management, road drainage maintenance, conflict resolution and capacity building.

Objective of the Planting Activity

To create the plantations in and around the rapidly expanding ravine for protecting the catchments from further degradation. It was combined with capacity building of the community on resource management.

Success and Performance of the Planting Activities

Over a period of 5 years (2001-2005), 80.8 ha of tree and bamboo plantations were established and ravine expansion arrested – but there was high mortality among tree seedlings and bamboo rhizomes, thus many had to be replaced. Due to limited human and financial resources effective monitoring and care could not be carried out.

Factors Influencing Success/Failure of Plantation

The success of the activity was based on the local people's participation and on their will and perseverance (inculcated through awareness and capacity building) to combat land degradation. Inadequate labour resources and limited maintenance cost were the main constraints in this activity.

Lessons Learned

Local people can be mobilized to create successful forest community plantations which would in part contribute to the improvement of critical watersheds. The restriction of cattle grazing in ravine areas, not only encouraged natural regeneration and prevent soil erosion but ensured the survival of the plantations. The community developed a sense of ownership for the plantations, given the support in terms of materials (e.g. barbed wire) and inputs (e.g. seedlings). Adequate funding for plantation establishment and maintenance is critical for creating successful plantations.

Box 4: ***Afforestation at Pachu-Wangchu Valley in Western Bhutan***

Summary of Analysis

The dry barren slopes along the Wangchu-Pachu Valley (2200 m.a.s.l) covering an area of 497 ha were planted by the Department of the Forest in the early 1980s with Blue pine, Chir pine, Cupressus incurring Nu. 17.23 million provided by the World Food Program (WFP).

Objective of the Planting Activity

The main objective was to create green vegetation cover for aesthetic values along the National Highway leading from Paro Airport to Thimphu, the capital city.

Success and Performance of the Planting Activities

From the start, the mortality rate of the seedlings was more than 50% in winter months following planting. The gaps were refilled by planting in the subsequent planting seasons. After establishment, periodic die-backs were observed in the early spring months of 1994, 1999, 2001, 2003 and 2008.

Success and Performance of the Planting Activities

The visible symptoms of die-back including wilting, drying and eventual death in the seedling and sapling stages started to appear from early spring until early summer following certain distinct altitudinal belts. Die-backs were significantly prominent on the south and south-west facing slopes with shallow sandy/rocky soil conditions.

Following the entomological and pathological investigation, biotic factors were ruled out and attention was given to analyzing the growth of the pine trees using dendro-climatological data. The investigation showed significant correlation between tree growth and the climatic factors, particularly precipitation, in October to December of the previous years. The correlation of the precipitation of the previous year's fall (Oct-Dec) against the year of measurements of 17 years (1992-2008) clearly showed that die-back of the current year was the result of low or no precipitation of the previous fall. Interestingly, low precipitation was always followed by high temperature leading to the incidence of die-back in the current year.

Lessons Learned

The plantation die-back is strongly dependent on precipitation of the previous fall and it is predictable. Strong upstream river valley wind in combination with strong sunshine during the day increases evapo-transpiration leading to specific local dryness. These complex factors favour only xeric plant species to survive. Thus, plantation development on such extreme sites should be carried out with extreme care. The dieback is a result of natural phenomena and restoration is only possible through long term measures including:

- Introduce, fence and protect the native legume and shrub species at the planting sites for soil and moisture conservation for 2-3 years;
- Do micro-site tree planting to protect seedlings from cold wind and frost;
- Plant Blue Pine seedlings raised from seeds collected at the die-back sites;
- Monitor and maintain the plantations until they are established (5-6 years); and
- Expect high cost (e.g. Nu. 65,880/ha/year) of creating and maintaining plantations in such difficult areas.

3.4 International Interventions

In the past (mainly during the 1980s), the World Bank supported projects to reforest degraded forests in Southern Bhutan (DoF, 1981) and replanting of bark-beetle infected spruce and mixed conifer forests of Western Bhutan (DoF, 1987). The World Food Program (WFP) supported afforestation of degraded forestlands along the Wangchu-Pachu Valley. At present, United Nation Agencies, Swiss Development Coorperation (SDC), Netherlands Development Organization (SNV), GTZ (Germany), Japanese International Cooperation Agency (JICA), World Wildlife Fund for Nature (WWF), International Centre for Integrated Mountain Development (ICIMOD), Government of India (GoI), European Union (EU) and the Global Environment Facility (GEF) are involved in supporting natural resource management and environmental protection in the country but do not support any direct re-forestation and forest restoration initiatives.

Bhutan is also a signatory to the United Nations Convention to Combat Desertification (UNCCD) which was ratified in 2003. Therefore, the preparation of the National Action Plan (NAP) to Combat Land Degradation has started, which also includes actions to combat forest degradation in the country.

4. Institutional Capacity Building

The Department of Forests (DoF) has come a long way since its establishment in 1952. It is growing and its capacity is gradually being built up in the areas of forest conservation and management including forest reforestation and restoration. The capacities in forest research & extension, and education and training to support forest conservation and management are also in the process of being developed

4.1 Forestry Research and Extension Program

4.1.1 Forest Research

The Forestry Research Program (FRP) was institutionalized in 1987 with the creation of the Forest Research Division under the Department of Forests (DoF), Ministry of Agriculture. In 1992, following a review of the forest, agriculture and livestock research system, forest research was integrated with field crops, horticulture and livestock to form a network of four Renewable Natural Resource Research Centres (RNR-RC) located at Yusipang (Thimphu), Bajo (Wandue), Jakar (Bumthang) and Wengkar (Mongar). The FRP is now one of the four national research programs, under the Council of RNR Research for Bhutan (CoRRB) in the Ministry of Agriculture (MoA). The FRP is coordinated nationally from the Renewable Natural Resource Research Centre (RNR-RC), Yusipang, Thimphu.

Based on existing forest policy and forest sub-sector policy objectives, and taking into account the concept of sector integration, the long term objectives of the forestry research program can be summarized as follows:

- To enhance conservation and utilization of biodiversity, water resources, soil, land and forest through research on proper conservation and management practices based on the principle of sustainable use and biodiversity maintenance;

- To improve production of wood and wood products for domestic and industrial uses through selection of sustainable forest management and sound wood processing technology;

- To increase sustainable production of fodder, fuel wood and non-wood forest products by pursuing multi-use concepts and participatory forest management; and

- To increase the contribution to the production of food, water, energy and other products by coordinating and enhancing interaction between forests and farming systems.

Forest Research Strategy

(a) Research Program Focus

The national objective of poverty reduction is the guiding principle for planning and implementing forest research programs and activities. Accordingly, forest research is focused on the areas that have direct bearing on increasing the economy of the rural poor such as development of NWFP resources and intensification of social forestry and community forestry development. Therefore, research activities on NWFP and social forestry are being stepped up while long term on-going activities on conifer forest management, broadleaf forest management, forest protection, nature conservation and re-afforestation that will contribute to the national goal of sustainable management and conservation of forest resources, is continued in the selected areas only. In order to transfer technology to the clients efficiently and in the shortest time possible, the research is carried out in close collaboration with farmers, extension agents and field foresters, mainly in the form of action and participatory research on farms, in the FMUs and national parks; and at outreach research sites and adopted villages.

(b) Forest Research Planning and Prioritization

Forest research agenda setting is increasingly becoming client-based and client driven. Two meetings annually are conducted for research program planning and identifying collaborative research activities. The main client, Department of Forests (DoF), and Dzongkhag (District) forestry are involved in planning, prioritization and even implementing research in a few selected areas. This arrangement ensures that forest research activities are responsive to the needs and problems of regional stakeholders and at the same time the national forestry interests are safeguarded through consultations and discussions at the national level.

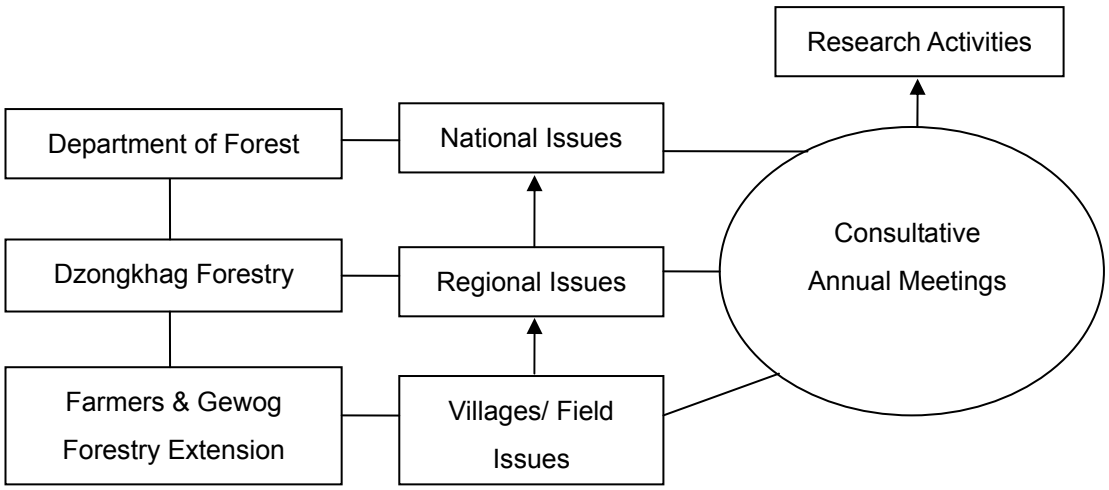


Figure 2: ***Forest Research-Extension Agenda Process***

(c) Research Program Networking and Linkage

RNR-RC Yusipang co-ordinates forest research projects/activities nationally through frequent exchange among forest researchers. In regular meetings scientists discuss and review planning and implementation of research activities.

In order to build up a critical mass of forest researchers, FRP pursues twinning with overseas universities and centers of excellence such as Tokyo University, University of Natural Resources and Applied Life Sciences (BOKU), Austria, CAB International, and Columbia University, New York, USA and with the institutes within the country (e.g. College of Natural Resource) to undertake selected

research mainly in the areas where there is dearth of basic information and on where FRP has no capacity to conduct research.

(d) Forest Research Themes

The FRP is managed under 8 research themes corresponding to the main operational programs in the Department of Forest (DoF) as listed below. Main research on reforestation and plantations is carried out within the research theme – Government and Industrial Re-afforestation.

- Nature conservation
- Conifer forest management
- Broadleaf forest management
- Wood products
- Non-wood forest products (NWFP)
- Government and industrial re-afforestation
- Social forestry
- Forest protection

Nature Conservation Research

About 34% of the country belongs to a protected area system in the form of national parks, wildlife sanctuaries, nature reserves and wildlife corridors. Forests are rich in bio-diversity and reported over 5000 species of vascular plants and over 770 species of birds and over 160 species of mammals. The list contains many species of conservation significant for their endemic, rareness and genetic resources for the future use.

Research capacity on nature conservation within RNR Research Centers is limited. Therefore, specialized research on nature conservation is mainly undertaken by the Nature Conservation Division, DoF. Information on flora and fauna of protected areas are available. Work on tree and fern arboretum, orchid and rhododendron domestication is currently going. Research has been initiated on human wildlife conflict especially crop damages, assessment of conservation programs on rural livelihoods in collaboration with the Nature Conservation Division of DoF.

Conifer Forest Management Research

Conifer forests play important roles in satisfying basic local needs and generating earnings for the national economy. More importantly, since conifer forests occupy fragile upper watersheds, how judiciously conifer forests are utilized and conserved is linked with the well being of people living both up-stream in the watershed areas as well as down-stream in the valleys.

Due to their proximity to settlements and road networks, conifer forests have been extensively managed for wood production through establishment of FMUs. Considerable experiences have been gained in managing conifer forests. The group felling system has proved to be a potentially sustainable silvicultural system for managing mixed conifer forests. Important research questions were addressed and results generated on important management and conservation issues such as phenology, seed cast, growth studies, genetic variation and thinning regimes for blue pine forests. The ecology of fir forests in Central Bhutan was intensively studied. Local volume tables specific to FMU are available for all conifer species.

However, there are still considerable knowledge gaps in understanding the ecology and dynamics of mixed conifer forests in general and of tree species like spruce, juniper and larch. Stand development in the logged-over mixed conifer forests requires continuous monitoring. Studies on dynamics of mixed conifer forests, light requirement of the main tree species in the conifer belt, recruitment distances, ecology of juniper and causes on fir die-back phenomena are being carried out.

Broadleaf Forest Management Research

Natural broadleaf forests are potential sources to provide goods and services for the well-being of the nation and local people provided they are utilized on a sustainable basis. Although, broadleaf forests were systematically utilized since 1950s, little is known about the ecology and silviculture as the complex ecosystem and biodiversity make intervention to manage them challenging and uncertain. Endeavors to study broadleaf forest have started only recently. The research activities include characterization of the broadleaf forest sub-types, assessment of natural regeneration, growth characteristics and grazing impact in Warm Temperate Broadleaf Forests, and evaluation of silviculture options to manage Temperate Oak Forests (*Quercus semecarpifolia*).

Wood Products Research

Forestry contributes about 11% to the Gross Domestic Product (GDP) and generates 3% of the revenue through royalty collection and sale of wood and wood products (World Bank, 1997). Logs, sawn timber and veneer including non-wood products account for about 20% of the exports. The recent move towards timber pricing and marketing reforms has resulted in the ban of saw log export creating a suitable environment to improve logging, wood conversion and wood processing technology. Research on wood products was initiated to determining physical and mechanical properties of major broadleaf and conifer species in collaboration with the FRI, Dehra Dun in 1980s. Scientific work on this important area is restricted due to limited resources, research capacity and facilities.

However, there is ample scope to increase the supply of quality wood products through a reduction in cost and wastages during logging and wood conversion, and by improving wood processing technology. Also, there are many lesser-known tree species still underutilized that could be made use of by converting to value-added wood products that would bring in extra revenue to the country.

Non-wood Forest Products (NWFP) Research

Rural people largely depend on NWFPs for subsistence and income and NWFP development to reduce poverty is the main theme in the current 10^{th} FYP. Many studies show that NWFPs are indispensable at the household level for medicine, food, cash, employment and utility. The DRC Bhutan Trade Statistics (1991-1999) indicates the export value ranges from Nu. 14.29 million and Nu. 44.04 million. The most important NWFPs that are exported are bamboo, ratan cane, chirata, pipla, rosin and turpentine oil, agar-wood, lemon grass oil, *Cordyceps*, mushrooms as well as plants used for incense sticks and handmade papers.

A number of individual studies on NWFPs have been undertaken on documenting resource distribution and uses. Studies are undergoing on important NWFPs (bamboo, rattan canes, mushrooms, agarwood, *Cordyceps* and Medicinal plants) to quantify and domesticate them so that the results have implications on conservation and sustainable use.

Government and Industrial Re-afforestation Research

As a large proportion of natural forest is still intact, national plantation forestry is negligible, for it constitutes a meager 0.2% of the country's forest. With the increasing population, the forest boundaries near settlements are gradually receding and forest cover in some watersheds are diminishing due to collection of wood and non-wood products and grazing. Such areas are being re-forested through plantation by the government, industries and people. In line with the long-term goal of the forestry sub-sector "enabling mechanism for wood based industries" wood-based industries such as Bhutan Board Products Limited (BBPL) and Bhutan Carbon and Carbide Limited (BCCL) have been allocated state forest land for clear felling followed by plantation establishment.

Numerous experiences are available with field foresters on seed collection, nursery and planting techniques but few have been documented. Very limited plantation research has been undertaken except for species/provenance evaluation of *Alnus* and *Eucalypt* and fertilizer trial for blue pine plantations.

Social Forestry Research

The legal framework of forest management was established with the enactment of the Bhutan Forest Act in 1969. This Act brought all forests in Bhutan under the control of the State and it has been successful in protecting forests and maintaining forest cover at 72.5% of the land area. To attract the participation and cooperation of local communities to manage and protect forest resources the Forest Act 1969 was revised in 1995 to provide a legal avenue for local people to participate actively in the forest management process. Community forestry programs are going on in a few selected areas of the country.

In order to support the program, research is in progress in the areas of multi-purpose tree selection and assessing impact of local uses on forest resources within the context of Community Based Resource Management (CBRM) and social aspects of community forestry.

Forest Protection Research

Outbreak of pests and diseases is natural in all types of forests. Some information on common pests and diseases, such as spruce bark beetle, chir pine defoliator, mistletoe are available and preventive and control methods for them have been worked out through studies.

However, there is still inadequate knowledge on pests and diseases to develop prevention and control measures. Therefore, a proper surveillance system to monitor pests and diseases outbreak is not in place. Also, there is little understanding of forest fire behavior and ecology to develop appropriate strategies for preventing and controlling forest fire.

Forest fires in Bhutan are man-made and therefore awareness campaigns are organized on a regular basis. But still forest fire incidences occur frequently in blue pine and chir pine forests. In order to properly plan for forest fire protection, zoning of fire risk based on fuel load accumulation and plantation, die-back problems investigated in plantation are currently being carried out.

4.1.2 Forest Extension

Forest extension in Bhutan is decentralized with the Dzongkhag Forest Officer (DFO) administratively under the District Administrator (Dzongda) heading the forestry extension program. However, the DFO is technically and functionally under the Social Forestry Division, Department of Forest (DoF). DFO is supported by a number of Foresters and Forest Guards who are posted at Geogs (Block) and Chiwogs (sub-blocks). The main job of the DFO and his team is to extend advisory and technical services to the local community on forestry issues, forest fire protection and rural timber allocation. The work also includes operating nurseries and creating plantations and other integrated services such as watershed management and implementing collaborative participatory research in the Dzongkhags and Geogs.

4.2 Education and Training

The education system in Bhutan has come a long way and a modern school system started in 1961 with the launching of the 1st Five Year Plan (FYP). Traditionally, Bhutanese foresters have been trained mainly in India using facilities of the Indian Forest College at Dehra Dun, the Northern Forest Ranger's College, Dehra Dun and Dowhill School, Kurseong for its officers, rangers and foresters, respectively. Even today the forest officers, forest researchers, wild-life biologists and other professionals are trained in India and abroad as Bhutan does not have a graduate college for studies on forestry and environment.

In keeping with the policy of building its educational and training program on local foundation, the RGoB started a school for Forest Guards in 1971 at Kalikhola in Southern Bhutan. In 1977, the school was shifted to Taba, Thimphu. In 1979, the school was opened for training of technical officers

(forester). Then, the Ministry of Agriculture, RGoB, started an integrated Natural Resource Training Centre (NRTI) at Lobesa in 1991 for training the technical officer level for DoF, Department of Livestock and Department of Agriculture. Besides, undertaking training on the selected streams (i.e. forestry, livestock, agriculture), the trainees are also exposed to extension, communication and participatory methods.

At the start of the NRTI at Lobesa, the technical officers (forester) training at Taba was moved to Lobesa while the forest guards training continued at Taba. The course at NRTI is a two-year course after ISC (10+2) with a combination of theory and practical trainings. Upon completion of the diploma training, the forestry graduates are mainly recruited by the DoF, Forest Research and Dzongkhag Forestry Extension in positions as forest rangers. Depending on duty station their responsibilities and nature of duties significantly differ.

With the recent establishment of the Royal University of Bhutan (RUB), NRTI has been brought under the RUB's administration and re-named as the College of Natural Resources (CNR). From 2009, CNR will offer a 3-year bachelor course in forestry, agriculture and animal science.

With upgrading to a tertiary education institute, Sherubtse College, Kanglung also offers a bachelor degree in general science subjects. The BSc graduates of Sherubtse College can join the Department of Forests and later pursue in-service higher studies in forestry and allied subjects. As Bhutan has no higher learning institutes, the professional foresters and higher degree courses are still trained in India and abroad. At present, the Ugyen Wangchuk Environmental and Forestry Institute (UWEFI) is being established at Lamegonpa. Bumthang, designed as an institute for conducting MSc courses and research in the areas of environment and forest management.

5. Innovation and Prospects for Re-Afforestation and Conservation

5.1 Ecosystem Services

Bhutan is well known for its pristine environment and conservation of its natural resources mainly forest resources. With the national policy of keeping 60% forest cover all times to come, Bhutanese population can largely benefit from ecosystem services. Bhutan is a signatory to the Rio Convention on Biological Diversity and the National Assembly has ratified the convention in 1995. In supporting this convention, Bhutan is committed to protect rare, endangered and endemics species and to uphold it's national, regional and global responsibility. Presently, work is in progress to draft a National Action Plan (NAP) for biodiversity so as to translate the ideas of the Rio Convention into action. Towards this end, the Bhutan Trust Fund in pursuing "Bhutan 2020 –A Vision for Peace, Prosperity and Peace" envisions the greening of national accounts, by including environmental satellite accounts as the basis for calculating the GDP. The protection of forest resources in Bhutan can provide economic benefits primarily categorized into three benefits; (1) market and non market values associated with NTFPs, bio-prospecting, and genetic resources); (2) aesthetic values for eco-tourism and; (3) ecosystem service values which are being appreciated and becoming important worldwide.

Similarly, air filtration, water purification, maintenance of soil fertility, crop pollination, flood control, erosion control, maintenance of stream and river discharge rates are some of the ecosystem services provided by the forest coverage in Bhutan.

The two critical ecosystem services provided by maintaining forest cover are (1) erosion control and (2) maintenance of water discharge patterns. Erosion control would have impacts both at local and regional levels. Locally, it would control the water quality, provide water supply to settlements, agricultural lands and increase the economic benefits from hydro-power development. Regionally, it would reduce sediment loads (i.e. reduce floods during the monsoon months) in low lying areas of Bangladesh and India.

The maintenance of discharge patterns aims at a more uniform discharge rate and provides substantial economic benefits for hydro power development. This is because peak discharge rates are lessened when forest cover is maintained, thereby reducing the risks of flooding.

Based on the ecosystem services provided by maintaining forest cover, Bhutan and local communities can benefit through the following initiatives:

(a) Ecotourism and Nature-based Tourism

In Bhutan, tourism is increasingly being seen as one of the major opportunities for economic diversification. At the same time, Bhutan does not wish to compromise the fast economic return of tourism with erosion of cultural heritage and biodiversity. Thus, the policy of high return and low impact tourism targets rich individuals and countries in order to limit the ill effect of tourism on physical and cultural environments. Eco-tourism and nature based tourism is increasingly becoming popular with the people living in the industrialized countries. Thus, Bhutan, endowed with bountiful nature and rich-unique culture and tradition has a big potential to benefit from this growing market. The plan of establishing eco-tourism or agro-tourism (FSD, 2000) based on the principle of en ecologically friendly, culturally acceptable and economically viable environment should be implemented involving all stake holders including local people.

Integrated conservation and development projects (ICDP) are in place within the protected areas in Bhutan and so far it seems to show that conservation can be strengthened by promoting development for local communities while enhancing income of local residents.

(b) Non-wood Forest Products (NWFP)

Recent studies show that NWFPs are indispensable at the household level for medicine, food, cash and employment. Also, a substantial amount of revenue is brought into the country through export of NWFPs. Bhutan Trade Statistics (1991-1999) indicates that the export value of NWFPs ranges from Nu. 14.29 million to Nu. 44.04 million[16] The most important NWFPs that are exported are bamboo, cane, Chirata, Pipla (P*iper spp*.), rosin and turpentine oil, lemon grass oil, mushroom, incense sticks and handmade papers.

Non-wood Forest Products (NWFP) such as medicinal plants, mushroom, bamboos, local handicrafts constitute a growing market worldwide as scarcity for such niche products increases. There is a growing demand for ecological nature-based products offering attractive prize mainly in industrialized countries. Bhutan's rich forests will provide a wide range of these NWFP with benefits to both conservation and development efforts. NWFP can be managed sustainably by local people under community based natural resources management programs (CBNRM). The CBNRM is becoming a popular concept and mechanism to manage natural resources such as NWFP in Bhutan. CBNRM would enhance the rural economy while natural resources are conserved, managed and marketed through community empowerment and participation. Research initiatives such as bringing Chirata, Masutake and Cordyceps under CBNRM initiatives are underway. Community-based management and product development are under consideration for other important NWFPs such as bamboo, lemon grass, pasture grazing and water through rural enterprise projects.

(c) Bio-prospecting

Rich biodiversity and its relatively unexplored state represent a big potential for bio-prospecting in Bhutan. Bio-prospecting is a growing endeavor that involves search for new genes or chemicals of great value. Local people use different plants and animal products for medicine, dyes, spices and aromatics. If carefully undertaken, it may offer an opportunity for substantial economic benefits. However, patenting and ownership of the products should be carefully considered so that benefits also

[16] USD 1=NU. 1

go to the local people for their efforts and pains they have taken to preserve the valuable resources and indigenous knowledge (IK) on their use that led to the development of these useful commercial products. The recently approved Bio-Diversity Act 2003 protects farmers' rights and guarantees equitable benefit sharing from the commercial use of such resources.

(d) Hydropower

Agriculture and hydropower are two pillars of the Bhutanese economy. But because of the rugged terrain, dependence of economic development solely on agriculture is hard to imagine. Bhutan is rich in water resources and hydro-electricity projects are built to generate electric power. The surplus power is exported to India generating about 40% of the government revenue.

Therefore, to sustain hydropower generation, keeping intact the forest and environment close to nature is a crucial task which in turn will need the co-operation of local communities to optimize the use of forest resources. Returning parts of the revenue from electricity to improve the living conditions of local people staying within hydropower catchments would help sustain power generation while human communities and plant/animal communities prosper side by side.

(e) Water Resources

Water resources are abundant in Bhutan and this represents a growing economic value. The continuous availability and quality of water depend on proper ecosystem management. Promoting community forest management and putting a price tag on the intangible services from forests such as water and recreation and sharing these benefits with rural communities are some of the potential areas that would enhance rural income.

5.2 Payment for Environmental Services (PES)

Payment for Environmental Services (PES) is one type of economic incentive for those that manage ecosystems to improve the flow of environmental services that they provide. Generally these incentives are provided by all those who benefit from environmental services, which include local, regional and global beneficiaries. A number of PES schemes are now ongoing all over the world. Buyers, from local water-depending industries to climate-conscious companies in distant countries, from international conservation organizations to national governments, are increasingly aware of this opportunity and invest in their present resource needs and future local and regional environment.

The success of the payment for environmental services schemes requires a solid understanding of the markets for the environmental services. Among the vast environmental services ecosystems provide, the ones that currently stand out for payment systems are watershed protection, carbon sequestration and storage, biodiversity protection and landscape beauty.

5.2.1 Payment for Watershed Services

PES for watershed management usually involves upstream land users and downstream water users. Upstream land users may be paid for, as an example, not to build roads, harvest trees, or other land activities that could affect water quality and quantity for drinking water, irrigation, among others, downstream.

Using payments for water services can be a tool for poverty alleviation. For example, if downstream water users pay upstream communities to maintain good water quality, their livelihood could be enhanced. The mechanisms, by which upstream land managers in critical parts of watersheds can receive incentives to encourage them to avoid damaging land use changes, remediate poor land use and continue with good land use.

In Bhutan PES is still at the conceptual stage. The documents and projects are being developed on PES in relation to water resources and nature conservation in consultation with the concerned international institutes and donors (NEC, 2004). The underlying principle in PES is that there should be equity in benefit-sharing and the concrete benefits should go to the local communities as compensations for restricted use of local resources for the cause of the ecosystem services.

Indicative activities:

- Analyze the link between watershed outcomes sought and practices required to support these and assess the sufficiency of organizational and institutional arrangements for delivering, monitoring and reporting the delivery of these services.
- Calculate costs (initial and on-going) involved in improving watershed conditions to maintain or improve downstream water quality.
- Identify and test mechanisms to make payments to upstream land managers (particularly villagers) at a scale sufficient to have a downstream impact.
- Identify and put in place monitoring mechanisms to ensure that upstream land management is progressively improved, and that downstream water quality is maintained or improved.

5.2.2 Carbon Sequestration

Bhutan, due to low industrialization, has relatively insignificant emission of green house gas by the world standards but it is definitely increasing with population growth and the advent of economic development. There is a general lack of clarity on the contribution that forests make towards poverty alleviation resulting to un-appreciation on the globally emerging trend such as carbon trading that could bring immense benefits for the poor. For instance, farmers could trade carbon credits with companies for trees grown in private land or community forestry and for intact natural forests that exist because of community efforts in forest plantation and conservation.

Bhutan is also a signatory to the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and the National Assembly has ratified the convention in 1995 with the Convention on Biodiversity. By ratifying the convention Bhutan is fully committed to the objectives of the UNFCCC. Towards this end, the Clean Development Mechanism (CDM) which is one of the flexibility mechanism authorized in the Kyoto Protocol 1997 to the 1992 UNFCCC, was implemented such as the micro-hydro project at Rukubji, Wangdi is the approved CDM project. The other activities include:

Renewable energy technology options: Although mainly dependent on larger-scale hydropower generation which is a clean source of energy but expensive because of the need for extended power grids to reach scattered settlements. Therefore, options to explore mini-hydro-electrics, solar and bio-mass gasifiers are explored.

Improved technology to reduce fuel wood consumption: A majority of Bhutanese uses wood for cooking and heating purposes. Improved stoves are introduced to reduce fuel wood consumption and air pollution. Electric heaters are being introduced but they are expensive and beyond the reach of average households.

Introduction of fuel-efficient vehicle: Vehicles currently used are not fuel-efficient. In addition, they are major sources of CO_2 emissions. Monitoring systems to check emissions are in place and import of re-conditioned cars banned.

5.2.3 Markets for Carbon Sequestration

Carbon sequestration for climate change mitigation is seen as a global public service, making it difficult to develop effective payment systems. In Bhutan, the share of plantation forest is very small and almost all forests are natural, making them not qualified for carbon trading. However, community forestry and watershed rehabilitation programs are increasingly becoming popular in Bhutan. To date

(October 2008), 5,137 households are members of 100 Community Forest Management Groups (CFMGs) that plant and manage about 12,600 ha of forest. The management of these areas combines both timber and non wood forest products. It is projected that the number of CFMGs could rise to about 400 by 2013 (covering about 6% of the total forest area). In the long term, about 20% of the Government Reserved Forest (about 238,000 ha) has the potential to become community forest under the existing guidelines of 2.5 ha of community forest per household. In this regard, there is big potential for community forest plantations which can serve as the carbon sink and ultimately benefit the local communities.

6. Recommendations

Based on the analysis of various issues affecting re-afforestation and plantation, the following strategies are recommended in line with the National Re-afforestation Strategy 2008.

6.1 Policy and Legal Adjustment

Re-afforestation is the mechanism to rehabilitate barren and degraded areas to compensate for the losses of forests through deforestation. However, re-afforesation programs in the past had suffered heavily due to minimal funding for both plantation establishment and maintenance. In order to sustain the long term policy goal and to ensure success of re-afforestation, a sustainable funding mechanism for re-afforestation has to be sought and secured. Policy and legal instruments need to be instituted to develop mechanisms where various agencies using forest resources could allot some funds for re-afforestation programs as payment for services (PES) provided. Hydro-powers, tourism sector and wood-based industries are some of the beneficiaries and potential sources of funding.

As per the FNC rules 2006, there is no provision to hand over the government plantations raised near and in between the settlements to the local communities. This needs to be looked into, as most of the plantations in the vicinity of settlements have failed due to grazing and browsing damage. Handing over of such plantations to the communities as part of community forestry (CF) and making arrangements to get payment for carbon sink will help to promote greenery and to raise the economic wellbeing of local people.

6.2 Outsourcing of Reforestation/Plantation Activities

Estimations of degraded forest in the country range from 32,356 ha (Dhital, 2005), 95, 430 ha (SFD, 2004), and 231,000 ha (MoA, 1991) to 325,000 ha (LUPP, 1997). It is essential to field truth and map these degraded areas to effectively plan and facilitate the plantation programs. A detailed survey will be conducted to verify and map the degraded forestland and collect basic information including the land use rights and patterns, site conditions and interventions needed.

The areas identified and mapped can be outsourced for re-afforestion for the following:

- The larger parts of the barren and degraded areas which require protection and need to be maintained permanently under tree cover can be released for raising plantations under carbon trading funding.
- Large areas in the South where harvesting operations can be carried out on a sustainable basis will be released to FDCL for raising commercial plantations.
- Open areas near army bases, schools and other institutions will be handed over to them for raising plantations with management rights.
- Similarly, degraded forestland will be leased out to the wood-based and other industries and institutions interested in taking up plantations to meet their resource demand.
- The remaining barren and degraded areas which are small in size will be planted up by the Dzongkhag forestry sectors, territorial forestry divisions, parks and other agencies.

6.3 Involvement of Local Communities

Most plantations in the past have failed due to uncontrolled grazing and browsing of plantations. One of the viable measures to protect plantations from biotic interferences is to secure local people's support for the plantation program. It has therefore become critical to involve local people in planning and implementation of the program. Consultative meetings should be held to identify plantation needs, selection of sites and species based on their needs. Further, the plantation activities can be contracted out to the local people to provide employment opportunity. As per Section 27(1), Chapter IV of the FNC Rules 2006, plantations raised by the department shall not be included in the Community Forest (CF). This policy needs to be reviewed as the M&E exercise has revealed that most plantations near and in between the settlements have completely failed due to great pressure from biotic interferences. The handing over of such plantations to the nearest communities as part of CF would ensure better management of the degraded forestland, benefitting both the government and the public in the long run.

6.4 Strengthening Nursery and Plantation Management

To raise quality plantations, plantation activity requires proper planning. This includes consultation of the nearby communities, selection of species according to site condition and objective of the plantation, correct method and time of planting. In addition, due consideration should be given to site preparation, seedling transportation, fencing and post plantation care.

Maintenance activities like replacement of mortality, weeding, cleaning and fence repairing is a critical component of plantation management. The field offices should ensure that all the plantations are properly maintained.

There is a need to deploy plantation caretakers to guard the plantations from biotic interferences. This will go a long way in ensuring success of plantations and fulfilling the policy objectives.
Considering the role of quality seedlings in ensuring success of plantations, the present nurseries need to be improved and more of standard nurseries established by applying appropriate nursery techniques and practices. The nurseries should have a good mixture of species having economic, aesthetic, and ecological values to fulfill the varied requirement of seedlings for different types of plantations. As directed, all the Dzongkhag forestry sectors, territorial forest divisions and parks should have a central nursery each to fulfill the ever increasing demand for seedlings for different categories of plantations viz. normal plantations, commercial plantations, recreational plantations, soil and water conservation activities, etc.

The field offices which do not have nursery caretakers should appoint labor caretakers to ensure effective management of the central nurseries. Private individuals who are keen to operate nurseries for the purpose of generating income will be provided with full technical support for the exploration of markets for the seedlings.

6.5 Strengthening Technical Capacity in the DoF and Dzongkhags

People with skills and expertise are a prerequisite for managing quality nurseries and plantations. Sound knowledge on correct choice of species, basic nursery and plantation techniques and tending operations are essential for effective implementation of the plantation programs. In recent times, a major focus has been on bioengineering and landscaping activities which also require professional expertise. Therefore, technical capacity in both the DoF and Dzongkhags will have to be enhanced through intensive ex-country and in-country training programs.

6.6 Strengthening Linkages with the RNR Research System

Effective research and development based on appropriate genetic planting materials, planting environment and good silviculture are the foundations of successful plantation forestry. The Social Forestry Division (SFD) will collaborate with the research centers to carry out trials on various plant species having multipurpose values to develop appropriate plantation and nursery management practices under different ecological conditions. The research should also focus on pest and disease management in nursery and plantations.

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List of Acronyms and Abbreviations

BBPL	Bhutan Boards and Products Ltd.
CDM	Clean Development Mechanism
CBNRM	Community-based natural resource management
CF	Community Forest
CFO	Chief Forest Officer
CoRRB	Council for Renewable Natural Resource Research of Bhutan
CNR	College of Natural Resources
FDCL	Forest Development Corporation Ltd.
DFO	Dzongkhag Forest Officer
DoF	Department of Forest
DoL	Department of Livestock
FMU	Forest Management Unit
FNC	Forest and Nature Conservation
FRP	Forest Research Program
FYP	Five Year Plan
GDP	Gross Domestic Products
ICDP	Integrated Community Development Project
RGoB	Royal Government of Bhutan
MPFP	Master Plan for Forestry Development
NAP	National Action Plan
NWFP	Non-Wood Forest Product
NRTI	Natural Resource Training Centre
PES	Payment for Environment Services
PIS	Pre-investment Survey
PPD	Policy and Planning Division
RNR	Renewable Natural Resources
RNR-RC	Renewable Natural Resources Research Centre
RUB	Royal University of Bhutan
UNFCCC	United Nation’s Framework Convention on Climate Change
UWEFI	Ugyen Wangchuck Environment and Forest Institute

Dzongkhag Terms

Geog	Block
Dzongkhag	District
Dzongga	District Administrator
Chiwog	Sub-block
Tseri	Shifting cultivation
Maang	Community
Reesup	Forest caretaker
Meesup	Fire watcher

Fir Forest at Bumthang (3200 m) Central Bhutan

Natural Regeneration Assessment in Temperate Broadleaf Forest at Lampari (2600 m)

Mature *Cordyceps sinensis* at Namnala (4200 m) North Bhutan

Pine Dieback at Chuzom (2100 m), West Bhutan

Community Meeting with Community Forestry Group at Pema Gatshel (1800 m), East Bhutan

INDIA: BRINGING A THIRD OF THE LAND UNDER FOREST COVER

Promode Kant[17], Preet Pal Singh[18], Ghazala Shahabuddin[19], and Rajeshwar Singh Jasrotia[20]

1. General Information

India is a land of unparalleled diversity, diverse in physical features, in climatic conditions, in its flora and fauna, and diverse in the people that inhabit this vast land. It is a land of many races, cultures, faiths, ethnicity, languages and traditions. The topography ranges from the highest of mountain peaks in the north to sea coasts in the south, from the driest deserts in the west to the wettest rainforests in east and from near equatorial tree line in the deep south to the cold deserts high in the Himalayas.

1.1 Physiography

The country's geographical area of 328 million ha forms about 2.4% of the world's total area. It has a land frontier of 15,200 km and coastal length of 6,100 km. The main land extends from 8^o to 37^o N latitude and from 68^o to 97^o E longitude, measuring 3,214 km between extreme latitudes and 2,963 km between extreme longitudes. India's mainland comprises four broad geographical areas: the Northern Mountains comprising the great Himalayas, the vast Indo-Gangetic plains, the southern Deccan peninsula bounded by the Western and the Eastern Ghats, and the coastal plains and islands.

The Northern Mountains the comprising Himalayas embrace three almost parallel ranges interspersed with large plateaus and valleys and extend in the north of the country over a distance of about 2,000 km. The physical dominance of the Himalayas is evident from the large number of world's highest mountain peaks. The basin of three distinct river systems - the Indus, the Ganga and the Brahmaputra - forms the Great Plains, also known as the Indo-Gangetic plain. The Plains extend from Rajasthan in the West to Brahmaputra valley in the East. These plains comprise one of the world's greatest stretches of flat and deep alluvium and are one of the most densely populated areas of the world (more than 456 persons per km^2). The Deccan Peninsula covers the whole of South India. The Indo-Gangetic plains and the peninsular plateau are separated by mountain and hill ranges known as the Aravali, Vindhya, Satpura, Ajanta and Maikala ranges. The peninsula is flanked on either side by the Eastern Ghats and the Western Ghats. The western coastal plains lie between the Western Ghats and the Arabian Sea in the west, whereas the eastern coastal plains face the Bay of Bengal in the east. This is also a region with very high-density population (more than 349 persons per km^2).

Table 1: *Physio-geographic Zones of India*

Physio-geographic Zone	Area (km^2)	% Area
Northern Himalayas	322,158	10.50
Great Plains	730,955	22.20
Deccan Plateau	1525,279	49.76
Coastal Plains and Islands	486,635	15.38

(Source: MoEF, 2001)

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Soil: India has a wide range of soils, each type being specific to the locality. Alluvial soils cover about 78 million ha (about 24%) of the total land and occur in the great Indo-Gangetic Plains. These soils are excellent for the production of wheat, rice, other cereals, pulses, oil seeds, potato and sugarcane. The black cotton soils cover about 51.8 mha and are also good for cultivation of cotton, cereals, pulses, oil seeds, citrus fruits and vegetables. In addition, red soils cover about 51.8 million ha and are suitable for rice, ragi (millet), tobacco and vegetable cultivation. Laterite and lateritic soils occur over 12.6 million ha and desert soils in 37 million ha. These soils are not suitable for agriculture.

River Systems: The country is divided into 20 river basins comprising 12 major river basins, each having a catchment area exceeding 20,000 km^2, and eight composite river basins (Sharma and Paul, 1999). In addition, other water resources include reservoirs, tanks, ponds and lakes, which cover about 7 million ha of the surface area of the country. India has 14 major river systems that may be classified as: Himalayan rivers, peninsular rivers, coastal rivers and, rivers of inland drainage basin. Because of uneven precipitation, the availability of renewable freshwater varies enormously in different river basins. The Himalayan rivers are generally snow-fed and perennial. The peninsular rivers are rain-fed and, therefore, fluctuate sharply in volume. The coastal rivers are short in length with limited catchment areas. The rivers and tributaries of the peninsular and coastal rivers are intermittent and non-perennial in nature. The streams of the inland drainage basins of western Rajasthan are few and with little water holding capacity.

Climate: India is mainly a tropical country but due to great altitudinal variations, almost all climatic conditions from the driest to the rainiest, and very hot to very cold, exist. The climate of India may be broadly described as tropical-monsoon over most parts and montane temperate in the Himalayas. The monthly spread of four seasons can be categorized as: winter (December-February), summer (March-June), southwest monsoon season (June-September), and post monsoon season (October-November). The maximum temperature of the year occurs in May or early June and starts decreasing rapidly from October and reaches the minimum of the year in December or January.

India has a highly seasonal rainfall pattern, with 50% of precipitation falling in just 15 days. India receives annually about 4,000 km^3 of water through precipitation. About 80% of the country's annual rainfall is mainly in the form of southwest monsoon from June to September, followed by northwest monsoon from November to December. It varies from as low as 100 mm in western Rajasthan to as high as 9000 mm in Meghalaya in northeast India. Monsoon rainfall is usually torrential in intensity. This high intensity run-off results in intense soil erosion (Sharma and Paul, 1999).

1.2 Demographics

India has a human population of 1.03 billion comprising 193 million households living in about 600,000 villages and more than 5,000 towns (GoI, 2001). The decennial growth rate (1991-2001) of population is estimated to be 21.97%. Urbanization is significant and increasing rapidly, with 28.7% of the population living in urban areas. The average density of population has increased from 267 in 1991 to 325 per km^2 in 2001. The age composition of the population is given in Table 2.

Table 2: ***Proportion of Population by Broad Age-groups***

Age group (years)	Persons	Male	Female
0-14	35.3	35.6	35.1
15-34	33.8	33.7	33.9
35-59	23.1	23.3	22.9
60+	7.4	7.1	7.8
Age not stated	0.3	0.3	0.2

(Source: GoI, 2001)

Although it is difficult to accurately predict population growth rates for the next 20 years, the population is expected to be about 1.33 billion by 2020, despite continuous efforts to reduce fertility rates (Gupta, 2002). India is in the process of a demographic transition from high fertility, high mortality and unstable population to low fertility, low mortality and stable population. Falling mortality rates have been accompanied by a steady decline in birth rates, but this decline has not been as steep as the fall in death rate. Even after reaching the replacement fertility rates, the population will continue to grow because of large numbers of young person entering the reproductive age group.

The largest growth of population will be in the 15-64 year age group, which is estimated to expand from 604 million in 2000 to 883 million in 2020. This rise will accentuate the need of increasing employment opportunities. The elderly population is also expected to rise sharply from 45 to 76 million and their share in the total population would rise from 4.5 to 5.7 per cent. As a consequence of these changes in population, the age-dependency ratio (ratio of non-working age population to working age population) is expected to fall from 67% in 2000 to 46% in 2020 (Bhatt, 2001).

1.3 Economic Situation

India is presently the second fastest growing economy in the world and fourth largest economy in the world in terms of purchasing power parity (World Bank, 2008). The Indian economy has experienced dynamic economic growth with the gross domestic product (GDP) growing by 9.4% in fiscal year (FY) 2005-06, 9.6% in FY 2006-07 and 9% in FY 2007-08 (ES, 2008). Agriculture contributes 16.6% per cent to GDP, compared to 28.4% by the industry and 55% by the service sector (ES, 2008). The major part of agriculture land in the country is rain-fed, extending to over 87 million ha and constituting nearly 61% of the net cultivated area. The wide variation in rainfall and potential evapo-transpiration decides the actual land-use and vegetation cover. Presently a large percentage of area under cultivation of coarse cereals (90%), pulses (81%), oil seeds (76%), cotton (65%) and rice (50%) is rain-fed (NAPCD, 2001). Agriculture supports the livelihood of 67% of the population (HDR, 2007). Even though the contribution of agriculture to the national economy has been rapidly shrinking over the years (MoA, 1996), the displacement of agriculture, animal husbandry, forestry and fishing as the main source of employment has been relatively slow. The work force in these occupations was 71.8% in 1961, declining to just 67% in 2005. The service sector accounts for 20% and the industrial sector accounts for livelihood of 13% of the population. The productivity of agriculture and allied activities needs to increase rapidly to improve the living conditions of the majority of the people.

India had a Human Development Index (HDI) value of 0.619 in 2005, and was ranked 128th worldwide in terms of HDI (UNDP, 2008). In the year 2005 the GDP per capita was US$ 3,452 (PPP) and its Human Poverty Index was 31.3%. As many as 28.6% of the population lives below the national poverty line (UNDP, 2008), a Gini index of 36.8 indicates that income distribution is somewhat uneven. Almost half of the children of age less than 5 years are under-nourished or under-weight and 22% (89 million) of the total labor force suffers from chronic unemployment and underemployment (GoI, 2001). Per capita electricity consumption is one-sixth of the world's average and one-twentieth of that in high-income countries (World Bank, 2000).

1.4 Environmental Status

The economic surge provided by 9% growth in GDP has led to increasing demand for services and natural resources. This rapid economic growth and the social and infrastructural development required to achieve the United Nations (UN) Millennium Development Goals suggests that the natural resources, particularly land and water, shall be under heavy pressure in the coming decades. A World Bank study (Brandon and Honmann, 1997) estimated that the major environmental costs for India measured 4.5% of GDP. Water pollution, soil degradation and urban air pollution have the highest share, followed by rangeland degradation, deforestation and tourism. This study, however, does not account for the loss of biodiversity, the loss of soil productivity, and health costs arising out of pollution caused by industrial wastes and use of pesticides.

A little less than half (about 173 million ha) of the country's geographical area is degraded thus affecting the productive resource base of the economy. The major causes of land degradation are deforestation, unsustainable agricultural and water management practices, land use changes for development, and industrialisation. The major process of land degradation is soil erosion (water and wind erosion), contributing to over 71% of the land degradation in the country. Of this soil erosion from water alone contributes to about 61.7%. The land degradation, in turn, results in loss of agricultural productivity; loss of natural resources of flora and fauna, problems of sustenance, and overall decline in the quality of life. Table 3 lists the status of key natural resources and reasons for their qualitative decline.

Table 3: ***Key Natural Resources, Status and Causes***

Key Resource	Status	Causes
Loss of critical habitats/ biodiversity	• 23 species extinct • over 1500 plant species, 79 mammals, 44 birds, 15 reptiles, 3 amphibians and several insects listed as endangered • Conversion of tropical wet evergreen and semi-evergreen forests to littoral and swamp, tropical thorn and tropical dry deciduous forest types.	• Overexploitation of biological resources • Land use changes and developmental activities – roads and mining
Groundwater resources	• Groundwater pockets in industrialized zones contaminated with heavy metals, fluorides, phenols and coliform bacteria	• Excessive extraction of groundwater without commensurate recharge • Leaching of pollutants to the aquifers
Surface water	• 90% of the surface water contaminated • High Biological Oxygen Demand values in rivers and lakes of national importance • Half of the rural households and nearly 20% of the urban households do not yet have access to safe drinking water.	• City sewage and industrial waste discharge into river • Grossly inadequate waste water treatment facility • Lack of national bench marks for consumption of water.
Air	• Annual average concentration of Suspended Particulate Matter (SPM) exceeds the maximum permissible levels in 14 cities. • Delhi listed as the fourth most polluted mega city in the world • Six of the largest cities in the country have annual average concentration of SPM more than three times the average WHO standards. • In 20 cities, the Air Quality Index falls in 'dangerous' category	• Rapid economic development and industrialization • Lack of an efficient and effective public transport system. • Poor urban/land use planning leading to concentration of industries in urban areas
Solid waste	• Increasing generation of solid waste • Increasing generation of toxic and hazardous waste • Only 2-3% of annual fly-ash generated utilized	• Rapid urbanization • Lack of an integrated solid waste management system • Absence of toxic and hazardous waste disposal facilities

(Source: TERI, 1998; JICA, 2002)

1.5 Agricultural Situation

India supports 18% of the world's population and 15% of its livestock on merely 2.2% of the world's geographical area. Of the reported area of 306.05 million ha, nearly 46% area is being utilized for agricultural purposes; 23% is under forests; 8% under buildings, roads and surface water; 6% is barren and uncultivable land covered by snow and desert areas; and 17% under other uncultivated land including fallows. About 60% of the net sown area of 142 million ha is rain-fed. There has been an increase in the gross cultivated area, from 132 million ha to 190 million ha (Table 4) in the past 50 years because of the increase in cropping intensity from 111% to 135%.

Table 4: ***Land Use Date for 1950/51 and 1999/2000***

Category (area in m ha)	**Years**	
	1950/51	**1999/2000**
Geographical area	328.73	328.73
Reporting area	284.32	306.05
Forests	40.48	69.02
Not available for cultivation	44.35	47.52
Area under non-agricultural uses	9.36	22.97
Other uncultivated land excluding fallow land	49.45	28.49
Net cultivated area	118.75	141.23
Gross cultivated area	131.89	189.74
Net irrigated area	20.85	57.24
Gross irrigated area	22.56	76.34

(Source: Directorate of Economics and Statistics, 2003)

Agricultural growth is essential for overall growth of the Indian economy. This growth rate is essential for improving the living standard of agricultural dependent people. The historical growth rate in Indian agriculture post 1950s has been 2.55% per annum. It is estimated that the requirement of food stock to feed India's projected population of 1.4 billion in 2030 will be 114 million tonnes of rice, 83 million tonnes of wheat, 13 million tonnes of maize, 106 million tonnes of fruits, and 193 million tonnes of vegetables (TERI, 2005).

Considering various factors such as population growth rate, diminishing per capita of land and water resources, and increasing land degradation problems, an annual increase of 5-6 million tonnes in the output of food grains will be required (NAPCD, 2001). This is expected to result in tremendous pressure on soil resources considering competitive demand for land for meeting the requirements of industrialisation and urbanisation (MoA, 2000), and raising lucrative cash crops. The National Agricultural Policy aims to achieve more than 4% growth rate. This is a formidable task particularly in context of the historical low rate of growth in Indian agriculture. This growth rate can be achieved through biotechnological breakthroughs, expanding area under irrigation and increasing area under cultivation. Out of these three options, the scope for increasing physical area under cultivation is limited.

Net cultivated area has stagnated at 142 million ha (Table 3). The potential area now available for extension of agriculture comprises marginal and sub-marginal lands and, therefore, further extension of agriculture will be costly, as it would require extensive soil and water conservation works, irrigation, and reclamation (Gundimeda et al., 2005). The physical area under crops is unlikely to increase in future (Persaud and Rosen, 2003; Ravindranath et al., 1995). Intensification of agricultural production and growth in crop yields will play a major role in increasing India's food production in future (Persaud and Rosen, 2003). In India, there is a large scope to increase the crop yield. The productivity of rice in India in 1996 was 2.8 t/ha as against 6.1 t/ha in China and 8.5 t/ha in Australia. Yield gap studies reveal that even in agriculturally advanced states like Punjab, actual yield of paddy can be raised by

87% using existing improved technology. In case of most of the crops, improved technologies are already available to substantially increase the actual yield (Joshi, 1996).

1.6 Livestock Situation

The bovine population has increased substantially by 42% during the last five decades (1951-2003). The sheep population has increased from 39 million in 1951 to 61.5 million in 2003. In the same period, the goat population has increased by 164% from 47 million to 124 million (NDDB, 2003). Across all species, livestock population in India is high but of low productivity. However, livestock rearing is a major instrument for improving rural employment, particularly rural self-employment as it contributes 5-6% to the nation's GDP. In 1991, 65% of the total Indian workforce was dependent on agriculture; 80% of which were involved in livestock production, either as producers or as workers. Women contribute 60% of the livestock rearing and management in rural households (NAPCD, 2001).

2. Forest Information

2.1 Forest Area

Forest Survey of India (FSI) defines 'forest' as 'all lands, more than one hectare in area, with a tree canopy density of more than 10 per cent' for the purpose of mapping forest cover. Using these criteria the forest cover of the country is 67.71 million ha or 20.60% of India's total geographical area (FSI, 2008). The distribution of area under very dense, moderately dense and open forest is given in Table 5. Moderately dense forests cover almost half (10.12%) of the total forests and open forests slightly less at 8.82% of the total land area. Very dense forests cover just about 1.66% of the land surface.

Table 5: ***Forest Cover in India***

Tree Canopy Cover (%)	Area (mha)	% of Geographical Area
Very dense forest (> 70)	5.46	1.66
Medium dense forest (40-70)	33.26	10.12
Open forest (10-40)	28.99	8.82
Total forest cover	67.71	20.60

(Source: SFR, 2005)

In India, information[21] in respect of forest area is also available in terms of 'recorded forest area' which refers to area recorded as forests in government records and reported by the State Forest Departments (SFDs). The recorded forest area in the country are 76.96 million ha and includes 41.90 million ha of Reserve Forests (RF), 21.66 million ha of Protected Forests (PF) and 13.44 million ha of Unclassed Forests (UF) (FSI, 2008). The difference of 9.25 million ha between the recorded and actual forest cover is partly due to the fact that a good part of the recorded forest areas are under permanent snow cover or are deserts without tree growth and partly because some of these recorded forests have been cleared of the tree vegetation by anthropogenic interference.

[21] In this paper, the 'recorded forest area' and 'forest cover ' are reported as indicated in this paragraph

2.2 Forest Distribution

Forests are not distributed evenly in India, but are concentrated in Northeast, the Himalayas and Shiwalik Ranges, the Central highlands, Andaman and Nicobar Islands, strips along Western Ghats, Eastern Ghats and other hilly areas, and in coastal mangroves patches. Madhya Pradesh has the largest land of 7.6 million ha under forest cover constituting 11.22% of the India's forest cover followed by Arunachal Pradesh (10.01%), Chhattisgarh (8.25%), Orissa (7.15%) and Maharashtra (7.10%). The seven states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura in India's northeast together account for one-fourth of the forests and are considered one of the 18 biodiversity hot spots of the world. The total forest cover in the region is 170, 054 km^2, which is 67% of the geographical area of the region, of which 10.32% is very dense; 46.14% moderately dense forests; and 43.42% open forests (FSI, 2008).

The forest cover in the hilly region of the country spread over 124 districts across the country is 38.85% with 55 of these districts having more than two third of the area under forests. Another repository of large extent of forests is the 188 tribal districts that contain 60.11% of the total forest cover of the country. The percentage of average forest cover in these tribal districts is 36.81% (FSI, 2008).

2.3 Forest Tenure

Forests constituted into RFs (41.90 million ha) and PFs (21.66 million ha) are located outside the village boundary with the State governments, represented usually by the state forest department, holding ownership title. RFs and PFs forests are constituted under the Indian Forest Act or under forest laws of the States that prohibit their use by the local population unless specifically authorized. However, the *de-facto* position is different and firewood collection and grazing is common across most of the RF areas. In PFs all activities are permitted unless prohibited. Activities usually not prohibited under PFs include grazing of cattle, and collection of leaves, firewood, fodder and other non-timber forest produce.

However, post-1990 RFs and PFs are increasingly being managed under Joint Forest Management (JFM). The Joint Forest Management (JFM) notification of June 1990, issued by the Government of India pursuant to the National Forest Policy of 1988, emphasises participation of communities living close to forests in the management and development of forests. The JFM guidelines provide a framework for decentralization and devolution of rights and duties to the local forest dependent communities. The JFM committees are entitled to prepare micro-plans for management of the forests, sustainably harvest grass, lop and tops of branches and other NTFPs, and receive a share in income from the sale of timber and other commercially traded NTFPs. About 28% (21.44 million ha) of the total recorded forest area is under the management of 99,868 JFM committees. There is a clear trend towards devolving on the local communities to manage, to sustainably use and the right to earn income from the forest resources falling within the JFM areas (FSI, 2008).

Besides RFs and PFs, there is another category of land notified as 'village forest' within the village boundary which may belong to the forest department, or any other government department but is formally under the management of *village panchayat* (a community of the village). *Van panchayat* forests in Uttaranchal, and *Gramya Jungle* in Orissa, which are formally managed by village communities, are a part of this category. The villagers enjoy rights over timber, fuel wood, fodder and NTFPs in village forests and woodlots subject to the supervision of the *village panchayat*. NSSO (1999) estimates the extent of village forests and woodlots to be 7.9 million ha. Village forests and woodlots form a significant proportion of common property land falling within village boundary in Eastern Himalayas and Bramhaputra Valley, Western Himalayas, and Eastern Plateau and Hills.

In northeast India, indigenous institutions play an important role in forest management. About 9.8 million ha of forestland is under community control in the seven north-eastern states. In states like Nagaland and Meghalaya, over 90% of the forests, categorised as unclassed forests, are under the direct control of traditional village institutions, village communities, tribal clans and private individuals

(Proffenberger, 2006; GoI, 1999). A unique system of governance has evolved in the north-eastern tribal states, where district or regional councils have been given powers to legislate on issues such as forest management, shifting cultivation, and allotment, occupation and use of land with the intention of ensuring community empowerment and strengthening community-based institutions (Proffenberger, 2006).

Table 6: ***Forest Cover in North-east Under Community Control***

State	% of Total Area Under Forest Cover	% of Area Under Forest Cover Under Community Control	Area by Forest Cover Under Community Control (km^2)
Arunachal Pradesh	82	62	42685
Assam	30	33	7817
Manipur	78	68	11821
Meghalaya	70	90	14070
Mizoram	87	33	6052
Nagaland	85	91	12889
Tripura	55	41	2355
		Total	97689

(Source: Proffenberger, 2006)

The protected area (PA) network in India comprises 96 national parks and 510 sanctuaries covering an area of 15.59 million ha constituting 4.8% of the geographical area of the country. Of these, 28 PAs covering 37,761 km^2 have been declared as tiger reserves. Extractive forestry activities are not permitted in core areas of national parks and access of neighbouring communities to such areas are strictly restricted. However, the *facto* position is often different from the *de-jure* and 40% of the PAs are subject to severe livestock grazing, fodder extraction, timber extraction and NTFP collection (Kishwan et al., 2007)

2.4 Ecological Description

Indian forests are highly diverse and contribute about 8% to the world's biodiversity in terms of the total number of species. Out of 18 unique biodiversity 'hot-spots', which are storehouses of nearly 50,000 species or about 20% of the world's flora, two are located in India in the northeastern Himalayas and the Western Ghats. The number of plant species is estimated at more than 45,000, representing nearly 7% of the world's flora. India's faunal diversity represents about 6.4% of the world's fauna, with some 81,000 species (Khoshoo, 1995).

The classification by Champion and Seth (1968) is the most widely used ecological classification for Indian forests. This classification categorises forests into five major groups further divided into 16 forest types based on climate and moisture regimes. Of the area under forest cover the largest extent of 38.2% falls under the category of tropical dry deciduous forests followed by 30.2% under tropical moist deciduous forests. Tropical thorns extend over 6.7% while tropical wet evergreen forests cover 5.8%. Temperate and subtropical forests both cover about 5.6% each and alpine and sub-alpine forests of all descriptions cover about 12.9%. The ecological description and distribution of various forest types in the country is given in *Appendix A.*

2.5 History of Deforestation and Degradation

Before the organization of state forest departments by the British colonial regime in the 19th century, the cultivated and forest lands were in a state of flux and clearing of the forests was as often for military reasons and extending the land under cultivation (Rangarajan, 1994). In the early days of British East India Company rule forests suffered degradation due to large-scale felling for valuable timber and expansion of agriculture. The timber-rich forests in the western coastal tracts were heavily exploited for teak and other timbers required for ship building and for laying rail tracks and manufacture of rail wagons (FRI, 1961). After the excesses of the First World War there was a brief period of serious attempts at sustainable management of forests but soon the Second World War interrupted the process and led to excessive demands for timber and fuel wood all over the country. The discontinuation of supply of coal to the industries and rationing of petrol during the Second World War added further pressure on forests resulting in widespread degradation of forests (TERI, 1998).

After independence in 1947, the government abolished the prevailing *zamindari* (feudal) system, introduced land reforms and large private forestlands were taken over by the government. Before surrendering the forest estate many private forest owners indulged in indiscriminate felling during the transition period between 1946 and 1951 causing large scale degradation (MoEF, 1999). Though the recorded forest area increased from 39.94 million ha in 1947 to 62.70 million ha in 1951 (FRI, 1961), degraded forests formed a sizeable proportion of this increase. In the late 1950s and early 1960s, forestland was also allotted for farming under the 'Grow More Food' programme. Rehabilitation of refugees who came to India after partition also resulted in large-scale deforestation (TERI, 1998).

Diversion of forestland to agricultural, mining, industries and industrial townships and other infrastructural projects has been the main reason for decline in forest cover. An estimated 4.5 million ha of forestland was diverted during the 1950-1980 period for non-forestry purpose (MoEF, 1999) and this trend changed only after the enactment of the Forest (Conservation) Act in 1980.

The quantitative information on overall deforestation rates prior to 1980 is patchy, though a number of estimates for deforestation rates are available. NFAP (1999) reports annual forest loss of upto one million ha from mid 1970s to 1980. TERI (1998) estimates annual forest loss of 144,000 ha till 1980 and from 1975 and 1982 an aggregate loss of 1.4 million ha of forests. The1995 forest assessment by FAO places the area under natural forest cover at 64.96 million ha and under plantations at 17.7 million ha. It estimates annual deforestation rate of 0.6% (0.34 million ha) totalling 3.37 million ha during 1981-1990 period. Another study estimates that the cumulative area afforested in India during the period 1980–2005 at about 34 million ha, at an average annual rate of 1.32 million ha, though reliable information on survival rates or consumption rate of biomass from surviving plantations is lacking (FSI, 2006).

FSI reports an increase of forest cover of 64.08 million ha in 1987 to 67.71 million ha in 2005 and the FAO estimates for the period are only slightly different at 63.93 million ha in 1990 to 67.70 million ha in 2005. However, FSI's forest cover assessments from the year 2001 onwards are not strictly comparable with previous assessments because of change in the technique (digital in place of visual) and scale (1:50,000 in place of 1:250,000) of interpretation. Therefore, difference in forest cover assessed post-2001 from earlier assessments cannot be entirely attributed to actual changes on the ground. The latest FAO and FSI estimates do not differ significantly and indicate an increase in forest cover by 3.6-3.8 million ha over the last two decades. The broad trends of the various assessments, therefore, indicate that the forest cover in India has increased over last two decades and may have stabilized for short term at about 68 million ha. India is one of the few developing countries where the deforestation rate is near zero and forest cover nearly stabilized, unlike most other tropical countries (FAO, 2005; FSI, 2008).

2.6 State of Forest Degradation

Degradation is defined as the reduction in productivity, changes in species composition and reduced biological richness of a forest due to unsustainable harvesting, selective over-exploitation, loss of

natural regeneration, fire, pests and diseases, removal of nutrients and pollution. Change in forest composition, loss of natural regeneration, low growing stock and low productivity are important parameters that indicate the state of forest degradation.

Change in Forest Composition: There has been a steady decrease in high diversity tropical evergreen, semi-evergreen, montane wet temperate and sub-tropical pine forests and increase in relatively low diversity tropical dry deciduous and tropical thorn forests on account of human interference (Bhat et al., 2001). The combined effect of fire and grazing has converted forests into oak shrubs (*Quercus spp.)* in the outer ranges of Himalayas and into grasslands in Nilgiris (TERI, 1998). In disturbed native forests, lantana (*Parthenium hysterophorus* L.) has become the dominant understorey species, disrupting succession and decreasing biodiversity. Lantana has invaded not only natural forests but also PAs and is considered a major threat to native plants and animals (Sahu and Singh, 2008). Lantana invasion and proliferation is resulting in loss of biodiversity and decline in other ecological services in Corbett Tiger Reserve, Kalesar National Park and Pachmarhi Biosphere Reserve (Babu, 2006). *Mikania micrantha*, a perennial fast growing weed, has become a major menace in natural forests, plantations, agricultural systems in northeast and southwest India (Ragubanshi et al., 2005).

Shifting cultivation, fire and over-grazing have resulted in the gradual reduction in the spread of vulnerable species and in making selected tolerant species more abundant. The preponderance of teak (*Tectona grandis*) and sal (*Shorea robusta*) in the deciduous forests and of chir (*Pinus roxburgii*) in the sub-tropical regions of India is attributed to their inherent gregariousness and their resistance to injuries from fire and grazing (TERI, 1998). Concentration of human settlements in the mid-montane regions (about 1000–2000 m elevation) and the spread of fire from *chir* pine forests have reduced the area under *banj* oak (*Quercus leucotrichophora*) in the central Himalayan region (Rana and Singh, 1990). According to many ecologists, a greater part of this area is now dominated by *chir* pine where *banj* oak should have been the climax and dominant species (Champion and Seth, 1968). Bamboo has been wiped out from many parts of central India because of its overexploitation for industrial uses and also because it is extremely sensitive to damage from fire and grazing (TERI, 1998). In tropical forests, biotically disturbed sites have lower regeneration in comparison to relatively undisturbed sites (Champion and Seth, 1968).

Inadequate Natural Regeneration: Adequate natural regeneration is an indicator of well-managed and healthy forests. Loss of natural regeneration represents potential loss of future flow of environmental and economic services and has important implications in the context of rehabilitating degraded forests. Forest fires have also resulted in loss of natural regeneration, particularly of broadleaved species. Natural regeneration is either absent or inadequate in 53% of the country's forests (MoEF, 1999). FSI (1995) conducted regeneration survey in 1995 and estimated that regeneration of important species is absent in 73.56% forests (FSI, 1995). Further, the number of states in which the extent of regeneration was high decreased between 1987 and 1995 indicating progressive degradation of forests (TERI, 1998). Table 7 shows the extent of forest area with inadequate or no regeneration.

Table 7: ***Extent (%) of Forest Area with Inadequate or No Regeneration***

State	% Forest Area with Inadequate/ No Regeneration		State	% Forest Area with Inadequate/ No Regeneration	
	1987	***1995***		***1987***	***1995***
Assam	89.7	84.8	Madhya Pradesh	49.95	75
Arunachal Pradesh	76.8	68.6	Maharastra	-	89
Andaman and Nicobar Islands	31.7	-	Manipur	8.42	90
Bihar	54.01	32.5	Meghalaya	57.6	94
Dadara and Nagar Haveli	-	81	Nagaland	89.4	-
Gujarat	86.13	-	Orissa	85.66	66
Goa	67.93	-	Rajasthan	91.8	90.6
Haryana and Panjab (Shivaliks)	-	90	Sikkim	83.81	47
Himachal Pradesh	69.1	88.8	Tripura	-	69
Jammu and Kashmir	98.97	90.2	Uttar Pradesh	80.55	79.5
Karnataka	98.1	62.6	West Bengal	70.8	15

(Source: TERI, 1998)

Low and Declining Growing Stock in Forests: Table 8 illustrates the growing stock conditions in India's forests in contrast with other parts of the world. The volume of the growing stock in the country is much lower than global and regional values and also much below its potential productivity. The area under open forests is another indicator of extent of degradation. The forest area under open forests (canopy density 10-40%) is 28.99 million ha and has increased from 24.92 million ha in 1995 (FSI, 1995). Forests with canopy density of 40-70% and 10-40% contain 74.1% and 28.2% of the growing stock contained in forests with 70-100% canopy density (FSI, 1995). TERI (1998) estimates that despite an increase in the notified forest area from 62.7 from 1947 to 76.5 million ha in 1995, the growing stock has declined from 5.184 billion m^3 to 4.740 billion m^3 and attributes this to sharp increase in extraction during the industrial expansion after the World War II and also liquidation of tree assets by private land owners to realize quick profits before surrendering surplus lands under land reform acts.

Latest estimates by FSI place the total growing stock of wood in the country at 6.218 billion m^3 comprising of 4.602 billion m^3 inside the forest areas and 1.616 billion m^3 outside the recorded forest areas. The average growing stock per hectare in forest areas is 59.79 m^3 (FSI, 2008). Most of the growing stock in the forest is contributed by *Shorea robusta* (8.04%), *Tectona grandis* (4.33%), *Terminalia crenulata* (2.82%), *Pinus roxburghii* (2.71%), *Anogeissus latifolia* (2.44%), *Abies smithiana* (2.43%), *Quercus semicarpifolia* (2.08%), *Abies pindrow* (1.94%), *Castanopsis* species (1.76%) and

Schima wallichii (1.68%). In contrast, the largest amount of growing stock of wood in areas outside forests is contributed by *Mangifera indica* (11.18%), *Cocos nucifera* (4.94%), *Syzizium cuminii* (4.20%), *Azadirachta indica* (3.91%), *Madhuca latifolia* (3.72%), *Borassus flabelliformis* (3.64%), *Ficus* species (2.72%), *Prosopis cineraria* (2.65%), *Tamarindus indica* (2.57%) and *Acacia arabica* (2.31%) (FSI, 2008).

Table 8: ***Comparative Stocking of Forests***

Country	Region	Volume (m^3/ha)	% Forest Area
India	Asia	43	21.6
Japan	Asia	145	64.0
Nepal	Asia	100	27.3
Congo	Africa	132	64.6
Gabon	Africa	137	84.7
Indonesia	Asia	79	21.6
Austria	Europe	286	47.0
Germany	Europe	268	34.1
USA	N&C America	136	24.7
New Zealand	Oceania	125	29.7
Brazil	South America	131	64.3

(Source: FAO, 2005)

Low Productivity and Loss of Important Forest Functions: The current productivity of Indian forests is 1.37m^3 ha^{-1}, calculated on the basis of net annual increment of 87.62 million m^3 and forest cover of 63.7 million ha (FSI, 1995). This is low when compared to the global average of 2.1 m^3 ha^{-1} yr^{-1} (MoEF, 1999) and very low compared to the maximum potential productivity assessed on the basis of Paterson's index - an index designed to predict the maximum growth potential in terms of volume production over large areas (Johnston et al., 1967) based on evapo-transpiration, annual temperature range, mean annual precipitation, length of growing season and mean monthly temperature of the warmest month. On this basis and accounting for the biotic interference, productivity of forests would range from 1.35 m^3 ha^{-1} yr^{-1} in the arid regions of India to 7.66 m^3 ha^{-1} yr^{-1} in the humid/perhumid regions, with other regions of the country having a productivity of around 3-4 m^3 ha^{-1} yr^{-1} (MoEF, 1999). TERI (1998) estimates that reduced stocking of degraded forests in comparison to achievable potential results in annual loss of Rs 45 billion worth of industrial wood and Rs 12 billion worth of firewood. Forests are unable to meet the needs of the increasing population resulting in unsustainable usage of forests leading to further downward spiral of productivity and loss in important forest functions like watershed protection, soil protection, NTFPs and firewood availability for subsistence use, carbon storage in biomass, and biodiversity.

2.7 Reasons for Degradation

2.7.1 Direct Causes

Direct causes of forest degradation in India are uncontrolled fires, unregulated firewood extraction, grazing, mining, encroachments and shifting cultivation.

Fires

It is estimated that 98% of the forest fires are manmade (Ahmed, 2002). The Forest Survey of India conducted a sample survey in 1995 to estimate forest area annually affected by fire and their assessment reveals that on an average about 53.1% forest area is affected by fire every year. The

figure ranges from as low as 6.8% in Upper Subansiri in Arunachal Pradesh to as high as 97% in Dadra and Nagar Haveli. Of the total inventoried area, on an average, 8.92% is affected by frequent fires and 44.25% by occasional fires (FSI, 1995). Table 9 shows the incidence of fires across different types of forests. Repeated fires have affected relatively hardy species also and their ability to regenerate. The majority of fires are deliberately caused to facilitate collection (Bahuguna and Upadhayay, 2002) of commercially important NTFPs as 'mahua' (*Madhuca indica*) and 'sal' (*Shorea robusta*) seeds. It also results in new flush of grass for grazing and 'tendu' leaves (*Diospyros melanoxylon*) used for rolling local cigarettes. Fire is also used by shifting cultivators as a centuries old practice to clear the forests in northeastern states and in parts of Orissa and Andhra Pradesh.

Table 9: ***Percentage of Forest Area Affected Annually by Forest Fires***

Type	Area Affected by Frequent Fires (%)	Area Affected by Occasional Fires (%)
Coniferous forests	8	40
Moist deciduous forests	15	60
Dry deciduous forests	5	35
Wet/Semi evergreen	9	40
North Eastern Region	50	45

(Source: Bahuguna and Upadhaya, 2002)

Firewood Extraction

In 1996, wood energy consumption in India was 3,210 PJ, or 17.4% of the country's total energy consumption (Ravindranath et al., 2000). Fuel wood is used as a source of energy in 71.7% of all households in rural and 32.7% in urban areas (MoEF, 1999). Reliable information, on the income level at which households switch to other more expensive forms of energy, is not available (Lele et al., 1994). Since most wood used for fuel does not pass through the market the data on fuelwood extraction in India is inadequate and unreliable (TERI, 1998; Lele, 1994). Studies by the National Council of Applied Economic Research, Operations Research Group, FSI (1996), Mukherji (1994), Joshi and Sinha (1995), Lete et al. (1985), and Ravindranath and Hall (1995) have dealt with various aspects of fuel wood consumption, such as estimates on fuel wood consumption and rural-urban shares. FSI (1996) estimates total annual household fuel consumption for 1996 to be 162 million tons against sustainable supply of 17 million tonnes from forests and 98 million tonnes from non-forest areas, and concludes that the net deficit of 86 million tons of firewood is unsustainably removed from the forests. Tracing the origin of fuel wood, this study concluded that 51% of the fuel wood is derived from the forest areas and 49% from the non-forest areas of the country. A report prepared for the National Action Program for Combating Desertification (MoEF, 2001) also records that consumption of wood is 4 to 5 times higher than what can be sustainably removed from the forests and conclude that this contributes to the overall deterioration of the quality, stocking condition and productivity of forests ultimately leading to deforestation and degradation.

Shifting Cultivation

Shifting cultivation or *jhum* is a long-standing practice of raising food crops with "slash and burn" technique and ingrained in tradition and culture of most of the tribes inhabiting northeast India and in parts of Andhra Pradesh, Bihar, Madhya Pradesh and Orissa. At least 100 different indigenous tribes and over 600,000 families in the seven states of northeast India depend on *jhum* for subsistence. The area affected by shifting cultivation in northeast is assessed to be 3.8 million ha (Kishwan, 2007). Traditionally shifting cultivation was practiced with long fallow period ranging from 10 to 30 years. However with increase in population and progressive reduction of land, the fallow period has been reduced to about 2-3 years (Ahmed, 1997). This in turn does not permit the natural processes of recuperation to repair the disturbed ecosystem resulting in erosion and decline in soil fertility.

Encroachment

Reliable data on encroachments on forestlands are not available (Ahmed, 1997). In 1987 the Forest Survey of India estimated that over 700,000 hectares of forestlands were under encroachments (FSI, 1990). A 1999 report of the Ministry of Environment & Forests report states that about 1.5 million ha of forest area to be under illegal occupation for agriculture and other uses (MoEF, 1999). Encroachments on forestlands for cultivation and habilitation have been a regular phenomenon since independence. Though such encroachment rarely exceeds 1 or 2 ha at any given spot, the cumulative impact of such practices has resulted in the fragmentation of forests (TERI, 1998). The illegal encroacher cannot avail of technological and financial extension services for farmers and improve their productivity and he has to depend upon surreptiously extending the land under encroachment to increase his agricultural production thus further accelerating forest degradation. At several places the encroachments started as shifting cultivation and subsequently changed to permanent settlement and cultivation resulting in extensive fragmentation of forests (Ahmed, 1997).

Grazing

Several estimates are available in the literature regarding the availability (supply) and requirements (nutritional demand) of feed and fodder for livestock and the actual deficits. India's livestock population of 467 million grazes on 11 million ha of pastures. This implies that an average of 42 animals graze on a hectare of land compared to a threshold level of 5 animals. In the absence of adequate grazing land, nearly a third of the fodder requirement is met from forest resources in the form of grazing and cut fodder for stall-feeding. It is estimated that during 1993, the country faced a deficit of 570 million tonnes green fodder and 276 million dry fodders. In 1995 combined availability of green fodder from permanent pastures, other grazing lands, agricultural lands and forests was estimated at 434 million tonnes, whereas the minimum requirement was estimated to be 882 million tonnes. The big gap has resulted in unlimited and unrestricted grazing on forestlands (MoEF, 1999). An estimated 100 million cow units graze in forests annually whereas the sustainable level is only 31 million (TERI, 2001). Additionally graziers collect an estimated 175–200 million tons of green fodder annually (MoEF, 1999).

Grazing has been reported in 67% of the national parks and 83% of the wildlife sanctuaries surveyed (Singh, 2001). FSI (1995) survey reports incidence of grazing in 77.62% of the inventoried forests. Severe compaction from hooves of the animals have made the soil impervious and rendered it less fertile because of destruction of organic matter (TERI, 1998). Overgrazing and over extraction of green fodder are resulting in forest degradation through loss of vegetation and physical deterioration in the form of compaction and reduced infiltration, and increase in soil erodibility. Studies estimate that overgrazing results in annual erosion 6000 million tons of top soil and in changing plant association that is suitable only for sheep and goats (MoEF, 2001).

Mining

FSI and the Indian Bureau of Mines, Nagpur undertook a study in 1998 to analyze the extent of leased area for mining under forest cover. The study focused on the mining areas of five important metal minerals - bauxite, copper, iron, chromite and manganese - which caused most of the environmental degradation. A total of 353 mining leases of these minerals covered an area of 90,795 ha. It was found that 53,217 ha of the leased area were under forest cover out of which 71% was under dense forest cover. Madhya Pradesh, Orissa and Bihar accounted for 45%, 36% and 19% of the forest cover respectively. Figures about other mines are not available. Considering the area under working and abandoned coalmines, the total area under mining is greater than 1.3 million ha (TERI, 1998). Since 1980, more than 160,000 ha have been diverted for mining and in just last three years, about 300 mining projects involving a diversion of over 20,000 ha of forestlands have been accorded sanction by the central government (Bhullar, 2008).

2.7.2 Underlying Causes

Population Pressure

In heavily populated countries like India population is a major source of both poverty and environmental degradation. Development programs, howsoever innovative, are not likely to yield desired results. The stress on all common resources increases rapidly with increasing population and sustainability becomes nearly unachievable. In India, between 1950 and 1980 the number of people dependent on one hectare of Common Property Resources (CPRs) increased from 4.9 to 13.7 resulting in decline of both the range and the quantity of products from the CPRs. The extent of CPRs also has decreased sharply on account of their privatization through allocation by local and provincial governments further adding to the stress. The total area of CPRs in the country has declined from 100 million ha in 1947 to only 72.80 million ha in 1997 (TERI, 1998). Impoverishment of the natural woody cover of trees and shrubs occurs because per capita forest land in the country is one of the lowest in the world at only 0.08 ha against the requirement of 0.47 ha to meet basic needs, creating excessive pressure on forest lands (UNEP, 2001). Shrinking CPRs are leading to higher levels of resource extraction causing rapid deterioration of the forests across the country.

Poverty

Poverty is said to be both cause and effect of environmental degradation though the link between poverty and environment is an extremely complex phenomenon. The poor, who rely on natural resources more than the rich, deplete natural resources faster for their survival if the exploitation is beyond the carrying capacity. This becomes a vicious cycle with the environment degraded by over exploitation itself becoming the cause for accelerating the process of human impoverishment. In India, NTFPs provide gainful employment during the lean periods and supplements incomes from agriculture and wage labour (Tewari and Cambell, 1997). Nearly 400 million people living in and around forests in India depend on NTFPs for their sustenance and supplemental income and NTFPs provide up to 50% income to about 30% of the rural people (MoEF, 1999). Shortage of fodder, firewood, raw material for handicrafts, small timber requirements and other NTFPs greatly affect the survival needs of the poor and the increase in population results in more number of poor people being forced to share from the shrinking resources. Acceleration in poverty alleviation and a sharp reduction in the population growth rate are needed to break this link between poverty and the environment.

Improper Policy Interventions

A number of policy interventions may have also contributed significantly to the degradation of forests. In order to promote rapid industrialization after independence, vast stretches of bamboo and other forests were leased to paper and pulp mills without creating any long term stakes for the industry to invest in the leased lands for the future. Excessive harvesting by the industry and lack of proper monitoring by the forest departments led to the degradation of large extent of forest resources (TERI, 1998). This practice of leasing forestlands to industries was reversed after the 1988 forest policy came into effect but enormous damage had already been caused.

Prior to the enactment of the Forest (Conservation) Act in 1980 it was the unwritten policy of the state governments across the country to meet the land requirements of all developmental projects from the forest lands in order to reduce the costs instead of acquiring lands through purchase. In addition, the practice of regularly regularizing the encroachment of forest lands provided perverse incentive to encroachers of forest lands. An average of 150,000 ha (MoEF, 1999) of forest lands were lost annually due to this reason which has, fortunately, been brought down to a mere 8,000 ha per year after the enactment of the Forest (Conservation) Act.

Large scale privatization of CPRs, in pursuance of the policy of most state governments for land distribution to the landless, has resulted in a sharp reduction of this common land resource. This also increased pressure on the forests as the demand for grazing and other land related services that were being fulfilled by the CPRs got transferred to the forests as the only other non-privatized lands available accelerating degradation.

Insecure Land Tenure

Many of the lands classified 'forests' or 'wastelands' in official records and formal laws were, and continue to be, under communal property use recognized by local custom. These include shifting cultivators, hunter-gatherer pre-agricultural tribal communities, forest-based settled cultivators and nomadic pastoralists, tenant cultivators of the former Zamindars (big landlords) as well as other communities with diverse livelihood systems (Sarin, 2005). Non-recognition of *de facto* land tenure and other property rights creates suspicion in the minds of the communities and prevents their genuine participation in restoration and protection of degraded forests and generates perverse incentives to fell forests as the communities fear they may not reap the benefits of their labour if the forest department reverses its policy of sharing usufructs prior to the harvests (Proffenberger and Singh, 1998)

Market Failures

Marketing in the technical sense has not been developed for forest products in India. In fact, the situation in the forestry sector in India is one of 'market failure', in which economic efficiency has not been achieved through following a market mechanism (MoEF, 1999). The forest departments sell a wide range of forest products, tariffs and royalties, rents, taxes, levies, fees (grazing, transport permit) and other charges but the prices capture neither the environmental benefits of forests nor the resulting damage to forests (MoEF, 1999). The charges and levies are also not objectively linked to cover the monitoring or implementation cost incurred by the SFDs. In some states like Orissa, the price of NTFPs is administratively fixed by Revenue Department officials at rates higher than the market price only to avoid criticism from the press leading to the buyers withdrawing themselves from the market and hurting the primary gatherers who are mostly tribal and poor forest dependent people (Saxena, 2003).

Poor Inter-sectoral Policy Co-ordination

Forestry interfaces with many other sectors – land records, agriculture, water and soil conservation, animal husbandry, rural development, energy, industry, irrigation tribal welfare and tourism. Current policies are fragmented across several government agencies with differing policy mandates (UNEP, 2001). The weakness of the existing system lies in the inadequate enforcement capabilities of environmental institutions, both at the centre and state levels (UNEP, 2001). Although the 1988 forest policy takes into consideration the dependence of people on forests, the impact that other sectors have upon forests and forestry activities is not recognized; policy is not supported by legislation and appropriate strategies and the task to implement policy recommendations is left to the state governments. Policies for agriculture, settlements, energy, animal husbandry, rural development and other sectors do not recognize their impacts on forests (TERI, 1998). There is no collaborative strategy between forestry and animal husbandry sectors for the management of grazing and fodder production. Tribal welfare departments are poorly linked to forest departments and the plans are not developed in co-ordination (MoEF, 1999).

3. Forest Degradation Control Mechanisms to Date

3.1 Linkage to National and Provincial Forest and Land Use Policies

Forests in India have been protected and administered by the ruling kings for at least two millennia. Generally the motivation was control over these assets not claimed by any individual or community the grant of which could form rewards for loyalty to the king. But, in the case of well established large kingdoms like the Mauryas and Ashoka, larger public good and religious piety to protect wild animals was the primary objective of states' intervention in the management of forests. The focus of this work, however, is on the period beginning with the Industrial Age, a period which coincides with the British colonial rule in India.

By the end of the nineteenth century British India consisted of nine provinces spread over 1.4 million km^2 and a human population of 228 million which was administered either by a Governor or a Lieutenant-Governor. In addition it exercised sovereignty over 675 princely states of various sizes and ranks and the entire administration was under the control of the Central Government of British India under the Viceroy. Central legislative functions fell within the mandate of this central government.

The Indian Forest Act of 1865 was the first centralized forest legislation in India. The primary focus of this Act was the protection of trees, prevention of fire, and prohibition of cultivation and grazing in forest areas in British India. It was revised in 1878 (Act VII of 1878) to provide for the constitution of 'Reserved' and 'Protected' forests thus bringing into India's forestry the concept of landscape management, and was extended to most provinces of British India.

In order to provide intensive forest management, the forests of the country were divided into divisions and forest boundaries were surveyed and mapped. Working plans were prepared to regulate the output of these forests and work them according to scientific principles. A country-wide Forest Service was constituted in 1869. Considerable progress in forestry was made between 1871-1900 when vast areas under forests were surveyed and demarcated. In 1894 the first formal Forest Policy was enacted with the following central features:

(1) The central defining objective of State forests was public benefit at large and the rights and privileges of the people in the neighborhood were regulated with that motive.
(2) Forests were categorized as hill forests/protection forests, economically important/production forests, minor forests, and pasturelands.
(3) Forests situated on hill slopes were to be conserved to protect the cultivated plains situated downstream.
(4) Lands suitable for agriculture within the forests were to be made available for cultivation, provided such conversions did not harm forests and were permanent in nature.
(5) Local populations were to be allowed grazing rights in low-yielding forests.

The centralization of forest governance, however, led to disaffection among many communities dependent upon forests and it was soon clear that in such a vast country forests can not be managed in a centralized top down manner. At the same time there was also an increased awareness that forests serve the legitimate interests of people far removed from its neighborhood and that they too have a stake in their proper management. This led to a unique legislative experiment in India in the form of the reformulated Indian Forest Act of 1927 in which an overarching central law allowed the incorporation of local concerns. This Indian Forest Act provided enabling provisions to make rules and regulations; which made it distinct from the other Acts of that time. It is this distinct provision that enabled this central Act to continue after independence when the forest was made a subject for the provincial governments to legislate on.

In addition, a number of provinces also enacted their own forest laws, like the Madras Forest Act and the Assam Forest Regulation Act which, while having much in common with the Central Act, provided flexibility for local opinions, conditions and cultural ethos. However, it would not be correct to conclude from this that the restrictive framework now in evidence in many states in India has been the result of a centralized process of law making. Various orders passed by state governments since 1927 (e.g. Forest Produce Transit Regulations, Sawmill and Forest Depot Regulations) have actually contributed to a more restrictive legal framework for the forestry sector and more directly impinged community rights and responsibilities.

After independence, and partition, and the incorporation of the former princely states in Independent India in 1947, a new phase in the administration of forests in India began. The old forest policy was revised and replaced by another policy in 1952 which envisaged evolving a system of land use that would enable optimal production without degradation. This policy recognized the productive, protective and recreational values of forests and classified forests in protected forest, national forest, village forest, and tree lands. It identified vital national needs including a system of balanced and complementary land use, need to check denudation of mountainous regions, erosion of river banks and invasion of sea-sands on coastal tracts and the need to ensure supply of fodder and small wood.

The policy called for maintaining a minimum of one-third of the geographical area of India under forests.

A major shift in focus in India's forestry originated from the recommendations of the National Commission on Agriculture (NCA) in 1976. Two major recommendations of the Commission regarding forests were as follows:

> *'Institutional changes should be brought about in the management for production forestry, and man-made forests should be raised on an extensive scale with the aid of institutional financing. The existing system of harvesting of major and minor forest produce through the intermediary contractors must be replaced by taking it up either directly by the Social Forestry Department or by a network of forest labour cooperative societies, or by a combination of both.'*

For production and social forestry, recommendations of the NCA included identification of 48 million ha of forestland being dedicated as production forest, promulgation of grazing rules, increasing of the grazing fee, prohibiting grazing in regeneration areas, planting of fodder trees, overcoming the problem of shifting cultivation and allotment of homestead lands to tribal communities. The NCA also recommended that development of minor forest produce should be the responsibility of the Forest Department. For protection of forests and wildlife management, the NCA was of the view that there should be sufficient buffer around the boundaries of National Parks and that the Wildlife Division in the Government of India be headed by an officer of the rank of Additional Inspector General of Forests. On forest protection and law, the Commission suggested soliciting support of voluntary associations and local government, undertaking large-scale social forestry programs, creating depots to supply timber to villagers and enacting an All India Forest Act by Parliament.

The NCA's recommendations led to the creation of a separate and full-fledged Department of Forests within the Ministry of Agriculture of the Government of India. This also signaled the birth of the social forestry program in the country and nationalization of forest harvesting, thus eliminating the forest leasing system in vogue for years. Based on the recommendation of the NCA, as well as other progressive ideas that emerged in the period from within and from international covenants, the following important steps were taken between 1971 and 1996:

1. Creation of State Forest Corporations for harvesting forest produce, thereby eliminating contractors and middlemen.
2. Establishment of the Indian Institute of Forest Management to produce qualified managers with the skills to manage forest resources as a business concern.
3. Initiating social forestry on village common lands and private farms.
4. Formulating a new National Forest Policy in 1988.
5. Making forestry a subject of concurrent jurisdiction, whereby both the Centre and States have the powers to legislate on forests (through the 42nd Amendment of the Indian Constitution in 1976).
6. Creating a separate central Ministry of Environment and Forests in 1984.
7. Amendments to the Wild Life Protection Act of 1972 and streamlining the implementation of provisions of the Convention on International Trade in Endangered Species and the Ramsar Convention on Wetlands in India.
8. Ensuring people's participation through adoption of Joint Forest Management as a tool for managing forest resources.

The Forest Policy of 1988, formulated on the basis of the recommendations of the National Commission on Agriculture, had the following basic objectives:

i. Maintenance of environmental stability through preservation and, where necessary, restoration of the ecological balance that has been disturbed by serious depletion of the forests of the country.

ii. Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna.

iii. Checking soil erosion and denudation in the catchment areas of rivers, lakes, and reservoirs in the interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs.

iv. Checking the extension of sand dunes in the desert areas of Rajasthan and along the coastal tracts.

v. Increasing the sustainability of the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on denuded, degraded and unproductive lands.

vi. Meeting the requirements of fuel wood, fodder, minor forest produce and small timber of the rural and tribal populations.

vii. Increasing the productivity of forests to meet essential national needs.

viii. Encouraging efficient utilization of forest produce and maximizing substitution of wood.

The primary objective of the Forest Policy of 1988 was environmental stability and direct economic benefits were subordinated to this principal aim. This policy also advocated a shift to an integrated approach to the management of forests so that the pressing needs of forest-dwellers could be met. The policy continued with the national goal of the previous policy of bringing a minimum of one-third of the total land area under forest or tree cover.

In pursuance of the objective of preventing exploitation by middlemen the State Governments have also enacted several legislations to control trade in forest products and protect the primary collectors from exploitative trade and patron-client relationships. The most common regulations relate to *tendu* (*Diospyros melanoxylon*) leaves often with separate sets of legislations also covering other NTFPs. An increasing number of NTFP species are being taken out from regulated lists, so that their transport and trade can come under the control of the Panchayati Raj Institutions (PRIs) and local communities can more directly benefit from them.

3.2 Case Studies

Box 1: Greening of Himalayas by Eco-Task Force, Jammu

An innovative model for eco-restoration of degraded forests that has evolved lately in India involves building on the synergies between diverse organizations, such as forest departments with their technical competence and the Army with its unutilized energy and resources during peace times. One of the successes of this approach is in a severely degraded area of 4,735 ha in Rui Watershed of Basantar River in Jammu and Kashmir State. The project area comprised of 9 villages with a human and cattle population of 3,960 and 4,136, respectively.

The primary economic activity was rain-fed agriculture and animal rearing with a heavy dependence on forests combined with over-exploitation of the dominant forest species of *Acacia modesta* for meeting the needs of the calico and printing industry of the area. Over a period of 8 years the Army planted 2.224 million saplings of native species and 0,204 million grass slips over an area of 3,929 ha along with a large number of locally suitable soil and moisture conservation measures, both vegetative and engineering structures. Multiple tangible gains followed that served to strengthen the active co-operation and participation of the stakeholders in forest protection and their restoration and a progressive shift towards high yielding breeds like Jersey cows from the previous goats with increasing economic prosperity. This approach of utilizing the resources of the army during peace time to restore degraded forests is now an institutionalized mechanism across a number of states in India *(Source: The Citizen's Fifth Report, CSE, New Delhi).*

Box 2: Sukhomajri – from Destitution to a Land of Plenty

Sukhomajri is a small village in the Shivalik foothills in Panchkula District of Haryana,that faced severe ecological problems, sparsely vegetated hills and sub-optimal agricultural productivity leading to poverty. In 1970 it was a village of 455 people with 15% literacy and 83 households comprising of traditional graziers of very small land-holdings, on which they practiced rain-fed agriculture and supported a cattle population of 411 animals. With agricultural production of as low as 0.275 tonne/ha in 1977, a large number of people from the village were forced to work outside in factories and business establishments. Its ecological transformation began in 1976 with the construction of two small earthen dams for soil and moisture conservation and the resolve of all stakeholders to voluntarily stop free grazing in order to regenerate the hills. A very crucial role in this entire exercise was played by a village level institution called Hill Resource Management Society consisting of one adult member from each household.

These activities resulted in averting the loss of topsoil, substantial increase in production of grasses and improvement of tree cover. The tree density increased from 13-tree/ha in 1976 to 1,272 per ha in 1992. Similarly, agricultural production increased 22% to 25% while the grass harvest increased from 40 kg/ha in 1972 to 3,000 kg/ha in 1992. As the watershed regenerated, villagers shifted from rearing goats to buffaloes and the number of goats decreased from 246 to 10 between 1975 and 1986 while buffaloes increased from 79 to 291. Enhanced availability of fodder resulted in increased milk yield, which went up from 2.23 liter per animal per day in 1977 to 3.01 litres in 1986. In 1986, the villagers together earned of Rs 0.35 million from milk sales and Rs 0.15 million from the sale of khair and bhabbar grass taking the average household income from Rs. 10,000 in 1979 to Rs. 15,000 in 1984. The cumulative effect of rehabilitation of degraded forests and increased vegetal cover has led to disappearance of hunger and destitution from the area. This example proves the effectiveness of participatory principles in realizing the wealth-creation potential of land *(Source: The Citizen's Fifth Report, CSE, New Delhi).*

Box 3: Indo-German Changar Eco-Development Project (IGCEDP)

IGCEDP (1994-2006) had the basic aim of reversing the degradation of mixed deciduous and coniferous forests and of other lands in parts of Changar area of Kangra District in Himachal Pradesh. The project covered an area of 428 km^2 spread over 578 villages with a total population of 130,000 people. The state government created a flexible public private partnership institution, Himachal Pradesh Eco-Development Society (HPEDS), Palampur, for the purpose of implementing this project with the main objective of bringing about behavioral changes among citizens in the use of natural resources. This society assisted the villages in developing their own micro-plans as a part of the Integrated Resource Management Planning (IRMP), helped government departments to integrate the delivery of their programs, and mediated between the two.

IGCEDP adopted a socio-technical approach on watershed restoration. The newly created village development committees included weaker sections of society and comprised women membership of at least 40% to address social and gender issues. In the early stages the HPEDS undertook and financed plantations and other works at a micro-watershed level, but later changed this direct supply-oriented approach to one that required villages to articulate their own demand for assistance by developing and deciding on their own resource management plans. The hallmark of the project was the demand-oriented approach.

The project has been successful in attaining the quantifiable indicators it had set. The project's success can be attributed to the implementation of village-level planning approach called Integrated Resource Management Planning (IRMP). The result was the evolution of IRMPs into a methodology for villagers to make village cluster level micro-plans. The forest plantations created in the strategic places at the head of watersheds were being maintained and guarded by village groups against incursions from unauthorized persons. The project and the work of the Eco-Development Society have received recognition in several ways. IGCEDP approach is replicable and being emulated by projects supported by other donors such as the UK's Department for International Development and the World Bank. The project has been held up as an example in a joint publication of the Union government and the United Nations Development Programme (Final Evaluation 2006, Indo-German Changar Eco-Development Project, India Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Germany).

Box 4: Greening of the Thar Desert in Rajathan

Spread over 20 million ha in the western boarder state of Rajasthan, the Thar Desert typifies vast expanse of sands, almost no precipitation, very high temperatures, lack of vegetation and little forest area. This work of planting trees in this most inhospitable of lands first began as a measure to protect the 1,040 km long Indira Gandhi Canal and its tributaries built in 1961 from shifting sand dunes. The initial successes soon triggered a major afforestation programme along the entire length of the canal and transformed the landscape to a large green tract at the center of this desert.

Shelterbelt plantations, comprising species like *Dalbergia sisoo* (Shisham), *Eucalyptus terreticornis*, and E. *camaldulensis,* have reduced wind erosion by 50% and pan evaporation by 5-14%, increased biodiversity and enhanced production of biomass. With improved availability of biomass, livestock recorded 53.11% increase against 35.65% at national average. The productivity of individual animals has also increased significantly and this has resulted in overall development of the area: higher economic returns, improved standards of living, better nutritional status and higher employment opportunities. Annual revenues of Rs. 500 million are being generated by harvesting the forest plantations raised on desert lands that supported no vegetation earlier. Afforestation of more than 1,000 km^2 of treeless desert area under most hostile and extreme conditions is a significant achievement and, thus, constitutes a major success story in the annals of reforestation and greening programme of the country *(Sources: Third Party's Evaluator's Opinion on Indira Gandhi Canal Region Afforestation Project by Subarta K. Mandal, July 2003; Prospects of Indira Gandhi Canal Project published by ICAR, New Delhi,1991; Indira Gandhi Canal Project by Rakesh Hooj; www.jbic.go.jp/english).*

Box 5: Forest Restoration by Jungle Bachao Groups in Gujurat

Baluji-Na-Muvanda in Panchamahal district of Gujarat is a village of 140 households that depend on forests for subsistence needs. Till the early 1970s, thick tropical dry deciduous teak forests covered its surrounds but when a road was built in its vicinity to facilitate construction of a dam across the Panam River its forests disappeared quickly due to illegal felling of trees by migrant labour and others.

Distressed by the degraded state of the forest, Nanabhai, a former *'Patel',* a traditional village authority, persuaded the villagers of the need for protecting and regulating the harvesting of forests by appointing *chowkidars* (village guards) the payment of which was shared by the villagers through contributions in the form of grains and small sums of money. Forest usage was regulated and only deadwood collection was allowed and firewood cutting was permitted for only two days in a year. Under this system called 'chutti', members who paid their dues were allowed in the forest, but not allowed to carry implements. In exceptional cases, the village committee sanctioned genuine requests for timber extraction for agricultural instruments and house construction.

This protection resulted in improved health of the forests, increased regeneration and enhancement in biological diversity. The area under protection management supports 31 tree species and 17 scrub species compared to only 9 tree species in the neighboring unprotected forests. About 60% of the regeneration resulted from seedlings while the remaining 40% came from coppice indicating that simple low-cost protection measures as regulation of grazing and extraction can help in restoring degraded forests.

The motivation to restore the forests by enhanced forest protection and management originated in the village itself and it was the vision and initiative of Nanabhai and the willingness of the villagers to forgo short term benefits for long term rewards that made it possible (*Source: Singh, G., Rathore D.S., Solanki, D.S., Sisiodia, N.D., 2000 Forest Protection by "Jungle Bachao Groups' in Panchmahals District Gujurat. In: Ravindranath et al. (eds.) Joint Forest Management and Community Forestry in India – An ecological and institutional assessment. Oxford & IBH Publishing Company, New Delhi).*

Box 6: Eco-restoration of Jhabua Forests in Madhya Pradesh

Jhabua, dominated by Bhil tribals, in the western Madhya Pradesh, recorded rapid increase in human population from 0.79 million in 1981 to 1.13 million in 1991 and the resultant stress on the already degraded forests brought the percentage of dense forests to a mere 4.9% by 1993. This meant sharp reduction in the value of this resource for tribals dependent on this resource for their livelihood and consequential large-scale seasonal migration of population for wage labour outside the region.

In 1994, Rajiv Gandhi Mission for Watershed Development was launched and restoration of degraded forest was initiated over 1240 km^2 project area spread over 218 watersheds in this tribal belt. The project has improved local ecology and simultaneously enhanced collective and individual financial security of villagers. Of Jhabua's total forest area, 60% is now managed by 344 JFM committees comprising 72,656 active members, who guard and the forests and other community assets. More than 2 million saplings of *Bambusa vulgaris*, *Phyllanthus emblica*, *Acacia catechu*, *Azadricta indica*, *Shorea robusta,* etc. were planted in the area. This reduced the degraded area by about 66%. The villagers generated and saved Rs 4.2 million in "Village Fund" for use by the villages for undertaking collective activities besides another Rs.4.8 million for maintenance of water harvesting structures. Women's Thrift and Credit Groups also generated another Rs. 24.40 million to help women with soft loans. Low cost indigenous technology use and people's participation have contributed significantly to the success of the project (*Source: The Citizen's Fifth Report, Centre for Science and Environment, New Delhi, 1999; Making Water Everybody's Business, CSE, New Delhi, March 2001).*

Box 7: The Solitary Green Guard of Ralegaon Siddhi

In 1975, Ralegaon Siddhi, a small drought prone village situated in Ahmednagar district of Maharashtra with a small population of 1,508, presented an extremely dismal picture. The village land was dry, barren and devoid of tree growth. This low productivity land was burdened with an excessive cattle population. The village society itself was facing social problems such as alcoholism, illiteracy, infighting, out-migration and debt. It was under these conditions that Mr. Baburao Anna Hazare, who had just returned to his native village after seeking retirement from the Indian Army, resolved to act to cause fundamental changes in the manner in which people were leading their lives.

Mr. Hazare motivated inhabitants of the area to impose a complete ban on felling trees in the village and on brewing of countryside liquor and smoking. Emphasis was laid on education, removal of untouchability and organization of collective marriages. These steps resulted in progressive reduction of social problems and utilization of resources and energies toward improvement in the environment and economy. Mr. Hazare was able to channelize the energies of the youth in implementing soil and moisture conservation measures to enhance storage and percolation of rainwater. A modest beginning was made on an area of 122.71 ha of wasteland, 50.78 ha of degraded pastures, 2,200 ha of degraded forest and 3.95 ha of panchayat land (village common land) for their reforestation. An improvement in the local economy and environment soon followed. Moisture conservation significantly enhanced the regenerative capacity of degraded areas and increased production of grass, fodder, food and other NTFPs (*Sources: A Successful Case of Participatory Management of Ralegaon Sidhi Village in District Ahmadnagar, Maharashtra (India) by B. Mishra, FAO Composite Document Repository) 2003, The Citizen's Fifth Report, Centre for Science and Environment, New Delhi,1999; www.ralegaonsidhi.com; www.wikipedia.org/wki/RalegaonSidhi).*

Box 8: The Arabari Experience

The lands in the districts of Midnapur, Bankura, Purulia, Burdwan and Birbhum in southwest Bengal are characterised by red loamy and lateritic soil with sub-soil canker pan. The climate is hot and dry with average rainfall of around 1,300 mm. Earlier the sal (*Shorea robusta*) forests in Midnapur district were under private ownership and subjected to repeated coppicing. When acquired in 1954-55, the forests were already in an advanced stage of degradation. The forests occur in disjointed and isolated patches of varying sizes and as islands amongst the cultivated field surrounded by habitations. The fragmentation combined with population pressure resulted in continued degradation of forests over the years.

Policing efforts to eliminate the biotic pressure lead to increased conflicts between the forest dependent people and the forest department personnel and led to alienation of people. Faced with an impossible situation, a pilot project was undertaken in the Arabari area in 1971-72 with an objective of involving people, living around the fringe of the forests, in protecting the forest resources through improvement of their socio-economic conditions. 1,270 ha of degraded Sal forests including 185 ha of refractory areas unfit for tree farming was taken up for restoration. Through a series of meetings and contact programmes, cooperation of 618 families was secured for rehabilitation of degraded forests. The villagers were assured forestry based employment and entitlement to collect the fuel wood and other usufructs from forests if they cooperated in protecting the forests. They were also guaranteed 25% share in the final harvest of the forest produce generated from restored forests.

From 1971 to 1985, various forestry based activities like afforestation and enrichment plantations with fast growing species over 290 ha, cashew plantations over 65 ha and sisal plantation over 12 ha were taken up. Periodic operations like coppicing, multiple shoot cutting and the like were also carried out. By 1986, the entire pilot project area was restocked with nearly 700 ha of sal coppice forests and another 300 ha of plantation crops with total expenditure of Rs. 1.64 million. In 1987, the West Bengal Forest Development Corporation harvested 97 ha of restored sal forests. A total of 0.22 million man days were generated along with a final harvest benefit amounting to Rs. 6,000 per ha to each family.

Box 9: Participatory Management of the Village Commons in Jammu & Kashmir

Decline of traditional agro-silvo-pastoral management systems and persistent over-exploitation resulted in large-scale degradation of village commons in Chinota Hills, Akhnoor District, Jammu. By early 1980s, the area supported just thorny and unpalatable shrubs. In 1988, the J&K SFD initiated a socio-ecological experiment with people of 15 villages living in and around Chinota hills to develop an alternative forest management system leading to the evolution of participatory management based on mutual respect for common interests.

Appropriate village institutions were formed so that participatory management could be institutionalized. The emphasis was on economic incentives to sustain people's continued participation. In anticipation of multiple benefits, the community members voluntarily agreed to halt free grazing of cattle on common lands to allow regeneration. Approximately 350 ha of degraded land were taken up for forest restoration.

This voluntary protection effort enhanced vegetal cover, increased biomass production of grass and fodder, and allowed natural regeneration and growth of existing plants. Grass production registered an increase of about 3 tonnes/ha. Fodder became available over a longer period and reduced the need to purchase fodder during the dry season (*Source: Co-Managing the Commons - The J&K Experience, SPWD, New Delhi).*

Box 10: NGO-mediated Joint Forest Management in Udaipur

The year 2000 saw an important initiative by an Indian NGO, Foundation for Ecological Security (FES), and the Forest Department to regenerate tropical dry forests and grasslands in Udaipur district of the north-western state of Rajasthan. The framework of the project was the Joint Forest Management (JFM) Programme which forest regeneration and protection is undertaken jointly by government and people. The cash and in-kind benefits from forest recovery are shared between the government and local village committees. The primary concern of FES was the linking of ecosystem recovery with the tribal people's livelihoods, particularly those of the most marginalized groups.

A successful instance of a project is the area managed by Chitrawas Village Forest Protection and Management Committee which covers 14 habitations of three adjacent villages having a beneficiary population of 1500 people in 350 tribal households. This Committee is currently managing 291 ha of forest land and 167 hectares of pastures. The households also, together own 133 ha of mostly unirrigated agricultural lands. When FES began its intervention, tribal livelihoods were based on a mix of subsistence agriculture and livestock dairying, both of which were operating at sub-optimal levels, due to recession of the water table, drying up of streams and lakes and severe degradation of forests and erstwhile pastures. At that time, degraded forests, on three legal categories of land- forest land, revenue wasteland and village-owned pastures-were still important sources of biomass for the locals. The FES' initial assessment suggested that the forest commons provided critical support to tribals during the period of drought and stress. Even in the degraded state, the share of income from biomass of the degraded commons was 20-25%, which was envisioned to be increased substantially through restoration efforts.

Through a detailed tripartite agreement made between FES, village committees and Forest Department, several ecosystem restoration activities are being undertaken from 2000 onwards. Such activities include live and stonewall fencing of forests and pastures, bunding, check-dam construction to stall erosion and planting of native tree species and bamboos. Restoration of forest cover upstream of village water sources was expected to help rejuvenate the water and nutrient cycles, thereby enabling the community to get increased income from their agricultural patches as well. The forest protection duties lie primarily with the villagers who take turns on a voluntary basis. Fodder-grass harvesting and fuelwood extraction is closely monitored and controlled, with equitable distribution of benefits among

After a few years of management, the protected areas of forests and pastures show visible improvements in ecological indicators such as grass diversity and productivity, animal species diversity, water table depth, soil moisture, canopy cover and tree basal areas. There has been a distinct increment in tree species diversity too, due to strict protection and controlled harvest. Ecosystem recovery is paralleled by strengthening of village institutions as was manifested in united action on various fronts by the villagers *(Source: Dr Ghazala Shahabuddin, Scholar-in-Residence, American University, Bethesda MD 20817, USA).*

Analysis of Case Studies

One common strand among these case studies is that success in reversing degradation of land could be achieved only with full community participation in planning, execution and benefit-sharing. In some cases the initiative was of government while in other leadership emerged from local communities but in all the participation of the community was widespread. Besides the participation of the community other important points that emerge from an analysis of these case studies could be summarized as follows:

Effective and Acceptable Leadership: All the cases indicate that the initiative was taken either by a local leadership that had the vision for the community and acceptability among them or a well organized government program led by a competent officer in the beginning.

Access to Resources: In all cases there were sufficient common resources available in the vicinity of the community in the shape of either government or community forests or common lands which were large enough to indicate the possibility of changing the lives of the locals in future if sufficient efforts were made in the present.

Freedom to Decide and Act: The local leadership could do what it did because the laws and policies enabled them, acquiesced in their actions or at least did not oppose their initiatives strongly enough.

Merging with Locally Held Knowledge and Beliefs: The community participation was obtained by recalling the relative prosperity and good life of the past when the forest resources were in good shape. Recourse to the local dominant religious beliefs was also invariably made by the local leadership.

Long Term Assurances of Returns: An assurance of long term control over the resources created was important to sustain the interest of the communities in these common ventures beyond the initial enthusiasm. This either came from the government on their own or, more often, through the insistence of the communities.

Results Far More than Simply Forest Regeneration: A common feature of these success stories have been that the outcomes have invariably transcended the initial objectives of making productive use of forest and the land resources. In almost all cases there has been significantly improved social capital in terms of enhanced gender and caste equity, literacy and health besides strengthening of village institutions. And the economic regeneration has also been significant with better access to financing for micro enterprises at reasonable rates of interest.

These early initiatives yielded notable successes, and formed examples on the basis of which larger institutional programmes like JFM and other large scale watershed projects were later developed. From 1990s onwards, the approach of major restoration initiatives shifted from being purely technical

to socio-technical which has since been increasingly adopted by international donors such as the UK's Department for International Development and the World Bank.

The community initiatives can be successful if formal legal framework is aligned to, and is supportive of, informal community institutions. Absence of effective legal support and lack of recognition of economic assets created through community activities could worsen existing vulnerabilities and may undo the local initiatives. Community initiated restoration initiatives are unlikely to succeed if the community institutions are in conflict with other institutions that surround them. There is thus a need of creating broader enabling frameworks for the governance of commons.

The biggest challenge that lies before local community-based forest management institutions is of mobilizing the community in the first place and in finding common ground on a continuous basis for action among diverse local stakeholders. The success of the restoration initiative at Ralegaon Siddhi can be attributed to the ability of inspirational leaders to channelize the community efforts towards achieving common good, enhancing social capital and community capacity by encouraging the villagers to solve their social problems themselves. The leader, Anna Hazare, understood the prevalent social system and realized that community capacity building and restoration of degraded watershed were interlinked. The case studies indicate that appointing or co-opting local inspirational leaders and motivators in formal institutional restoration programmes, who can encourage the local community in pursuing collective goals, can increase the probability of successful forest restoration outcomes.

3.4 National-level Degradation Control Measures

The Government initiated a major drive towards rehabilitation of degraded forests soon after the promulgation of the National Forest Policy in 1952. By 1961, these efforts brought a total of 35 million ha of forest area under working plans (47.14% of the total forest area). By 1961, 0.49 million ha was planted under various schemes and 10.40 million ha was regenerated by bringing 0.57 million ha of coniferous forests and 9.83 million ha of broad-leaved forests under natural regeneration. The Third Plan (1961-66) laid greater emphasis on artificial plantations of fast-growing species of economically valuable species and on introduction of exotic tree species, particularly eucalyptus, poplars and wattle in a large scale. However, it was during the Fourth Plan (1969-74) that the term afforestation was introduced for the first time and plantation works continued at a modest pace well into the Fifth Plan period (1974-79).

In 1985 the Government of India recognized that continuing deforestation had brought India close to a major ecological and socio-economic crisis and created the National Wasteland Development Board (NWDB) to tackle this problem. This Board started functioning during the Seventh Five Year Plan (1985-90) and laid great emphasis on regeneration of wastelands through participatory restoration activities. The Board covered 8.45 million ha and was upgraded to the status of Technology Mission in October 1989 and assigned a target of 17 million ha during the Eighth Plan (1990-95).

With the exponential increase in human population from 361 million to 838 million and livestock population from 307 million to 470 million from 1956 to 1992, natural forests began facing significant pressures to meet the bona-fide needs of fuel wood, fodder, timber, fiber and other products. The period from 1970 to 1980 witnessed acute shortage of fuel wood and fodder in rural areas resulting in over- exploitation of natural forests while the strict policing regimen of forests by SFDs further alienated the local communities. Due to large-scale diversion of forest land, and their over-exploitation, the area under forests declined from 64.2 million ha in 1983-85 to 63.34 million ha in 1993-95 with the sharpest decrease between 1991-93 and 1993-95. The achievement of afforestation for the various plan periods is given in Table 10.

Table 10: ***Areas Afforested During Successive Five-Year Plan Periods***

Plan Period	Area Afforested (million ha)	Expenditure (million Rs)	Percent of Outlay of Total Plan
First (1951-56)	0.052	12.8	0.39
Second (1956-61)	0.311	68.6	0.46
Third (1961-66)	0.583	211.3	0.53
(1966-69)	0.453	230.2	0.63
Fourth (1969-74)	0.714	443.4	0.54
Fifth (1974-79)	1.221	1072.8	0.31
(1979-80)	0.222	371.0	0.54
Sixth (1980-85)	4.650	9260.1	0.71
Seventh (1985-90)	8.865	25398.80	1.01
(1990-91)	0.750	NA	NA
(1991-92)	1.15	NA	NA
Eighth Plan (1992-97)	7.953	12000.0	1.13
Ninth Plan (1997-2002)	1.48	29657.20	0.34
Tenth Plan (2002-2007)	1.21	5112.37	

(Source: Kishwan et al., 2007)

Social Forestry and Farm Forestry: On the recommendations of the NCA in 1976 during the Sixth Plan (1980-85), Social Forestry and Farm Forestry Projects were launched in as many as 14 States of the Indian Union from 1982-84 to 1999. The Social Forestry Project brought a significant attitudinal change in the mind of the Indian public to undertaking degradation control measures and large-scale plantations in non-conventional areas. An area of 2.64 million ha was brought under plantations under this project at a cost of Rs. 18.4 billion. However, the SF afforestation schemes carried out on public lands were characterized by lack of a viable long-term institutional framework conducive to the objective of increased biomass for the poor, social equity and resource sustainability.

Massive investments in the SF programmes converted private agricultural lands, barren public revenue lands to productive assets. SF schemes in reality took a resource away from the local poor, since they no longer had access to the areas now policed by the forest guards. The experience of SF made it abundantly clear that it would be impossible to prevent the degradation of forests unless real and immediate benefits equitably accrue to the local communities who depended most on forests for their livelihood needs. Consequently, a revised approach that required decentralized and participatory management involving active participation between the forest department and local villagers was advocated.

National Afforestation and Eco-development Board: In order to promote afforestation and restoration of forests on a massive scale in the country, the National Afforestation and Eco-development Board was set up in August 1992. This Board focused on rehabilitation of degraded forest areas and lands adjoining the forest areas, National Parks, Wildlife Sanctuaries and the ecologically fragile areas in the western Himalayas, Aravallis and Western Ghats. Subsequently, to decentralize the planning of afforestation and involve local communities, Forest Development Agencies (FDA) was formed in 2001, comprising village community members and technically supported by forest officials. As of 2008, 743 FDAs have been operationalized in the country. Since the launch of FDAs, they have been instrumental in rehabilitation of 1.231 million ha of forest area at a cost of Rs. 19.2 billion.

Private Sector Plantations and Farm Forestry: The National Forest Policy of 1988 altered the government strategy towards supplying raw materials to wood-based industries such as paper, providing for growing raw materials through industry-farmer collaborations. For meeting raw material

requirements, the industry promoted partnership initiatives expanding agro-forestry and farm forestry on private lands with credit facilities to farmers being provided by National Bank for Agricultural and Rural Development. The potential of this scheme is being constrained by the generally small landholdings (<1.5 ha) of farmers who opt for farm forestry and by the Land Ceiling Act that limits the area under private control.

Removal of Subsidies: High subsidies to the industry in the past have led to indiscriminate exploitation of natural forests and lack of restoration strategies. For instance, leasing forestlands to paper and pulp industry without creating stakes in their future productivity, led to indifference towards sustainable extraction practices, to a large extent. Since the late 1970s, subsidy to the industry has been gradually reduced.

Establishment of Protected Areas: As of 2003, 35,780 km^2 is under National Parks and 117,300 km^2 under Wildlife Sanctuaries. Tiger Reserves refer to larger areas comprising different categories of PAs, Reserved Forests and Protected Forests but do not have separate legal status. Protected Areas are primarily managed by the governments at the state level but substantial funding is received from the central government. The legal framework for establishment and management of PAs is the Wildlife Protection Act established in 1972.

The considerable importance of the PA network in India lies in the fact that these PAs could be considered as best-case scenarios for forest and biodiversity conservation and represent relatively intact forest remnants in India, compared to other management categories such as community-managed forests, social forestry or commercial tree plantations. This is because the primary management objective in these areas is the conservation of biodiversity rather than utilitarian values. Compared to the various categories of used forests, PAs usually harbor a greater variety of flora and fauna in their natural habitats and could well be the last remaining source habitats for much of India's genetic diversity. However, existing research and anecdotal evidence reveals that, there is considerable forest degradation even inside PAs due to heavy local dependence for biomass and forest products, grazing, fragmentation due to dams, roads and settlements and disturbance due to tourism and pollution. However, inappropriate management practices related to the control of invasive species and the use of fire for habitat management are as often responsible for species loss as over-exploitation of biological resources. This is particularly true for Wildlife Sanctuaries where there is lower protection, less restrictive rules and lower financial allocation in comparison to National Parks. PA degradation takes the form of reduced species richness of flora and fauna, loss of viability of animal populations, loss of endemics, or less commonly, outright deforestation in portions of PAs.

Creation of Community Reserves: Community or people-based informal conservation on a small-scale has always been prevalent in India. In many cases, this takes the form of localized protection of endangered animal species such as the golden langur in Chakrashila Sanctuary in Assam, or the spotted-billed pelican in the village of Kokkrebellur in Karnataka. In some other cases, local people are simply protecting forest patches for religious or utilitarian reasons and other times, reacting to perceived declines in their natural resources base.

An amendment to the Wildlife Protection Act (1972) in 2002 allows the establishment of people-managed wildlife areas named Community Reserves (CR) where there is evidence of local interest in conservation, adjacent to existing National Parks and Wildlife Sanctuaries. Several CRs have been declared since then for instance India's first Marine Conservation Reserve in Lakshadweep initiated by the Bombay Natural History Society in 2005, centred on the commercial importance of the valuable giant clam. Another instance is of a wildlife sanctuary that has been created for the rare pheasant, the Blyth's tragopan by the village of Khonoma in Nagaland.

Community Reserves can play an important role in supporting conservation in the larger PAs through acting as buffers and corridors and diverting extraction pressure from them. While Community Reserves are a promising legislation that can revolutionize the participation of local people in conservation, their efficacy is likely to depend on the process of establishment of a Reserve, particularly in the extent of involvement of local stakeholders. For instance, in the Lakshadweep instance, the collaborators went through a consultative process where more than 400 public meetings

were held before the Reserve was formally notified. If the government simply takes over existing community reserves under the Wildlife Protection Act, without a sensitive framing of rules, these reserves, along with their conservation value, might be destroyed. Such existing community initiatives have to be nurtured, through a system of local incentives and encouragement before they are commonly institutionalized under the Community Reserve network.

Joint Forest Management (JFM): JFM involves institutional arrangements in which local people jointly protect and manage forests with government agencies on a benefit-sharing basis. Forest management and protection activities are decided beforehand through a consultative process and recorded in micro-plans. Today more than a hundred thousand JFM Committees in 27 states are protecting about 22 million ha of degraded forests. This program has been a major recipient of bilateral and multilateral financial assistance in the past two decades.

Voluntary Participation: Successful examples of voluntary involvement in eco-restoration are also available from different parts of the country. The National Tree Growers' Cooperative Federation is an example, made possible by organizing village-level Tree Growers' Cooperative Societies in states of Andhra Pradesh, Gujarat, Karnataka, Orissa, Rajasthan and Uttar Pradesh. Research expertise and financial and extension facilities are made available to them. There are today numerous examples of village-initiated and NGO-initiated restoration of forests and soils that were originally started with the aim of reviving people's livelihoods. Aravari, Bastar, Jhabua, and Ralegaon Siddhi are some instances of this approach. Though these initiatives typically impact just a few villages at a time, the results appear to be more durable in the long-run due to more effective empowerment at the local level, local initiation and support and have been found to improve the quality of people's lives in a significant way.

3.5. International Support for Degradation Control

To fulfill the policy objective of increasing forest cover to 33% of country's area by 2020, an annual programme of afforestation and regeneration of 3 million ha is required. This would require an estimated annual budget of Rs. 52,850 million against the average annual availability of Rs. 8,186.2 million for the forestry and wildlife sectors, Rs. 6013.80 million under Environment and another Rs. 16,150 million of related programmes under different ministries for the current year; which adds up to just about half of the required amount.

The Earth Summit had recommended that about 80% of the cost involved in sustainable development should be found from within the country. In the long run, available resources for afforestation would be determined by the country's resource mobilization capability, which in turn is determined by national income and the willingness of the society to invest in forestry related activities. Private investments would come if private profits could be made from these ventures. In such a situation, external assistance plays an important role by acting as a catalyst, providing the much needed initiative, breaking inertia, improving management capabilities and encouraging technology acquisition.

The first forestry project to be undertaken with external assistance was the World Bank-aided Uttar Pradesh Social Forestry Project in 1979. So far, 16 such afforestation projects have now been completed in 14 states covering approximately 2.64 million ha. Between 1981-82 and 1991-92, the percentage share of donor assistance in the total forestry plan outlay was around 30%. In some years (e.g. 1990-91), it reached as high as 40% while in other years, it was reduced to 5% (e.g. 1998-99). Financial resources mobilized annually for forestry are currently about Rs 9.9 billion and are allocated through Central and State plan budgets. The important activities in externally-aided projects have been rehabilitation of degraded forests, farm forestry, institutional plantations, agro-forestry and plantations on community land. Most of these externally aided projects have approached the problem of tackling degradation through comprehensive programs that included institutional development, human resource development, biodiversity conservation, Joint Forest Management and development of Management Information Systems and Geographical Information Systems. This approach enabled capacity building of the forest departments and NGOs, setting up of grassroot community organizations, coordination between the working partners, technology infusion, modernizing

management and policy formulations at the center and state levels besides the actual work of raising trees on forest and non-forest lands.

4. Capacities to Address Degradation Problems

4.1 Research

4.1.1 Present Status and Capacity

Forestry research in India is carried out by institutes under the Indian Council of Forestry Research and Education (ICFRE), State Forest Research Institutes (SFRI), research wings under the SFDs, NGOs, international forestry organizations and private organizations. ICFRE, an autonomous and apex body established in 1986 manages and coordinates forestry research and education in India. Some agroforestry related research is also undertaken by the Indian Council of Agricultural Research (ICAR). The mission of the ICFRE is "to generate, preserve, disseminate and advance knowledge, technologies and solutions for addressing issues arising out of interactions between people and forests and environment on a sustained basis through research, education and extension". ICFRE has eight regional research institutes and three research centers in different bio-geographical regions of the country to cater to the region-specific forestry research needs.

Besides the continuance of its conventional forestry research programs the ICFRE has also under new activities In the field of social forestry at its specialized Center at Allahabad on planting stock improvement program, wasteland reclamation, development of agro-forestry models, reclamation of mined areas through afforestation and studies on *shisham* mortality among others. In the area of eco-restoration and rehabilitation of heavily degraded forests, where technical interventions are required, ICFRE has undertaken systematic research on rehabilitation of problematic soils like quartz dumps and mine spoils, fly ash dumps and sodic soils using suitable tree species and proper soil amendments. The findings of these research activities are expected to help in making significant additions to tree cover in India through utilization of some of the most refractory lands.

Each state has a State Forestry Research Plan (SFRP) and each ICFRE institute also prepares an institute level research plan. On the basis of these research plans, national level priorities are decided, and accordingly research projects are developed. The prioritized projects constitute the dynamic National Forestry Reseach Plan. Seven states namely Kerala, Madhya Pradesh, Uttar Pradesh, Jammu and Kashmir, Karnataka, AP, and Uttaranchal have established their own forest research institutes (SFRIs) to carry out research on state specific forestry and wildlife issues. In other states, a separate wing within the SFDs exists which undertakes state specific research activities.

Some non-governmental organizations have also been active in the field of forestry related research, particularly in its social aspects. The Society for Promotion of Wasteland Development has set up a National Support Group (NSG) on JFM to generate information to assist policy makers. The NSG works through a system of networks, namely the institutional network, equity and gender network, training network, and ecological and economics research network (EERN). The EERN, which is being co-coordinated by the Indian Institute of Science, is a network of research institutions and NGOs and is responsible for research and monitoring through a coordinated multi-locational research programme (Ravindranath et al., 2000).

4.1.2 Constraints and Suggested Approach

Though systematic data collection on forestry resources of India has been undertaken for the last 150 years the data is still inadequate for the requirements of modern forestry management and requires a thorough revision in the nature of data to be collected, process of collection, quality control, data storage, access and retrieval. The Working Group (WG, 2007) constituted by the Planning Commission identifies major critical gaps in the forestry database and its management as:

- Absence of systematic approach to generate, collate and correlate data on natural forest resources.

- Availability of sketchy, non-standard and scattered database that is inadequate for national or regional level policy research and studies.
- Absence of a comprehensive management information system i.e. no warehouse has been conceptualized for the creation of a database on natural resources.

- Lack of institutionalized access to whatever information is available.

- Psychological mindset that impedes data sharing - data are normally thought as something very personal /institutional.

The urgent need to develop a unified forestry database for meaningful policy planning and implementation research cannot be overstated. Lack of adequate funds and non-availability of trained personnel is a major constraint that limits the capacity of forestry research institutions in India. The scope for the ICFRE to generate its own financial resources is limited. This resource constraint could be narrowed if it is made mandatory for the forest departments to make 5% of their budgets available for research activities. The constraint of personnel could be addressed if the universities across the country are co-opted in forestry research. Efforts in this direction are already underway through the research extension programs of the ICFRE but are limited by resource crunch as also lack of innovative proposals from the universities.

While India has done reasonably well in research on silviculture and community based forestry much needs to be done in fields like environmental ethics, political ecology, environmental history and ecological economics. Biological control over exotic weeds like *eupatorium, Mikenia, Strobilanthes, lantana, mimosa* and *parthenium*, which are a serious threat to the regeneration of natural forests, is an urgent requirement (NFCR, 2006). Other important areas are productivity enhancement of private and community landholdings, rationalizing barriers to the marketing and utilization of minor and major forest produce, appropriate management models of JFM. Identification of species indicates the presence or absence of key ecological functions that affect productivity, diversity and sustainability of forest communities (WG, 2007). Institutions specializing in specific sectors on similar subjects in areas like soil sciences, microbiology, eco-friendly technologies, natural disaster management, floods, coastal cyclones and landslides, coastal resources, mountain ecosystems, and freshwater resources and wetlands need to develop strong and effective linkages for coordinated, integrated and multi-disciplinary research at low costs. All large forestry projects should have an inbuilt component of research to ensure improvement in project implementation and in mobilization of scarce financial resources for forestry research.

4.2 Education and Training

4.2.1 Present Status and Capacity

In India, different types and levels of forestry education and training systems under university and non-university systems, covering specialists, professionals, technical and vocational requirements have evolved over the years. The information contained in Box 11 below provides an overview of forestry education and training facilities in India.

4.2.2 Constraints

Forestry, like professions, requires new technological, legal and management tools to keep pace with the changes that are occurring all around us thus necessitating regular training of the forestry professionals. With the shift towards sustainable development and participatory mode of forest management, forestry has been undergoing fundamental changes in recent times. Emphasis on conservation practices and collaborative management involving the local stakeholder communities and

individuals is required. Lack of financial resources and adequately trained teaching personnel and effective teaching aids and material is a key bottleneck in achieving this objective. The course content is focused excessively on technical aspects of forestry and other social science subjects like rural sociology, traditional ecological knowledge, rural economy and political ecology are not adequately covered. The financial and infrastructural resources available to support forestry training are generally insufficient.

Box 11: Forestry Education and Training Facilities

- ***Indira Gandhi National Forest Academy, Dehradun***: Establish in 1938 as Indian Forest College; provides induction and mid-career training to Indian Forest Service officers.
- ***State Forest Service Colleges*****:** Three colleges located at Burnihat, Coimbatore and Dedradun provide training to State Forest Service officers.
- ***Indian Institute of Forest Management, Bhopal:*** Established in 1982; offers post-graduate diploma and M. Phil. course in forest management; provides in-service trainings to mid-career forestry professionals.
- ***Wildlife Institute of India, Dehradun:*** Established in 1986, offers post-graduate diploma course in wildlife and PA management; provides in-service trainings to mid-career forestry professionals.
- ***State agricultural universities:*** Five ICFRE recognized universities offer graduate, post-graduate and PhD in forestry.
- ***Forest Survey of India, Dehradun***: Established in 1970s; provides training in remote sensing, forest inventory management and preparation of thematic and vegetation maps and digital data processing.
- ***Rangers Training College***: Six colleges provide two-year training course to forest rangers.
- ***Foresters Training and Forest Guards Schools***: Run by the SFDs; provide 6 months to 1 year training programmes to fresh recruits/promoted personnel.
- ***Forest Extension workers training programmes:*** Imparts trainings to forestry extension workers as per programme specific requirements.
- ***Other trainings***: Special workshops and training programmes by international forestry organizations, private organizations, NGOs, central and state governments on specific topics.

Institutional Capacity: Establishing sustainable forests and forestry in a country requires institutions that can provide enabling environment so that actions are based on rules, processes and practices that can be sustained through time and the local communities see these rules and their implementation as fair and legitimate. India has been fortunate in having a number of sound institutions but for it to reach its true potential lots of work needs to be done in this field. A network of local, regional and central institutions must develop afresh, those already in existence need to be strengthened and emboldened to act without fear and all must seek to upgrade their quality of output at all events. This requires resources but, more importantly, a vigilant civil society and high emphasis on information generation and sharing.

4.3 NGO Activities

India has a long tradition of social service, social reform and voluntary work. Over the years a large number of NGOs have emerged in India to work on issues related to socio-economic problems, livelihood and social discrimination. These groups work on behalf of the poor, the landless, the tribals, the labourers and other social groups who face marginalization and discrimination under the existing social structure. Many are grassroots organizations that work at the micro-level with limited resources but often achieve significant results at the village or watershed level. Still others have a more scientific focus with greater attention to environmental research that can inform national and local policy-making on environment.

In the forestry sector a number of non-government organizations of all sizes and capabilities have been actively working for the past many decades particularly in the field of extension, implementation, policy advocacy and environmental public interest litigation. Many of the achievements of the past two decades in the field of biodiversity conservation, wildlife management, social forestry and sustainable development can be attributed to the active role that the NGOs have played. These NGOs have also been able to use the country's judiciary to bear on the executive to enhance the quality of delivery in these areas. The NGOs have also played an important facilitation role that includes research, training, policy analysis, documentation and the organization of seminars and workshops. More than a thousand NGOs have been active in the JFM programme in the states of Andhra Pradesh, Manipur, Tamil Nadu, Tripura, Uttar Pradesh and Uttaranchal alone (Saigal et al., 2005). The level of NGO participation, however, varies considerably from state to state – from very limited participation in states such as Himachal Pradesh and West Bengal to very active participation in Andhra Pradesh where over 250 NGOs are involved in the JFM programme (Saigal et al., 2005).

NGOs have a major role to play in educating the public and creating a broad public demand for government-wide responsiveness towards environmental conservation. Forestry and watershed management have attracted the maximum attention and interest of voluntary agencies to built environmentally sound principles, processes, procedures and practices related with forests and environment while keeping a special focus on social and economic equity. In situations of partnerships between forest managers and NGOs, there are significant gains in the area of forest conservation. In the Eighth Five Year Plan, the importance of NGOs was enhanced due to their participation in rural appraisal for drawing up development plans at a very low cost and involving the rural community. Today, India has a vigorous NGO sector. Though there has been no complete census of NGOs, it is estimated that about 25,000 to 30,000 of different sizes are active in India.

Yet there are a number of constraints that limit the effectiveness of NGOs in India such as reduced access to technical expertise and knowledge, limited area of reach and small scale of funding. A problem with environmental NGOs in India, as with NGOs anywhere else in the developing world, has also been their increasing dependency on governmental funds or international bilateral and multinational donors leading to a lack of flexibility on the part of NGOs to pick up their missions/objectives and maintain impartiality. Accountability and misuse and inappropriate use of funds are also significant issues as are the lack of institutional infrastructure and trained personnel to carry out the tasks. Nevertheless, the experiences in India indicate that the NGO community has a very important role to play in capacity building, education, awareness raising and training community

representatives to take up the leadership role in forest restoration initiatives under the JFM programme.

4.4 Extension

The objective and purpose of meaningful extension is to extend, reach out and spread knowledge, technology or benefit to the designated target groups irrespective of their spatial distribution, position or reach. Forestry extension in India gained importance with the introduction of social forestry in 1980s. Most SFDs had initially created separate wings under their social forestry directorates to perform the extension role. A major extension programme under the National Forestry Extension Programme (NFEP) has also been initiated through specially created Directorate of Extension under ICFRE. The NFEP disseminates information on forest protection, land and water conservation, eco-restoration, JFM, agro-forestry, rationalization of shifting cultivation, and greening campaigns to the target groups. Forestry Extension in India is usually promoted through publications, a network of *Van Vigyan Kendras* (forest information and extension centres) and adoption of villages to showcase the latest innovations and technologies.

The general opinion, however, remains that the research results are not being transferred into field applications (WG, 2007). One of the root causes of such a situation is that research in most of the research institutions is conducted in isolation without consulting or involving the potential stakeholders. The WG (2007) recommends that it is essential to dovetail forestry extension activities with the general activities of the SFDS to make up for the shortage of the trained extension personnel. This requires structured capacity building of the extension staff to enable them to disseminate information about adaptable forestry technologies. The NFCR (2006) also recommends that an in-built system of dissemination of research results to the SFDs and other stakeholders needs to be developed through refresher courses, seminars, workshops, electronic and print media. It further recommends that effective linkages should be established amongst research institutes and the beneficiaries of research to enable multi-stakeholder learning.

The extension activities for successful implementation of community based forest restoration initiatives require not only the transfer of plantation technology from the laboratory to the field but also transfer of knowledge about the JFM institution itself. A number of states such as Andhra Pradesh and Karnataka have involved local NGOs in creating awareness in local communities about JFM policies, procedures and other opportunities that it offers. Outsourcing extension, particularly activities pertaining to raising awareness about the JFM programme, can be a viable mechanism to overcome shortage of skilled extension personnel and simultaneously develop capacity in this specialized field. This will also reduce the burden on the frontline staff enabling them to focus more on technical aspects of forestry.

5. Innovative Approaches to Address Forest Degradation

5.1 Ecosystem Services, Carbon Sequestration and REDD

A promising market based mechanism for capturing another ecosystem service provided by forests - forest carbon storage - is through earning carbon credits. The National Environment Policy Draft circulated by the MoEF in 2004 envisages an environment policy that promotes carbon trading and trade in other environmental services. The move towards carbon forestry also dovetails with the existing National Forestry Action Programme (NFAP) to bring 31 million ha of degraded forests and other lands under industrial tree and cash crop plantation by 2020 through collaboration with the private sector, state governments and local communities. A Planning Commission (PC, 2003) document estimates that Indian plantations could sequester 5 million tonnes of carbon resulting in a possible flow of about USD 125 million during the Kyoto Protocol's first commitment period. The Government of Himachal Pradesh, India has submitted a Project Idea Note for Bio-Carbon Conservation Sub-Project as an additional component of the World Bank aided Mid-Himalayan Watershed Project. The intervention proposed under the Bio-Carbon Conservation Sub-Project makes villagers a strategic seller of carbon credits under the Kyoto Protocol. Reforestation has been identified

as the principal carbon sequestration activity involving 600 villages. Indicative value of US$ 5 per tonnes of Certified Emission Reductions is proposed subject to negotiations and financial due diligence. The state of Uttranchal is also taking up carbon conservation sub-projects as an additional component of the World Bank aided Participatory Watershed Management Projects (Singh, 2008).

With the Bali Action Plan categorically placing reduced emissions from degradation and deforestation (REDD) activities on the agenda of future climate change negotiations, there is now a strong possibility that policy approaches and incentives relating to enhancement of carbon stocks in low biomass forests will be successfully negotiated and accepted as a legitimate greenhouse gas mitigation option in the upcoming post-2012 climate change regime. Using the institutional mechanisms provided by community-based forest management (CBFM), 833.8 Tg carbon can be sequestered by enhancement of forest carbon stocks in low biomass Indian forests (Singh, 2008). Bhadwal and Singh (2002) estimate that Indian plantations between 2000 and 2050 could sequester as much as staggering 7 billion tonnes worth of carbon credits. A study (Haripriya, 2001) projects carbon mitigation estimate of 153 Tg yr^{-1} till the year 2030. The higher estimate is because of the consideration of carbon storage in pools other than the above ground biomass and the assumption that the entire area of feasible land is used for forestry. Another study by Ravindranath et al. (2001) proposes that sustainable forestry scenario may enhance additional carbon stocks by 237 Tg (19.75 Tg C yr^{-1} over a 12-year period) from 2000 to 2012 and in addition to meeting all the incremental biomass demands of the nation, commercial forestry would lead to an additional carbon stock of 78 Tg (6.5 Tg C yr^{-1}) during 2000-2012 under the commercial forestry scenario. The findings reported here indicate that even if moderate efforts towards rehabilitating degraded forests are carried out, the potential of additional carbon storage is enormous.

Channeling carbon investment funds into CBFM projects can make both development and conservation economically viable and attractive for the local communities to maintain biodiversity and integrity of nature. The strategy of dovetailing carbon sequestration subprojects with larger national development programmes can result in improved participation and additional financial income to the small stakeholders. However, before actual funding under the Clean Development Mechanism and other international Carbon investment funds is available, policy approaches and positive incentives on issues relating to REDD need to be negotiated and agreed upon by the participating nations to the UNFCCC.

5.2 Landscape Approach

Important landscape level initiatives that are being undertaken in India, apart from the Project Tiger and Project Elephant, are the Asian Rhino and Elephant Action Strategy Wild Lands Programme and the Terai Arc Restoration Initiative. Under the Asian Rhino and Elephant Action Strategy (AREAS) of WWF India four priority landscapes – Nilgiris-Eastern Ghats (elephants) in Karnataka; North Banks (elephants) and Kaziranga-Karbi Anglong (rhino and elephants) in Assam; and Western Terai (rhinos) in Uttar Pradesh have been identified for conservation. Another innovative landscape level approach that involves pro-active management of high conservation value private lands is being attempted under the Wild Lands Programme. Under this programme the thrust is on identifying, prioritizing, securing and managing private owned lands that are of critical importance to the threatened wild species and, thereby, creating buffers for the PAs.

The Terai Arc Restoration Initiative, supported by World Bank/WWF Alliance for Forest Conservation and Sustainable Use, is one of the largest landscape level interventions in South Asia that covers approximately 5 million ha of land from Nepal's Bagmati River in the east to India's Yamuna River in the west. The Terai Arc ecoregion initiative is highly innovative and ambitious where almost all the CBD principles of Ecosystem Approach are being implemented across a single continuous landscape. The initiative aims to restore and reconnect eleven national parks in Nepal and India to create one continuous landscape that allows wildlife to flourish and simultaneously benefit the local people by integrating biodiversity and livelihoods and addressing these challenges in an integrated manner.

5.3 Prospects for Future and the Likely Countries Approach

The PA network presently covers about 20.42% of the forest area of the country. The National Wildlife Action Plan (2002-2016) aims to double this area and focuses on landscape level initiatives. The plan emphasizes on landscape level planning and seeks to develop buffer areas and corridors to link protected areas. The Planning Commission has been requested for financial allocations for developing areas falling within the radius of 5 km of the boundary of national parks and sanctuaries as special development areas so that a human-park interface can be effectively managed. The Wildlife Conservation Strategy, 2002 also focuses on protecting the interests of the rural poor and tribes living around protected areas. It recommends that lands falling within 10 km of the boundaries of the national parks and sanctuaries should be notified as eco-fragile zones under the Environmental (Protection) Act.

Project Tiger, launched in 1973, initially adopted traditional conservation approaches but this is now changing to incorporate an ecosystem approach to manage forests and wildlife. The emphasis is now on managing the landscape by linking the tiger habitats to improve the viability of tiger populations. The thrust is on identifying on priority basis, clusters of PAs and non-PAs areas, which seem contiguous through potential corridors and linkages. A minimum core area of 300 km^2 with a sizeable buffer is recommended for each of the 28 tiger reserves (2005). The ecosystem approach adopted by Project Tiger in 2001 seeks to superimpose land use features, settlements, and livestock distribution to assess biotic pressures on the landscape and evolve mechanisms and processes to ensure planning and strategy continuum across Wildlife Management Plans, Forest Working Plans and District and *Panchayat* Plans. This approach emphasizes formulation of land/water use plans at local, state and national levels based on regional perspective that identifies critical conservation areas within and across stated levels where human activities should be compatible with conservation values (NBASP, 2004). The revised Project Tiger based on the ecosystem approach is the national-level institutional approach that the country is most likely to adopt for managing other high value conservation areas. Project Elephant, which is another major national programme to conserve elephants and being implemented in 12 states of India and 14 elephant reserves, is also based on the similar ecosystem management approach.

Another innovative initiative that seems to be a promising approach for conservation and restoration of degraded landscapes is the creation of community and conservation reserves. A step was taken in this direction by creating two special categories of protected areas - community reserves and conservation reserves by amending the Wildlife (Protection) Act, 1972 in 2003. Section 36C of the Wildlife Act provides that the state government may, where the community or an individual has volunteered to conserve wild life and its habitat, declare any private or community land not comprised within a National Park, sanctuary or a conservation reserve, as a community reserve, for protecting fauna, flora and traditional or cultural conservation values and practices. The objective behind creating community reserves is to provide enabling legal environment so that people are able to conserve community owned or private land that have high conservation value or have high traditional cultural or religious values and practices.

Conservation reserves, another promising likely country approach, provides that the state government may, after consulting the local communities, declare any area owned by the government, particularly the areas adjacent to National Parks and sanctuaries and those areas which link one protected area with another, as a conservation reserve for protecting landscapes, seascapes, flora and fauna and their habitat. The management of conservation reserves rests with a committee, comprising five representatives nominated by the village panchayat (village council) or where such panchayat does not exist, the members of the gram sabha (village assembly) and one representative of the SFD or wildlife department under whose jurisdiction the community reserve is located. Conservation reserves provide a legally enabling environment for creating buffer areas and corridors for wildlife management and simultaneously involving local communities in active planning and conservation. In 2005, Tiruvidaimarudur Conservation Reserve became the first Conservation Reserve to be established in the country.

However, the most dominant institutional approach to manage degraded forest land outside the PA network that is likely to be strengthened in coming decades is that of Joint Forest Management. Appropriately designed JFM policies can sustain and strengthen community livelihoods and simultaneously avoid deforestation, restore forest cover and density, provide carbon mitigation and other ecosystem services and create rural assets and livelihoods. JFM is being ambitiously funded by the central government under the National Afforestation Plan and international funding institutions and as such the area under CBFM is likely to increase rapidly. The JFM approach is likely to be strengthened institutionally and seems to provide promising prospects for the future to rehabilitate and manage degraded forests in India.

5.4 Payment for Environmental Services

Markets for a number of environmental services provided by the forests – water, timber, fire-wood, charcoal, NTFPs, fodder, grasses, and recreation and tourism in National Parks and Sanctuaries already exists in India since decades. Other environmental services of forests like watershed protection and carbon storage are the emerging markets for payment of ecosystem services (PES) in India.

One of the most basic economic instruments for PES in India is the payment of Net Present Value (NPV) of forgone ecosystem services resulting from forestland diversion for non-forestry purposes. The provisions of the Forest (Conservation) Act, 1980 (FCA) stipulate prior central government approval before any forest land is sought to be diverted for non-forestry purpose. Prior to the enactment of the FCA, forestlands were *defacto* zero cost land resource and were increasingly being diverted for settlements and development projects by the state governments. The FCA provides for the mandatory compensatory afforestation on equivalent non-forestry land or double the area on degraded forest land if non-forestry land is unavailable. In addition the user agency is also required to pay NPV to compensate for the consequential loss of environmental services to the society resulting from diversion of forestland for non-forestry purposes, the amount of which ranges between Rs 0.58 million to Rs 0.92 million per hectare depending on the canopy density of the diverted forestland. In the case of hydroelectric projects the project authorities are also required to pay for catchment area treatment.

A study by Sengupta et al. (2003) explores the potential and appropriateness of using market-based mechanisms for improving watershed protection services and livelihoods in India at small, intermediate and large scales and reports several successful examples of small initiatives which more or less replicate market-based mechanisms for watershed protection services. In *Sukhomajri* and *Nada* in Haryana and *Pani Panchayats* in Maharashtra, the allocation of equal water rights to all villagers, irrespective of whether or not they own land, in return for their participation in watershed protection activities on common lands, have enabled the landless and the land poor to sell their water rights to larger landowning farmers who need the surplus water. This market-based mechanism has significantly increased equity and improved livelihoods at the village level. But, the study notes, that the examples where such trading of water rights have taken place are more of exceptions rather than the rule, and more research is needed to find out why such market-based mechanisms have not occurred at a larger scale in other parts of India. The study also explores the prospects of upstream JFM communities receiving payments for sustainable use and protection of upper forest catchments from hydroelectric power project authorities or from Irrigation and Public Health Department for supplying piped water to downstream water users. The study concludes that more theoretical analysis is required so that an enabling framework for creating and functioning for watershed protection services markets could be developed.

The share of the forestry sector in the plan outlays of India is around 1% which translates into an annual allocation of about Rs. 15,000 million. As against this the recorded and unrecorded removal of the forest produce from forests is valued at over Rs. 300,000 million which is 20 times the total outlay (NFAP, 1999). The restoration of degraded forests in India on a sustainable basis thus requires huge funding. The government through its command and control methods alone cannot manage the forest successfully and this calls for looking at strengthening alternate options, particularly economic instruments like PES. The introduction of suitable economic instruments for PES for forests can

strengthen forest conservation and sustainable development in India by raising the necessary capital to rehabilitate degraded forests on one hand and by providing financial incentives to communities in return for their participation in managing degraded forests.

6. Recommendations

India is one of the few developing countries that has consistently taken a large number of steps in the six decades of its independent history to protect its natural resources and restore its forest vegetation and has strived, with commendable resolve though inadequate results, to bring one third of its land area under forest cover. Its large and increasing population, burgeoning demand for forest products, the grinding poverty of a significant section of its population, limited financial resources and pressure on land for its multifarious developmental needs have made the progress slower than what it would have hoped for. Now, with the giant strides it has made on the path of development in the past decade or so, its improved access to financial resources, enhancement in its technological and management capacities, and the new opportunities that are opening up for the forestry sector in view of its importance to climate change mitigation it is now poised to take major progress in reaching its objectives. On this fast pace journey the approach suggested below may be of help, based as it is on the lessons of the past.

Recommendations for the future are:

- **Accord priority to community based programmes**: Policy changes and legislations have been able to bring down deforestation and the forest cover has stabilized at about 64 million. Forests continue to be subjected to increasing local extraction pressures with growing demands. As such, strategy of involving communities should be given priority given that the landscapes requiring conservation and restoration are human dominated ecosystems.

- **Increase in forestry sector funding:** The effort for restoring degraded forests in India requires huge funding. The present share of the forestry sector in the outlay is around 1%. This needs to be augmented and backed by strong institutional support.

- **Integrate climate change mitigation and payment for other ecological services at the core of forest development and management**: The wide acceptance of forests as one of the most important climate change mitigation tool and the availability of carbon markets provide new opportunities for capturing true economic value of the forests. Similar market mechanisms also need to be evolved for other important ecological services that the forests provide. Only then bringing, and maintaining a third of the land under forests would be economically feasible for a country of limited resources like India.

- **Make forest conservation based economic activities locally important**: Economic activities like eco-tourism provide a service that would be increasingly in demand as the country prospers and has the potential of creating a large number of dispersed employment opportunities across the country. The fact that the presence of good forests enriches ecotourism experience would help make forest conservation an economically desirable activity.

- **Recognize pre-existing rights:** Customary tenures are often poorly recorded in official records which prevent genuine participation of individuals and communities in restoration and protection of degraded forests. These rights need to be recognized and simultaneously balanced by adequate legal and institutional measures so that the sustainability of ecosystem services is not compromised.

- **Broaden forest research beyond the traditional:** Forestry research needs to reorient its focus from traditional silviculture to the current needs in the areas of community based forestry, environmental ethics, political ecology, environmental history and ecological economics, urban forestry, mitigation of and adaptation to climate change etc. There is a need to develop

institutions for integrative and multi-disciplinary research to overcome the current disciplinary fragmentation of the forest science community located in forestry institutes and universities.

- **Reduce gaps in forestry database:** The existing forestry database is fragmented, patchy and inadequate. The urgent need to develop a unified forestry database for meaningful policy planning and implementation research is required for meaningful national and regional level policy research and implementation.

- **Increase forestry infrastructure and existing managerial capacity**: The weakness of the existing system lies in the inadequate policy enforcement capabilities of environmental institutions, both in terms of the inadequate manpower and the quality of services they are capable of delivering. This needs to be improved by upgrading their physical infrastructure and managerial capacity. Some of these services can also be obtained through outsourcing from academic centers and private sector. This will compensate for lack of adequate institutional capacities while building academic and private economic interest in creating and protecting forests.

- **Develop institutions for multi-scale governance:** Forests serve not only needs of the communities on their periphery but also those far beyond. There has been success in building village level institutions but to ensure the delivery of sustained social benefits to larger distant communities requires the adoption of multi-scale institutions for governance. Excessive focus on centralized governance or solely on local community based governance may be counterproductive in the long run. In this context, local community-based forest restoration should be nested within larger ecosystem and landscape management programmes.

- **Inter-sectoral policy coordination:** In India, excessive firewood harvesting and grazing are major causes leading to forest degradation. Collaborative mechanism between forestry and other sectors especially animal husbandry sector for management of grazing and fodder production, and energy sector for management of rural energy requirements need to be set-up at local, state and national level.

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List of Acronyms and Abbreviations

CAT	Catchment Area Treatment
CBD	Convention on Biological Diversity
CBFM	Community-based Forest Management
CPR	Common Property Resources
CR	Community Reserves
EERN	Ecological and Economics Research Network
FAO	Food and Agricultural Organization
FCA	Forest (Conservation) Act, 1980
FDA	Forest Development Agency
FES	Foundation for Ecological Security
FSI	Forest Survey of India
FY	Fiscal Year
GDP	Gross Domestic Product
HDI	Human Development Index
HPEDS	Himachal Pradesh Eco-Development Society
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IGCEDP	Indo-German Changar Eco-Development Project
IRMP	Integrated Resource Management Planning
JFM	Joint Forest Management
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
NAPCD	National Action Programme to Combat Desertification
NBASP	National Biodiversity Action Plan
NCA	National Commission on Agriculture
NFAP	National Forestry Action Plan
NFCR	National Forestry Commission Report
NFEP	National Forestry Extension Programme
NGO	Non-Governmental Organization
NPV	Net Present Value
NSSO	National Sample Survey Organization,
NTFP	Non Timber Forest Products
NWDB	National Wasteland Development Board
PA	Protected Area
PC	Planning Commission
PES	Payment of Ecosystem Services
PF	Protected Forest
PIL	Public Interest Litigation
PPP	Purchasing Power Parity

PRI	Panachayati Raj Institutions
REDD	Reduced Emissions from Deforestation and Degradation
RF	Reserve Forest
Rs	Rupees
SFD	State Forest Department
SFR	State of Forest Report
SFRI	State Forest Research Institute
SFRP	State Forestry Research Plan
SPM	Suspended Particulate Matter
TERI	The Energy and Resources Institute
UF	Unclassed Forest
UN	United Nations
UNFCCC	United Nations Framework on Climate Change Convention
USD	United States Dollar
WHO	World Health Organization

Appendix A: ***Ecological Description and Distribution of Forest Types***

Forest Type	Distribution	% of Forest Areas
Tropical Forests		
Tropical wet evergreen	Northeast and South India, A&N Islands	5.8
Tropical semi evergreen	South and East India	2.5
Tropical moist deciduous	Central and East India	30.3
Tropical littoral and swamp	Along the east and west coast	0.9
Tropical dry deciduous	West and Central India	38.2
Tropical thorn	West and Central India	6.7
Tropical dry evergreen	Central and South India	0.1
Subtropical Forests		
Subtropical broadleaved hill forests	South India	0.4
Subtropical	Sub-himalayan tract	5.0
Subtropical	Northeast and South India	0.2
Temperate Forests		
Montane wet temperate	Himalayas and Nilgiris (in Western Ghats)	2.0
Himalayan moist temperate	Temperate areas of Himalayas	3.4
Himalayan dry temperate	Dry Temperate areas of Himalayas	0.2
Sub-alpine and alpine Forests		
Sub-alpine	Himalayas	
Moist alpine shrub	Himalayas	4.3
Dry alpine shrub	Himalayas	

(Source: MoEF, 1999)

Bluepine (*Pinus wallichiana*) Forests of Jammu & Kashmir State, India

Mangrove Forests (showing *Rhizophora*) of Coastal India

Intrinsic Dependence of Locals on Forests for Fuelwood

Harvesting of Fodder Grass by the Local Communities to Sustain Cattle Population

STATE OF LAND DEGRADATION AND REHABILITATION EFFORTS IN NEPAL

Krishna Prasad Acharya[22] Buddi Sagar Poudel[23], and Resham Bahadur Dangi[24]

1. General Information

1.1 Geography, Topography and Climate

Nepal is situated in the Central Himalaya and has diverse physiographic zones, climatic contrasts, and altitudinal variations. Nepal occupies a total area of 147,181 km^2 and lies between 26^0 22' and 30^0 27' N latitude and 80^0 04' and 88^0 12' E longitude. Hills and high mountains cover about 86% of the total land area and the remaining 14% are the flatlands of the Terai, which are less than 300 m in elevation (Table 1). Altitude varies from 60 m above sea level in the Terai to Mount Everest (Sagarmatha) at 8,848 m, the highest point in the world (HMGN/MFSC, 2002). Physiographically, Hagen (1998) divided Nepal into seven divisions which are, from south to north: Terai, Siwalik Hills zone, Mahabharat Lekh, Midlands, Himalaya, Inner Himalaya, and Tibetan marginal mountains.

Table 5: ***Physiographic Zones of Nepal***

Zone	Area (%)	Elevation (m)	Climate
High Himalaya	23	Above 5000	Tundra type and arctic
High Mountains	20	4000 - 5000	Alpine
		3000 - 4000	Sub-alpine
Mid-hills	30	2000 - 3000	Cool temperate monsoon
		1000 - 2000	Warm temperate monsoon
Lowlands Terai and Siwalik Hills	27	500 - 1000	Hot monsoon and sub-tropical
		Below 500	Hot monsoon and tropical

(Source: LRMP, 1986)

In the Terai, the soil is alluvial and fine to medium textured. In the Siwalik Hills, soil is made up of sedimentary rocks with a sandy texture, while in the mid-hills it is of medium to light texture with a predominance of coarse-grained sand and gravel. The soil in the high mountains is shallow, stony, and glacial (HMGN/MFSC, 2002).

A wide range of climatic conditions right from tropical through sub tropical, temperate, sub alpine to alpine exists in Nepal mainly as a result of altitudinal variation. The major perennial river systems that drain the country are the Mahakali, Karnali, Narayani, and Koshi Rivers, which originate all from the Himalayas. Medium-sized rivers include the Babai, West Rapti, Bagmati, Kamla, Kankai, and Mechi Rivers. These generally originate from the mid-hills or from the Mahabharat Range. The Terai region has a large number of small and usually seasonal rivers, most of which originate from the Siwalik Hills (HMGN, 1989).

Eighty percent of the precipitation that falls in Nepal comes in the form of summer monsoon rain, from June to September. Winter rains are more common in the western hills. The average annual rainfall in Nepal is about 1,600 mm, but total precipitation differs in each eco-climatic zone. The eastern region is wetter than the western region. Temperature varies with topographic variations. In the Terai, winter temperatures are between 22-27^{o}C, while summer temperatures exceed 37^{o}C. In the Mid-hills,

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temperatures are between 12-16^{o}C. In general, the average temperature decreases by 6^{o}C for every 1,000 m gain in altitude (Jha, 1992 cited in HMGN/MFSC, 2002).

Nepal has a population of 23.2 million people, 48.5% of which lives in the Terai, 44.2% in the Mid-hills and 7.3% in the Mountains. The average population density is 157.73/km^2, with the highest density (330.78/km^2) in the Terai, medium density in the hills (167.44/km^2) and lowest in the mountains (32.62/km^2). The average annual growth rate was 2.08% between 1981 and 1991, but the 2001 census indicates an average population growth rate of 2.27%, highest in the Terai and lowest in the mountains (CBS, 2003). The average literacy rate was 39.6%.

1.2 Nepal and its Natural Resources

Natural resources form an important component of the physical environment and are very significant for the development processes of Nepal. Nepal has varieties of natural resources available, such as forest, land, water, biodiversity and non-timber forest products. The unique topographic features of Nepal have created a rich and diverse natural resource base. Nepal is heavily dependent upon its water, land and forest resources to meet its development objectives (HMGN, 1988).

Forest resources are one of the major resources directly affecting the survival of rural people in Nepal. Large numbers of rural households in Nepal are still subsistence users of forest and tree products. Access to forest or tree resources can also help rural households diversify their livelihood base and reduce their exposure to risk. Forests can thus form an important safety net for the very poor in times of hardship (Arnold, 2001).

Protected Areas and wildlife are the important biological resources of Nepal. Protected Areas occupy about 28,998.67 km^2 or 19.70% of the total land area of the country. Species richness among floral diversity comprises 465 species of lichens (2.3% of the global diversity), 1,822 species of fungi (2.4%), 687 species of algae (2.6%), 853 species of bryophytes (5.1%), 380 species of pteridophytes (3.4%), 28 species of Gymnosperms (5.1%), and 5,856 species of Angiosperms (2.7%). Faunal diversity includes 168 species of platyhelminthes (1.4%), 144 species of spiders (0.2 %), 5,052 species of insects (0.7%), 640 species of butterflies and 2,253 species of moths (together 2.6%), 182 species of fishes (1.0%), 43 species of amphibians (1.0%), 100 species of reptiles (1.6%), 863 species of birds (9.3%), and 181 species of mammals (4.5%) (GON/MFSC, 2006). Nepal is home to a diverse range of non-timber forest products which are of critical importance to rural people as sources of nutrition, health care, raw materials and cash income. It is a significant source of revenue for Nepal.

Land is a principal natural resource of Nepal that constitutes about 97% of its total area (147,181km^2). About 21% of the country's total land area is cultivated. About 1.74 million ha (11.9%) are defined as pasture/grasslands. Of this, 50% are found in the high mountains, 29% in the high hills, 16.7% in the mid-hills, and about 4% in the Siwaliks and Terai (MOEST, 2006).

Nepal has abundant sources of water in the form of rivers fed by the monsoon, glaciers, and snowfields. It is ranked second in the world in terms of water resources. Water bodies (rivers, lakes and ponds) occupy only three percent of the country's total land area. The steep geography and high runoff provide great potential for generating hydroelectric power. However, the use of water for hydro electricity generation is negligible in Nepal.

Nepal's mineral resources are limited. Low-grade deposits of iron ore are found in the mountains near Kathmandu. Small deposits of copper exist in many areas and small reserves of mica have been found in the hills northeast of Kathmandu. Mineral extraction and transport is a major problem due to the country's rugged terrain.

1.3 Subsistence Agriculture and National Economy

In Nepal, land and forest resources have been intensively used to meet the basic requirements of the people, such as food, fuelwood, fodder, and small timber. Hill people cultivate their agriculture field even on steep slopes. As more than 87% of the people depend on agriculture for subsistence, agriculture has been a major source of income and living for the people in rural areas. The economy largely depends on the use of its natural resource base and is dominated by the agrarian sector (Acharya, 2002).

Forestry is one of the leading sectors for the development of Nepal. Forests are invaluable environmental and economic resources affording several goods and services at local and national levels and basis for living for many people in Nepal. The main use of Nepal's forests is to provide biomass to satisfy the needs for domestic fuel and fodder. About 80 percent of the total population depends on forests for fuelwood (WECS, 1997). Similarly, forest products contribute about 42% of the total digestible nutrients of cattle in Nepal (MOEST, 2001). In addition, rural households collect diverse Non Timber Forest Products (NTFPs) for use at the household level and for cash income (Poudel, 2004).

The Government of Nepal has implemented the Tenth Five-Year Development Plan (2002-2007) formulated as Poverty Reduction Strategy Paper (PRSP) with a sole objective of poverty reduction. The government is also committed in achieving the Millennium Development Goals (MDGs). In 2003-04, 31% of the population was poor in Nepal, compared to 42% in 1995-96. Thus, the incidence of poverty in Nepal declined by about 11 percentage points (or 26%) over the course of eight years, a decline of 3.7% per year (CBS, 2005). The incidence of poverty in 2003-04 varied considerably across different parts of the country, ranging from a low rate of 3.3% in Kathmandu to 42.9% in rural Eastern Hill and 38.1% in rural Western Terai. The incidence of poverty in urban areas has more than halved, declining from 22 to 10%, representing a change of 9.7% per year. While poverty in rural areas also declined appreciably, at 1% point per year, its incidence remained higher than in urban areas (CBS, 2005). The Government's Three-Year Interim Plan (2008–2010) lays a strong emphasis on reducing poverty, improving the living conditions of the poor, and establishing lasting peace and stability. The plan aims to achieve an annual average economic growth of 5.5% and to reduce overall poverty incidence to 24% by 2010 (ADB, 2008).

The Human Development Index (HDI) for Nepal in the year 1996 was 0.403, which is a slight improvement, reaching 0.471 in 2004 (UNDP, 2004). Nepal has made progress in raising living standards over the last 50 years, particularly since 1990. Yet the country's level of human development remains among the lowest in the world. Development outcomes have varied inequitably, manifesting themselves in gender, caste, ethnic and geographic disparities. But the HDI in its urban areas (0.581) outstrips that of the rural hinterlands (0.452) where the majority of the population lives. The HDI is lowest in the mountains followed by the Terai and the hills. Similarly, the far western and mid-western development regions lag far behind the others. Poverty has become intractable. In Nepal, a wide disparity exists in the distribution of land, with inequality of 0.544 as measured by the Gini coefficient (UNDP, 2004). According to HDI score, Nepal holds 140th position in the world (UNDP, 2004).

Employment opportunities have become increasingly scarce. People's needs have gone unfulfilled, institutions have weakened, and policies have not been sufficiently pro-poor, leaving vast segments of the population outside mainstream development (UNDP, 2004).

1.4 Ecology, Forest and Environmental Issues

Nepal has only about 0.1% of the total land mass of the world while it harbors over 2% of flowering plants, 3% of pteridophytes, and 5% of bryophytes of the world's flora. In addition, more than 246 species of the total flora reported are endemic which accounts for about 30% for the whole Himalayan region (MFSC, 1997). Similarly, Nepal possesses over 4.2 and 9.3% of the total world's mammals and birds reported so far.

The high topographic complexity and climatic variability give rise to significant ecological gradients, and thus high ecosystem diversity over relatively small areas. A total of 118 ecosystems with 75 vegetation types and 35 forest types have been identified. In terms of species diversity, Nepal has remarkable assemblages of flora and fauna, which include several endemic species. A total of 181 mammal species, including several endangered species such as rhinoceros, elephant, tiger, snow leopard, clouded leopard and 863 species of birds have been recorded in Nepal.

Nepal is actively involved in environment protection and biodiversity conservation through establishing networks of protected areas in the country. With the primary objectives to conserve the country's major representative ecosystems, unique natural and cultural heritage and give protection to the valuable and endangered wildlife species promoting at the same time scientific research, many protected areas have been established over the past four decades. The protected area system includes nine national parks, three wildlife reserves, three conservation areas, one hunting reserve and eleven buffer zones (Table 2). Till date, 19.70% of the total area of the country has been declared a protected area (DNPWC, 2007a; ICIMOD/MOEST, 2007).

Due to their outstanding ecosystems and landscapes two of Nepal's national parks (Chitwan and Sagarmatha) are listed as World Natural Heritage Sites. Protected area management in Nepal received a real thrust in the 1970s. Not only protected areas were added, but also actions on both their protection and conservation were intensified (Poudel, 2007). Community participation in protected area management has been initiated through buffer zone program throughout the country since 1996.

Table 2: ***Protected Areas of Nepal***

No.	National Parks	Year Established	Area (Km^2)	No.	Conservation Areas	Year Established	Area (Km^2)
1	Chitwan NP	1973	932	**1**	Annapurna CA	1992	7629
2	Bardia NP	1988	968	**2**	Manasalu CA	1998	1663
3	Shivapuri NP	2002	144	**3**	Kanchenjunga CA	1997	2035
4	Khaptad NP	1984	225		**Buffer Zones**		
5	Rara NP	1976	106	**1**	Chitwan NP	1996	750
6	Shey Phoksundo NP	1984	3555	**2**	Bardia NP	1996	327
7	Langtang NP	1976	1710	**3**	Langang NP	1998	420
8	Makalu Barun NP	1991	1500	**4**	Shey Phoksundo NP	1998	1349
9	Sagarmatha NP	1976	1148	**5**	Makalu Barun NP	1999	830
	Wildlife Reserves			**6**	Sagarmatha NP	2000	275
1	Suklaphanta WR	1976	305	**7**	Suklaphanta WR	2004	243.5
2	Parsa WR	1984	499	**8**	Koshi Tappu WR	2004	173
3	Koshi Tappu WR	1976	175	**9**	Parsa WR	2005	298.17
	Hunting Reserve			**10**	Rara NP	2006	198
1	Dhorpatan HR	1987	1325	**11**	Khaptad NP	2006	216

(Source: DNPWC, 2007a)

Nepal has shown its commitment to wetlands conservation by signing the Ramsar Convention on December 17, 1987 by designating Koshi Tappu wetland in the Ramsar list. Since then, the Government of Nepal has initiated the protection and management of wetlands. Further more, Nepal has designated three Ramsar sites viz - Beeshazari and associated lake, Ghodaghodi Lake area and Jagadishpur reservoir in 2003. In addition to already included four wetlands, four more wetland sites *viz*- Rara Lake, Phoksundo Lake, Gosaikunda and associated lakes and Gokyo and associated lakes were declared as Ramsar Sites in 2007. Nepal presently has 8 sites designated as Wetlands of International Importance with 34,365 ha of land. These wetlands broadly represent high altitude and lowland Terai wetlands.

Extensive human activities such as deforestation, encroachment, pollution, habitat depletion, low awareness level, poaching and illegal trade are major environmental issues in Nepal. On the other hand, proliferation of invasive species, forest fire, flooding and landslides, soil erosion are compounding the environmental problems in Nepal. An attempt has been made here to describe major forest and environmental issues in three broad heads i.e., deforestation, degradation and pollution.

Deforestation

In Nepal, 29% of the total land mass is covered by forests and 10.6% by shrubs. The total area under forests therefore, is 39.6% (DFRS, 1999). The Master Plan for the Forestry Sector (1989) which was based on the 1978 data showed 38% forests and 4.7% shrubs (altogether 42.7%) of the total land covered by forest areas. The National Forest Inventory (1994) revealed that there was a decline in forest areas, compared to the figures in 1978. It has been reported (DFRS, 1999) that forest cover in the Terai and hill areas decreased at an annual rate of 1.3% and 2.3% respectively between 1978/79 and 1990/91. On average, forested areas have decreased at an annual rate of 1.7% and shrub lands have decreased at an annual rate of 0.5%. The forest area has decreased and area of shrub has increased in comparison to the previous assessment (DFRS, 1999). It has been estimated that the annual loss due to deforestation amounts to Rupees 11.55 billion (i.e., USD 148.08 million) (MFSC, 2002).

Degradation

Alien invasive species are proliferating and invading the natural environment leading to destruction and shrinkage of native flora and fauna. Many natural habitats have been degraded due to invasion of alien species such as *Mikania macrantha, Lantana camara, Parthenium spp*, or *Eichornia crassipes* (Poudel et al., 2007). The management of invasive species is becoming important at present times, as *Mikania macrantha* is a major problem in Chitwan National Park and Koshi Tappu Wildlife Reserve (DNPWC, 2007b).

Encroachment into forests is as old as agriculture and forest management in Nepal. Until the late 1970s, it was never considered an evil of forest degradation. It was rather used as a cost effective tool by the government to clear forests for resettlement programs (COMFORTC, 2007). The rehabilitation programs implemented on humanitarian ground soon turned out to be one of the most lucrative political businesses to the elites and politicians of the country. The Panchayat Government cleared more than 1,200,000 ha of natural forests and distributed these mostly to its supporters as rehabilitation of landless people and flood victims (MFSC, 1988). As a consequence, poor and landless people were mostly excluded from the government resettlement programs and they continued to stay in forests for their sustenance. A recent study (COMFORTC, 2007) revealed that the main causes of encroachment are migration from high to low land. The study further identified a number of pull factors attracting people to the Terai, such as highly productive land, better infrastructure development, better and easier life and Government resettlement policies. Push factors responsible for the people leaving in the hills include unemployment, low infrastructure development, natural calamities, insurgency and mass poverty. All these factors promoted in-migration into the Terai and give rise to forest encroachment. A total of 70, 256 ha of forest land has been encroached in 24 Terai and Siwalik districts of Nepal (Adhikari, 2002).

The conversion of the natural environment (forest, grassland, and wetland) into agriculture, horticulture, plantation forest, residential or industrial development, roads, and other infrastructure developments have changed the land use patterns in the region and caused profound impacts on floral and faunal assemblages. The greatest threat comes from the need of subsistence farmers to extend their agricultural activity, and the perception that this is best achieved through the conversion of forests and other virgin lands.

Similarly, grazing is a year-round threat to many of the protected areas in the Terai, whereas it is usually only a seasonal threat to the high elevation pastures of the Himalayas. In either case, overgrazing is prevalent. The level of livestock grazing is also one of the most serious threats to the ecological integrity of the mid-hill and highland protected areas and public lands. Over-grazing not only disturbs the habitat but also alters the soil properties and leads to soil erosion and increased surface run-off.

Pollution

The country's topography is rugged with about 86% of the total area made of mountains and hills. The lowland Terai covers only 14%. The hilly areas are geologically fragile and inherently prone to landslide and soil erosion. Cultivation on steep slopes has been common in Nepal. Cultivation on steep slopes without taking into account improved farming such as terracing or use of organic manures contributed to the increase in soil erosion. About 66% of the wetlands of the hills and mountains are threatened by siltation. A further 62% show problems due to agricultural pollution through fertilization and organic waste water runoff. In addition to agricultural runoff, they also suffer from factory effluents, washing and sewage emissions, and domestic effluents. Extraction of forest resources beyond its renewal capacity, shifting cultivation in the mountains and overgrazing have exacerbated the problem of pollution in many respects.

The use of maximum fertilizer, chemicals, pesticides and insecticides in land use practices are causing degradation of land and forest habitats. Due to the application of these chemicals and pesticides, the soil has lost its fertility and production capability and the various types of micro-organisms like bacteria and fungi have been destroyed (Singh, 1994). Increasing levels of water, land and air pollution negatively affect many habitats and their biological communities.

2. Forest Resources Information

2.1 Forest Area

The Forest Act (1993) defines forest as an area fully or partly covered by trees. However, the National Forest Inventory (NFI) of Nepal carried out by the Department of Forest Research and Survey under the aegis of the Forest Resource Information System Project through technical assistance of the Government of Finland between 1990 to 1998 considers forest as all land with a forest cover i.e., with trees whose crowns cover more than 10% of the area, and not used primarily for purposes other than forestry (DFRS, 1999). Out of the total land area of Nepal (14.72 million ha), forests cover about 4.27 million ha (29.0%) and shrubs cover 1.56 million ha (10.6%). Both forest and shrub together cover 39.6% of the total land area of the country (DFRS, 1999). Table 3 shows forest and shrub cover by development region in Nepal.

The NFI estimated an accessible forest area of Nepal at 2.18 million ha (about 52% of the total forest area). Total stem volume (over bark) of Nepal is 388 million m^3. Total stem volume up to 10 cm top (under bark) is 285 million m^3, and up to 20 cm top (under bark) equals 240 million m^3. The total biomass of stem, branches and leaves is estimated at 429 million tones (air-dry) (DFRS, 1999). The NFI also classified the forests according to Development Regions of Nepal and the results accrued thereof are presented in Table 3.

The main tree species in terms of proportion of total stem volume are sal (*Shorea robusta*) with 28.2% of the total volume, oak (*Quercus spp.*) with 9.3% and asna (*Terminalia alata*) with 7.6%, chir pine

(*Pinus roxburghii*) with 6.3%, *Abies specabilis* with 4.4%, *Rhododendron spp*. with 4.2% and *Alnus nepalensis* with 2.9% (DFRS, 1999).

Table 3*: Forest and Shrub Cover by Development Region*

Region	Total Land Area (ha)	Forest Area (ha)	Forest in % of Total Land Area	Shrub Area (ha)	Shrub in % of Total Land Area	Forest and Shrub Total (%)
Far Western	19,53,900	6,87,400	35.2	2,63,900	13.5	48.7
Mid Western	42,37,800	11,92,400	28.2	4,42,000	10.4	38.6
Western	29,39,800	7,34,300	25.0	2,56,900	8.7	33.7
Central	27,41,000	9,18,600	33.5	2,33,800	8.5	42.0
Eastern	28,45,600	7,36,100	25.9	3,62,600	12.7	38.6
Total	1,47,18,100	42,68,800	29.0	15,59,200	10.6	39.6

(Source: DFRS, 1999)

2.2 Forest Distribution

The tropical forests in Nepal are below 1,000 m elevation and located in the Terai and the Siwalik (Churia) hills. *Shorea robusta* (sal) dominates the whole of the Terai region. It is accompanied by *Adina cordifolia, Aegle marmelos, Albizia spp., Anthocephalus chinensis, Anogeissus latifolia, Butea frondosa, Dillenia pentagyna, Dillenia indica* and others. Wherever sal is absent or less prevalent *Lagerstroemia parviflora, Garuga pinnata, Mitragyna parvifolia, Schleichera oleosa, Terminalia bellerica, Terminalia chebula, Terminalia alata* form forests along with *Holarrhena pubescens* and *Mallotus philippensis*. In the riverine areas these species are replaced by *Acacia catechu, Dalbergia sissoo, Dalbergia latifolia, Syzygium jambo* and *Eugenia operculata* (FRA, 2000). Tropical forests account for a total of 1,829 species of flowering plants and about 81 species of pteridophytes (BPP, 1996). The tropical forests are also characterized by the presence of a number of grasslands, popularly known as *Phantas*.

Subtropical forests occur between 1,000 and 2,000 m elevation and support more than 1,945 flowering plant species. The subtropical forest consists of species such as *Schima wallichii, Castanopsis indica*,and *Castenopsis tribuloides* on relatively humid sites while *Pinus roxburghii* forms forests in drier regions. Conifer forests are dominated by species like *Tsuga dumosa*, *Pinus roxburghii* and *Pinus wallichiana* with patches of *Quercus spp*, and *Rhododendron spp*. This zone consists of more than 1,945 flowering plant species. Some common forest types in this region include *Castanopsis tribuloides* mixed *with Schima wallichi, Rhododendron spp., Lyonia ovalifolia, Eurya acuminata*, and *Quercus glauca; Castanopsis-Laurales* forest with *Symplocas spp*.; *Alnus nepalensis* forests; *Schima wallichii-Castanopsis indica* hygrophile forest; Schima-Pinus forest; *Pinus roxburghii* forests with *Phyllanthus emblica*. *Semicarpus anacardium, Rhododendron arboreum* and *Lyoma ovalifolia*; Schima-*Lagestromea parviflora* forest, *Quercus lamellosa* forest with *Quercus lenata* and *Quercus glauca*; Castononpsis forests with *Castanopsis hystrix* and Lauraceae; mesohygophile forests with *Quercus glauca* and *Quercus lanata* (FRA, 2000).

The temperate forests are spread at elevations between 2,000 and 3,000 m and mainly support broad-leaved evergreen forest dominated by plants such as *Quercus lamillosa* and *Q. semicarpifolia* in pure or mixed stands. The common forest types of this zone include *Rhododendron arboreum, Rhododendron barbatum, Lyonia spp., Pieris Formosa; Tsuga dumosa* forest with deciduous species as acer and magnolia; deciduous mixed broadleaved forest of *Acer campbellii, Acer pectinatum,*

Sorbus cuspidata, and Magnolia campbellii; mixed broadleaved forest of *Rhododendron arboreum, Acer campbellii, Symplocos ramosissima* and Lauraceae (FRA, 2000).

The subalpine zone covers about 43% of the land and the forests are present at elevations between 3,000 and 4,000 m. The Betula-*Rhododendron campanulatum* and *Abies spectabilis* forest represents the vegetation of this zone. *Rhododendron spp*. forms a mixed forest within Abies or Betula forest or occurs as open shrub. Some important trees and shrub species of this zone include *Sorbus cuspidata, Euonymus tingens, Ribis glaciale, Acer pectinatum, Salix spp., Lyonia spp., Prunus rufa, Acer candatum, Acanthopanax cessifloia, Sorbus microphylla*, and *Berberis spp*. The *Juniperus spp*. occurs in the drier forest areas of this zone (FRA, 2000). This zone supports more than 1,400 flowering plants and about 177 endemic species out of a total of 246 endemic plants in Nepal (BPP, 1996).

The alpine forests occur at elevations between 4,000 and 5,000 m and are characterized by the presence of various stunted bushy shrubs. The main species are *Rhododendron setosum, R. anthopogon, R. lepidotum, Potentilla fruiticosa, Ephedra gerardiana, Berberis spp.* and *Cotoneaster accuminata* (FRA, 2000).

Nival vegetation is found at elevations above 5,000 m. This zone is mostly without vegetation except for some lichens on exposed rocky places and few flowering plants such as *Stellaria decumbens*. This zone consists of permanent snowfields, rocks, glaciers and ice on the high Himalayan ranges in the north (FRA, 2000).

2.3 Forest Tenure System

The tenure regime in the natural resources sector has undergone major changes from time to time in Nepal since Nepal's formation as a nation-state in 1769 (Adhikari et al., 2008). The Forest Act (1993) and Forest Regulation (1995) have direct bearing on tenure system in Nepal. However, there are *de jure* and *de facto* tenurial rights over natural resources. The prevailing act and regulation classifies forests into two broad categories i.e., private forest and national forest. Private forest means a forest planted, nurtured or conserved in any private land owned by an individual pursuant to prevailing laws. National forest means all forests excluding private forests in Nepal, whether marked or unmarked with forest boundaries. This term also includes waste or uncultivated lands or unregistered lands surrounded by the forest or situated near the adjoining forest as well as paths, ponds, lakes, rivers or streams and riverine lands within the forest.

The national forest is further classified into five categories i.e., Government-managed forest, protected forest, community forest, leasehold forest and religious forest. Government-managed forest means a national forest to be managed by the Government of Nepal according to an approved work plan. Protected forest means a national forest having special environmental, scientific or cultural importance or is of any other special importance and declared by the Government of Nepal as a protected forest. Community Forestry refers to the control and management of local forest resources by users. The Forest Act 1993 defines Community Forestry as part of natural forests, handed over to the Community Forest Users Group (CFUG) by the District Forest Office for development, protection, utilization and management together with authorization of sales and independent distribution of forest products according to an approved operation plan. So far, more than 14,000 forest user groups have been formed managing about 1.2 million ha of forests under community forest titles (Table 4). Leasehold forest means a national forest handed over as a leasehold forest to any institution established under prevailing laws, industry based on forest products or community. Religious forest means a national forest handed over to any religious body, group or community for its development, conservation and utilization.

Table 4*: Status of Community and Leasehold Forests in Nepal*

Management Regime	Community Forestry*	Leasehold Forestry
Districts covered	74	22
Handed over area (ha)	11,87,023	6,973.79
No. of forest user group	23423	4,194
Total households involved	16,40,239	13,220

(*Source: DoF, 2007)

The Buffer Zone Management Regulation (1996) groups forests into four categories *viz*- buffer community forest, buffer religious forest, buffer private forest and buffer zone forest. Buffer community forest means the buffer community forest handed over to the users' committee. Buffer religious forest means the buffer religious forest handed over to the religious body, group or community to develop, conserve and utilize any religious place situated in the buffer zone from ancient time or the peripheral forest of such place. Buffer private forest means the buffer private forest planted in private lands within the buffer zone. Buffer zone forest means the forests excluding buffer community forest, buffer religious forest and buffer private forest within the buffer zone.

2.4 History of Degradation

The majority of the earth's land surface (83%) has been transformed by human activities to a greater extent (Sanderson et al., 2002). About 60% of the earth's ecosystems are considered degraded or unsustainably used (MEA, 2005a). The Himalayan region is thought to be one of the most fragile mountain ranges in the world and is increasingly threatened by large scale human activities. Extensive deforestation and intensive farming on steep slopes, heavy population pressure on natural resources have resulted in overall environmental degradation (Shengji and Sharma, 1998).

Fast degradation of forest land is a post 1950s phenomenon in Nepal (HMGN/NPC, 2003). During the year 1957, nationalization of forests took place leading to the removal of the ownership and management of the resource base away from villagers without changing the demand for forest products. In addition, Nepal's population growth accelerated, roads were constructed that provided easy access to urban areas with growing demand for timber and firewood, while an increasing number of foreign trekkers visited mountain areas consuming additional firewood (HMGN/NPC, 2003). The result was a significant degradation and loss of hill forests, accompanied by other forms of land degradation.

The history of forest encroachment into the forests of Terai started from the rehabilitation program of the government in the late 1950's under the Rapti Dun Development Project in the Chitwan Valley. In the 1960s, the government cleared more than 1,200,000 ha of natural forests and these areas distributed for rehabilitation of landless people and flood victims (MFSC, 1988). The real poor or the landless people were marginalized and could not get land; as a consequence, they continued to stay on the forest land. The Commission on Landless established to ease the situation further aggravated the problem. The diminishing forest area can be attributed primarily to the rapid growth of population. Thus, forest depletion has brought about many other environmental impacts such as floods, landslides, erosion and land degradation.

Bad government policy is itself another factor that has contributed to the reduction of forests. It is argued that the Private Forest Nationalization Act, 1957 appears to have been unfavorable for the protection of dwindling forest resources. The act was implemented on the assumption that it could consolidate the protection and management of forests, but conversely it rather led to degradation of the national forests by providing uncontrolled local access (MOEST, 2001). Likewise, the Land Tax Act

1977 defined lands with forests as government lands. This policy also encouraged local inhabitants to fell down trees standing around their farms (Shah, 1997 in MOEST, 2001).
The degradation of the Himalayan mountain environment does not only affect the livelihood of mountain communities but also has a significant impact on the adjacent plains (ICIMOD, 1993). Degradation of natural resources and loss of biodiversity in Nepal Himalaya have become a major concern, and the sustainable management of biological resources and conservation of biodiversity have emerged as major challenges.

Land degradation is one of the greatest challenges facing mankind and Nepal is no exception. Anthropogenic causes such as deforestation, excessive use of chemical fertilizers, overgrazing, construction works and unscientific farming in the hills have resulted in the loss of flora and fauna, erosion of top soil, occurrence of landslides in the hills and flooding in the plain areas. This has led to severe environmental degradation leading to poor socio-economic conditions and disruption of natural ecosystems in Nepal.

2.5 State of Degradation and Deforestation

Deforestation

Over the past three centuries, about half of the world's forest cover has been removed to make way for croplands, pastures and settlements. In 25 countries, no forest remains, and in an additional 29 countries, more than 90% of forest has been lost (MEA, 2005b). It has been estimated that worldwide, between 1990 and 2000, the proportion of land area covered by forests decreased from 30.4% to 29.7% (UNEP, 2002).

In Asia, the forests in the Himalayan region are considered to be among the most depleted (Tucker, 1987 in Ali and Benjaminsen, 2004). Deforestation in the Himalayan region is also often attributed to increasing human population (Eckholm, 1975). Ives and Messerli (1989) called this explanation "overly simplistic" and have named it the "Theory of Himalayan Environmental Degradation." They argue that environmental degradation has been exaggerated, and often mere correlations between environmental degradation and other factors have been represented as a causal relationship.

The latest physiographic data show that Nepal comprises around 4.27 million ha (29% of total land area) of forest, 1.56 million ha (10.6%) of scrubland and degraded forest (Table 5), 1.7 million ha (12%) of grassland, 3.0 million ha (21%) of farmland, and about 1.0 million ha (7%) of uncultivated lands. In terms of total land area, the Terai occupies only 23.1% whereas hills occupy 41.7% and mountains 35.2%. In the Terai and Siwalik deforestation is wide spread due to government resettlement programs in the past and current illegal clearing of forests for agriculture. In general, main causes of deforestation are agricultural production, need of firewood, forage for livestock as well as local unemployment and insufficient management by the government. There are also other reasons which include political instability, politicians' attitudes, forest fire, shifting cultivation, natural process, forest rewards, attitude of individuals, donor's role and government policy (Joshi et al., 2000).

Table 5*: Forest and Shrub Cover Change (%)*

Category	1978/79	1984	1985/86	1994
Forest	38.00	35.90	37.40	29.00
Shrub	04.70	0.00	04.80	10.60
Total	42.70	35.90	42.20	39.60

(Source: LRMP, 1986; MFSC, 1989; DFRS, 1999)

There is an increase in forest cover in the hilly areas of Terai districts and a minimum loss of forest land is estimated at 0.27% per year in Terai plain. The whole forest area has declined by -0.08% per year in the Terai (DoF, 2005). There was a positive change in the forest cover in the protected areas of Terai districts (MOEST, 2006).

Land Degradation

Land is degraded by biotic as well as natural processes. Land degradation is identified as one of the major environmental problems in Nepal. Most of the forest in the mid-hills are under community management and are well managed (Kanel, 2004). Forests in the Terai, Siwaliks and High Mountains are under severe pressure from biotic interferences. In general, forests under government management face a high degree of uncertainly (MOEST, 2006). Rautianien (1994) argued that previously the Sal Terai hardwood forests are now Terai hardwood due to selection felling resulting in degradation. It can be inferred that the over exploitation of this species has gradually changed sal dominance to sal Terai hardwood species and subsequently Terai hardwood species. MOEST (2006) estimated that over 28% of the total land of the country is under the process of desertification (Table 6). Of the total forest area of the Terai districts about 1.3 million ha is degraded. The sloping areas are under agricultural cultivation without adopting adequate soil and water protection measures. Likewise, about 40% of the forests, mostly in the high mountains have crown cover of less than 40%. The situation of pastureland is even worse and high mountain pasturelands are adversely affected by uncontrolled migratory grazers because of rapidly deteriorating effects of traditional systems of management (MOEST, 2006).

Annual loss of soil from soil erosion is estimated to range between 182 to 708 ton/year (MOEST, 2006). The forest area has been converted into degraded lands and the vegetation cover is extremely low in some areas. Also landslides are common phenomena in the geologically fragile hills thereby increasing the area of degraded lands. Out of the total watersheds of the country, 0.4%, 1.5%, and 11.7% are in very poor, poor and fair conditions respectively (MOEST, 2006).

Table 6: ***Land Area under Some Kind of Degradation in Nepal***

Land Use Category	Degraded Area (million ha)	Total Land Area (million ha)	Land Degradation (%)
Poorly managed forest	2.100	5.828	36.03
Poorly managed slopping terraces	0.290	2.969	10.00
Degraded rangeland/open land	0.647	1.750	37.00
Area damaged by floods and landslides (1984-2003)	0.106	11.551	0.72
Forest encroachment	0.119	5.828	2.04
Total	3.262	11.551	28.24

(Adapted from MOEST, 2006)

Nepal is considered to be a country rich in wild animals and plant biodiversity. However, 11 species of birds and 3 species of mammals are believed extinct due to forest destruction and habitat alteration (Pokharel et al., nd). Similarly, the agriculture sector has been facing severe problems from soil degradation, erosion, landslides, floods and sediment deposition (MOEST, 2001). Chemical and physical deterioration was also considered as a threat to the environment in Nepal (Table 7).

Table 7*: Types of Land Degradation in Nepal*

Types of Degradation	Area (Million ha)	Total Area (%)
Water erosion	6.68	45.5
Wind erosion	0.59	4.5
Chemical deterioration	0.25	1.7
Physical deterioration	0.20	1.3

(Source: MOEST, 2006)

2.6 Constraints for Forest Restoration and Rehabilitation

Land restoration is the process by which an area is returned to its original state prior to degradation of any sort. However, some have argued that it is impossible to restore degraded natural habitats. Gunn (1991) has clearly argued that provided that species have not been made extinct as a result of the degradation, then restoration is possible.

Rapid growth of population is putting severe pressure on natural resources. Some administrative and managerial constraints prevail in the forestry sector mainly due to inadequate staff. Large tracts of Terai forest are unattended by forestry department staff and their management is getting weak. There are some setbacks in community forestry programs in the Terai. Similarly, increasing demand of forest land for development projects such as roads, power lines, industry and public infrastructure and absence of adequate land use policy are posing threats to existing forest land in Nepal. The country's topography is rugged with over three-quarters of the total area made up of mountains and hills (Himalayas, Mahabharat, and Churia). Moreover, the hills and mountains are geologically fragile. A majority of the Nepalese people use the products of forests for firewood, fodder, timber, and medicines. As a result, the forest area has dwindled.

The constraints for forest restoration and rehabilitation are legion but major ones are listed hereunder:

- Unsustainable harvesting of natural resources;
- Encroachment;
- Land-use change pattern;
- Overgrazing/unregulated grazing practices;
- Forest fire, slash and burn practices;
- Overuse of chemical fertilizers and pesticides;
- Landslide/flooding/natural hazards;
- Steep slope cultivation; and
- Pollution and solid waste.

3. Forest Degradation Control Measures

3.1 National Policy and Legislation

Over the past three decades, Nepal has seen considerable changes in institutional, policy and legislation in forest and other natural resource management.

3.1.1 Policy Framework

The **Nepal Conservation Strategy of 1988** emphasized the need for sustainable use of land and natural resources. It imparts policy, program interventions, and strategies reckoned necessary for the effective conservation and development of the nation's natural resources including socio-economic

upliftment of the people through their participation in resource mobilization. It specifically points out that the forests must be protected from deforestation, forest should fulfill basic needs for forest products, and local communities should be made responsible to forest management according to geographical conditions and social needs (HMGN, 1988).

The **Master Plan for the Forestry Sector of 1989** aims to fulfill the basic needs for forest products on a sustained basis, conserve ecosystems and genetic resources, protect land against degradation and other effects of ecological imbalance and contribute to local and national economic growth. The plan identifies community and private forestry as largest among the five primary forestry programs. This plan adopts a holistic approach of multiple land use, local level participation in forest management, institutional development and research, which are the major strengths of this document.

To meet the long and medium–term objectives, the plan proposes six primary and six supportive programs for the forestry sector. Primary programs include: community & private forestry programs, national and leasehold forestry, wood based industries, medicinal and aromatic plants and other minor forest product, soil conversion and watershed management; and ecosystem and genetic resource conservation. Supportive programs include: policy and legal reforms, institutional reforms, human resource development, research and extension, resource information system and planning assistance; and monitoring and evaluation (MFSC, 1989).

The **Nepal Environmental Policy and Action Plan of 1993** seeks to institutionalize environmental protection in the development processes. The plan focuses on sustainable management of agriculture and forestry resources. It also emphasizes national energy policy, watershed management, and participatory forest management. The plan proposes the EIA process to mitigate adverse environmental impacts of development efforts. It was further elaborated in 1998 (NEPAP - II) addressing cross-sectoral and sector plans with the identification of fifty four environmental projects related, directly or indirectly, to the forestry sector (HMGN, 1993).

The **Revised Forestry Sector Policy of 2000** introduces provisions on block forest management in Terai, Churia and Inner Terai to curb widespread deforestation and degradation. The policy proposes to delineate and gazette the contiguous large blocks of national forests as a potential collaborative forests. It further states that the open and isolated forest patches in Terai, Churia and Inner Terai will be made available for handing over as community forests and the Churia hills will be managed as protected forests. The policy recognized the forestry sector as one of the priority sector for planning and investment (HMGN, 2000).

The **Nepal Biodiversity Strategy of 2002** includes provisions on biodiversity convention in protected areas, forests, rangelands, Agro-forestry, wetlands, and mountain areas on a sustained basis for the benefit of the local people. The key strategy of forest rehabilitation involves inventory of flora and fauna, ecosystem network and representation, local participation, strengthening the management regime, sustainable harvesting, non-timber forest products, and religious forest management. It is the first government document that specifically catalogued and addressed mountain biodiversity and called for an integrated mountain policy (HMGN/MFSC, 2002).

The **Leasehold Forest Policy of 2002** includes provisions on leasehold forestry in shrub lands, the restored land from encroachment and reclaimed land from natural disasters, which has less than 20% crown coverage or vulnerability to soil erosion. The policy provisioned different procedures for pro-poor and industrial or institutional leasehold forests. A pro-poor leasehold forestry program is simple, decentralized and short, whereas other leasehold forests are centralized and lengthy (DoF, 2002).

The **National Wetland Policy of 2003** includes provisions that involve local people in the management of wetlands to conserve wetland biodiversity for wise use and ecological services. Emphasis is given to prevent and control the pollution and invasive species. The policy emphasis to formulate and implement integrated action plan that encourages multi-dimensional model and promotes wetland conservation (HMGN, 2003).

The **Agriculture Policy of 2004** emphasizes rapid agricultural growth (both production and productivity) and market development. The policy explicitly expresses the commitment to mitigate the

negative impact of usage of agricultural chemicals on soil and wetlands and to manage degraded forest and natural ecosystems for the biodiversity conservation and management (HMGN, 2004).

Herbs & Non-Timber Forest Products Development Policy of 2004 emphasizes the conservation and sustainable use of NTFPs, promotes people's participation, facilitates forest certification, raises awareness and supports skill development programs to contribute in the nation's economic development through conservation of high value medicinal and non-timber forest products. Policy includes provisions on loan facilities, value addition, and research; enact laws for genetic resources, skill development program, marketing, information dissemination center, and domestication in private lands, etc. (MFSC, 2004).

Nepal Biodiversity Strategy Implementation Plan of 2006 includes provisions on 13 projects such as: forest biodiversity conservation, integrated wetland management, Phulchki-Chandragiri biodiversity conservation, the Rhododendron conservation program in the Tinjure-Milke-Jaljale area, habitat management in protected areas, agro-biodiversity conservation through community participation, management of pollinators for sustainable agriculture, integrated rangeland management, establishment of Kanchenjunga Tri-National Peace Park, and above all institutionalization of biodiversity conservation in Nepal for the years 2006 to 2010 (GON/MFSC, 2006).

The **Interim Constitution of Nepal of 2007** emphasizes the protection of forest and environment through people's participation to safeguard the local and national interest. It contains a provision on giving priority to the protection of the environment, and also to the prevention to its further damage due to physical development activities by increasing the awareness of the general public about environmental cleanliness. It includes also provisions on making explicit arrangements for the protection of the environment and the rare wildlife species (GON, 2007).

3.1.2 Legislative Measures

The Government of Nepal has enacted several legislations for the protection of the environment and natural resources that have both a direct or indirect impact on controlling deforestation and rehabilitating degraded forests.

The **National Parks and Wildlife Conservation Act of 1973** is a key legal instrument to protect biodiversity in Nepal. The Act prohibits hunting or injuring any wild animal, selling parts or whole parts, damaging habitats, illegally felling or removing any tree or other plants, and any acts that disturbs wild life habitat. This Act includes 27 species of mammals, 9 species of birds and 3 species of reptiles listed. The Act allows to earmark 30-50% of park and to reserve revenue for community development activities in the buffer zone (HMGN, 1973).

The **Buffer Zone Management Regulation of 1996** provides conservation and development programs implemented through the local community participation The Regulation promotes community forestry activities in buffer zones to promote natural regeneration. The regulation contains provisions on community forests, religious forests, and private forests (MFSC, 1996).

The **Soil and Watershed Conservation Act of 1982** aims to manage catchments areas, including rivers and lakes, by empowering the Government authority to declare any catchment as a protected area. Within the protected watershed the government could resettle or relocate industries, businesses, and settlements. This Act also prohibits activities, such as forest clearing, stone quarrying soil and /or sand excavation, interfere water bodies, free grazing and others (HMGN, 1982).

The **Forest Act of 1993** enacted to protect and properly utilize the forest resources also empowers the government authority to declare any part of national forests as a protected area provided the area has environmental, scientific and cultural importance. It also empowers local people to actively participate in decision-making processes regarding forest management and benefit sharing. It also decentralizes the forest hand over authority from the center to the local authority. The Act provides legitimacy to the community forest user groups as an autonomous institution, which empowers them to manage the forests according to the approved operational plan. Similarly, the Forest Regulations of

1995 and the Community Forestry (CF) Directives of 1995 have also been promulgated for the effective implementation of the Forest Act (MFSC, 1993 and 1995).

The **Environmental Protection Act of 1996** emphasizes the proper use of natural resources. The Act prohibits illegitimate levels of pollution emission having adverse impacts on the environment or being hazardous to public life or people's health. It provisions Initial Environmental Examinations or Environmental Impact Assessments Reports as a mandatory requirement for approving development proposals in forests, industry, roads, tourism, drinking water, solid waste management, and agriculture. It further provisions a fund for the environment protection to safeguard the environment and the national heritage from further deterioration (HMGN, 1996).

The **Local Self Governance Act of 1999** provides immense autonomy to the local governments- District Development Committees (DDCs), Municipalities and Village Development Committees (VDCs) - are empowered to enforce regulations in particular for the protection of forests, environment, and biodiversity conservation. It also empowers local governments to levy taxes on the utilization of natural resources. The Act allows DDC to enforce measures against environmentally sensitive developmental projects (HMGN, 1999).

3.2 Linkages to National Forest and other Land Use Policy

There are several natural resource policies, acts and regulations that are relevant to forest, environment and biodiversity conservation. The Government of Nepal has recognized four basic elements- restoration, wise use, protection and preservation of natural resources –that are crucial in long term natural resource management. Accordingly, several policy instruments have been designed and implemented by the government. Despite all these efforts, implementation is still below expectation (NPC, 2005).

The Department of Forests has prepared an eviction plan for encroachment and about 11,000 families have been evicted and the encroached land brought under plantation and natural regeneration. About 41,470 ha of barren land have been brought under plantation during the period 1991/92 and 2004/5 (MOEST, 2006).

Forest history and experiences in Nepal show that inappropriate and top down policies have always failed to reduce forest degradation. Community forestry has been effective in landscape restoration, due to local participation, a supportive legal framework, a dynamic process of policy change, and a financial as well as methodological support from donor agencies (Pokharel et al., nd). Branney and Yadav (1998) argued that the quality of the forests is improving in nearly all forest areas under community forest management. Evidences from 60 case studies from Dolakha, Ramechap and Okhaldhunga suggest that the majority of farmers who are members of FUGs feel that the forest-agriculture interface has improved following the establishment of community forests in their villages (NSCFP, 2003).

Various studies suggest that community forestry is effective in improving the forest condition and reversing the trend of forest degradation. Forest users claim that there have been less forest fire and encroachment incidence in community forests in recent years compared to the adjacent national forests. The overall forest condition has also improved in community forests, in terms of regeneration, number of stems per unit area, basal area, growing stock, the rate of annual increment, density of a number of forest patches, species diversity, wildlife and the total biomass (Pokharel et al., nd).

3.3 Case Studies

Case Study 1: Managing Forest through Local People

So far, about 1.2 million hectare of forest land has been handed over to more than 14,000 CFUGs. Thirty five percent of the total population has benefited from this program. The community forestry program has been successful in improving the natural regeneration and productivity of the forest.

Community forestry is an extensively studied field in Nepal and the impacts of community forestry on bio-physical aspects are satisfactory. However, the research has indicated mixed outcomes on social and economic transformation after community forestry. Barren and waste lands have turned into green forests. Users have secured rights - access, use, and control- on forest resources. Besides, fulfilling basic needs, many CFUGs have collected a big sum of money by selling surplus forest products that have significant contribution in community development and in additional income opportunity. This program has been received as one of the successful participatory forest management models in Nepal and elsewhere.

Case Study 2: Managing Conservation Area through Local Community

It is a unique example that a committed national non-governmental organization has been involved in the management of a protected area located in the Annapurna area. This became possible after the third amendment in the National Park and Wildlife Conservation Act in 1989.

The Annapurna Conservation Area (ACA) is the first conservation area and the largest protected area, covering 7,629 km^2 in Nepal. This region is one of the most diverse regions in the world, in terms of both geography and culture. ACA is managed under integrated conservation and development program (ICDP) principles. ACA is managed by the National Trust for Nature Conservation, a national NGO committed for nature conservation through the Annapurna Conservation Area Project (ACAP). Conservation area management committees (CAMCs) are responsible to prepare management plans and to develop programs for community development. ACA focuses on strengthening institutional capacity of CAMCs so that they can effectively manage various development activities. The ACA has been divided into four land use management zones - intensive use zone, protected forest/seasonal grazing zone, wilderness zone and special management zone. The ACA has been cited as a unique model of protected area management in Nepal and abroad.

The Kanchenjungha Conservation Area (KCA) is the first and only protected area managed by local communities in the Kanchenjungha region, which was declared a conservation area in 1998 and also declared a gift to the earth by the Nepalese Government. The management responsibility of KCA was handed over to the KCA Management Committees based on an approved management plan (2063/64-2067/68) and the KCA Management Regulation of 2008. The council is continuously supported by the Kanchenjunga Conservation Area Project (a project implemented by DNPWC and WWF Nepal since 1997). The project is presently working with community based organizations including 7 user committees, 46 user groups, 35 women groups, 26 forest user groups, 3 snow leopard conservation sub-committees, 8 anti poaching sub-committees and other functional groups.

Like the Annapurna conservation Area, Manaslu Conservation Area (MCA) is also managed by the National Trust for Nature Conservation. The MCA was established to improve the livelihood of local people, to conserve and manage the natural and cultural resources; and to promote ecotourism in that area. The natural resource conservation, agriculture and livestock development, community development, conservation education and extension, tourism management and heritage conservation are the key interventions implemented in the MCA. Seven conservation area management committees and several sub-committees have been formed to implement the proposed activities with financial support from the MCA Project.

Case Study 3: Buffer Zone Program: Community-based Participatory Biodiversity Conservation

The Buffer Zone Program in and around national parks and wildlife reserves has been initiated in 1994 on the basis of several community based conservation initiatives. Between 1996 and 2006, the Government of Nepal established buffer zones around 11 national parks and wildlife reserves covering a total area of 5076.67 km^2. So far, over 33 crore Nepali Rupees (USD 4.2 million) from the Nepalese Government and even more than that through projects has been invested in buffer zone development programs that have benefited 0.7 million local people.

The Buffer Zone Program includes community forest development, plantations in community and private land, wetland conservation and management, soil conservation and land protection and alternative energy promotion. These activities aim to increase the resource base, restore wildlife habitats, generate income and eventually reduce pressure on protected areas for forest products. A total of 523 community forests are managed by the local communities to improve the biodiversity status and to restore the lost habitat of wildlife, and to provide basic forestry needs. Forest products are collected for household use only. Selling of forest products outside the buffer zone area is strictly prohibited.

The Buffer Zone Program includes activities like-nursery establishment, integrated livestock management, alternate energy development and plantation of multi-purpose tree species. Such participatory conservation program has many positive outcomes that have been well recognized in Nepal and international fora.

Case Study 4: Restored Khata Corridor: an Animal Abode

Initiated in 2001, the Terai Arc Landscape (TAL) Program is jointly implemented by the Department of National Parks and Wildlife Conservation, Department of Forests and WWF Nepal. The program aims to restore corridor and bottleneck forests that link protected areas between Nepal and India to restore ecological integrity at landscape level. The TAL program in Nepal stretches from the Bagmati River in the East to the Mahakali River in the West occupying 22,199 km^2 area in 14 Terai districts. The Khata is one of the important corridors that connect Nepal's Bardia National Park with India's Katarniaghat Wildlife Sanctuary.

The Khata corridor aims to restore and manage the fragmented and degraded forest corridors to facilitate smooth dispersal of floral and faunal resources between the Pas. TAL has supported plantation and natural regeneration of degraded forests. Many community-based anti-poaching operation units have been formed in the TAL area to control poaching, illegal logging, encroachments and illegal harvest of NTFPs. After the implementation of TAL, there was an increased use of corridor forests by flagship species such as tiger and rhinos. Photographic evidence from this corridor confirms that it is also developing as a feeding ground for rhinos. There are also records of increased sighting of other wildlife species in this corridor.

TAL has also contributed to the promotion of alternative energy in local communities to reduce pressure on corridor forests for household energy sources. So far, 550 toilet-attached biogas plants and 2,000 Improved Cooking Stoves (ICS) have been installed in the TAL area. It has been estimated that this has contributed to save more than 4,000 MT of fuel wood annually. TAL has also supported the local communities to enhance livelihood opportunities through promotion of off farm, farm-based and NTFP-based income generation. More than 70 households benefited from cultivation of alternate crop Mentha in the Khata Corridor and Bardia National Park Buffer Zone. Mentha farming has provided an opportunity to enhance income level of farmers reducing at the same time crop depredation vulnerability by wildlife.

Case Study 5: Greening of Public Land and Livelihood Improvement

The Government of Nepal, under the aegis of development partners, has recently initiated and implemented the public land management program in 14 Terai low land districts of Nepal. The program focuses on environmental conservation and livelihood improvement of the rural poor. The Biodiversity Sector Program for Siwalik and Terai (BISEP-ST) has been supporting greening public land initiatives including school land, river belts, denuded and encroached lands, and area under hi-tension line. A group comprising the 15 poorest households in Dhanusa has leased 2 ha of VDC's public land for 15 years to cultivate vegetables, cash crops, NTFPs and fodder species. Similarly, 76 households have leased 7 ha of public land in Bara District to cultivate vegetables, fruits, NTFPs and trees. The lessee have received immediate benefits and earned NRs. 54,297 (USD 696) out of the sale of surplus vegetables. Under the Livelihood Forestry Program (LFP) in the Nawalparasi, Rupandehi and Kapilvastu districts, about ninety-seven public land management groups are managing 313.89 ha for 5 to 20 years for additional income.

Preliminary findings have shown that public lands can be contracted to local people to support livelihood and to make greenery by efficient use of wasteland. This has been effective to reduce land encroachment and to reduce pressure on forests for household consumptive goods. However, land tenure and coordination issue needs to be addressed for better result in future.

Case Study 6: Catchment Conservation Ponds: Multiplying the Benefits

The Churiya Forest Development Project (ChFDP) was executed in Siraha, Saptari and Udayapur with support from the German Government through the German Agency for Technical Cooperation (GTZ) and aimed at reducing the ecological imbalance I the Churiya region *vis-a-vis* improve the ecological balance. The project started in July 1992 and continued till June 2007. The core program includes community forestry, soil conservation and watershed management, agroforestry/private forestry, energy saving alternative sources of energy and saving and credit. Community forestry has been effective in recovering degraded forests, improving bio-diversity, and improving livelihoods of local people.

Altogether 47 catchment ponds have been built in the Siraha, Saprtari and Udayapur districts with the support from the ChFDP. Over 4,000 households have benefited from this program. Catchment ponds are built in the Churiya hills by blocking small rivulets and gullies. Catchment ponds have contributed by controlling soil erosion, reducing floods and river cutting, recharging ground water, improving micro-climate, providing water for irrigation, and farming livestock. The income from the ponds has been invested in community development and pond maintenance.

Catchment ponds are mainly built in community forests and are managed by the respective CFUGs. The regular maintenance has improved the life of catchment ponds. Ex-post project evaluation reveals that these ponds are effective to improve local livelihoods and to safeguard water, land and forest resources.

Case Study 7: Leasehold Forestry for Environmental Conservation and Poverty Reduction

The Government of Nepal, with financial support of IFAD, has implemented leasehold forestry and livestock programs since 2005/2006 in 22 districts of Nepal. Its twin objectives are poverty reduction and environmental rehabilitation. This program is widely rated as pro-poor and pro-environment priority program. The target groups are 2.55 million people in 480,000 households. One of the program objectives is to manage 31,000 ha of degraded forest lands to raise the income of poor households and to conserve the environment through 3,300 groups within 8 years project period. It is the amalgamation of four major components *viz* - leasehold forestry and group formation, livestock development, rural financial services and program management and coordination.

Land and forest development starts by ending free grazing and preventing forest fires. Then, allotted plots are allotted to pro-poor groups for planting improved varieties of grasses and fodder/forage species. The program has made considerable progress in forming leasehold forest groups. During the last three years period, 6,973.74 ha of forest have been handed over to the leasehold groups. The leasehold areas handed over to the groups indicate that the average area per household is lower than the initial targets due to less area available for leasehold forestry and the higher number of poor people in the community. However, this program has significant contribution in restoring degraded forest, improving livelihoods, increasing forest productivity, empowering pro-poor, and increasing food security.

3.4 National Level Degradation Control Measures

Until 1951, forest resources were used as one of the main sources of government revenue. After 1951, the Government gradually enacted several policies and legislations with regard to forest resource development. The Forest Nationalization Act 1957, the Wildlife Protection Act 1958, the Forest Act 1961, the Forest Protection Act 1967, the National Parks and Wildlife Conservation Act 1973, the National Forestry Plan of 1976, the Panchayat Rules and Panchayat Forest Rules 1978, the Soil Conservation and Watershed Act 1982, the National Conservation Strategy 1988, the Master Plan for the Forestry Sector 1989, the Forest Act 1993, the Nepal Environment Policy and Action Plan 1993, the Environment Protection Act 1996, the Forestry Sector Policy 2000, the Nepal Biodiversity Strategy 2002, the Leasehold Forestry Policy 2002 are noticeable policies and legislations in forestry sector.

The Master Plan for the Forestry Sector (1989) and other conservation policies have forwarded many strategies and programs to cope with deforestation and forest degradation. Of these programs the community forestry and leasehold forestry program have been realized as an effective intervention to halt and reverse degradation and deforestation. By 2007, the Government handed over a total of about 1.2 million ha of state owned forests to over 14,000 community forest user groups for development, conservation, management and sustainable use. The Government of Nepal, with financial assistance of IFAD, has been implementing the pro-poor leasehold forestry program that has been effective in reversing the environmental degradation.

The Terai Arc Landscape (TAL) Strategic Plan (MFSC, 2006) aims to restore and conserve forests resources outside the protected areas to maintain the ecological integrity and support the sustainable livelihoods of people. The plan envisages the restoration of 70% of the degraded forests by natural regeneration and 30% by plantation. The restored corridors and bottlenecks will contribute to restore degraded habitats and reduce grazing pressure in the future. MOEST (2006) has estimated that an area of about 18,000 ha is annually rehabilitated (Table 8).

Table 8: ***Lands under Rehabilitation***

Land area under rehabilitation	Area (Ha)	Remarks
Rehabilitation of degraded crop lands	5,176	Annually rehabilitated
Rehabilitation of degraded rangelands	900	Annually rehabilitated
Rehabilitation of degraded forests	12,992	Annually rehabilitated

(Adapted from MOEST, 2006)

3.5 International Cooperation

The forestry sector in Nepal has over more than forty years experience in foreign investment. Foreign aid has helped in bridging the gap between demand for investments and allocation from national budget in this sector. Due to the low revenue surplus from the forestry sector, financing of development expenditures for forestry sector are largely met by foreign aid. Government of Nepal allocates less than 2% of total national budget for the forestry sector. A significant number of forestry sector development program and projects have been financed by foreign aid, which contribute about one-fifth of the total budget the Ministry of Forests and Soil Conservation has prepared the Forestry Sector Foreign Aid Policy Guidelines 2004, which is in line with the national Foreign Aid Policy 2002. The guideline assesses the trend of foreign aid investment and proposes recommendation for future investment. Foreign Aid Coordination Division (FACD) has been established within the Ministry of Forests and Soil Conservation (MFSC) to ensure compatibility and convergence of foreign aid to national development priority.

The Government of Nepal has been working with other Governments, international non-governmental organizations and other international communities to conserve and manage the forests and biodiversity. Significant contribution was obtained from the Natural Resource Management Sector Assistance Program (NARMSAP), the Livelihood and Forestry Program (LFP), the Churiya Forest Development Project (ChFDP), the Nepal Swiss Community Forestry and Livelihood Project (NSCFLP), the Nepal Australia Community Forestry Project (NACFP), the Terai Community Forestry Development Project (TCFDP) supported by the governments of Denmark, UK, Germany, Switzerland, Australia and the World Bank respectively. Similarly, UN agencies, several governments and NGOs, such as UNDP, GEF, WWF, IUCN, ICIMOD, FINNIDA, JICA, IFAD, etc. gave their support as well. International cooperation is also received from multilateral organizations such as World Bank, Asian Development Bank and others.

4. Capacities to Address Degradation Problems

4.1 Research

The Department of Forest Research and Survey (DFRS) under the Ministry of Forest and Soil conservation is an authorized governmental organization to carry out forestry research activities in Nepal though there are at least 30 different agencies involved in forestry research (Amatya, 1999). However, the research activities are limited which is mainly due to financial and technical constraints. Nonetheless, considerable research studies have been carried out in forestry in Nepal over last three decades. Community forestry research has traveled a relatively long way since its birth. Literature published in the last few years provided ample evidence to this (Poudel, 2004). Various researches have been carried out in forest resource assessment, impacts on livelihood, benefit sharing and participation, institutional issues, social, economic and biophysical topics.

Protected area research has had a long history in Nepal. Over the last three decades or so plenty of research work has been done in protected areas of Nepal. Research permissions taken from the Department of National Parks and Wildlife Conservation in the last few years give proof of these efforts. Nepal's protected areas (PAs) are known as extensively studied areas.

Despite the vast repository of biological diversity in protected areas, its flora and fauna have been inadequately explored and even if studies were undertaken, the existing information is scattered. Often these studies are species-oriented concerning selected endangered mammals and do not deliver conservation actions potentially to serve management needs (Poudel, 2008). Moreover, most of the research studies reflect the fact that the study remained largely as pursuit of students of various colleges and universities for their academic purpose. The number of studies, for example, on lesser known species is rather minimal.

Sound protected area management rests to a large degree on scientific research and monitoring. In many instances, research and monitoring has remained a low priority activity. Sporadic research applying modern tools and techniques also exists. There is very high possibility of using GPS, GIS and remote sensing methods successfully in forestry research. Research policies, guidelines, prioritizations and evaluation criteria should be prepared and the research and monitoring need to be incorporated within the broader forest management system (Poudel, 2008).

4.2 Education and Training

The forestry school was established in 1947, under the aegis of the Department of Forests to commence the training of foresters at the technical level. Initially, it started as Nepal Forestry Institute at Singh Durbar in Kathmandu. It was shifted to Bhimphedi, Makwanpur in 1957-58. The Institute was moved to Hetauda in 1965. It was run by the Department of Forests until July 1972. It then became a part of the Tribhuvan University, the first and the biggest university in the country. After its incorporation into the Tribhuvan University, it became the Institute of Forestry (IOF). IOF is the only institution in Nepal providing professional level training and preparing manpower in the field of forestry and related

natural resources management aiming at developing technically and socially sound and competent human resources in the field of forestry and natural resource management. The objectives of IOF are:

- to design and implement educational programs that address the current needs and interests of the civil society in the country in the area of forestry and allied science;
- to develop competent and application-oriented professional foresters and efficient managers in the area of natural resource management;
- to develop academic environment and encourage faculty members and students to develop their professional career;
- to encourage research activities that can address the practical problems of farmers and communities at large; and
- to develop IOF as the centre of excellence in forestry education.

Until late 1970s the IOF trained only sub-professional or technical grade forestry manpower (Rangers, etc.). Until 1980s, many forestry professionals were trained and educated in India. The IOF expanded its academic program in 1981 to two degrees, namely a two-year Technical Certificate in Forestry and a Bachelor of Science in Forestry. The Bachelor's degree program was shifted to new campus premises at Pokhara. The IOF offered a two-year Certificate in Forestry only at Hetauda until 1981, when, in order to meet the growing demand for trained natural resource managers in the country, it initiated two academic programs; a two-years Technical Certificate in Forestry (TCF) and a three-years Bachelor of Science in Forestry (B.Sc. Forestry). In 1995, the latter was increased to a 4-year program for students to attain 16 years of education after the completion of the undergraduate level. The M.Sc. Course in Forestry was launched in 2001.

Currently, IOF operates at two separate campuses, one at Pokhara and another one at Hetauda, implementing academic programs, such as a Technical Certificate in Forestry, Bachelor of Science in Forestry and Master in Forest Science. IOF has further grown and added nine Master's degree programs, M. Phil. and Ph.D. at Pokhara. The Institute is a well-established national academic and training institute. Opportunities for advanced studies (Master's degree level) in the field are limited in the country. Many students go, either on government scholarship programs or on self-financed basis, every year to foreign universities in the region or abroad to pursue their graduate studies in forestry and natural resource management.

The Institute of Forestry has more than 20 years of experience in running the undergraduate degree programme. It has fairly good physical facilities, including classrooms, laboratories, library, computer center, research forests/nursery, student apartment and upgraded teaching staff. Most of the faculty members of IOF have got their advanced training from Australia, USA, United Kingdom, Norway, Philippines, Malaysia, India, and Pakistan. IOF is responsible for the pre-service training of staff employed by the MFSC. However, the professional interactions and collaborative exchanges between the IOF and MFSC are minimal.

The Kathmandu Forestry College (KAFCOL), affiliated with Tribhuvan University, established in 2005, is the only private forestry college in Nepal. It offers a 4-year Bachelor degree in Forestry. The first intake started in 2005. KAFCOL is committed to providing quality education of international standard, which enables the College to compete globally in the field of forestry.

Presently, five Regional Forestry Training and Extension Centers and Human Resource Development and Training Centre of MFSC conduct training of forestry staff. There are many training institutions in the private sector and a few of them are also involved in the training of forestry staff. Similarly, a few staff members have got their advance training from abroad, but it is minimal.

4.3 Institutional Capacity

Over the last few decades there are rapid changes in the policy and institutional arrangements related to natural resource management in many developing countries. Originally, *Ban Janch Adda*, the Forest Check Office for the protection and harvesting of the Terai forest, was established in 1934. The office continued until 1956, when the office of the Chief Conservator was established (MFSC, 1989). However, the first organized approach to institutionalize natural resource management in Nepal dates back to the year 1951 when the Ministry of Forests has been established. The Ministry has four technical divisions – the Foreign Aid Co-ordination Division, the Planning and Human Resource Development Division, the Monitoring and Evaluation Division, and the Environment Division. Each division is headed by the joint secretary level forest officials. The ministry oversees the forestry related program and activities in Nepal and is responsible for the overall policy coordination, monitoring, and planning of activities related to the forestry sector. The Ministry's five Regional Forestry Directorates and five Regional Forestry Training and Extension Centers are responsible for overall directing, monitoring and capacity building. MFSC has 9,549 allocated staff positions in both gazetted and non gazetted (inclusive of classless) categories. It has five departments, namely:

1) Department of Forests;

2) Department of National Parks and Wildlife Conservation;

3) Department of Soil conservation and Watershed Management;

4) Department of Forest Research and Survey; and

5) Department of Plant Resources.

The Departments are responsible for program implementation. The Department of Forests (DoF) is responsible for the management of national forests outside the protected areas. The Department of Forests in Nepal was established in 1925. Its original mandate was to administer timber exports to colonial British India and to supply wood and wealth to ruling Rana families (Kanel and Acharya, 2008). DoF is the largest department of the ministry, and employs more than 7,000 staff. It is responsible for the implementation of community and private forestry, and the national and leasehold forestry programs. Field level forest management activities are implemented through 74 District Forest Offices (DFOs). Each District Forest Office has a number of Illakas (Sub-district units) and a number of range posts under them. There are up to 3 Illaka Offices, and 8 to 15 range posts in a district forest office. Independent and self governing Forest User Groups (FUGs) are formed for the management of forest patches handed over to them as community forest, leasehold forest and religious forest as legally recognized by the Forest Act 1993.

The Department of National Parks and Wildlife Conservation (DNPWC) is responsible for the implementation of national parks and the genetic conservation program. DNPWC administers and manages national parks, wildlife reserves, hunting reserves and buffer zones, whereas the Nepal Army is responsible for surveillance and protection activities. Buffer zone institutions i.e., the buffer zone management committee, buffer zone user committee, user group and functional groups are formed for buffer zone management in accordance with the provisions of Buffer Zone Management Regulation 1996 and Guideline 1999. In 1970, a wildlife section was established within the department of forests to have specific responsibility for developing protected areas for the conservation of wildlife. National Park and Wildlife Conservation Act was approved in 1973 and the Department of National Parks and Wildlife Conservation was established in 1979. At present, there are 9 national parks, 3 wildlife reserves, 3 conservation areas, 1 hunting reserve and 11 buffer zones covering an area of 19.70% of the total land area of Nepal.

The Government of Nepal established the Department of Soil and Water Conservation in August 1974 under the then Ministry of Forests. In 1980, it was renamed as Department of Soil Conservation and Watershed Management (DSCWM) to better represent its roles and responsibilities of watershed

management. DSCWM has been planning, implementing and monitoring soil conservation and watershed management programs/activities based on the principles of integrated watershed management. At present, DSCWM is providing SCWM service through 55 District Soil Conservation Offices (DSCO). There are altogether 665 member staffs within the department.

The Department of Forest Research and Survey (DFRS) conducts research activities in the areas of afforestation, natural growth rates, silvicultural methods, use of forest resources, agro-forestry technology and tree improvement. It also carries out forest inventory, analysis of remote sensing information and biomass studies to assess forest resources and identify patterns of change in area and growing stock.

The Department of Plant Resources (DPR) is a research-based institution responsible for carrying out activities related to conservation, promotion, and utilization of plant resources and their scientific and practical study. It also assists in scientific and technical research studies of herbs/medicinal plants and other related activities. DPR and DFRS are more involved in service provision in the field of research and development and surveys and research related to the management of forests in Nepal (Kanel et al, 2005).

Some activities related to forest management have also been entrusted to public corporate bodies. The Timber Corporation of Nepal (TCN) has the sole right to harvest, transport and market government timber. Similarly, the Forest Products Development Board (FPDB) works in plantation areas under different guidelines. Some biodiversity conservation activities have been given to NGOs and public corporate bodies. For example, the National Trust for Nature Conservation (NTNC) is a non-profit organization that has successfully undertaken projects in the field of nature conservation, biodiversity conservation and sustainable rural development. It carries out various tasks related to conservation of national parks and wildlife, public awareness on nature conservation, and scientific research on wildlife and other natural resources (FRA, 2000).

Moreover, there several commissions and committees involved in guiding natural resource management in Nepal, namely the Parliamentary Committee on Environment and Natural Resources, National Planning Commission, Environment Protection Council, National Commission on Sustainable Development, Water and Energy Commission, Department of Agriculture, Department of Water Induced Disaster Prevention, District Development Committees, and Municipalities and Village Development Committees.

4.4 NGO Activities

The 1980s have seen a major initiative to strengthen and expand the role of NGOs in resource conservation activities (HMGN, 1988). The National Trust for Nature Conservation (NTNC) was established under the provision of the NTNC Act 1982. The International Centre for Integrated Mountain Development (ICIMOD) was established in 1983 in Kathmandu as a regional knowledgebase institution. During this decade, some professional organizations like the Nepal Foresters Association, Nepal Heritage Society, and Nepal Environmental Journalists Forum were formed. WWF Nepal is working with the Government of Nepal in the field of nature conservation.

Promoting the private sector, NGOs and CBOs involvement in forestry development was one of the major strengths of the Tenth Development Plan (2002-2007). Large numbers of NGOs are working on environmental and natural resource concerns and programs, including forestry. These NGOs work at different levels *viz*- local, national, regional and international. The government has liberalized the rules for local NGOs to work in partnership with international NGOs. The government's policy is to utilize the comparative abilities of NGOs and to utilize them as partners in development (FRA, 2000). More than 6,000 NGOs are formally affiliated with the Social Welfare Council but only about 6.5% (386) of them have environmental protection as one of their main objectives (HMGN, 1988).

Several other Non-Governmental Organizations and Community Based Organizations (CBOs), such as the Federation of Community Forest User Groups (FECOFUN), Buffer Zone Management

Committees, User Committee and User Groups, and The World Conservation Union (IUCN), are also working for the cause of natural resource conservation in Nepal. Likewise, a number of service providers are involved in social mobilizations works, too.

4.5 Extension

The Ministry of Forests and Soil Conservation, its departments and field offices are trying to reach the general public with extension materials. Forestry extension is being implemented by the governmental departments and partner organizations. Development partners, NGOs and private sector are also supporting the Government's endeavors in extension. Largely, the conservation message is aired by mass media like radio, television, and FM stations. The community forestry user group itself is an extension agent in Nepal. Group approach is widespread in the forestry sector as the individual approach is very difficult.

Until and unless the people understand the value of forests and biodiversity for their well being, the conservation is difficult. Therefore, the extension and awareness can not be overshadowed by any other development program. Many forestry programs are aiming at raising awareness and educating people on resource conservation but the current situation still leaves much to be desired. Vast numbers of people are still unaware of the Government's policy, laws and other conservation measures. The extension materials published includes booklets, brochures, pamphlets, posters, banners, and display boards. Publications are helpful to disseminate the message of forest resource conservation. Since most of the rural people are illiterate, the audio-visual is the only means which works effectively. Extension work is targeted towards high school students and children. Nepal is a country of several castes and their own dialects. There is a need to publish extension materials in local language. Extension of scientific results is greatly lacking at present, needing immediate attention. Therefore, conservation education and public awareness programs need to be further intensified.

5. Innovation Approaches to Address Forest Degradation

5.1 Payment for Environmental Services

Payment for Environmental Services (PES) is a kind of voluntary contractual arrangement, and is widely implemented as an innovative conservation financing mechanism to achieve the dual goal of environmental conservation and poverty reduction (Karn, 2008). PES is a mechanism to compensate the producers for the environmental services by the potential consumers. It is based on the "users pay' principle. PES mechanisms has been well implemented for hydrological services in Nepal, Costa Rica, India and many other countries. A pioneering initiative in implementing the PES mechanism has been adopted by the Kulekhani Hydroelectricity Project in Nepal. The project uses water stored at the Kulekhani reservoir and generates 92 MW of electricity every year. This electricity is sold to the electricity authority of Nepal at a fixed price. The production function of this project depends on the water recharge capacity of the catchment, which again depends upon the extent of human pressure on the local forests. Winrock Nepal facilitated to make a compensation arrangement to motivate people to reduce their forest product consumption level and to increase investment in forest development activities. It is envisaged that such compensation would be effective in restoring the catchment forests, which is vital for improving the water recharge capacity and for reducing the siltation rate in the reservoir.

For this purpose, a certain percentage of hydropower royalty is being allocated for development activities to benefit the local communities. This has a positive influence on land use changes in the watershed areas that has reduced sedimentation and increased dry season water flow to the reservoir, estimated to be equivalent to US$ 44,570 per year (Karn, 2008). Hydropower electricity projects also pay the costs for tree planting in accordance with the National EIA guidelines 1993 and subsequent directives. Similarly, another type of PES that exists in Nepal is that the concessionaire hotels are paying conservation fees. There are seven hotel concessionaires inside the Chitwan National Park, a world heritage site. These hotels pay royalty to the government which goes directly to the national

treasury and pay additional charge, equal to royalty, as a conservation fee to the National Trust for Nature Conservation (NTNC). Thus, collected conservation fees are used in conservation activities as per decision of the conservation fee management committee. The committee is led by the senior officer of the Department of National Parks and Wildlife Conservation (DNPWC). Such arrangement also exists in Bardia National Park and Suklaphanta Wildlife Reserve.

There is another type of compensatory payments to finance conservation activities in the Langtang National Park. The Himalayan Spring Water Co. Ltd. established in Dhunche, Rasuwa produces mineral water by using stream water flowing from the Park, for this the company pays US$ 0.00038 per liter to the Park Authority. There is an agreement between the Park and the Company that the Company will regularly pay user fees to the Park and will also provide a vehicle for office work.

The Government has been implementing buffer zone programs in and around the national parks and wildlife reserves. There are 11 buffer zones declared by the Government. In accordance with the provision of National Parks and Wildlife Conservation Act, 1973, fourth amendment in 1993, the Government is returning back 30-50% of the park revenue to the local buffer zone committees. It is also a kind of compensatory payments where the Government is paying local communities for their active participation in conserving National Park and Wildlife Reserves.

5.2 Carbon Sequestration and REDD

Carbon sequestration is the process of storing excess carbon dioxide (CO_2) from the atmosphere. Carbon trading is one of the emerging global markets where developing countries like Nepal can participate through regulatory or voluntary market framework. Forestry resource is important for absorbing the green house gases. Carbon sequestration in biomass is estimated at 2.0 Mg C ha^{-1} $year^{-1}$ in regeneration of natural forests in Nepal (Aune et al., 2005). The carbon trade came in existence as a response to the Kyoto Protocol, signed in December 1997.

The Kyoto Protocol's Clean Development Mechanism (CDM) recognizes carbon sequestration through forestry as a way to mitigate global warming and also allows industrialized countries to counterbalance their carbon emissions by investing in forestry projects in developing countries. In addition, many international private organizations are voluntarily promoting carbon sequestration projects to reduce their carbon emissions. Carbon sequestration projects' economic and environmental benefits are particularly relevant for Nepal (Dalit, 2007).

The Nepal Biogas Project is the first greenhouse gas emission (GHG) reductions project in Nepal under CDM, that have linked rural communities with the carbon market. The project promotes the use of biogas for cooking and lighting in rural households. It is estimated that each biogas unit contributes to reduce carbon dioxide emissions equivalent to two to five tons annually. So far, 150,000 biogas plants have been installed in Nepal. Nepal has been selling carbon credits through the World Bank for US$ 7 per ton of carbon dioxide. Nepal has been receiving US$ 600,000 annually from The World Bank for reducing the carbon emission by biogases. Biogas plants have also contributed to restore forest from further degradation by reducing pressure on forests for energy sources.

Nepal's Initial National Communication Report on Climate Change to UNFCCC mentions increased seasonal and annual air temperatures over the last few decades. The observed annual trend of temperature rise per decade is 0.41^0C while seasonal trends of temperature rise during pre-monsoon, monsoon and winter periods are 0.43^0C, 0.43^0C and 0.37^0 C per decade, respectively (HMGN/MOEST, 2004), which is much higher than the global average. Consequently, the river flow has increased at 1.48m^3/s per year, which is about 1.5 times higher than the rate of annual increment of precipitation. High increases in summer river flow indicate sufficient evidence that high summer temperatures have been leading to fast glacial melt.

As a result of fast glacial melt, new glacial lakes have formed and those already existing have grown rapidly. This alarming highland trend threatens downstream communities and the environment due to the increased risk of glacial lake outburst floods. The occasional bursting of glacial lakes in the past

has seriously damaged the lives and livelihoods of mountain communities. Such threats operate in conjunction with other changes to the patterns of river flow, spring water recharge, precipitation and vegetation types. Such hazards are expected as an impact of global warming in the Himalayas.

Regarding forestry, the potential new policy under UNFCCC, Reduced Emissions from Deforestation in Developing Countries (REDD), moved to the centre stage at the UN Climate Change Conference (CoP13) in Bali Indonesia, 2007. REDD policy entails the idea that a developing country may receive compensation for reducing their deforestation rate, in proportion to the amount of reduced carbon emissions. This is quite different from the CDM framework, which provides carbon credits for afforestation and reforestation program only. To receive optimal benefits from REDD policy, Nepal needs to prepare a broad national framework to participate in REDD. However, community forestry has the potential to reap benefits from global markets under REDD policy, provided Nepal chooses project approach to participate in the program.

5.3 Landscape Approaches

Nepal has taken many important steps to conserve its rich biological diversity since the 1970s. With the realization of the need for more holistic approaches to benefit both nature and people, landscape level conservation has emerged as a promising approach of wild life conservation in Nepal. Landscape level conservation was proposed mainly for two reasons. First, the realization of the fact that long-term conservation is not possible without addressing the needs of local people. Second, the protected areas in Nepal are like islands which are too small to support a viable population of endangered species and ecological processes. In such circumstances, the existing forests that can link protected areas and provide refuge for wildlife populations could play a critical role in landscape-level conservation. Realizing that the problem of restoring and preserving the wild flora and fauna is of international importance, Nepal has launched landscape level conservation initiatives.

It is a new paradigm in conservation planning and implementation that allows for the representation of various facets of biodiversity and human dimensions collectively. The concept of landscape level approach was recognized as a priority program in the Tenth Development Plan (2002-2007). This approach was legitimized after endorsement of the National Biodiversity Strategy in 2002. Consequently, the Ministry of Forests and Soil Conservation endorsed the 10-year Terai Arc Landscape (TAL) Strategic Plan in 2004 and Sacred Himalayan Landscape (SHL) Strategic Plan in 2006. The Terai Arc Landscape Plan has already been translated into the 10-year Implementation Plan in 2004.

Terai Arc Landscape

The Terai Arc Landscape (TAL) initiative is a long-term vision – 50 years and encompasses an area of 49,500 km^2 from the Bagmati River in Nepal to the Yamuna River in India. It is a biologically diverse habitat with 86 species of mammals, 550 species of birds, 47 species of herpetofauna, 126 species of fish and over 2100 species of flowering plants. In Nepal, TAL extends from Bagmati River in the east to the Mahakali River in the west and covers 14 districts including over 75% of the remaining lowland forests of the Terai and foothills of the Churia. TAL is not only a critical habitat for biodiversity; it is a home for 6.5 million people who depend on its resources for their livelihood. TAL includes 11 PAs - four in Nepal: Parsa Wildlife Reserve, Chitwan National Park, Bardia National Park, Suklaphanta Wildlife Reserve and seven Protected Areas in India. Emphasis is placed on critical corridors like Basanta and Khata. Three bottlenecks are identified in Nepal: Mahadevpuri, Lamahi, and Dovan. Major activities undertaken include: forest restoration, maintenance of high biological diversity, ensuring the continued provision of key ecological services, and facilitating gene flow dispersal between wild population and livelihoods improvement. These activities are incorporated under five thematic areas - Sustainable forest management, species and ecosystem conservation, sustainable livelihoods, conservation education and coordination and monitoring.

Sacred Himalayan Landscape

The Sacred Himalayan Landscape (SHL) is a transboundary conservation area covering 39,021 km^2, of which about 73.5% is located in Nepal, 24.4% belong to Sikkim and Darjeeling of India and the remaining 2.1% belong to Bhutan. The SHL builds links with the three major trans-boundary conservation areas in China, India and Bhutan. The landscape is contiguous with one of the largest protected areas in Asia, the vast Quomolongma Nature Preserve in Tibet (China) to the north. In the east, the SHL-Nepal maintains continuity with the Kangchenjunga Landscape in India, linking further to the Bhutan Biological Conservation Complex that has a natural connectivity to Toorsa Strict Nature Reserve of eastern Bhutan. SHL Nepal includes four Protected Areas – Langtang National Park, Sagarmatha National Park, Makalu Barun National Park, and Kanchenjungha Conservation Area - covering about 22% area of the total landscape (HMGN/MFSC. 2006).

Although SHL is presently sparsely populated, with about 5 million people, its inhabitants face abject poverty. Forestry, agriculture and tourism are dominant livelihood strategies adopted by over 80% people in the SHL. In terms of species diversity, the SHL supports remarkable assemblages of flora and fauna, which include several endemic species. A total of 85 mammal species, including charismatic species such as the snow leopard, are known to occur in the SHL. Other mammals include red panda, musk deer, Tibetan wolf, blue sheep, and clouded leopard. Over 440 species of birds have been recorded from the SHL.

Degradation of large tracts of agriculture, forest and pasture lands in the hills and mountains of the SHL seem to have considerably increased in the last two to three decades. The predominant agro-pastoralist livelihood, such as slash and burn or shifting cultivation or 'khoriya' practices in the mountains, are associated with land degradation. Croplands are characterized by increasing soil erosion, landslides, slope failure, poor fertility, and reduced cropping intensity. The mountains in the SHL are prone to natural disasters due to unstable geology and extreme climate. Landslides are the most common natural disasters in this region caused by intense seasonal precipitation during monsoons. The SHL Strategic Plan set different strategies on 22 targets and 15 outcomes (HMGN/MFSC. 2006).

5. 4 Prospects for the Future and the Likely Countries Approach

Nepal has undergone a major shift in forest management with the introduction of participatory forest management concept in 1970s. The bottom up planning approach adopted by participatory natural resource management programs has yielded several positive outcomes. The local communities have initiated community stewardship in resource management.

Biotic pressures have already resulted in deforestation and land degradation. If the immediate and underlying causes of land degradation are not identified soon and remedial actions taken, then it is possible that the land of Nepal will further deteriorate to such an extent that the desertification is inevitable. Deforestation could appear as an acceptable explanation for the nationwide land degradation. The ecological and economic implications of land degradation are serious and the consequences will undoubtedly affect the livelihood of rural populace.

The Government of Nepal has done a commendable work in establishing a good network of protected areas for conservation which is almost one-fifth of the total surface area. The establishment of protected areas has been effective in protecting the endangered wild life species. Due to the involvement of the Nepal Army in protecting National Parks and Reserves, the wild land resources and environmental functions are safeguarded.

It is envisaged that Nepal will continue to support natural forest rehabilitation and forest plantation activities in the future. Experience has shown that the land restoration succeeds only when people are brought to the forefront of natural resource management. It is expected that the full implementation of innovative and participatory policies will halt and reverse the further land degradation. However,

careful planning is needed to mainstream rural population in nature and environmental conservation activities in Nepal.

6. Recommendations

The Government of Nepal is committed to strengthening, reviving and restoring the ecological balances and the conservation of land, forest and water resources in the country. It is necessary to work more on the ground to identify not just the problems in land degradation in Nepal but also the underlying causes as well. Sincere attempts to emulate the lessons and experience learned from different forestry development programs are required. It is essential to consolidate the lesson learned and experiences of the past 30 years Nepal got success in conservation of natural resources in order to design new programs and encourage a heuristic learning process. Initiatives towards collaboration and partnership with local, national and international organizations should be intensified. Measures are necessary to address the widespread poverty and reduce the dependency of local communities on dwindling forest resources. Siwalik Hills and other ecologically sensitive areas should be declared as protected forest to restrict the environmentally destructive activities.

It is needed to step up the initiatives to partake in the conservation of natural resources by evolving innovative measures where local communities perceived themselves as custodians and partners of conservation. Forestry practices in public land perhaps offer the best chance to prevent encroachment and demands further attention. The best models and practices should be replicated in other parts of the country. Effective law enforcement would result in land and forest protection, to a large degree. It is imperative to heighten environmental awareness. Documentation of information together with research and monitoring should be given importance. Above all, proper land use planning should be accorded utmost priority.

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List of Acronyms and Abbreviations

ACA	Annapurna Conservation Area
CAMC	Conservation Area Management Committee
CBO	Community Based Organization
CBS	Central Bureau of Statistics
CDM	Clean Development Mechanism
CF	Community Forestry
CFUG	Community Forestry User Group
DDC	District Development Committee
DFO	District Forest Office
DNPWC	Department of National Parks and Wildlife Conservation
DoF	Department of Forests
FACD	Foreign Aid Coordination Division
GHG	Greenhouse Gas
GIS	Geographical Information System
GON	Government of Nepal
GPS	Global Positioning System
IOF	Institute of Forestry
HDI	Human Development Index
DFRS	Department of Forest Research and Survey
HMGN	His Majesty Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
KCA	Kanchenjungha Conservation Area
LRMP	Land Resource Mapping Project
MOEST	Ministry of Environment, Science and Technology
MCA	Manaslu Conservation Area
MDG	Millennium Development Goal
MEA	Millennium Ecosystem Assessment
MFSC	Ministry of Forests and Soil Conservation
NGO	Non Government Organization
NPC	National Planning Commission
NTFP	Non Timber Forest Product
NTNC	National Trust for Nature Conservation
PA	Protected Area
PES	Payment for Environment Services

REDD	Reduced Emission from Deforestation in Developing Countries
SHL	Sacred Himalayan Landscape
TAL	Terai Arc Landscape
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat

A Comparison of Land Rehabilitation through Community Forestry in the Hills after 20 Years

Public Land Rehabilitation in the Terai of Nepal

Community Managed Forest in the Hills: Balancing the Gender

FOREST COVER REHABILITATION – SRI LANKA

Anura Sathurusinghe, Conservator of Forests, Forest Department
Sri Lanka

1. General Information

1.1 Geographic Area

Sri Lanka is situated near the southern point of the Indian sub continent, between 5^0 54' and 9^0 52' N latitude and 79^0 39' and 81^0 53' E longitude. The total land area of the island is 6,570,134 ha. The island has a maximum length of 432 km from north to south and a maximum width of 224 km from east to west. Topographically, it consists of a south-central mountainous region, which rises to an elevation of 2,500 m, surrounded by broad lowland plains at an elevation of 0 – 75 m above sea level (asl).

1.2 Climate

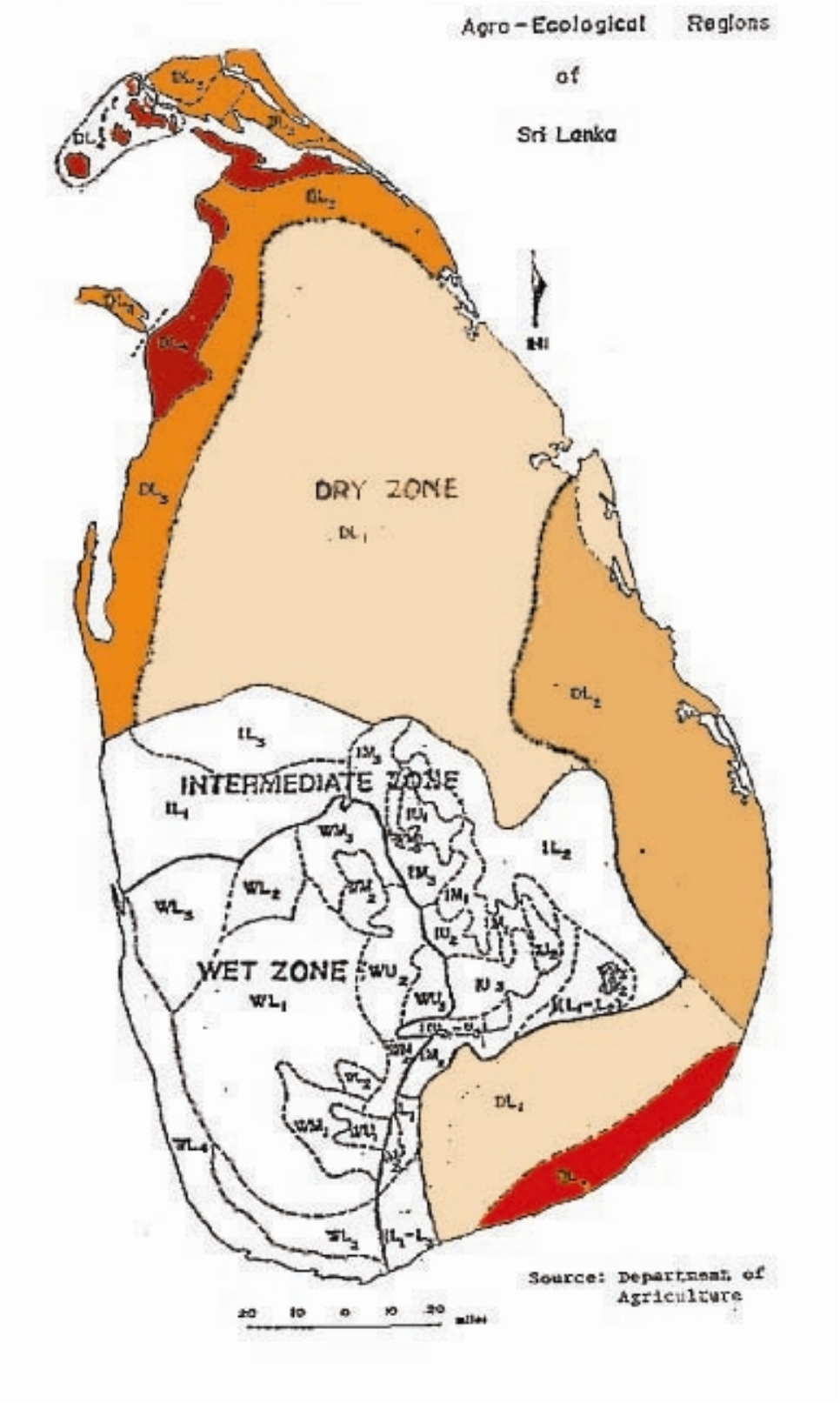
The climate of Sri Lanka is basically determined by the geographical location of the island in the equatorial belt and its position in the inter-tropical convergence zone. It is tropical overall, but shows variations across the island due mainly to difference in rainfall pattern and elevation.

The main determinants of Sri Lankan climate are temperature and rainfall. The mean temperatures in the lowland areas are 27^0C in the wet region and 30^0C in the dry region. In the mountain region the mean monthly temperature varies from 13^0C to 16^0C, with the night temperature occasionally dropping to around 0^0C.

The rainfall is of three types, monsoonal, conventional and depression. There are two monsoonal periods, South West (May – September) and the North East (December – February) responsible for the major part of the annual precipitation. Local topography plays a major role in determining the rainfall distribution over the island. The southwest monsoon provides rain mostly to the south-western quarter and the central highlands. The northeast monsoons along with inter-monsoonal depression active in October and November are stronger and produce rain throughout the island.

The country has been divided into climatic regions in many different ways. Generally, three broad climatic regions are recognized: the wet zone, the dry zone and the intermediate zone. Whereas the dry zone is all lowland, the other two zones are further subdivided on the basis of altitude**.** Figure 1 shows a division of the island into a large number of agro-ecological regions, where the annual rainfall and its seasonal distribution and the altitude are taken into consideration.

Figure 1: ***Agro-ecological Regions of Sri Lanka***



1.3 Geology and Soils

Most of Sri Lanka is underlain by Precambrian rocks which are metamorphic in nature. Two major groups of Precambrian rocks namely (1) the Highland series and (2) the Vijayan series could be identified. The more recent rock types of sedimentary origin, found mostly in the north west of the country including the northern tip of Sri Lanka - the entire Jaffna peninsula. These are predominantly Miocene limestone. Small extents of Jurassic sandstone, shale and grit are found among the Vijayan rocks. Alluvium, beach and dune sands, red earth and mottled gravel of quaternary origin are found all over the island but predominantly near the coast.

There are fourteen major soil groups recognized in Sri Lanka, but only two of them are found extensively. Accordingly, reddish brown earths occupy most of the dry and intermediate zones while reddish brown latosols are found in the wet zone and montane region of the intermediate zone. Since the parent material of the Precambrian rocks is relatively uniform over the landmass weathering by climate appears to be the main determinant of soil type. Soil groups therefore closely coincide with the climatic zones of the country.

1.4 Population

The population of Sri Lanka is recorded as 20.22 million in 2006. The decline of infant mortality and increase in the life expectancy were recognized as main contributing factors towards the population increase. However, the population growth has shown a decreasing trend over the recent past and dropped from 1.5 percent to 0.8 percent during the period of 2002 – 2006.

Sri Lankan people represent multi-ethnic, multi-religious and multi-cultural groups, in which Sinhalese (75%), Tamil (17%) and Muslim (7.5%) are the three major ethnic groups that make up more than 95% of the country's population.

Sri Lanka has achieved the highest level of literacy rate, 92%, among South Asian countries. Fifty six (56%) of the total population has attained the secondary and higher level of education. About 30-35% of the work force is employed in the agriculture sector. As a result of improved health, the higher literacy rate and better education, Sri Lanka has been able to maintain sustainability of natural resources to an appreciable level compared with other countries in the region.

Over the last 50 years there is a gradual decline of the percentage of rural population with a simultaneous but gradual increase in the urban population. This decline of the rural population is continuing since people are migrating from villages to towns looking for employment opportunities in the industrial and service sectors over the agricultural sector.

1.5 Economic Situation

The agriculture sector which includes agriculture, fisheries and forestry is considered as a substantial contributor to the Sri Lankan economy. In 2005, this sector which depends intimately on the environmental and natural resources contributed about 17% to the country's Gross Domestic Product (GDP). Out of the three, agriculture contributes the largest share to the GDP followed by fisheries and forestry.

In Sri Lanka, 31% of the total land area is under agriculture. Agriculture is considered to be an important source of livelihood in the rural areas accounting for nearly one third of the country's labour force in 1999. According to a survey carried out in 2002, agriculture households (defined as households engaged in agriculture derived an income from crop production, livestock raising and agricultural wage labour) comprised over 60% of the rural population in all provinces of Sri Lanka except in the Western province.

1.6 Environmental Status

Land degradation, loss of biodiversity, depletion of coastal resources, deterioration of water resources and waste disposal are considered as the key environmental issues of the country.

Land degradation has been considered as one of the most serious environmental problems in the country. Key causal factors responsible for land degradation have been identified as land clearing, poor land management practices, over exploitation of land due to fragmentation, shifting cultivation, insecure land tenure, growing of erosive crops as well as gem stone and sand mining. In addition to these, soil erosion and poor irrigation practices have contributed to a decline in the productive capacity of lands.

Loss of biodiversity is also a major environmental issue in Sri Lanka. Sri Lanka has been named as one of the 25 biodiversity hotspots in the world. This indicates the richness of its biological diversity manifested by the wide range of ecosystems and species therein. The key cause responsible for biodiversity loss is the forest degradation and other factors including collection of wild species for commercial purposes, introduction of invasive species, draining of wetlands for development purposes, destruction of mangrove forests and coral reefs, over exploitation of some fish species, conversion of salt marshes into other land use types, aquatic pollution caused by agricultural, industrial and domestic waste and hunting and poaching.

The other major environmental issues in the country have been identified as depletion of coastal resources mainly due to various development programmes, deterioration of water resources and waste disposal problem.

2. Forest Information

2.1 Ecological Description

In Sri Lanka the natural vegetation is predominated by different types of forest ecosystems which reflect the combined efforts of topography, climate and soils.

The wet zone vegetation which represents at least nine different floristic zones and a high proportion of endemic plant species has been largely categorized by elevation with wet evergreen forests or rain forests in the lowlands and lower montane forests on the lower slopes of mountains between 1000 – 1500 m, and upper montane forests above 1500 m. Although the wet zone is only a small area of 15,000 km^2 in extent, the combination of topography, climate and geological history has resulted in a diversity of species rich associations in this zone as compared to the vegetation types in the rest of the country. These features of the Sri Lankan wetland lowland rainforests and montane forests make them of critical importance in understanding the biogeography and floristic wealth of South and Southeast Asia.

In the intermediate zone, the vegetation gradually changes to moist semi evergreen forests. Although these forests have a fair proportion of deciduous species, they are essentially evergreen. However, within the southeastern intermediate zone, they mostly constitute the forest canopy. Hence, those forests are more deciduous or semi-evergreen in character than those of the northern block.

The most extensive type of the forest in Sri Lanka is the dry mixed evergreen forest found in the dry zone. Although deciduous species exist in these forests, their evergreen character is maintained by a few widespread species. Consequently, these forests are also referred to as semi-evergreen forests. They receive rains only from the northern monsoon.

Tropical thorn scrub forests are found in the two arid zones of the northwest and southeast extremities of the country. This comprises small trees and thorny scrubs. Along the rivers in both dry and arid zones, where there is no acute shortage of moisture, are impressive riverine forests or gallery forests.

The tall, buttressed spreading trees arch over waterways, and the cool, shady environment beneath them is in sharp contrast to the heat and dust away from the water.

In the coastal areas mangrove forests colonize inundated bays, inlets and river estuaries with scrub vegetation invading sandy shores and dunes. Inland areas inundated by freshwater have swamp and floodplain forests. Most of these have been converted to flood plains.

Table 1: ***Distribution of Different Forest Ecosystems in Different Agro-ecological Zones of Sri Lanka***

Agro-ecological Zone	**Mean Annual Rainfall (mm)**	**Altitude (m)**	**Mean Annual Temperature (^{o}C)**	**Forest Type**
Wet Zone	2500 - 5000	0 - 1000	27 - 30	Tropical wet evergreen forest
		1000 - 1500	20 - 24	Sub Montane Evergreen Forest
		1500 - 2500	13 - 16	Montane Forest
Intermediate Zone	1900 - 2500	0 - 2500	28 - 30	Moist Evergreen Forest
Dry Zone	1250 - 1900	0 - 500	29 - 31	Dry Mixed Evergreen Forest
Arid Zone	< 1250	0 - 100	29 - 32	Tropical Thorn Scrub Forest

2.2 Forest Area

The forest types in Sri Lanka are categorized into four major categories depending on their structure and composition and special distribution. These are tropical rain forest, dry mixed evergreen forest, submontane forest and montane forest.

The total forest area of the country is 2.0 million ha and includes the forest categories as presented in Table 2. A general overview of the forest cover and wildlife areas is presented in Figure 2.

Table 2: ***Different Forest Categories and their Extent in Sri Lanka***

Forest Category	Extent (Ha)
Tropical Wet Evergreen Forest or Tropical Rain Forest	141,506
Sub Montane Evergreen Forest	68,616
Montane Forest	3,108
Moist Evergreen Forest or Moist Monsoon Forest	243,886
Dry Mixed Evergreen Forest or Dry Monsoon Forest	1,090,981
Scrub Forest	464,076
Riverine Forest	22,435
Mangroves	8,688
Total	2,043,296

(Source: Forest Department, 1992)

2.3 Forest Tenure System

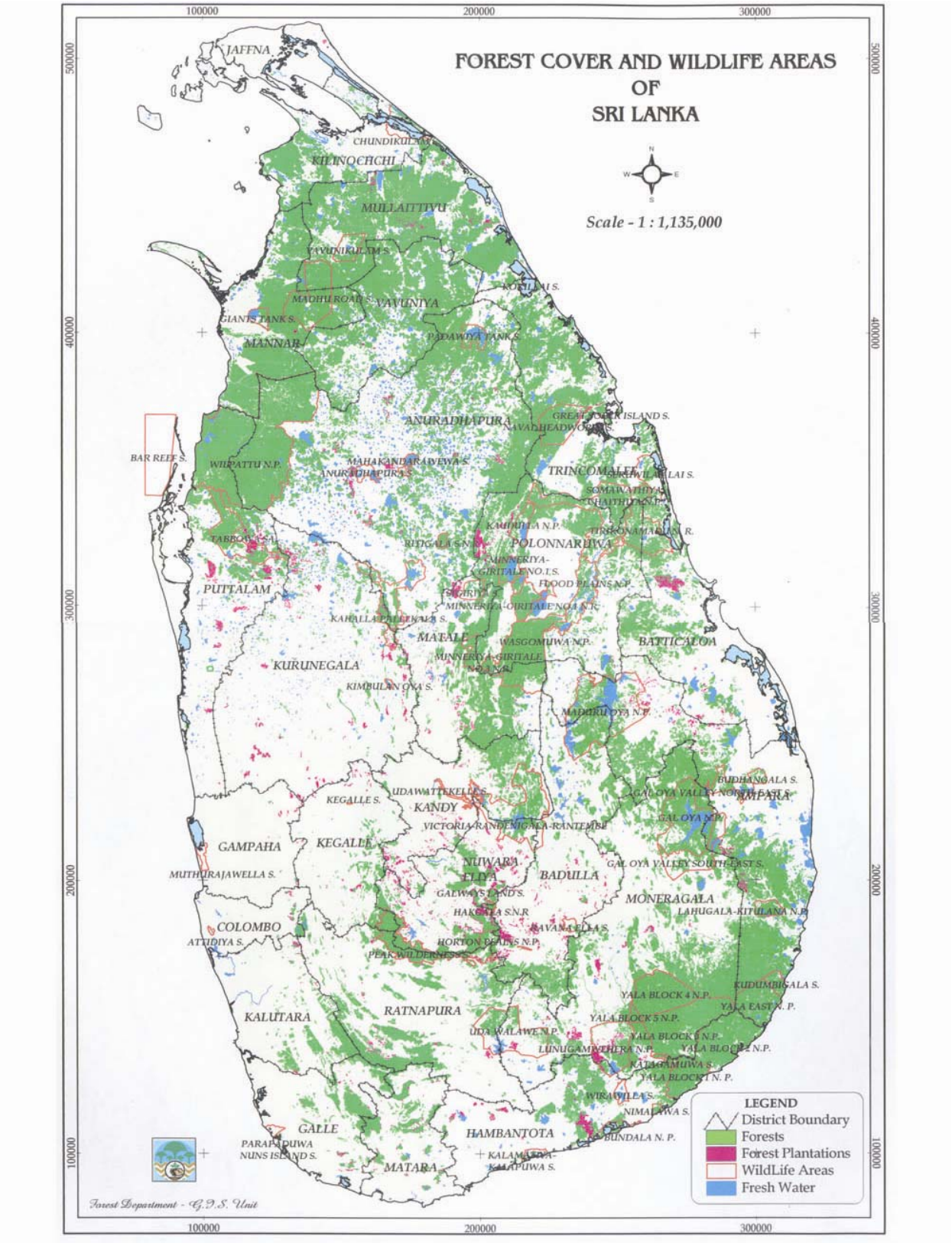
In Sri Lanka, 82% of the land area is under some form of state control. This includes the land alienated under settlement schemes which may be governed by restrictions on inheritance, transfer and subdivision and which accounts for 15% of the total land area of the country. Over the years, state land, which had been under forest cover, has been alienated under various schemes, such as village expansion, regularization of encroachments, special leases, and others.

Except for few catchment areas in privately owned plantations, and freehold land in some wildlife sanctuaries, natural forests are under the jurisdiction of the state.

2.4 History of Degradation

In Sri Lanka, protection of nature has a strong tradition, which dates back to the introduction of Buddhism in 246 BC. Prior to that, it is likely that hunting was enjoyed by at least the elite of society, but this practice changed under the Buddhist philosophy of reverence for all forms of life – killing was forbidden. One of the world's first wildlife sanctuaries was established by King Devanampiyatissa in 246 BC. Succeeding kings continued to uphold Buddhist precepts: Forests were protected by royal edicts, tree felling and collection of forest products were controlled, and the fragile ecosystems of the wet zone forests were left practically undisturbed. Kings appointed *Kele koralas* (forest officers), whose duties included prevention of poaching and protection of royal trees (Sri Lanka Forestry Master Plan, 1995). In the 12th century, King Keerthi Nissanka Malla proclaimed that no animals should be killed within a radius of *seven Gav* (35.7 km) of the city of Anuradhapura, then the capital of Sri Lanka (Abeywickrama, 1987; IUCN, 1990).

Figure 2: ***Forest Cover and Wildlife Areas of Sri Lanka***



Changes in attitudes and land-use practices began with the onset of the colonial period, which began in 1505. Until the early 19th century, however, most of the hill country and low country dry zone was forested; large tracts of forest remained in the North, East, and Southeast; only the extreme South and Southwest were generally cultivated, paddy fields and coconut plantations being common (Horldsworth, 1872). From 1830, vast tracts of forest at middle altitudes were cleared for coffee, to be replaced by tea from 1850 after the coffee plantations were devastated by a leaf-blight. Forest clearance in the dry zone began around 1869, accelerating towards the turn of the century with the introduction of large colonization schemes. Shifting cultivation or *chena* became more widely practiced, contributing significantly to the destruction of forest cover (Perera, 1977). In order to control this destruction of natural forests, then the colonial government took steps to appoint a Conservator of Forests in 1887 and established the Forest Department in Sri Lanka.

The Conservator of Forests, Colonel Clark, R. A. took the first attempt to control the destruction of wildlife resources of Sri Lanka, in 1889. He brought the disastrous effects of the commercial exploitation of wildlife resources of the country to the notice of the Government of Ceylon and advocated immediate legislation, which would forbid the destroying of wild animals for the export of hides.

According to the new constitution of Ceylon in 1930, forests and 'all that they contain' were placed under the responsibility of the Minister of Agriculture and Lands, who appointed a committee named Fauna and Flora Protection Committee to examine and report on the local situation. Based on the recommendations by this committee, the Fauna and Flora Protection Ordinance No. 2 of 1937 came to power in 1937. Further realizing the necessity of having a separate institution to enforce the Fauna and Flora Protection Ordinance, a separate department – Department of Wildlife Conservation was established in 1949. At present, both the Forest Department and the Department of Wildlife Conservation are responsible for the protection of the protected area network of Sri Lanka.

2.5 State of Forest Degradation and Deforestation

There is a strong link between population growth and deforestation and forest degradation. Agricultural production has been increased mainly through expanding the area under cultivation. Natural forest has been the victim of this type of unplanned development activities. The depletion of forest resources is also linked to demand for forest products such as timber and fuel wood. Population increase combined with economic growth has resulted in a higher demand for housing and construction, which in turn has resulted in increased demand for wood. The continuous economic growth and increasing population has influenced the demand for industrial round wood and poles rising from 1.7 million cubic meters in 1995 to 2.0 million cubic meters in 2020. At the same time, the closed canopy natural forest cover is expected to decline from 22.7% in 1999 to about 17% by 2020, if no planned action is taken.

2.6 Constraints for Forest Restoration and Rehabilitation

The pressures put on Sri Lankan forests are immense. Industry wants to produce sawn timber and other forest products. Rural people need fuel wood to meet their energy requirements. The growing population requires land for agriculture and environmentalists and other concerned people want to preserve the remaining natural forests intact. At the same time, international conventions such as the Climate Change Convention require an increase of forest land as sinks for carbon dioxide. Forestry professionals and other government officials are facing a multitude of problems and responsibilities, with too few resources to address the problem adequately. They have simultaneously to conserve biodiversity, protect watersheds, provide land for the landless, and provide a multitude of forestry products to the increasing population. Therefore, it is a difficult task for the forestry and land use administration with its limited manpower and financial resources to manage the forest resources under its control.

3. Control of Forest Degradation

Sri Lanka was well known as a forested island before its colonization by the Portuguese, Dutch and British (1505 – 1948). The industrial revolution in the northern countries and the increase in local population accelerated the rate of deforestation for timber and land. Since that period, the closed canopy (> 70% canopy cover) of natural forest cover has dwindled rapidly from about 80%, until, in 1999 it was estimated at less than 22%. However, the present forest cover (both closed canopy and scrub forest) of the island is considered to be about 30% of the total land area.

Several steps have been taken to control and minimize the degradation of natural forest vegetation in Sri Lanka. They are:

- Introduction of a national forestry policy; and
- Development of a forestry master plan

Based on recommendations made in the Forestry Master Plan a National Forestry Programme has been developed and implemented with donor assistance.

3.1 National Forestry Policy

Sri Lanka's National Forestry Policy (1995) has been drawn up to provide clear directions in planning and implementation of forestry programmes on the island. It reflects consultations lasting for almost a year involving a wide range of stakeholders including the general public and NGOs.

The National Forestry Policy objectives are as follows:

i. To conserve forests for posterity, with particular regard to biodiversity, soils, water, and historical cultural, religious and aesthetic values;

ii. To increase tree-cover and productivity of the forests to meet the needs of present and future generations for forest products and services; and

iii. To enhance the contribution of forestry to the welfare of the rural population, and strengthen the national economy, with special attention paid to equity in economic development.

The policy acknowledges that the natural forests are heavily degraded, and expresses concern over safeguarding the remaining natural forests for posterity in order to conserve biodiversity, soil and water resources. It also emphasizes the importance of retaining the present natural forest cover, and increasing the overall tree cover. A large part of the forests should be completely protected for the conservation of biodiversity, soil and water. Multiple use forestry is to be promoted, and the natural forests outside the protected area system should be used sustainably to provide for the growing demand for bio-energy, wood and non-wood forest produce, and various services, especially for the benefit of rural people, while ensuring that the environmental objectives are also met.

3.2 Forestry Sector Master Plan

The Sri Lanka's Forestry Sector Master Plan (FSMP) 1995 is considered as a comprehensive biophysical, environmental, socio-political, and economic projection of the forestry sector's optimal development, intended to guide decision making at national, regional and local levels. It provides a comprehensive long-term development framework for the forestry sector covering the period 1995-2020.

The Forestry Sector Master Plan (FSMP) puts particular emphasis on:

- Conserving the remaining natural forests to maintain wildlife as reservoirs of biodiversity
- Empowering people and rural communities to manage and protect multiple-use forests, mainly for their own benefit
- Building partnerships in forestry development activities
- Developing home gardens and other agro forestry systems as well as forest plantations to meet people's basic needs
- Developing and strengthening forestry institutions, both state and NGOs

The development objectives of the FSMP are the same as those of the National Forestry Policy of 1995.

3.3 The National Forest Programme

The three objectives of the National Forest Policy provide the required structure for the development of a National Forest Programme. The first two provides a clear path for the sector and the third identifies its impact on the sector and the welfare of the nation. Further, the National Forestry Policy clearly specifies partnerships with non-state and private sectors as the guideline for implementation of forest-related initiatives within the forestry sector in Sri Lanka. Therefore, the policy provides both the purpose to the programme, welfare and economic development for the nation, and programme structure includes:

- Conservation of forests
- Production from forests and utilization
- Implementation through partnership
- The development of effective and efficient institutions within the sector

Element IV is considered as a pre-requisite for effectiveness of I to lll above.

The Forestry Programme which at present is being implemented by the Forest Department represents a detailed plan for the first five years of the 25-year plan of the Forestry Sector Master Plan. In addition, the FSMP has identified 13 programme "components" to be implemented over the next 25 years.

The process of transforming the 25-Year FSMP into a detailed plan was initiated in 1995 based on recommendations of an identification mission appointed by the Ministry. The mission resulted in the development of an "Indicative Five-year *Implementation Programme of the Forestry Sector Master Plan".*

The *Indicative Five year Implementation Programme* includes:

- Forest land allocation and macro-level zoning
- Forest conservation
- Multiple-use management of natural forests
- Commercial plantation development
- Social forestry/agroforestry and extension
- Forest based industry development
- Institutional development

Most of the above components, if not all, have been implemented over the past five years in the form of various projects funded by various donors as well as the government itself. The components which have direct impact on forest degradation are described below.

3.3.1 Law Enforcement and Protected Area Network

Evolving Protection Policies and Legislation

Preservation of indigenous flora and fauna has featured consistently in forest policy, beginning with the country's first policy statements in 1929 by the British Governor, Herbert Stanley, and continuing in the first comprehensive statement of national forest policy objectives in 1953. The policy objectives were reformulated in 1972 and 1980, the latter revision giving more emphasis to preserving the environment and including new objectives, to involve local people in forestry activities through a program of social forestry (Sri Lanka Forestry Sector Master Plan, 1995). The present forestry policy, (National Forestry Policy – 1995) clearly emphasizes the responsibility of the State as stated by one of the three policy objectives which read as follows: "to conserve forests for posterity, with particular regard to biodiversity, soils, water, and historical, cultural and aesthetic values".

Protected Areas in Sri Lanka - Present Situation

The International Union for Conservation of Nature (IUCN) defines a protected area as an area of land (and/ or sea), especially dedicated to the protection and maintenance of biological diversity, and of natural and cultural resources, and managed through legal or other effective means (IUCN, 1994).

At present Sri Lanka has an extensive system of protected areas covering nearly 15% of the total land area. These can be broadly categorized into two categories depending on their administrative and legal status. This includes the areas administered by the Department of Wildlife Conservation (DWLC) and the areas administered by the Forest Department (FD). The majority of the protected areas which is nearly 13% of the total land area are administered by the DWLC, and the remaining 2% falls within the administration of the Forest Department. Within the forestry sector over 45% of the existing natural forests has been allocated as protected areas, specifically for protection and conservation purposes. The lands falling within the jurisdiction of the Department of Wildlife Conservation are considered as totally protected. The majority of these areas consist of forests except for a few wetlands. In contrast, in addition to the 2% mentioned above, the Forest Department administers about 18% of the total land area in the country, being managed for multiple uses. These two independent institutions are placed under the responsibility of the Ministry of Environment and Natural Resources.

The protected areas under the jurisdiction of the Department of Wildlife Conservation and the Forest Department are administered under the following legislation.

- The Forest Ordinance

  Administered by the Forest Department and deals with the establishment and protection of village forests, forest reserves, and other state forests and forest products. Regulates the timber transport.

- The Flora and Fauna Protection Ordinance

  Makes provisions for National Reserves (National Parks, Nature Reserves, Strict Nature Reserves and Jungle Corridors) and Sanctuaries and their administration by the Department of Wildlife Conservation.

- National Heritage and Wilderness Area Act

  Makes provisions for the preservation of genetic resources, unique ecosystems, and habitats of endangered and threatened species. Administered by the Forest Department.

Protected Areas Administered by the Forest Department

The protected areas under the Forest Department can be categorized as following:

i. World Heritage sites – Sinharaja
ii. National Heritage and Wilderness Areas – Knuckles
iii. Man and Biosphere Reserves – International Reserves –3 and National Reserves - 47
iv. Other Conservation Forests

Protected Areas administered by the Department of Wildlife Conservation

Table 3 shows the categories and extent of protected areas under the Department of Wildlife Conservation.

Table 3: ***Categories and Extent of Protected Areas under the Department of Wildlife Conservation***

Category	Number	Extent (Ha)
National Parks	18	505,182
Strict Nature Reserves	3	31,575
Nature Reserves	4	33,474
Elephant Corridors	5	-
Sanctuaries	55	274,767
Total extent under DWLC		**845,099.21**

3.3.2 Importance of Stakeholder Participation in the Forestry Sector

The policy also recognizes that the state agencies alone cannot protect and manage the forests effectively. People's participation in forestry development and conservation is to be promoted. The policy emphasizes the need to develop partnerships with local people, communities, NGOs and other local groups outside the state sector. The policy aims at broadening the institutional framework for forest management, with clearly defined roles and responsibilities for the various partners. Farmers, community organizations, NGOs and small and medium-scale commercial enterprises should all have a role in activities such as protecting the forests, growing trees to meet household needs, supplying raw materials for wood-based industries, harvesting, transporting, processing and distribution of various forest products.

Table 4: Distribution of Roles between Government and Non-government Stakeholders

Development Partners	Protected Areas	Multiple Use Natural Forests	Home Gardens and other Non-forest Land	Forest Plantations	Industrial Production
National Authorities	Policy and legislation, finance and audit	Policy and legislation, finance and audit	Policy and legislation, access to funds	Policy and legislation, access to funds	Policy and legislation, access to funds
Forest Department and Department of Wildlife Conservation	Policy formulation macro-level planning enforcement management monitoring, training and extension	Policy formulation macro-level planning; enforcement management conservation monitoring, training and extension	Policy formulation macro-level planning management conservation training and extension	Policy formulation macro-level planning, leasing enforcement monitoring training and extension conservation management	Policy formulation macro-level planning, extension, supply of wood
Wildlife Trust	Management of income generating activities, patron of conservation education of the public	Support in conservation			
Other State Institutions	Law enforcement, Industry licensing land-use monitoring, education, research collaboration and extension	Law enforcement, industry licensing, land-use monitoring, education, research and collaboration in extension	Law enforcement, industry licensing, land-use monitoring, education, research, collaboration in extension	Law enforcement, industry licensing, land-use monitoring, education, research, collaboration in extension, environmental monitoring	Policy formulation, law enforcement, industry licensing, environmental monitoring, education, research, collaboration in extension
Local Rural People	Participation in conservation, authorized utilization	Participation in management and conservation, authorized utilization and protection	Management and utilization, conservation and protection	Non-resident cultivators, hired labour, protection	Labour services, supply of wood

NGOs	Extension, mobilizing and facilitating, capacity and skill building, participation in conservation and management, advocacy of private rights , law enforcement and monitoring	Extension, mobilizing and facilitating, capacity and skill building participation in conservation and management, advocacy of private rights, law enforcement and monitoring	Extension, mobilizing and facilitating, capacity and skill building, advocacy of private rights	Extension, mobilizing and facilitating, capacity and skill building, advocacy of private rights and monitoring	Extension, mobilizing and facilitating, capacity and skill building, advocacy of private rights and monitoring
Other Non-State Sector (including Estates)	Support to conservation	Support to conservation and authorized utilization	Harvesting and transport, utilization	Management, harvesting and transport utilization	Management, supply of wood to manufactures

4. Recommendations

Compared with many other countries, Sri Lanka is in a relatively favourable situation. Deforestation is a major environmental and socio-economic problem, but fortunately with the implementation of various programmes, further destruction has been minimized. In addition to that, an active tradition of home gardens has been able to increase the supply of bio-energy, and of wood for subsistence and commercial uses.

At present, a number of objectives has been identified through various consultation processes to ensure further protection of these pristine ecosystems. Series of actions have been recommended to meet each objective.

Objectives:

- To ensure that threatened forest ecosystems and species are given adequate protection
- To put in place a system of monitoring forest biodiversity and taking corrective action when necessary
- To promote conservation of indigenous forest species both within and outside protected areas
- To involve local communities living on the fringes of forests in participatory activities for the conservation and sustainable use of biodiversity
- To promote mixed cropping with indigenous species in private lands and state lands leased for agro forestry
- To increase timber supplies through forest plantations , which will have the effect of reducing the pressure on forests for producing timber
- To promote public awareness of the environmental benefits of conserving forest biodiversity

Recommended Actions:

- Develop a system for the regular monitoring of forest degradation and take remedial action to rectify any negative trends as and when necessary, including threats from invasive species.

- Take effective action to stop further encroachments on the wet zone forests

- Take action to prevent the use of high forest areas and fragile ecosystems for shifting cultivation

- Define, demarcate and establish an optimal protected area system network utilizing scientific and distributional data available from the 'National Conservation Review' (NCR), paying special attention to the conservation of endemic species of plants and animals.

- Complete the preparation of management plans (including surveying and boundary marking) for all protected areas and ensure the active implementation; ensure that such plans continue to recognize the participatory role of communities living in proximity to the areas under protection and adequately address the conservation and sustainable use of biodiversity.

- Strengthen research capacity and pursue research on selected forest species, with a view to promoting natural regeneration of, or actively propagating, these species and strengthen research capacity and pursue research to determine sustainable use thresholds for selected forest species.

- Expand programmes for afforestation, reforestation and forest rehabilitation, paying attention to the use of indigenous species as far as possible and establish forest plantations on currently non-productive land as entrepreneurial ventures in collaboration with the private sector to cater to the timber and fuelwood demand.

- Organize skills enhancement and awareness programmes on biodiversity conservation for operational staff, NGO participants, CBO personnel and rural communities

- Review legal instruments relating to the collection of forest plants and animals, including regulations relating to export, and amend in order to eliminate anomalies and strengthen the law, so as to afford protection to threatened species of indigenous plants and animals.

- Expand and maintain the programme of setting up urban forests, and develop educational and awareness programmes in relation to these forests.

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