Rationale for

Prescribing the Requisite Forest/ Tree Cover in India

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Executive Summary

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The national forest policy resolution on maintaining one-third of the total land area of the country under forest cover has been debated and even questioned on many occasions and many a forum. The present study, conducted under a contract of Indian Council of Forest Research and Education (ICFRE) awarded to Academy of Forest and Environment, attempts to provide factual information and analysis in order to unravel the mystery surrounding the magical number.

Chapter 1 presents the background information on the ICFRE research contract including statement of objectives, expected outputs and analysis included in this report.

Chapter 2 describes the model and information system used to estimate the actual and required proportion of land area under forest and other land uses at the district, state and the country levels. This task proved most difficult, as land database agencies in the country work in a compartmentalized manner using often incompatible definitions and classification systems.

Chapter 3 presents the land use history during the colonial times characterized by high rate of deforestation, often accompanied with severe land degradation. This and the international thinking in the early nineteenth Century, to maintain one-third the country's total land area under forest, seemed to have influenced thinking of Indian policy makers in 1952.

Chapter 4 describes the 1952 forest policy resolution in detail including prescription of the forest area proportion by region (viz. Hills and plains) and for the whole country. The analytic thinking, which went in finalization of the policy, was acclaimed as a landmark event in the international forestry.

Chapter 5 makes an evaluation of forest policy implementation using time series data. A widening gap is observed between the actual and desired forest cover over time; mainly arising from land transfers to agriculture, which seems to have stabilized by 1990 and even reversed on account of forest / tree growth outside forests.

Chapters 6 present a 2020 forestry scenario to meet national needs of forest goods and services. An analysis of the trends leads to an optimistic conclusion about the possibility of achieving and, most likely overshooting, the magical forest cover target, through forestry working closely and in synergy with other sectors, in particular, agriculture.

The last Chapter 7 presents institutional arrangements and enabling environment to realize 2020 forestry objectives; and thereby contribute effectively to inclusive growth and environmental sustainability in the country.

Chapter 1
Framing the Research Issues

1.0 Background

Few statements of the National Forest Policy have been debated and even questioned, as the one on maintaining one-third of the country's land area under forests. The present study, conducted under a contract of Indian Council of Forest Research and Education (ICFRE) awarded to Academy of Forest and Environment, attempts to provide factual information and analysis on the subject.

The National Forest Policy 1988 states that "the goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile eco-system."

The National Forest Policy 1952 also contained a similar phrase (refer paragraph 19): "India, as a whole, should aim at maintaining one-third of its total land area under forests, about 60 per cent should be kept under forests for their protective functions in the Himalayas, the Deccan, and other mountainous tracts liable to erosion. In the plains, where the ground is flat and erosion is normally not a serious factor, the proportion to be attained should be placed at 20 per cent."

The above policy statements are, however, not accompanied with any technical annex providing background information on how this seemingly high level of forest cover goal was arrived at. The need for research on the subject has been widely felt because there is a large body of researchers, who question the scientific rationale behind the stipulation of the forest area objective. Some others feel that having 33% of geographical area under forest and tree cover might be a highly desirable goal, but the same may not be practical or even logical.

The ICFRE contract elaborates the issue with concrete examples. "As per the FSI SFR 2003, none of the three mountain States (HP, Uttarakhand and Sikkim) have the desired 66% forest cover despite over 64% of their geographical area being recorded as forest land. The issue here being that whether areas notified as forest of various kinds with different degrees of legal protection do necessarily have to support tree vegetation. If we go by routine definition, areas, which have a poor tree cover like pastures or grassland may be classified as 'poor/degraded forest land', with potential for afforestation without actually looking at their ecological importance and permanence. The question here is: are forest areas with trees the only areas worth protecting/conserving?"

The above document continues further: "Large areas notified or recorded as forests also include diverse grasslands, alpine pastures, wetlands etc. Under the present emphasis of enhancing the forest cover, these areas may be looked at as potential areas for expansion of tree cover. Apparently, such areas could not be brought under tree/forest cover due to unwanted and avoidable consequences for the local communities, and their cattle population.

Besides, we may lose mosaic/varieties of natural ecosystems. For enhancement of forest cover, therefore, one has to look beyond such ecologically/sociologically significant areas such as non-cultivable agricultural land/wasteland etc. A consistent land use policy that unifies the principles and goals of sectors like forestry, agriculture and livestock etc may be required to arrive at logically definitive goals."

1.1 Objectives and output

In the above context, the general objective of the present research is as follows:

"To scientifically assess the proportion of the land area of the country that should be under the forest/tree cover, and also examine the impact and feasibility of achieving the goal of 1/3rd forest/tree cover as prescribed in the National Forest Policy.

The specific objectives are the following:

Assess the rationale of the policy objective of keeping 33% of the country land area under forest / tree cover in view of local and national demand of forest goods and services and recommend, following scientific analysis, the proportion of land area of the country that should support forest/tree cover;

Impact of the current forest policy regime on ecosystems diversity, biodiversity, customary land use and eco-system based livelihoods; and

Need to reassess our conservation strategies so that the scientifically estimated forest cover is achieved within the overarching approach of maintaining the integrity of natural ecosystems.

Among others, the study was expected to provide a comprehensive well-researched report to serve as a source material for referential purpose by both Government/Non-Government organizations.

1.2 The stipulated Investigations

The ICFRE contract, among others, mentions the following assessments / analysis / deliberations to be included in the report:

(1) Assessment of role of existing forests/vegetation cover in providing goods and services to the country, from available data/records/reports (FSI, NRSA, SFDs) and gaps/deficiencies

(2) Assessment of requirement of area under forest/tree cover taking into account ecological, economic and social imperatives at local, regional and national levels.

(3) Deliberations on eco-system based approach for conservation rather than only tree based systems that require protection/conservation.

(4) Analysis of current conservation strategies as to how far they fulfilled the desired objectives with regard to following categories of areas: -

  (a) Unculturable area under control of Forest Departments

  (b) Tree cover outside forests

  (c) Potentially culturable areas under public domain

  (d) Key role of farm forestry/private plantation in enhancing forest/tree cover.

(5) Analysis of the impact of international developments related to Multilateral Environment Agreements (MEAs) like the Climate Change Convention/ Kyoto Protocol on domestic forest management policy especially with respect to the proportion of land area prescribed for forest/tree cover.

Keeping the above stipulations in view, the report is structured as follows:

Background information to present research contract (Chapter 1);

Presentation of a scientific approach to land suitability classification and forest land evaluations, a model for analysing land use status and changes, description of database and terminology as well as limitation of the study arising from a lack of geo-referenced database on distribution of forest area by physiographic zone (Chapter 2);

The historic setting of land use during colonial times (1850-1947) characterized by indiscriminate deforestation accompanied with land degradation, a precursor to 1952 policy (Chapter 3);

Discussion of the rationale for maintaining one-third land area of the country under forests (Chapter 4);

Review of implementation of 1952 forest policy and likely reasons for non-achievement of the policy objectives (Chapter 5);

A 2020 Forestry Scenario for achieving forest cover objective within the overarching national objective of inclusive growth and ecosystems integrity (Chapter 6); and

Institutional arrangements for achieving the policy objective of one-third land area of the country under forests (Chapter 7).

The above issues are in fact inter-related, but each will be discussed separately supported with assessment / analysis and discussions as indicated in the contract. The following chapter will present the model and data sources used in the study and some questions related to terminology.

Chapter 2
Techniques for Forestry Land Evaluation

2.0 Background

Decisions about the use of land have always been part of human society. One of the earliest decisions was concerned with the question: which forested land should be cleared of forests and converted to agricultural uses? Such decisions continue today in areas, where growing populations require more land for food production. Increasing demands for timber and more recently, ecosystem services such as Carbon Sequestration are contributing to land use changes in the opposite direction viz. the establishment of forest plantations.

Besides changes between forest and non-forest uses, there is a wide range of decisions involving choice between different types of forestry. To what extent should the management of a particular forest be directed towards timber, pulpwood or fuelwood production? How important are non-timber forest products, the soil and water conservation functions of forests, grazing or recreational uses? Recent emphasis on multi-purpose forestry has widened the range of such management options.

Experience shows that ad hoc land use decisions have led to land degradation and desertification. To avoid such costly mistakes, techniques have been developed for collecting land data and providing scientific analysis to decision makers. The best known among them is United States Department of Agriculture (USDA) developed Land Capability Classification (Klingebiel and Montgomery, 1961). The USDA system is interpretative, using soil survey maps as a basis and classifying the individual soil map units in groups that have similar management requirements. Eight soil classes are distinguished (see Annex 1). At the highest of categorization Class I soils have few limitations restricting their use. Erosion hazards on these soils are low; they are deep, productive and easily worked. Classes II to IV have increasing limitations due to sloppiness, erosion hazards and other factors, which can be reduced by terracing, agroforestry and alley cropping. Soils of classes V to VIII are generally not suited for cultivation, although certain of them may be made suitable for agricultural use with costly measures. Specific to India, All India Soil and Land Use Survey (AISLU) Organization has conducted assessments over most of the country and also produced maps to guide scientific land use and conservation planning.

More recently, FAO has developed guidelines for land evaluation covering agriculture, forestry and other important land uses. A key step in the process is what FAO calls “matching land use with land”. Requirements of each of land use options under consideration (termed as “land utilization types”) are matched with: 1) the land characteristics (the physical attributes of the land such as soils, climate, vegetation, topography, hydrology, etc.); and 2) the ecological, social and economic environment in which land use takes place. The Guidelines on Forestry land evaluation were published in 1984 and adequately incorporate forestry issues and are compatible with evaluation techniques of other lands uses.

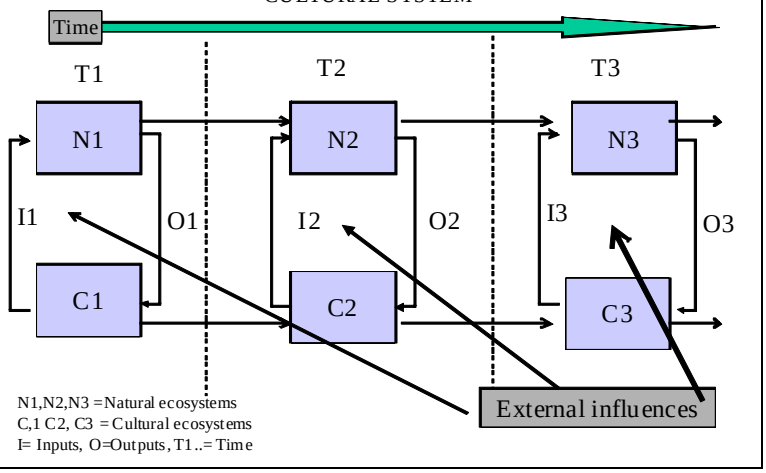
The Stockholm Conference on Human Environment 1972 recognized the role played by forests in maintaining environmental stability. Since then Forest Conservation, in particular, reducing the rate of tropical deforestation has become an integral part of the International

Forest policy Agenda. United Nations Conference on Environment and Development (UNCED 1992) gave further impetus to multiple use management of forests and gave rise to several global initiatives such as Forestry Principles; and three International Conventions, which strongly support national action plans for conservation and sustainable development of all types of forests. Articles of the Forestry Principles and brief introductory note on the Conventions are given in Annex 2 for ready reference.

2.1 A System Approach to Forest Land Evaluation

To capture multiple uses and in particular identify and evaluate environmental benefits of forests, it is necessary to follow a system approach (Singh and Nilsson 1974). In such a approach, working to begin with at a landscape level, forests are considered a component of the Natural Eco-system (N) and human related component a part of the Cultural Eco-system (C) (see Figure 1). Some examples of the Natural Ecosystem N are forests, wild life, water bodies, etc); and Cultural Eco-system C, human settlement, industries and agriculture, etc. The sub-scripts 1, 2, 3, etc. specify time-dimensions, when system wide assessments are carried out and data analyzed. In Figure-1, the cultural ecosystem is shown changing from the state C_1 at time t_1 to another state C_2 at the time t_2 and so on. For this purpose it transforms Natural Ecosystem in state N_1 at time t_1 to produce an output O_1 that requires the input I_1. As a result of the human intervention the state of the natural ecosystem changes from N_1 to N_2. The terms input and output are used in a wide sense and include not only planned inputs and effects, but also side effects of the process, e.g. land degradation, biodiversity loss, etc. The assessment is carried out in an integrated manner and at multi-levels; and externalities like Carbon-Sequestration, Biological diversity Conservation, Soil and Water Conservation, land degradation, etc are included in the analysis along with the main production objectives like timber, firewood. Moreover, forest is considered integrated with soil and water at the watershed level; and the biodiversity at the ecological zone level; and C-sequestration at the local / provincial / country levels.

Figure 1: MODEL OF AN INTEGRATED NATURAL AND CULTURAL SYSTEM



For land use planning purposes, let the total land area L be classified as:

$$L = P + U \qquad \text{……..(1)}$$

L is the total area under study; P is the land with forestry / agriculture potential; U the non-potential land for forestry /agriculture like inland waters, riverbeds, wetlands, glaciers, alpine grass lands and barren areas above the timberline. The both parts form an integral component of the ecosystem L, one affecting the functions of the other. For example, melting of mountain glaciers might affect water supplies downhill in the fertile plains.

The potentially productive land P is further broken down into three connected parts as:

$$P = F + A + D \qquad \text{…….(2)}$$

Where F is the forest ecosystem, A the agricultural (including human settlements) and D the degraded land (not included in F or A). The capital letters denote the absolute area of the components; while small letters denote the proportional values (in % terms), obtained after dividing each term in the equation (2) by P and multiplying each term with 100:

$$f + a + d = 100 \qquad \text{……..(3)}$$

Table 1 provides forest cover and land use data for Hill and Mountain districts of the country collected by FSI for 2005 State of Forest Report. The districts included are those, which have more than 50% area classified as Hill / Mountain and other districts are left out.

Table 1: Current Land Use in Hill and Mountain Districts of the Country

Variable	**Area**		
	Sq. Km.	**%**	**%**
Geographic area	707747	100	-
Unproductive Land	183135	26	-
Productive land area	524612	74	100
Forest Area	274932	39	52
Agriculture land Area	106162	15	20
Degraded land Area	143518	20	28
Deforested Area	**249680**	**35**	**48**
Normative Forest Area	**314767**	**44**	**60**

Source: FSI (2005)

It may be noted that the third column gives the (%) with respect to the geographic area and the fourth column with respect to productive land area. The sum of agriculture and degraded land (a+d) gives area already deforested. In undisturbed condition both terms **a** and **d** could be assumed zero (i.e. f_0 could be assumed as 100). The estimate of potential forests area (%), before any human intervention, is of great ecological interest, in particular, for modelling the loss of biological diversity. In fact, the stipulation regarding % land area of the country to be maintained under forest cover and the term maximum permitted deforested, are inversely related.

Max. Permitted Deforestation (%) = 100 – Min. Area to be maintained as Forest (%)
Referring to Table 1, of the total productive land, the degraded land is 28% and agriculture 20%. The two together add to total deforested land 48%, which is 8% above the permitted norm for Hill and Mountain Regions as per NFP1952. Thus total deforested land has already crossed the threshold laid down in NFP1952 by 8%. If one imagines that all the degraded lands, once carried rich forests, which have been lost for agriculture and forest for making short term individual gain and long term social loss!

There are two important remarks to me made based on the above Table. Form the degradation of mountain landscapes presented in Chapter 2, it seems that forest area requirement in the hills and mountains should be 60% and more, and not just 60%. The second issue related to the denominator in taking %. It seems appropriate that the current forest area in the hills and plains is compared to potential area, where forests could grow.

Table 2 gives cross-sectional data on land use for various sections of the Western and Eastern Himalayas. Forests occupy (on the dates of survey) between 40 to 55% of the geographic area in the West and 25% to 65% in the East. The latter statistics are deceptive as it includes large areas of shifting agriculture, interpreted as forest in FSI State of Forest Report.

Table 2**:** Land use pattern (%) in the selected catchments of Himalayas

Land-use pattern	**The western Himalayas**			**The eastern Himalayas**		
	Chenab (1968)	**Yamuna (1966)**	**Bhagirathi (1970)**	**Meghalaya (1960)**	**Nagaland (1960)**	**Manipur (1972)**
Geographic area (sq km)	9,464	7,450	10,456	19,704	1,480	12,594
Barren & grasslands (%)	47.7	32.0	48.3	21.2	0.0	7.0
Shifting cultivation (%)	0.0	0.0	0.0	19.0	72.6	12.9
Agriculture land (%)	11.7	13.0	11.6	11.0	2.7	14.3
Forested land (%)	40.6	55.0	40.1	48.8	24.7	65.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: FSI data collected in various catchments of the country

The proportion of land area in Table 2 under settled agriculture is between 10-15% on account of overall unsuitability of the land in the Hills and Mountains for the cultivation purposes. Barren lands occur 32-48% in the West and 7-21 % (much less in the East), latter less as quick regeneration capacity of the land (mostly with bamboo) makes it look green. The sustainable land area for agriculture purposes seems to be of the same order viz. 10-15% as given in Table 1. It is obvious that deforestation and subsistence agriculture (like shifting agriculture) are responsible for much of land degradation. At least 20% of the land area included under shifting agriculture or barren and grasslands categories could carry high forests, if just effectively protected.

2.2 Ecosystem Dynamics

The term P in the equation 2 (viz. Total productive land) is assumed invariant, whereas the areas of F, A, D could dynamically change over time. By differentiating (3) with respect to time, we get:

$$dF/dt + dA/dt + dD/dt = 0 \quad \text{or}$$

$$-dF/dt = dA/dt + dD/dt \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

The equation (4) tells that that the rate of deforestation is equal to the rate of agricultural area expansion plus the rate of (agriculture) land transfer into "degraded land" category, resulting usually from subsistence land use practices, such as non-sustainable agriculture, grazing, etc. In a subsistence economy, the drive for agricultural expansion in (USDA) land suitability classed IV-VIII needs to be discouraged and, in fact, curbed as in the long run, it leads to land degradation. Economic progress and introduction of technology has direct impact on increasing productivity and stabilizing agricultural area and introduction of agro-forestry (back to trees). The stable land area under agriculture in the country is an evidence of this. The subject will be discussed further in Chapter 5.

Assessment of size and location of degraded lands, associated with unplanned agricultural expansion, gives a possibility to restore such lands. To what extent and where deforestation for agricultural purposes could be promoted or tolerated, is an important policy issue.

Land degradation is one aspect of the problem related to deforestation. The other equally important issues relates to environmental implications of land degradation in forested areas on account of excessive forest use and abuse. Here degradation takes many forms such as lack of regeneration, soil erosion, effect on water table, biological diversity loss, etc., each of which call for complex analysis and interpretation. It is obvious that FSI needs to undertake regular collection and analysis of National Forest Inventory based on field plots to monitor forest degradation; and expand the scope of remote sensing based monitoring to include all land use classes, in particular, degraded land category for increasing the forest cover. The latter should not be a difficult task for the Organization, already involved in assessment of trees outside forests.

2.3 Available Data Sources

The important organizations of the country involved in publishing land related maps, reports and statistical data include: Survey of India (SOI), National Atlas & Thematic Mapping Organization (NATMO), National Bureau of Soil Survey & Land Use Planning (NBSS & LUP), All India Soil & Land Use Survey (AIS & LUS), Central Arid Zone Research Institute (CAZRI), Directorate of Economics and Statistics (Ministry of Agriculture), Forest Survey of India (FSI), Indian Council of Forest Research and Education (ICFRE), Settlement Survey and Land Records, Revenue Department, National Sample Survey Organization, State Land Use Boards, Town & Country Planning Organization (TCPO) and many other agencies. The main data sources used in the present report follow:

Directorate of Economics and Statistics, Ministry of Agriculture (DES)
The DES releases statistics on LAND USE and AGRICULTURAL PRODUCTION including area, production and yield in respect of principal crops of food-grains, oilseeds, sugarcane, fibers and important commercial and horticulture crops. The estimates of crop production are obtained by multiplication of area estimates by corresponding yield estimates. Therefore, the estimates of area and yield rates assume prime importance in the entire gamut of agricultural statistics.

NRSA Land Use / Land Cover Classification System
National Remote Sensing Centre (NRSC) has developed a land use / land cover classification system with 24 categories up to Level-II, suitable for mapping on 1:250,000 scale. The classification system was developed after discussions with nearly 40 user departments / institutions in the country and finalized aa common 22 fold classification system which was adopted for Nationwide Land Use / Land Cover Analysis. At the request of Planning Commission of India district-wise land use / land cover analysis of all the 15 agro-climatic zones, using the 22 fold land use / land cover classification system was completed using 1988 – 89 satellite data sets (Roy and Nagaraja 2006).

Wastelands Distribution in India (Remote sensing based)
Both Landsat Thematic Mapper (TM) and Indian satellite (LISS-II and LISS-III) data were used for mapping purposes. The final product is a wasteland map showing villages, forest administrative and micro watershed boundaries at 1:50,000 scale. All this information is available in the digital form covering 8000 + map sheets on 1:50,000 scale. It is possible to associate wasteland units with particular village goups / micro watersheds using these maps. In addition, possible ownership can be determined by comparison with cadastral maps available at scales of 1:4000 and 1:8000. The vector based digital database generated under this project using standard codification was organized in four different layers viz. base layer, administrative layer, watershed layer and wasteland layer.

About 63.87 million ha (20.17 per cent) have been estimated as wastelands through this study. About 5000 wasteland maps covering the country were prepared under this project. After completion, the maps are sent to various state users for wasteland reclamation measures. Brief reports for each district provide a general description of the wasteland and its distribution. User interaction workshops have been held in different states to demonstrate the utility of wasteland maps in reclamation activities and to instruct users in making the best use of such materials. An atlas covering the statistics of entire country is released on 22nd May, 2000 in New Delhi.

All these 63.87 million ha are highly degraded lands in the country. Apart from this, the process of degradation exists in the agricultural lands such as single cropped areas and fallow lands. Based on the statistics generated under land use / land cover project and the wasteland inventory project, it is estimated, of the total 145 million ha of the degraded land, about 63.85 million ha area are in severe / extreme degraded condition, 13.76 M ha under moderately

degraded lands and 67.49 million ha under slight to moderate degraded lands (Roy and Nagaraja 2006).

FSI Forest Cover Classification (Remote sensing based)
Currently, Forest Survey of India assesses the forest cover of the country on a two-year cycle using Indian Remote Sensing (IRS) Satellite data. The main objective is presentation of the information on forest resources of the country at state and district level and to prepare forest cover maps on 1:50,000 scale.

The forest cover is broadly classified in 3 classes, namely dense forest, open forest and mangrove. The classification of the cover into dense and open forests is based on internationally adopted norms of classification. It has not been possible to further segregate the dense forest into more classes owing to enormity of work of ground validation and limitations of methodology. Mangroves have been separately classified because of their characteristic tone and texture and unique ecological functions. The other classes include scrub and non-forest.

First assessment of forest cover of the country was made in 1987 and thereafter nine more assessments have been made. The last one was for 2005.Districtwise information on forest cover has been made available from the third assessment onwards (i.e. from 1991).

2.4 Critique of data sources

It may be hard to believe that consistent statistics and maps, showing distribution of forests and other land covers by physiographic zones such as hill / mountain and plains, are presently lacking, which would have served as the ideal database for investigating many of the points raised in the study. FSI does provide forest cover statistics every two year for “hill districts” following a classification adopted by the Planning Commission of India for the purposes of administering development grants. Many districts having mountains and hills, but less than 50% of their geographic area, have been missed. As a result of this, significant area (could be as high as 25% of the total) under mountain and hills, located in the Central India and the Eastern Ghats (in particular, MP, AP and Orissa), does not appear in FSI report for Hill Districts. A second major problem is lack of a consistent land cover map showing all “formations” including grasslands, scrublands, agricultural crop and forests. This would have helped in estimating land area available for future forests. Repeated on a cyclic basis, such maps could provide a reliable clue to fate of deforested lands and causes of deforesdtation: the first information for taking remedial action.

For the purposes of this study, the author has developed a database of Agencies concerned with Land in any form (Agriculture, Forest, Waste Land, etc). The National Remote Sensing Agency has agreed to prepare an overlay of the current forest area distribution on a physiographic zone, which will provide a reliable basis of obtaining forest area information by physiographic zone.

2.5. The Terminological Questions

From an ecological perspective, an important question needs to be resolved: what constitutes a forest and what implies deforestation? The Global Forest Resources Assessment 1980 and 1990 both defined forests as "ecological systems with a minimum crown cover (assumed as 10%) and generally associated with wild flora, fauna and natural soil conditions; and not subject to agronomic practices". Forest as a class was reserved for "natural forests" and 'forest plantations" term was reserved to cover forests with genetically altered population of trees and / or soil tillage. This definition excludes shifting cultivation areas from the forest class and includes that in agriculture category.

The forest cover increase has to be planned and implemented on a "functional basis". It is obvious that "trees outside forest" might contribute to carbon sequestration as natural forests might do, but would be less effective for "biodiversity conservation" for which key requirements are: naturalness, the size of the forest patch and its fragmentation. Accordingly, FAO Global Assessment defined deforestation as referring to natural forest loss. Forest plantations were not accounted at par with natural forests; because they might contribute to wood production, but do not exactly make up the biodiversity loss in natural forests.

Chapter 3
Forestry in a Historic Perspective

3.0 Background

A careful reading of forest history during the colonial times shows abundantly that forestry had to fight an up-hill battle to get acknowledged as a sector and its rightful place in the land use system. A lucid account of the early history is given in the Volume 1 of the Stebbins' History of forests in India, worth full reading. The on-going unregulated destruction of forests attracted the attention of the scientific men in Britain as early as in 1850. The British Association for the Advancement of Science at its meeting in Edinburgh appointed a committee of eminent scientists and public men to enquire into the probable effects of tropical deforestation from economical and physical points of view. The report was presented to the committee at the 1851 meeting and was able to convince policy makers in Great Britain on the necessity of organizing forest conservancy in India (Brandis 1897).

3.1 A Forests Department is established

By 1860, the major timber consumers in British India, including Railways and Public Works Departments, were threatened with timber famine as surviving forests could not withstand the systematic destruction for the purpose of cultivation and extensive exploitation without proper management. The Government of India (GOI) awoke to the serious situation and sent a dispatch in November 1862 to the Secretary of State for intervention. The note is very succinct and worth reading in entirety. Only one paragraph is reproduced here.

"The circumstance that forests till now have been reckoned **as waste, and their produce treated as miscellaneous revenue**, **could not fail, to be pernicious** and has very probably conduced no little to the present state of things. A primary object, to a collector of land revenue is to remove land from the class that pays no revenue to that which pays, and his tendency will be to sacrifice forest for cultivation. The idea, that forest is a thing valuable in itself and, in truth, just as essential to the community as fields of wheat, sugar or cotton, took a long: time to spring up and, in fact, is not even now generally realised in that complete manner that is essential before forest management can be said to stand on a proper basis. The forests, when set aside as such, should be made to assume a distinct plan of their own in the departments producing revenue, and the success or failure of the administration should be made at once apparent from the state of the balance on the forest budget."

The reply of the Secretary of State to above dispatch is equally revealing. It said among others the following: "Your, circular, cautioning the Local Governments to be careful that forests are not treated as waste lands under the new arrangement, has received my

approval in dispatch no.23 of the 17th December last. I quite agree with your Excellency that it is very important that in order at once to remove the forests from the category of waste lands, their boundaries should be established and set apart in some strict and formal manner; but I would suggest to you whether a legislative enactment will be necessary for this object. It occurs to me that inconvenience may arise from such a step, inasmuch as you admit that, it may be found desirable to give up land to cultivation, which may have been set apart for forests, and *vice versa;* and it seems to me that such questions would be best resolved by your Excellency in Council, acting on the recommendation of the chief officer of the Forest department, and in concert with the revenue officers of the district in which the land is situated.

While alluding to financial considerations, I will observe that, although it is of course to be hoped and although I firmly believe that a considerable profit will be derived from the forests, when permanently placed under experienced and careful management, still profit is not the only object to be kept in view, and in the state in. which many of the forests now are it may not be possible at once to obtain a revenue from them. An outlay even may now be necessary in many instances, and when necessary, should, I think, be incurred. And it is another advantage of a permanent administration that it will look forward, with certainty to the repayment of such an outlay in future years. I may add too, that, the superintendents should be supplied with a sufficient staff, or it will be impossible for them, and in particularly at first, to reinforce the rules and give sufficient protection to the forests under their charge."

3.2 The Forest Policy Resolution of 1894: ON 12 October 1894, the Government of India published an official document outlining the forest policy which it proposed to apply in the management of the state forests only. This was a notable formal step. It was based on Dr. Voelker Report on "Improvement of Indian Agriculture" published in Circular Number 222-F dated 19 October 1891. The paragraphs 6 and 7 of the report say as follows: "it should be remembered that, subject to certain conditions to be referred to presently, the claims of cultivation are stronger than the claims of forest preservation. The pressure of the population upon the soil is one of the greatest difficulties that India has to face, and that application of the soil must generally be preferred which will support the largest numbers in proportion to the area. Accordingly, wherever an effective demand for cultivable land exists and can only be supplied from forest area, the land should ordinarily be relinquished without hesitation; and if this principle applies to the valuable class of forests under consideration, it applies a fortiori to the less valuable classes which are presently to be discussed. When cultivation has been established, it will generally be advisable to disforest the newly settled area. But, it should be distinctly understood that there is nothing in the Forest Act or in any rules or orders now in force, which limits the discretion of local Governments, without previous reference to the Government of India. (though , of course, always subject to the control of that Government) in diverting forest land to agricultural purposes even though that land may have been declared reserved forest under the Act."

The report continues further. "Mention has been made of certain conditions to which the application of the principle laid down in the preceding paragraph should be subject. They have for their object the utilization of the forest area to the greatest good of the community. In the first place, the honey-combing of a valuable forest by patches of cultivation should not be allowed; as the only object it can serve is to substitute somewhat better land in patches for sufficiently good land in large blocks, while it renders the proper preservation of the remaining forest area almost impossible. The evil here is greater than the good. In the second place the cultivation must be permanent. Where the physical conditions are such that the removal of the protection afforded by forest growth must result, after a longer or shorter period, in the sterilization or destruction of the soil, the case falls under the principle discussed in paragraph 4 of this Resolution. So, again, a system of shifting cultivation, which denudes a large area of forest growth in order to place a small area under crops, costs more to the community than it is worth, and can only be permitted, under due regulation, where forest tribes depend on it for their sustenance. In the third place, the cultivation in question must not be merely nominal and an excuse for the creation of pastoral or semi-pastoral villages, which do more harm to the forest than the good they reap from it. And, in the fourth place, cultivation must not be allowed so to extend as to encroach upon the minimum area of forest which is needed in order to supply to general forest needs of the country, or the reasonable forest requirements, present and prospective, of the neighbourhood in which it is situated. In many tracts cultivation is practically impossible without the assistance of forests, and it must not be allowed to destroy that upon which its existence depends."

The last two sentences in the foregoing paragraph are noteworthy, as they seem to suggest that the author did realize the need for maintaining a certain land area of a country under forest cover and also the fact about interdependence between forestry and agricultural.

3.3 Forest area loss during 1900-1950

The colonial Rulers seem to be most careful in the selection of an area to be declared as reserved forests. By the end of 1945, after 90 years of its existence, the Forest Department owned only 25.1 million ha of forest lands, of which 19.0 million ha were "reserved forests" managed in accordance with strict principles of sustained yield forestry (see Table 3).

Table 3: Progress of Forest Reservation during 1900-1947

Year	Reserved Forest	Total Forest
	Area (million ha)	Area (million ha)
1897-98	21	30.3
1944-45	19	25.1

Source: History of Forests of India (1954)

The rest of areas had little or no restrictions on forest clearance. On the contrary, one arm of the government was actively supporting forest clearance as observed by Stebbing (1954): "There were two very obvious consequences associated with clearance of forests: 1) the continuously deteriorating condition and falling production in forest areas close to villages;

and 2) the expanding area of wasteland of different types. However, so unpopular were the regulatory measures that "regardless of consequences, large areas of reserved forests (not to speak of forests in general) were withdrawn from the control of the Forest Department in some States and transferred to the Revenue Department".

It is not precisely known as to how much land was deforested during this period. According a model study by FAO / UN Forest Resources 1990 Assessment Project (see Figure 2) the transfer is estimated of the size of 14 million ha during 1901-1950 (Singh 2008).

The laissez faire attitude, followed in colonial times, was also not very conducive to agricultural development either. A glance at Table 4 would suggest that the period of 1901-1950 was characterized by: rising population (column 2), static agricultural growth (column 4); and stagnant per capita income (column 5).

Figure-2 **India - Simulated Historical Trend of Forest Cover 1900 - 1990**

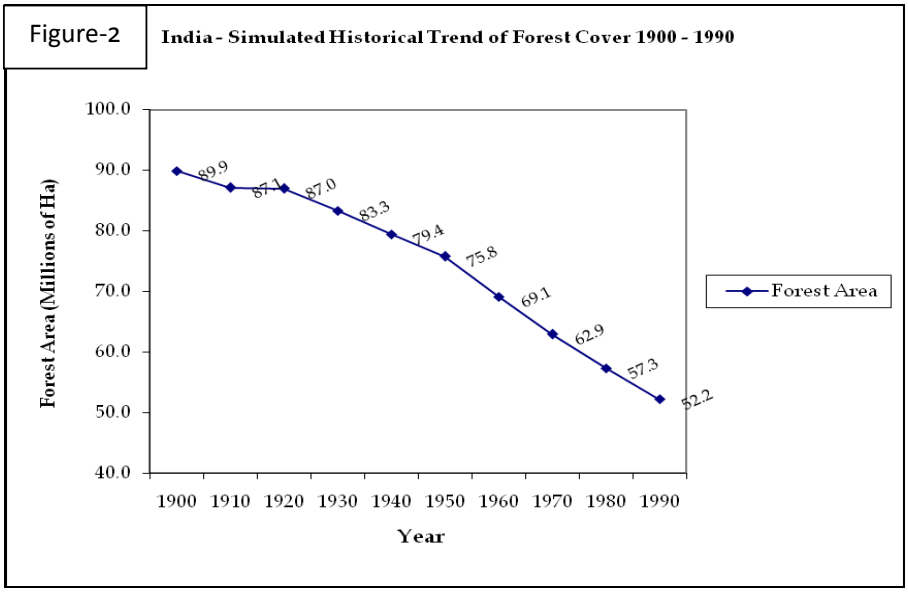


Table 4: Agricultural stagnation in India during 1900-1950

Year (1)	Population (2)	National Income		
		Total (3)	Agriculture Sector (4)	Per Caput Income (5)
	Millions	INR Crores	Rs Crores	Rs
1900-01	232	5109	3976	220
1910-11	247	6241	4433	253
1920-21	251	6469	3807	259
1930-31	276	7684	4598	278
1940-41	315	8646	4534	275
1950-51	359	8850	4405	246

Source: K. Mukherji (1960)

3.4 Early Independence Period

With Independence, the need was realized for a new policy covering the entire forests of the country, both under state and private control. What the new policy, aimed was to arrive at “a fair distribution of land between agriculture and forest? The needs of agriculture were admittedly no less in 1953 than they were in 1894; in fact, they were greater by far. But experience had shown that they must not be satisfied by indiscriminate extension of agriculture at the expense of the forest, and that the solution should rather lie in an intensification and improvement of farming methods, which can only be possible on soil properly protected from erosion and where the farming community has assured supplies of fuelwood and timber. In other words, the distribution of land between agriculture and forest must be based on "a system of balanced and complementary land use under which each type of land is allotted to that form of use under which it can produce most and deteriorate least A detailed survey of lands with a view to their proper utilization is, therefore, highly desirable ". The following Chapters will take up the key issue of this report viz. a model and rationale for estimating proportion of forests in the national land use.

Chapter 4
Forestry Right to Land Established

4.0 Background

The resolution that "India, as whole should aim at maintaining one-third of the total land area under forests" appears for the first time in paragraph 19 of the National Forest Policy 1952 formulated by the erstwhile Ministry of Food and Agriculture of the Government of India (hence forth called NFP1952). It replaced the 1894 Forest Policy Resolution passed during the colonial times by the erstwhile Department of Revenue and Agriculture of the Government of India. The reasons cited for the new policy were the changing political and economic realities of the country and better understanding of roles forests in maintaining the physical conditions of a nation. However, there are fundamental differences in perception of the role of forests in the two policies.

NFP1952 attempted to make up two major deficiencies in the 1894 Forest Policy Resolution. The first was regarding relative claims of agriculture and forests on land. The earlier policy stated that "claims of agriculture are stronger than the claims of forest preservation, subject to certain conditions". On this point, the new policy strongly differed and stated that "the indiscriminate extension of agriculture and consequent destruction of forests have not only deprived the local population of fuel and timber, but have also stripped the land of its natural defenses against dust-storms, hot desiccating winds and erosion … and has resulted in general deterioration of physical conditions to the detriment of national interests, and must, therefore, be given up. In the abstract, the claims of agriculture undoubtedly appear stronger than those of forestry. **The notion widely entertained that forestry, as such, has no intrinsic right to land but may be permitted on sufferance on residual land not required for any other purpose, has to be combated.**" The second point concerned the local and (short term) vs. national (long term) interests. In this regard, the new policy categorically stated that "**local use should in no event be permitted at the cost of national interests**. The accident of village being situated close to a forest does not prejudice the right of the country as a whole to receive the benefits of a national asset".

4.1 The Rationale for Maintaining One-Third of Country Land Area under Forests

Some question the rationale outright and others wish to know more about its scientific foundation. It may be noted that National Forest policy 1988 and the recently concluded National Commission on Forests have tacitly endorsed the 1952 resolution without any question or discussion. Still, this subject will be discussed here at length, as it forms an important terms of reference of the present study. First we will examine what NFP1952 has to say on the subject; and then present other collateral facts, without taking side.

Land Use Surveys as the basis of Land Use Allocations

The framers of the NFP1952 were very conscious of the fact and also witness to reckless destruction of good forest lands during the colonial times for non-sustainable agricultural

purposes (refer Chapter 3). A rational solution of the land problem, according to 1952 Forest Policy, was "evolving a system of balanced and complementary land-use, under which each type of land is allotted to that, form of use, in which it would produce most and deteriorate least. A detailed survey of land with a view to their proper utilization is, therefore, highly desirable."

Having stated the basic principle, which cannot be faulted, the Policy Analysts using only pencil and paper, robust common sense, knowledge of terrain conditions and forest protection needs, produced a set of numbers on the proportion of the land area in the country to be kept under forests. Their pragmatic thinking is very obvious from the following formulation on the subject:

"19. Proportion of forest areas-The proportion of land to be kept permanently under forests would naturally vary in different regions. **Practical consideration suggests**, however, that India, as a whole, should aim at maintaining one-third of its total land area under forests. As an insurance against denudation a much larger percent-age of the land, about 60 per cent should be kept under forests for their protective functions in the Himalayas, the Deccan, and other mountainous tracts liable to erosion. In the plains, where the ground is flat and erosion is normally not a serious factor, the proportion to be attained should be placed at 20 per cent; and in view of the pressure of agriculture effort at the extension of tree-lands should be concentrated on river banks and other convenient places not suitable for agriculture. At the same time it must be realised that **even distribution of forests in all physical regions** is as important as its over-all proportion. In certain localities deficient in forests, therefore, afforestation of marginal lands, and eroded river and village waste-lands, should be undertaken. **Forest area in excess of the indicated proportion, if any, however, should not be sacrificed.** To maintain an over-all average, it is essential that States better suited for the growth of trees should help to make good the deficiency in those parts where climatic and edaphic factors militate against tree-growth."

Sixty percent forests in the mountain and hills

The NFP1952 recommended a higher proportion of forests in the Himalayas, the Deccan, and other mountainous tracts, where lands are very fragile and liable to erosion. The rationale was presented in the following words: "Himalayan forests are the greatest of national assets; to them we owe the richness of the country. The denudation and under-development of the Himalayan slopes leads to greater intensity and frequency of floods, recurrent erosion, and to coarse detritus being deposited on the fertile sub-mountain tracts. This process inflicts immeasurable loss and misery on the unsuspecting millions in the Indo-Gangetic plain, and brings about a progressive and permanent loss of soil fertility, and a cumulative reduction in the agricultural potential of the whole land. While, therefore, the (agricultural) needs of the local population (in the tract) must be met to a reasonable extent, national interests should not be sacrificed because they are not directly discernible, nor should the rights and interests of future generations be subordinated to the improvidence of the present generation."

Twenty percent forest area in the plains

The NFP1952 mentions, in particular, two categories of lands in the plains for protective forest cover. The paragraphs 2(b) and (11) require a belt of forests on the banks of the major rivers to control gullies.

Assuming that 100 m wide strip of forests are planted on the either side, the total area of forests to protect 55, 000 km of river banks (CSO 2006) would come to nearly 11 million ha. Paragraph 2(c) and 12 mention tree planting as wind breaks and shelterbelts (see Table 5). The planting need for the latter is estimated at a minimum of 10 million ha. The two requirements make a total of 20-21 million ha of forests for combating desertification and river bank erosion.

Table-5: Area under desertification in the Arid Regions (‘000 ha)

Geographic area	Closed forest	Open forest	Total forest	Deforestation (2001-2003)	Scrub formation
35, 2 00	1,700	3,300	5,000	6	3, 100

The urgent need for providing green cover in the desert landscapes is illustrated with an illustration from China viz. the Loess Plateau (62 million ha), composed of wind-blown dust that was transported over millions of years from the dry center of Asia in a southeasterly direction. After deposition, the dust underwent a transformation process, changing into a solid material with the features of porous stone. The loess layers covering the bedrock can measure up to 200 m in thickness. High winds in the absence of native vegetation have made northern China a globally infamous target for dust storms, nowadays originating not only from the dry center of inner Asia but also from the Loess Plateau. Water-borne sediments give the Yellow River and the Yellow Sea their characteristic hue. Deposition of sediments has raised the bed of the Yellow River to such a degree that massive dike systems are now required to protect adjacent farmlands which have fallen below the river's water level. The loss of native vegetation has reduced the soil's capacity to retain moisture, and groundwater recharge can no longer ensure reliable flows of water into the Yellow River and its tributaries.

Tree-lands for overall physical and climatic amelioration

This functional class had a mind boggling target for growing trees and somewhat obscure method of calculation. The policy document sets a target of 2,000 crores (20,000 million) trees to be grown in ten years time outside forests for “the amelioration of physical and climatic conditions of the country and promotion of the general well being of the people”. The document also mentions another target set by the erstwhile Land Transformation Programme of the Government of India for planting of 30 crores of trees in ten years as inadequate for the purpose. Obviously, some calculations must have been made on the two set of numbers.

4.2. Consistency of NFP52 forest area recommendations

This Section makes a consistency check of two sets of NFP1952 forest Area recommendations viz. 1) Forest area proportions by physiographic zone (viz. 60% and 20% forest area in Hill and Plains respectively); and 2) forest area requirement for the country as a whole (viz. 33%). The Policy Makers must have carried out all the calculations using very limited data and technology and mostly the Expert Knowledge. The last two rows in Table 6 show the consistency of NFP1952 arithmetic.

Table 6: Forest area requirement by function and for the country as per NFP1952 (in million ha)

Land classification	Geographic area	Unproductive Land Area	Productive Land Area Allocation		
			Total	Forest	Non-forest[1]
Hill and Mountain	100	30	70	42 (60%)	28 (40%)
Arid Zone	35	20	15	9 (60%)	6 (40%)
Other Landscapes	193	15	178	35 (20%)	133 (80%)
Total by Function	328	65	263	86 (33%)[2]	167 (67%)
Total for Country	328	65	263	87 (33%)[3]	166 (67%)

Notes: (1) The Non-forest land use includes currently cultivated lands, degraded lands and others.
(2) The % value is obtained by adding recommended area of forest by physiographic zone.
(3) The % has been taken with respect to the area with forest potential viz. 263 million ha.

One may get an idea of the landscape with so many trees from the fact that in 2005 there were 5,160 million trees (and 1,616 million m^3 of growing stock) outside forest in the country (FSI 2005). Four times trees would have made the gray landscape of the Indo-Gangetic Plain much greener and provided a growing stock of 6,464 million m^3. At an assumed 2% growth rate, it would have given an annual increment production of about 128 million m^3 of wood. The Ganges water might have been with much less silt-load than today and citizens getting more regular supply of fuelwood and fodder than today. There is little doubt that the goal was noble and also "creditable" from today's perspective of climate change.

4.3 Scientific Data on Forest Cover Requirements

How does the proportion compare with scientific findings? The recommendations of the All-India Soil and Land Use Survey (AISLU) of the Government of India for maintaining perennial vegetation cover (including forests, natural grasslands and other perennial vegetation) in the mountain and hill regions as a % of the total land area, published in 2000, are given in Table 7 (Das et al, 2000). Depending on the presence and absence of required green cover, AISLUS classifies watersheds in one of the following risk classes (Table 8). The proportion of the natural vegetation in the mountain areas below the threshold values, without adequate soil conservation measures (e.g. terracing), invariably results in land degradation.

Table 7: AISLUS standards for maintaining green areas in the mountain / hill regions

Type of terrain	Desirable standards for green area
Plain land	around 20% of the total area
Undulating and rolling land	between 20 and 40 % of the total area
Foothills and sub-mountainous area	between 40 and 60% of the total area
Higher elevation and slopes	over 60 % of total area

Table 8: Risk level associated with green cover (%) below the minimum level

Green area cover (as % of the recommended value)	**Associated Risk Level**
Less than 20 %	Very high
Between 20 and 40 %	High
Between 40 and 60 %	Moderate
Over 60 %	Low

The rationale for a fixed forests or agriculture proportion in a landscape could be considered as two sides of the same coin. The question: how much minimum forest is needed, could also be restated as how much is maximum permitted agriculture area in a landscape or region. The recognition of environmental functions of forests, since the Stockholm Conference 1972 and UNCED have added a new complexity in the land evaluation process by adding environmental functions of forests as a very important parameter and, thus, made an area to area comparison of the two land use options viz. Forests and agriculture more complicated. The real issue, however, is controlling subsistence agriculture in environmentally sensitive areas, providing technology support to farmers and introducing agro-forestry to enhance farm income and farm productivity.

In the light of very high extent of land degradation arising from the agriculture, it makes sense that a proper land capability survey is carried out in the hills and other environmentally vulnerable regions, before allocating land for agriculture. Singh (1995), based on intensive field studies, concludes that "the present form of the agriculture in hill is non-viable". Accordingly, fixing an upper limit for land area to be ploughed in mountain and hilly regions, does seem a very good idea. From the statistics provides in Table 1 and 2 in Chapter on Land Evaluation, we find that land actually used for agriculture currently is only half of the limit set by NFP1952. Forest cover to be kept intact is ideally 60-70% and even slightly more of the total productive land area in the hills. The natural (non-forest) growth on the non-timber bearing land (e.g. alpine flora and fauna) has also a very important ecological role.

International thinking on Maintaining Minimum Forest Area in a Country

Zon et al. (1923), a forester from the US Forest Service, wrote a detailed report on world forestry. In the very first page, he mentions of the wide spread acceptance of a norm for maintaining a minimum forest cover in a country. In "World Forest Resources" on page 1, he writes as follows: "forests are also important in the life of every nation because of their influence on the water supply, on agriculture, and on the general welfare. It is now generally accepted that in order to guard a country against unfavorable changes, 30 per cent of its productive land area should be maintained under forest, leaving 60 per cent for crops, and 10 per cent for cities and villages. Only a few countries with an insular climate, as England and Holland, may with immunity against such changes reduce their forest areas beyond a certain limit. Ordinarily a country in which the forest area has been reduced to 20 per cent or less shows, to a marked degree, bad climatic conditions, with prolonged droughts, frosts, and alternating floods and low

water. Spain with a forest area of only 14 per cent, Greece with 15 per cent, Italy with 18 per cent, are good examples of this. Furthermore, each country has always a certain amount of land which is unsuitable for agriculture and which, unless under forest, is idle, unproductive land—a burden upon the community".

4.4 An overall appraisal of forest area objective in 1952 and 1988 Policies

The check of internal consistency of the policy and arithmetic of area proportions shows that NFP1952 was empirically very analytic. The analytical thinking also reveals that policy makers were well informed of the current world thinking on the functions of forests and its implications for forest policy and forest management. A remark on the 1952 forest policy document by FAO published in 1952 Issue of Unasylva is worth quoting, which reads as follows: "Early in May 1951, the Federal Forest Service submitted a draft declaration to a special meeting convened at Dehra Dun, to which FAO had been asked to send a representative. This meeting was attended by foresters, senior administrators, and Ministers of Agriculture and Forests from all the States of India. Agreement was not reached at once, and it was only subsequently, after a year's careful study by high officials that an agreed text could be adopted as India's new declaration on forest policy". The remark continues: "It was said at the beginning of this article that the document, published on 12 May 1952 by the Central Government, was of great importance to India. It may be said in closing that the declaration is also of importance from a regional and world standpoint. At its Sixth Session in Rome, the FAO Conference recommended that all Member Nations put into practice the general "Principles of Forest Policy" which and been at that time formally adopted. Many countries, fortunately, have honoured these principles over the years, yet a careful perusal of the Conference resolution may perhaps reveal certain deficiencies that could be made good. **India, however, is the first country which, through the voice of its Government, has adhered officially, explicitly and entirely to these principles**".

4.5. Changes in forest area objectives in 1952 and 1988 Forest Policies

A careful reading of the forest area objectives stated in 1952 and 1988 policy documents would show a trend towards increasing fuzziness in defining forest area, not to mention its decomposition by functional classes. Whereas NFP1952 refers to "forest area"; NFP1988 refers to "forest or tree cover" (see Table 9).

Table 9: A Comparison of resolutions on forest area proportion in 1952 and 1988 NFP

Sections	NFP 1952 statements	NFP 1988 statements
General Objectives	Establishing tree-lands, wherever possible, for the amelioration of physical and climatic conditions and promoting the general well being of the people	Increasing substantially the forest/tree cover in the country especially on all denuded, degraded and unproductive lands
In the hills and in mountainous regions	Maintain a much larger percent-age of the land, about 60 per cent under forests	The aim should be to maintain two-third of the area under such cover
In the plains	The proportion to be attained should be placed at 20 per cent	No specific statement

Overall distribution	An even distribution of forests in all physical regions is as important as its over-all proportion	No specific statement

Sources: NFP1952 and NFP1988 documents

Further, the crown density to qualify as forest is set at a minimum of 10%, which tends to inflate total forest area achievement by including even degraded forests or almost failed plantations as "forests". There is also less emphasis on forest area (%) distribution by function. All these considerations make the current forest cover monitoring achieve a very limited purpose.

While both the policy resolutions emphasize increasing of forest area as an important objective, the reality is otherwise. The forest area in the country is receding in the course of time further and further from the 1952 target: a clear signal to improve the policy on the subject or abandon it completely. The need is for introducing "a comprehensive survey of lands for evolving a system of balanced and complimentary land use, under which each type of land is allotted to that form of use, under which it would produce most and deteriorate least". This objective was mentioned in NFP1952 as the first paramount national need.

Chapter 5
The Elusive Forest Area Target

5.0 Background

NFP1952 was based on careful home work and also enjoyed strong political support. In particular, its minimum forest area objectives were intended to satisfy paramount national needs and a strategy well articulated. A time-series study, however, shows that the forest cover instead of going up went down from 75.8 million ha in 1950 to 64.0 million ha in 1990-91 (FSI 1991), viz. a reduction of 11.8 million ha. This Chapter analyzes the likely causes for the non-achievement of NFP1952 objectives; the approach adopted by NFP1988 and the current situation in this regard.

5.1 Unplanned Expansion of State Forest Area

The Zamindari Abolition Act 1952 was a major development just after Independence, which established state ownership over forests belonging to princes and landlords. The transfer involved was huge viz. 29 million ha, swelling the forest area under the State Forest Department control from 25 to 54 million ha, almost twice before Independence. The entire process seems to have been implemented in haste, without necessary planning of the follow up action or examination of the ground realities. The legal processes tended to be slow, providing scope for unprecedented deforestation and forest degradation, engineered by the parties affected to make up the loss. The settlement operations are still far from complete, as illustrated with an example from Orissa (see Table 10).

Table 10: Progress of forest settlement in Orissa

Legal status	1957-58	1972-73	1981-82
Reserved	2246	2590	2504
Protected	4316	3885	3492
Total	6562	6475	5996

Source: Sahu et al. 1997

A report by the Orissa State Forest Department to Central Government in the early 1972 noted with concern that “this valuable asset is being ruined at a much greater rate than is normally imagined. The low level of production of 0.17 m^3/ha speaks of a very low level of management. The forests are surely capable of producing at least twice as much, if not more. The revenue would also correspondingly double itself. If timely step are not taken, this valuable asset would be lost forever” (MoEF 1972). The statement is fully collaborated from loss of forest area in the protected category in Table 1. At a national level, of the total recorded forest area, 41.6 million ha are classified as “reserved” with all rights settled; 22.3 million ha “protected” and 12.5 million ha “unclassed”. The rights in the last two forest categories are yet to be settled.

5.2 Expansion of Subsistence Agriculture

The national economy, during fifties and sixties grew rather slowly. The Country was experimenting with socialistic development model, got engaged into three wars (China 1962, Pakistan 1965 and Pakistan again 1972 (Bangladesh Liberation). The country faced grim food shortages in two successive years on account of crop failures in 1965-66 and 1966-67. The food situation was really bad for the well to do, and very bad in deed for the common man. Everything was in short supply.

The green revolution, starting 1971-72 onwards, marks a turning point in the agricultural history of the country. This is associated with expansion of land area under agriculture, more irrigation facilities and application of improved seed varieties and, of course, efforts of progressive farmers, R&D inputs of Indian Agriculture Scientists and Policy support. The area under agriculture grew from 118.75 million ha in 1950-51 to 140.00 million ha in 1970-71; and the average productivity of food grains rose from 531 kg / ha in 1951 to 1023 kg / ha in 1980-81 (see Table 11).

Table 11: Economic & Agricultural Growth Trends during 1950-1980

Year	Populat-ion	Economic Trends		Agricultural Land Use		
		Real GDP Growth	GDP / Caput	Net Area Sown	Area irrigated	Yield Food Grain
	Millions	(%)	%	Million ha	%	Kg / Per ha
1950-51	361	3.7	1.5	118.75	18.1	536
1960-61	439			133.20	19.1	710
1971-72	548			140.27	24.1	872
1981-82	683			140.00	29.7	1023

Forests were cleared for many purposes during 1950-80 including:

i) Clearance for agriculture
ii) Clearance for non-agricultural purposes (roads, dams, mining, industries, etc): about 4.3 million ha (MoEF 1984);
iii) Shifting agriculture (including actual and rest period) in the North-East and other regions (total estimated at 9.5 million ha by FAO 1981). It must be added that figures from different sources on the subject are very variable;
iv) Unrecorded subsistence cultivation in the forest fringe areas, particularly where forest boundary is uncertain.

As per estimates of FAO Forest Resources Assessment 1990, the natural forests area of the country declined from 75.8 million in 1950 to 57.3 million ha in 1980. If one would add to this loss of forest area to shifting cultivation (about 7 million ha), one would get FSI equivalent figures of approx. 64.3 million in 1980 (FSI 1985).

5.3 Stricter Laws on Forests and Wildlife

The consequences of indiscriminate deforestation are obvious. A report in 1972, published by the Government of India, revealed significant loss of Tiger population, close to extinction limits of 1800. This raised alarm, both in the public and political circles. Coupled with Stockholm Conference on Human Environment in the same year, attended by the Prime Minister of India, Mrs Indira Gandhi, the concern about forests heightened. The 42nd Constitutional Amendment was passed in 1976, bringing Forests (17 A) and Protection of Wild Animals and Birds (17 B) under the concurrent list (as it was before 1920), thereby enabling the Union Government to enact legislation, overriding state laws, on a country-wide basis. A concrete outcome was the Forest (Conservation) Act 1980 to control indiscriminate diversion of forestland by States for non-forestry purposes. The Act made it compulsory for States to obtain the approval of the Central Government before making any transfer of forestland to non-forestry uses, and made it mandatory to undertake compensatory plantations equal to double the size of area deforested. Thus, the forestry pendulum seems to have swung towards extreme conservationism by the end of the review period.

5.4 National Commission on Agriculture 1976

The National Commission on Agriculture (1976) gave a number of recommendations to invigorate the agriculture and forest sector. Large scale Social Forestry Projects (SFP) were started, mostly donor supported. About 24.84 million ha of plantations were raised; 13.51 million ha during 1980s and 11.33 million ha in 1990s. The success of these plantations was very uneven. The NFAP India (1999) reports on them as follows: "The performance of these plantations, in terms of survival, growth and yield, has been poor. Based on survival rate and stock density, effective area has been estimated at 40-50% of the recorded total. The MAI of forest plantations varies from about 2 cu. m /yr/ha for valuable timber species and about 5 to 8 cu. m /yr/ha for Eucalypts and other fast growing species. This may be compared to an MAI of over 10 cu. m/yr/ha generally and about 50 cu. m/yr/ha for good quality industrial plantations in different countries."Moreover, as a consequence of much emphasis on tree planting activities, the natural regeneration of forests were not attended to properly. The major part of the budgetary allocation, say about 70-80% was earmarked for social forestry without giving any attention to the regeneration of natural forests resulting in the loss of biodiversity and non-wood forest product species (NFAP 1999).

Against the indicative target of 33-41 million cum for industrial wood production in 1990 recommended by NCA, only 24 million m^3 was reached (FAO 1993). In fact, during this period, the relative price rise in respect of timber and fuelwood has been steeper than the food commodities. As expected, organised theft and illicit logging from forests were reported in many states. Poorly staffed and badly equipped forest guards were facing an uphill task in protecting the forests. A staggering quantity of fuel wood was being removed annually viz. 200 million tons and animals grazed biomass 400 million tons from forests and fallow lands (FSI 1996), which amounts nearly to 300 million tons of Carbon per year! Other negative effects were almost complete lack of natural regeneration in forest, soil erosion and flash floods and reduced life of dams (FSI 1996).

The current stocking in the natural forests is less than half of the potential, which is also a reason for low forest productivity viz. 0.50 cum / ha / year. The main contributing factors are: uncontrolled grazing and removal of biomass throughout the year from the forests, year after year. The decreasing and sparse vegetal cover leads to severe soil erosion and land degradation and to a steep fall in productivity. It is possible to achieve a much higher productivity of the forests by effective protection and appropriate silvicultural operations.

5.5 National Forest Policy 1988 (NFP1988)

The opening paragraph of the National Forest Policy 1988 sums up well the forestry situation by the end of 1990: "Over the years, forests in the country have suffered serious depletion. This is attributable to relentless pressures arising from ever-increasing demand for fuel wood, fodder and timber; inadequacy of protection measures; diversion of forest lands to non-forest uses without ensuring compensatory afforestation and essential environmental safeguards; and the tendency to look upon forests as revenue earning resource. The need to review the situation and to evolve, for the future, a new strategy of forest conservation has become imperative. Conservation includes preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment. It has thus become necessary to review and revise the National Forest Policy."

Among the main objectives of National Forest Policy (1988) was "creation of massive people's movement with the involvement of the woman, for achieving the objectives and to minimize pressure on existing (reserved) forest". Pursuant to the policy declaration, the Government of India issued a notification in June 1990 to all the States providing broad guidelines for involvement of village communities and voluntary agencies in the protection of State forests and usufruct rights of the community over forest produce (including non-timber, grass, firewood and timber products), share in final harvest of timber; and preparation of micro-plan for the forest. The system is popularly called Joint Forest management (JFM).

The JFM movement witnessed a phenomenal growth during 1990-2000: twenty two States undertook concrete measures to create local institutions for protection and forest management, known by different names in different states, like Forest Protection Committee (FPC), Village Forest Committee (VFC), Van Samrakshan Samiti (VSS), Village Forest Protection Management Committee (VFPMC) etc. The nature of usufruct sharing also varies from state to state. In constitution of committees, representation of women is also ensured. By 2000 end, about 36,130 Forest Protection Committees were managing a total of 10.25 million ha of forest area.

5.6 NFP1988 Impact on Forest Area Objectives

It may be recalled that 1952 as well as 1988 National Forest Policies had achievement of the stated forest area proportion as a key objective. How far they have been successful in this regard? Thanks to availability of multi-date satellite data over large areas, it is possible to assess the impact statistically by constructing "**change matrices"** for 1980-90 and 1990-2000, to find if deforestation has accelerated, slowed down, completely stopped or reversed over successive periods. FAO Forest Resources Assessments 1990 and 2000 (FAO 1996, 2002) provide necessary statistics presented in Table 12, which will be used as the basis of discussion.

Table 12: Land Use Change matrices for the period 1980-90 and 1990-2000

Transition matrix 1980-1990 ('000ha)											
Land cover classes in 1980	**Land Cover Classes in 1990**									**Total 1980**	
	Closed forests	**Open forests**	**Long fallow**	**Frag-mented forest**	**Shrub**	**Short fallow**	**Other land cover**	**Water**	**Planta-tions**	**(area)**	**(%)**
Closed forests	40272	808	580	40	37	268	440	14	33	42493	21.1
Open forests	208	12246	4	73	91	6	328	9	40	13006	6.5
Long fallow	52		8989	4	2	1378	281		4	10710	5.3
Fragmented forest	29	36	11	6990	5	3	214	6	15	7309	3.6
Shrub		18			1855	1	58	5	13	1950	1.0
Short fallow	25		124	4	2	2126	9			2290	1.1
Other land cover	91	87	35	104	87	21	120441	100	69	121015	60.2
Water	7	3					40	57	9	116	0.1
Plantations	31	15		6	5		40		2114	2210	1.1
Total 1990 (area) (%)	40714	13214	9744	7220	2065	3803	121952	192	2297	201100	
	20.2	6.6	4.8	3.6	1.0	1.9	60.6	0.1	1.1		100
Transition matrix 1990-2000 ('000ha)											
Land cover classes in 1990	**Land Cover Classes in 2000**									**Total 1990**	
	Closed forests	**Open forests**	**Long fallow**	**Frag-mented forest**	**Shrub**	**Short fallow**	**Other land cover**	**Water**	**Plant-ations**	**(area)**	**(%)**
Closed forests	39994	144	30	132	2	282	172	31	18	40714	20.0
Open forests	61	12807		99	25	30	171	19	1	13214	6.6
Long fallow	1		8736	15		881	111			9744	4.8
Fragmented forest	6	17		7049		4	107	31	7	7220	3.6
Shrub		1		4	2020	15	22	4		2065	1.0
Short fallow			299			3483	50			3803	1.9
Other land cover	15	92	75	339	33	62	121050	96	90	121852	60.6
Water	6			4			33	149		192	0.1
Plantations							39		2258	2297	1.1
Total 2000 (area) (%)	39994	13061	9110	7643	2080	4755	121754	330	2374	201100	
	19.9	6.5	4.5	3.8	1.0	2.4	60.5	0.2	1.2		100

Source: FAO 2002

Change matrices are some-what difficult to read, but full of interesting information. One could, for example, get estimates of decadal forest cover change rate during 1980-90 and 1990-2000 using the first and the second matrix respectively. One could also compare the two decadal change rates, to get an estimate of acceleration or deceleration in forest cover changes over the twenty-year period to get a quantitative evidence of forest policy effectiveness in increasing the forest cover or, at least, stopping the negative slide. A summary of findings follows:

> The decadal loss of closed forests has decelerated from 1.7 million ha during 1980-90 to 0.7 million ha during 1990-2000;
>
> The trends towards open forests formation has been reversed; and area under long and short fallows and shrubs are decreasing;
>
> Agriculture land area is stable; and plantations area is increasing; but
>
> Forest fragmentation is increasing (bad for wildlife);

One finds significant positive changes happening in the forests of the country during 1990-2000 decade in comparison to 1980-90. The bad news is increasing of "**fragmented forests**". The latter is an indication of negative changes: forest is getting more and more broken into patches: **bad for wildlife movement and biological diversity**, as forest fragmentation increases biodiversity loss. Thus, there is evidence of slowing down of deforestation, but not its total control or directional change.

To get some clue to causes for slowing down of forest loss, the **national economic and agricultural growth data for** 1980, 1990 and 2000 are presented in Table 13. There is a definite indication that both national economy and agriculture productivity have improved during the period and these might have been instrumental in reducing the pressure on forests and the demand for more agricultural land. The economic grew exponentially during 1980-2000; and the agriculture productivity rose from 1023 to 1626 kg / ha. The net area sown, after deducting areas sown more than once, remained practically constant, varying up and down slightly between 140-142 million ha of land area. These developments seem ideal for forestry development.

Table 13: *Economic & Agricultural Growth Trends during 1980-2000*

Year	Population	Economic Trends		Agricultural Land Use		
		Real GDP Growth	GDP Per Caput	Net Area Sown	Area irrigated	Yield Food Grain
	Millions	(%)	%	Million ha	%	Kg / Per ha
1981-82	683	3.7	1.5	140.00	29.7	1023
1990-91	843	5.9	3.8	143.00	35.1	1380
2000-01	1027	6.2	4.4	141.63	43.4	1626

Source: Ministry of Agriculture 2005, Abdul Kalam et al. 2002

Still continuing deforestation is an indication that communities living on the forest edge are not fully benefitting from national economic growth and indulging in subsistence agriculture, for which new land is needed. Along with the tripling of per capita income in 20 years time, there is a strong evidence of a stagnant and / or slow growing economy, covering a sizeable part of the rural population.

Chapter 6
Forestry Scenario 2020

6.0 What went wrong?

From the foregoing discussions, it must have become obvious that the gap between actual forest area and the stated forest area objective has been systematically widening (rather than converging) since Independence. Against the national requirement of 1/3 of the total land area, corresponding to 87 million ha, the actual area under forests in 1952 and 1988 was 75 and 63.5 million ha respectively (FAO 1993, FSI 1990). The situation looks like a mountaineer, who finds one-self slipping downwards rather than climbing upwards closer to the summit. The question could be legitimately raised, if the stated objectives are realistic and if it is feasible at all to achieve them in the foreseeable future? Further question could be asked (in frustration): is the goal worth while pursuing? There are also lurking doubts if appropriate means (including right institutional means) were utilized in the past to realize the objective?

6.1 Need for reviewing NFP1988

Kishwan et al. (2004) under the title "Reinventing Forest Policy" argue that "policy of any sector has to be dynamic: a living entity alive to changes taking place in the national and international perspective. Although, traditionally (forest) policy is considered to be a long term document, its frequent review in light of fast changing global concerns and consequently national priorities and equations, cannot be ruled out. …National Forest Policy (FP) 1988 of India has come a long way since, and would require critical examination with respect to its efficacy of application and relevance in the present context of national concerns and international commitments. FP 1988 also has to take stock of the changes that have been effected in the policies of other closely related sectors, like environment, agriculture, animal husbandry and rural development." In this concluding chapter, the objective will be to highlight some policy measures which would contribute to increasing of the net forest area in order to achieve, and most likely exceed the target set by NFP1952. This phase of the present study was no doubt very stimulating to the author itself.

The starting point is the realization that forest area objectives need to be linked with the "vital national needs" as was done in NFP1952. Forests of a country have a "vital" national as well as global purpose. There is no doubt about it. But, there is no a priory reason for this. The forest sector has to compete for limited land and financial resources in order to justify its claim and then demonstrate it by the deed. Making such objective a national slogan is likely to serve very limited practical purpose.

6.2 The future policy for increasing the forest area and tree cover?

It was already mentioned in Chapter 4 that the arithmetic related to forest area proportion seems correct and its objective convincing. No one would disagree with protection of Himalayan

watersheds, stopping the march of Rajputana desert and controlling of the stream bank erosion. These are all paramount national needs. The reaching of the forest area objective of 87 million ha compared to the erstwhile forest area of 75 million in 1952 was not as challenging task then as it is now. In fact, area afforested since then has far exceeded the target figure. The problem we face today is due the fact that the country has been afforesting by one hand, and deforesting by the other, the balance tilting more on the latter side. Prior to publication of the infamous NRSA report on on-going rate of deforestation (MoEF), the nation believed that all was well with the sector. The change matrices presented in Chapter 5 suggest that problem is not yet over, though the rate of deforestation is slowing down, most likely due to launch of JFM movement! FSI SFR (2005) also reports deforestation of the order of 70,000 ha during 2003-2005.

During foregoing discussions, deforestation emerged as the single most important factor in determining the forest area target (besides meeting objectives of biological diversity convention) as establishment of plantations. Studies also indicate close association between deforestation with chronic poverty in the forest fringe regions (in particular among scheduled tribe population) to secure additional land for subsistence agriculture (FSI SFR , Singh 2005). It may not be a surprise to find that the 100 million poorest of the poor in the country live within 5 km radius of forests and majority of them are scheduled tribes. The leading states in the poverty ratio are: Orissa (39.9%), Jharkhand (34.4%) and Andhra Pradesh (32.4%). The same states lead in forest area and scheduled tribe population.

In the remote regions, hilly and mountainous, agriculture in itself can not constitute the sustainable basis for bridging the divide. Obviously, the current paradigm for the scheduled area development based on subsistence agriculture has failed to solve the poverty problem of the people there. On the contrary, more and more of the districts in the Central Zone are coming under the influence of the insurgency! A big question is about the Recognition of Scheduled Tribes and other Forest Dwellers (Forest Rights) Act: is it going to improve their living condition or reduce their vulnerability of the forest fringe dwellers? Apparently, a re-orientation of national development paradigm is called for.

Agro-forestry has been identified as an important land use for contributing to economic growth in the economically depressed rural areas dependent on agriculture. In the last two FYP, the progress of agriculture leaves much to be desired. The National Agriculture Policy (2000) states that “Agriculture has become a relatively unrewarding profession due to generally unfavourable price regime and low value addition, causing abandoning of farming and increasing migration from rural areas. …….“Farmers will be encouraged to take up farm- / agro-forestry for higher income generation by evolving technology, extension and credit support packages and removing constraints to development of agro-forestry”.

The above statements provide important directions for enhancing forests and trees role in a comprehensive manner as means of poverty alleviation. For the future, the need seems to integrate primary production with value addition in forestry as well as agro-forestry as a key

measure towards poverty reduction. The issue is not so much food or wood production, but adequate return on investment taking into account all costs, labour and other inputs.

The emphasis on forestry for poverty reduction does in no way imply underestimation of roles of forests towards environmental amelioration and biological diversity conservation. Taking into account economic, social and ecological dimensions associated with forests and agro-forests, a region specific strategy for increasing the forest area and tree cover will be suggested in the following Sections along with outlook for national economic growth.

6.3 The current economic development strategy and its impact on forest area

According to 11th Five Year Plan, the paramount national need is to achieve "faster, more broad-based and inclusive growth". The word inclusive could be taken to have both social as well as environmental dimensions to pure economic welfare. The document states further: "The fact that the economy in many ways better placed than it has ever been before should help us to achieve such ambitious targets" (see Table 14). The statistics given in Table 1 reflect the qualitative changes taking place in the national development, which give reasonable optimism in solving the poverty problem at the same time giving due attention to urban and industrial development. Millennium Developmental Goals (MDG) also places poverty as the top-most global developmental problem.

Table 14: Socio-economic indicators during 2000-2020

Year	Population	Population Pressure	Urbanization Trends	GDP / Capita (All)	GDP / Capita Lowest (10%)
	Billions	No/ha	(%)	US$	US$
2000	1.01	307	28	429	159
2010	1.16	357	32	762	282
2020	1.30	405	38	1538	569

Sources: Planning Commission 2004 and Kalam (1998)

The Tenth Plan had set the reduction of the poverty ratio by 2007 by 5% points; and by 2012 by 15% points. In relation to environment, the Plan set to increase the forest and tree cover to 25 % by 2007 and 33 % by 2012 from the 2001 value of 23.03%). These goals imply adding to forest cover by 18 million ha during 2002-2007 and 26 million ha during 2007-2012. In the 11th Plan the poverty reduction target is set to 5% and forest cover increase also to 5% points.

6.4 Broad Physiographic Zoning for the future forest area strategy

For presenting the future forestry strategy, the country will be classified into 2 broad physiographic zones, viz. Dominantly Forested or and Cultivated, which have distinct ecological and socio-economic setting and differ in respect of on-going land use changes and policy interventions to steer future development (Table 15). The two zones have distinct ecological and socio-economic setting and differ significantly in respect of poverty and on-going land use changes and needed policy interventions.

Table 15: Land Classification from future forestry development perspective in India

Regions	Major Land Use Types	Area (million ha)
I. The Natural Region (dominantly forests) ~ 164 million ha		
1.	Actual Forest covered areas	64
2.	Unrecorded cultivation in forest fringe areas	15
3.	Deforested lands in Hill / Mountains	30
4.	Permanently Unproductive areas (Glaciers, deserts)	55
II. Cultural Region (Rural and Urban Areas) 165 million ha		
1	Irrigated agricultural areas	50
2	Rain-fed areas with favourable weather	20
3	Rain-fed low lying flood plains	20
4	Dry lands in the arid and semi-arid zone	50
5	Ravinous, gullied lands	25
Total	**All Lands**	**329**

The Forest Regions have an area of 164 million ha and are generally located in remote tracts with under developed infrastructure. The number of inhabitants is estimated around 160 million people, which makes one person per ha. The forest region includes:

Most of the natural forests (close to 64 million ha)
Unrecorded cultivation in forest fringe (about 15 million ha)
Deforested hills and mountains (30 million ha)
Permanent unproductive areas including glaciers (55 million ha).

The terrain in the forest region is hilly, the growing season short and erratic. Agriculture land holdings are small and yield low; the major share of land (could be 80%) is under Government control. Population density, as expected from land use pattern and very inhospitable environment, is very low: about one person /ha, half of them Schedule Castes and Schedule Tribes.

The agricultural region covers about the same area viz. 165 million ha with the total population of 850 million people, which makes 5 persons per ha. About 140 million ha is reported under cultivation. Apparently, the figure does not include areas under shifting agriculture and unrecorded agriculture at the forest fringe. The region, as a whole, has made steady economic growth since Independence. By end of 2000, the food production had reached a satisfactory level to provide reasonable food security to the entire nation; infrastructure development is proceeding well; and the economic growth is almost reaching a two digit figure.

The forest region (also called hinterlands!) is generally located in remote areas with little developed infrastructure with an area of 130 million ha, includes most of the natural forests (close to 64 million ha in 1999 as per FSI 1999) and about 66 million ha of other lands including permanently unproductive lands (20 million ha), deforested since 1900 and presently under (unrecorded) cultivation (20 million ha) and the remaining area in degraded condition (50 million ha) e.g. with shrub growth or completely denuded. Population density is thin, with 150 million people mostly poor, it comes to 1 person /ha; half of them are Schedule Castes and Schedule Tribes. The region is very interesting because it is the source of many perennial springs and rivers, home of the many rare species of flora and fauna (i.e. rich in biological diversity); and

the source (almost 90%) of the medicinal plant products in the market. The pressure for use and extraction of the natural resources is very high.

The dominantly agriculture region accounts for 165 million ha of land area, most of which is cultivated (viz. 140 million ha, the reason for the term "Cultural") and home of about 850 million people, of which 60% live in rural areas. Due past abuse and misuse, nearly 50 million ha of land in the region is degraded and currently not cultivable (NRSA 2005). The region has made sustained economic growth. By end of 2000, the level of food production has reached a satisfactory level to provide reasonable food security; infrastructure development has proceeding well and a sound basis for future economic growth has been secured, as seen from overall high rate of economic growth by end 2000. A major issue is the development of landless and small farmers. Urban / industrial areas of the country form a part of the region and currently contributing to economic boom.

As major worrying issue is the growing economic disparity between the two regions and in the both regions as also the widening economic gap between the rich and poor within the regions. As noted earlier, the country's GNP index has risen from 60 to 140 during 1950 to 2000 (i.e. 50 years); that of people living in forest regions grew from 55 to 65 only in the same period: a slow growth rate even lower than the population increase (Singh 2001). The growing regional imbalance is the root cause of many separatist movements, violence, social and political unrest and demand for separate States. The following Sections will present forest based strategies to achieve faster and more inclusive development in the forested regions.

6.5 Strategy for forest cover increase in forested zones

There would hardly any disagreement about the first priority viz. contribution to eradication of poverty among the forest fringe dweller in general and scheduled tribes in particular through sustainable NTFO management and marketing. In this case, forestry has the advantage that it is natural to the region and the forest fringe dwellers have also traditional knowledge. The other two issues of national importance are: integrated watershed management and conservation of national biological diversity and wildlife which are under great threat. The increase of green cover is very critical for soil conservation and water supply in the important river basins; biodiversity conservation is an intergenerational and international obligation.

Sustainable NTFP Management and Marketing

There are examples of successful NTFP ventures in the country based on forest produce run in the form of large scale government cooperatives: (i) Girijan Cooperative Corporation (GCC) of Andhra Pradesh is organizing procurement of NTFP at fair prices to tribal community by eliminating the middlemen and private traders. The annual turnover reported in 2004-2005 was US$ 9.6 million, most of it in form of disbursement to tribal collectors; and (ii) Madhya Pradesh and Chhattisgarh Minor Forest Produce Cooperative Federations are organizing Statewide NTFP collection and marketing and supporting processing and sale in the whole sale and retail market. During 2005, the MP Federation organized collection of nearly 25,000 MT of medicinal and aromatic plants and sold branded medicinal products with fair return to the local communities.

There are, however, many questions on a country wide application. Forestry so far has mainly meant timber production, while in the context of tribal livelihood the most important are the non-timber species. The complexity is not only in terms of number of species, but the knowledge of their regeneration and harvesting, value addition and marketing viz. the expertise to manage and market NTFP on a sustainable and profitable basis. A system approach to management is called for including the entire value chain from planting / regeneration, management to marketing covering: (i) primary area production (in the forests and / or fields); (ii) secondary area production (harvesting and transport to a consumption point); and (iii) tertiary area production (manufacturing and end use). Presently, manufacturing is most organized; whereas the first two steps viz. primary and secondary area productions are most unorganized, hidden, unsustainable and very wasteful, to the great detriment of forest and the people. By integrating the three phases of the production, we expect to improve the health of the forests, local economy and sub-sector contribution to national GDP.

Integrated Watershed Management

Most of forest region is hilly and mountainous. Therefore, a strategy based on watershed development with emphasis on water conservation, appropriate combination of annual and perennial crops is most likely to provide a reliable source of income and livelihood security. A balanced approach to land use will be more profitable and ecologically more sustainable. Land use choices need to be made after proper land evaluation taking into account land capability, farmer needs and market demands (and micro-financing) in order to give the highest economic return to the farmer. Economic gains ate estimated high (6%) as there will a possibility of value addition from combining crops, forestry and cattle rearing. There are many success stories on the subject, which provide a sound basis for planning such projects. The main development goal will be to make the community self-reliant in respect of basic needs and consist of:

Improved agriculture practices through soil and water conservation, minor/micro irrigation, technology upgrading and extension with greater emphasis on high value crops including medicinal & aromatic plants.

Livestock improvement including poultry etc.

Access to safe drinking water.

Other income generating activities

Improving access to markets, market information and rural roads/marketing infrastructure.

The above issues are important in most forestry regions of the country. Other important considerations are: participation of all stakeholders including the private sector's involvement, building sustainability into the design of programmes at the start-up stage itself, promoting use of social capital, cost sharing among stakeholders and use of sustainable models / practices.

Protected Areas and Wildlife Management

The track record of forest protection, particularly in the tropical countries, has been poor. There is a strong emerging consensus that, if forest conservation is to succeed, conservation efforts need to go beyond protected areas and cover all forests (Singh 2005). Even the most ambitious exponents of biodiversity protection only hope to achieve the allocation of around 10% of the geographic area of the country under parks and reserves. In our country, it is presently (4.75%)

of the land area. Obviously, the fate of most of biodiversity will depend upon what happens to forests under sustainable forest management. To achieve an effective protected area system, even within the limited area, presents a formidable task, as obvious from the current debate on tiger protection in the country. A number of questions emerge from discussions: what minimum number of tigers, from a genetic perspective, one should aim to have in a park; what could be done to increase the number of tigers in two parks which are among the largest but contain among the lowest number of tigers? Can conservation and forest management be integrated to increase the effective size of the parks? What could be the role of intensive forestry practices, to reduce the pressure on protected forest areas?

6.6 Agro-Forestry Strategy

The increase of income will reduce further pressure on natural resources calling for increased productivity per unit land area and the improved management practices. Urbanization will increase pulling more and more people to urban areas with better amenities. The relative share of agricultural employment will decline with the rising economic growth, as observed in all developed countries (see Figure 3). The Planning Commission has foreseen the problem and allocated resources to increase the non-agricultural employment in rural areas at over 6% per annum during the 11th FYP.

It was observed in the earlier Section that agro-forestry has become a major supplier of industrial as well as non-industrial wood, and is supplying more wood than the State forests. This has significance not only from forest production, but also socio-economic and environmental perspectives, in particular, rural development. The tree cover is also contributing to environmental functions in the agricultural landscapes.

National Conferences on Agro-Forestry, held at Chandigarh in 2005 and 2006, attended by a wide spectrum of scientific community, progressive farmers and people's representatives, pointed towards great opportunities to enhance the farm income on a sustainable basis from adoption of suitable (agro-climatic zone adapted) agro-forestry systems compared to mono-cultural practices. It was reported at the conference (see Table 16) that agro-forestry is already being gainfully practiced on a large scale by medium and large farmers all over the country, but its potential has not been fully realized by small farmers.

Table 16: Addition to House Hold (HH) income by agro-forestry: 1998 Prices

HH Size	No. HH	Contribution to Income (RS.) by Sub-sectors				% Increase over crops
		Crops	Trees	Animals	Total	
Landless	79	0	2027	4430	6457	-
Small	64	9678	3648	6537	19863	2.01
Medium	27	26878	8128	9596	44602	1.65
Large	30	78637	12850	14014	105501	1.34
Average	200	30784	6367	7598	44749	1.45

Source: Rai et al. (1999)

Agroforestry is currently meeting more than 60% of the demand of industrial wood and there are new possibilities for increasing the production at costs much lower than imported products. A

study conducted at Yamuna Nagar, Haryana, shows that 2.3 million cum of wood is sold annually in the market for Rs. 3,500 millions, which in turn produces Rs 17,000 million worth of processed wood products, in other words five times value addition. This shows an excellent opportunity for private-public partnership with a win-win situation for both partners; and the state economy at large.

Currently, of estimated 70 million ha of unirrigated cultivated lands, nearly 50 million ha is located in arid and semi-arid zones and 20 million ha of subsistence and shifting agriculture in the scheduled areas, presents a major challenge to development. The Second Report of the National Commission on Farmers, 2005, quotes the statement of the Union Minister for Agricultural at the NDC meeting on 27-28 June 2005 as follows: "The tragic incidents of farmers' suicides in some of the States have been a matter of serious concern…..crop losses, consecutive failure of mansoon, recurrent droughts, mono-cropping, land tenancy , etc., seem to be some of the main causes…..76% of the victims were dependent on rain-fed agriculture and 78% were small and marginal farmers …. 76% and 82% of the victim households had borrowed from non-commercial sources in 2000-01 2002-03 respectively".

In the dry zones the rain fall is scanty and erratic. A strategy based on watershed development with emphasis on water conservation, appropriate combination of annual and perennial crops, is most likely to provide a reliable source of income and livelihood security. A balanced approach to agriculture will be more profitable and ecologically more sustainable. Land use choices need to be made after proper land evaluation taking into account land capability, farmer needs and market demands (and micro-financing) in order to give the highest economic return to the farmer. Still, in this zone, there will be the need to keep a minimum of best land area under high yielding agriculture as a means of livelihood security for some time. Demands for this will get less and less as transport network in the country improves and short falls in any region could be met from the national surplus in an expeditious manner.

In this region ideal seems a mixed land use strategy: say 1/3 (the best) for food production as a part of livelihood security; 1/3 with high with a mix of annual and perennial crops chosen with market demand in view e. g. organic farming in tribal areas; and 1/3 (lowest capability class) under plantation crops to meet fodder, small timber needs of rural population, tourism and industries. With economic development, food habits of people also change and demand for fresh fruits, vegetable, eggs and meat rises. An integrated approach to farming including agriculture, horticulture and forestry accelerates agriculture sector contribution to the total GDP and to poverty reduction by providing income and employment opportunities to the landless group, which forming a significant component of the population in the poor areas. The data in Table 17 also shows that medium and small farmers relatively benefit more from the land use diversification.

6.7 Opportunities for increasing the forest area and tree cover

Forestry and tree growing today hold key to a number of major national problems. The estimates of potential forest area (see Table 17) have been arrived at in consultation with Farmers Commission Secretariat jointly (Singh 2008).

Table 17: Scenarios for development and conservation of forest and tree resources

Dominant Land Use Class	Geographic Area (million ha)	Forest Cover (million ha)
Multiple Use Forestry	**164**	**84 (51.2%)**
1. NTFP Management and Marketing	50	50
2. Protected Area Management	14	14
3. Integrated Watershed Management	45	20
4. Permanently Unproductive Areas	55	0
Agriculture including Agro-forestry	165	35 (21.2%)
5. Agroforestry in favourable conditions [1]	90	5
6. Agroforestry in unfavourable conditions[1]	50	5
7. Afforestation of degrades lands	25	25
All Classes	**329**	**119 (36%)**

Note 1: Tree cover converted into closed forest area terms

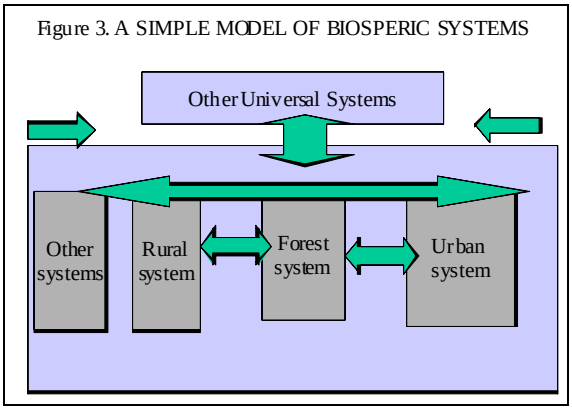
In terms of competition with agriculture for land, forestry faces a more comfortable situation today than say 60s and 70s, as the agricultural growth in future would be mainly based on productivity increase. In fact, globalization of agriculture and rising level of per capita income will both cause a relative reduction in demand of land for subsistence agriculture, which was the key factor in the past for forest area loss. On the other hand, trees are becoming an integral part of agriculture. Of special importance are trees and forests combined with dry-land agriculture. Agro-forestry provides a secure source of income in the times of crop failures; and food, fuel and feed for animals.

Chapter 7
The Needed Institution and Adaptations

7.0 Introduction

A major difference today compared to the forestry situation in 1952 or 1988 is the availability of vast body of new knowledge and understanding about the nature and functions of forests, their intrinsic value for the human society and environment at large. Forestry Principles, Conventions on Biological Diversity, Climate Change and international research on related issues, all strengthen the case of conservation and sustainable use of forests. Forests today are seen as a part of the larger and dynamic system connected with rest of the biosphere; including biotic and abiotic parts; national and global impacts together (See Figure 3).

Figure 3. A SIMPLE MODEL OF BIOSPERIC SYSTEMS



According to Forestry Principles, forests need to be viewed as a holistic entity, as part of the landscape together with other natural and cultural systems. Country is an important unit for study and planning as most of forest policy, strategy, institutions and programmes are made at that level. The need is for the Forest Sector strategy to integrate with the rest of sectors in a coordinated and planned manner at all levels, national to local. There is an increasing realization that Forestry Institutions of the country during the last 30 years have become more inward looking and isolated from the rest of the society.

The agricultural stagnation / progress has been the single most important factor affecting forest area during 1900-2000. The agriculture development during the last 20 years (see Table 18) suggest that the forestry and agriculture could grow in a synergetic manner.

Table 18: Economic & Agricultural Growth Trends during 1980-2000

Year	Population	Economic Trends		Agricultural Land Use		
		Real GDP Growth	GDP Per Caput	Net Area Sown	Area Irrigated	Yield (Food Grain)
	Millions	(%)	%	Million ha	%	Kg / Per ha
1981-82	683	3.7	1.5	140.00	29.7	1023
1990-91	843	5.9	3.8	143.00	35.1	1380
2000-01	1027	6.2	4.4	141.63	43.4	1626

Source: National Census 1991

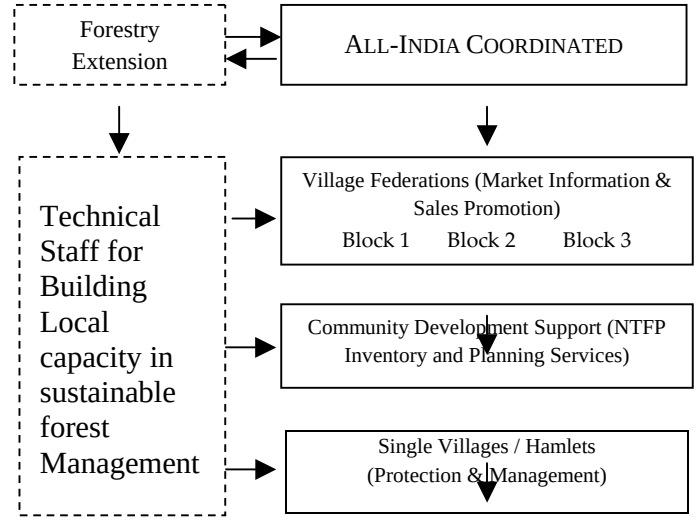
7.1 Apex Forest Policy Body

Till recently, (earlier to transfer of the Forest Sector responsibility from the Ministry of Agriculture to Ministry of Environment and Forests), there was a Central Board of Forestry (CBF) with the Central and State Forest Ministers serving as members, guiding the forest sector policy of the country and providing a continuing forum for consultation and discussion on the emerging forest sector issues. The CBF had a permanent secretariat called Central Forestry Commission (CFC), which provided continuing data collection and analysis support and organized policy studies as and when needed. CBF, or a similar body (or Forum), along with the data and analysis support as indicated above, seems to be very relevant in the context of fast changing forest sector priorities and the need for maintaining continuity as well as guiding the change in consultation with states and other stakeholders. An Inter-Ministerial Body, to connect the forest sector with other sectors of the country like the erstwhile Board of Forestry, is urgently needed.

7.2 The institutional architecture at grass-root level:

A question is being raised again and again: what after JFM. The forest sector has to move beyond JFM. The national Commission on Forests has diagnosed and recommended establishment of 'democratic forestry institutions" in order that the Forest Services is institutionally connected with the rest of society and do not function in dichotomy: Forest Service versus the rest of Society. It may be noted that policy objective of increasing the forest area without an appropriate institutional innovations, has very limited chance of success. Accordingly, the latter issue will be presented in some detail.

Figure 4: Local Institutional Infrastructure for NTFP Management



The new forestry institution must have a scientific basis (empirical or observation based) embedded in the local governance. Community must ensure protection, participate in the planning process and maintain database on: what is growing, how much has been actually removed in the past, what can be removed in future and what needs to be regenerated. Without such plans / controls, sustainable management is not possible. In Figure 4, two categories of institutions are shown: the one (RHS) consists of local community based institutions; the other (LHS) is formed by more specialized Forest Department technical staff.

NTFP protection and management (and agro-forestry) are proposed to be implemented at the **Village / hamlet level** (shown as the lowest box) as per plans approved by the community based on data collected by "**Community Development Support Group**", to be established say 1 center for 8-12 villages / hamlets; with the knowledge support provided by the extension staff in the block / district. They will closely work with village units and Extension staff in conducting inventory, maintaining records of production-consumption and sales and support local use planning. They would also render technical services to Government Departments as and when required and get paid for the same. A feasibility study on the CDSG has been carried out and found to be very cost-effective. At the next higher level, **Market Information Centers** are suggested, which would be a very important input to sustainable NTFP management and would be important for ensuring fair prices to community and taking further steps regarding pre-processing and processing, value addition in general.

In Figure 4 a Forestry Extension Officer is shown linked with Community Extension and Marketing Support Centers to provide them needed technical backstopping / guidance. Suitable training curricula for the Extension Staff of the FD and Community Institutions will be developed. These units (viz. FD and Community shown in Figure 1) will collectively ensure sustainable NTFP including NTFP surveys on a 5- year cycle, recording of annual production, consumption and sale, and NTFP planning in general.

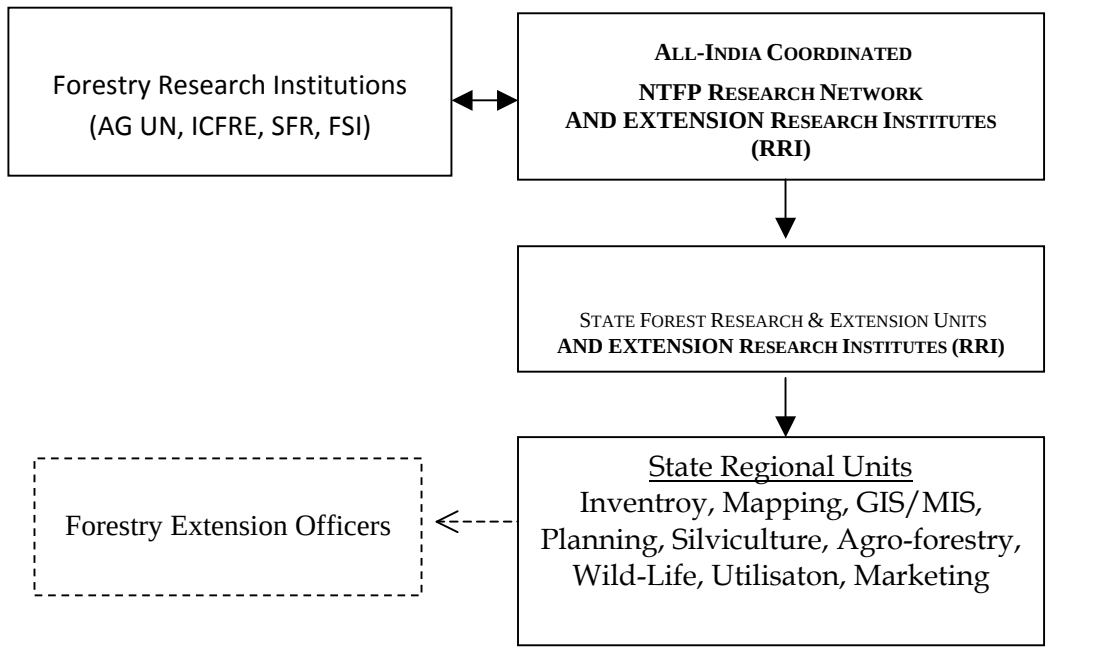
7.3 **Knowledge Support to local level forest management***:* These are two related issues. The first is development of an **All-India Coordinated NTFP (and Agro-forestry) Research Network** (see Figure 3). ICFRE, in close cooperation with other Central and State Research organizations, is expected to take a lead role in developing a strong NTFP knowledge basis to guide the process. The second is **establishing a communication system for the knowledge and information to percolate to the Community level**. States are expected to assume a lead role in establishing an effective communication system (see Figure 5), as a part of national network to provide enabling environment for the effective use of the knowledge. In Figures 4 and 5, a nodal person has been visualized and named as Forestry Extension Officer in concerned Districts (or Forest Divisions) liaise (network) with State and Central Forest Research Institutes and seek guidance from them on technical and market price issues.

The information on non-timber forest produce, which are the basis of subsistence of the forest fringe dwellers and main source of their cash income, is almost non-existent: what is the level of sustainable production, what is being actually harvested and sold? The knowledge about the management of NTFP, which number in hundreds does not exist. The responsibility for their management and marketing has now been transferred to local communities with no proper extension services and any accounting support. There is general apprehension that Tribal Act combined with uncontrolled market will hasten the decline of NTFP resources, which are already fast depleting. Nobody knows as to when they will completely disappear? The forestry scenario will fast deteriorate, if remedial measures are not soon undertaken.

For S&T to be successfully applied to the national development process people's participation is obviously essential, as has been amply demonstrated in the achievement of agricultural self-sufficiency in the country where agricultural professionals and farmers worked as partners. Forestry has to go one step further in that it must embrace the poorest section of society, viz. the tribal and landless people. This establishes the need for a strong extension wing for the dissemination of Science and Technology.

People's participation does not imply merely a passive involvement as beneficiaries and employees, but also active association in decision-making regarding the kind and level of S&T. The breakthrough achieved in agriculture and dairy production clearly demonstrates the crucial role of Science and Technology (S&T).

Figure 5 All-India Coordinated NTFP Research Network and Communication System



7.4 Public-private partnership

For the success of NTFP and agroforestry initiatives, it is absolutely necessary that they are run as a business enterprise. Such business prospects in both cases are great. The Government could play an important catalytic role by promoting investments, knowledge transfer and capacity building of the indigenous people, who could make a sustainable use of resources as a part of their social system. Andhra Pradesh established Girijan Cooperative Cooperation (GCC) in form an Autonomous Corporation in 1980 to get rid of the middle men and thereby increase the benefit to the tribal people.

The economic impact of GCC, Andhra Pradesh	
Forest area:	3.2 million ha
Number of forests districts: 130,000 ha per district)	25 (on an average
Beneficiaries:	2.5 million tribal people
Number of depots:	817
Processing units:	8
Annual turnover:	25 million US$

The GCC was able to eliminate the middleman, provide essential commodities (like food and medicine) even in the interior area and extend credit facilities for "agricultural activities". However, GCC fell short of promoting integrated development by excluding forest management from the scope of their involvement. In the new context of 1996 Constitutional changes, the local people have an important role as custodian of forest resources and their sustainable development.

Like NTFP, agro-forestry holds a promise for enhancing tree cover combined with prosperity to farmers. By end of the millennium, agro-forestry was producing industrial and non-industrial wood more than forestry proper. It was also improving the productivity of the farm environment and providing additional income and employment in the rural areas. The achievement of the minimum forest cover targets, enshrined in the 11th Five Year Plan Document, to a great extent, depends on the success of agro-forestry. The demand for additional wood by 2020 is estimated at 150 million m^3, of which share of industrial wood 50 million m^3 and non-industrial wood 100 million m^3 (MoEF 1999). Agroforestry could meet these production goals is a cost-effective manner provided a far-sighted policy and institutional mechanism could be put in place.

Yamuna Nagar Argoforestry Model in in Haryana	
Annual Wood supply:	2.3 million m^3
Price of Unprocessed Wood:	INR 3,500 millions
Price of Processed Product:	INR 17,000 million
Employment Generated:	150,000

7.5 Conclusion

At no point in the history of India has there been a greater urgency to develop forest resources and forest based occupations and forest industries than it is at present. The country is now at the stage of economic development when the primary goal of the nation is the creation of not only additional employment, but employment with greater purchasing power, and generation of new skills to sustain it. Forests can play can play an active role in achieving these objectives. It can be shown that jobs, skills and economic benefit "grow" on trees. These were the visionary words written by S. K Seth and Y. S. Rao, two great forester of the country, as opening words in an unpublished policy paper, "Forestry: New Directions", some times in 1978. They could feel the up-beat pulse of the nation, just when it was taking off in the economic field. These words hold still true with greater force, after 30 years, when the country has made rapid economic and technological progress and looking for approaches to solve some intractable socio-economic and environmental problems including poverty.

It is hoped that forestry will prove to be an effective instrument in realizing the twin goals of sustainable forest management and all round community development, the dream of "village republics" by the Father of the Nation (Gandhi, 1963).

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ANNEX 1

The USDA Land Capability Classification System

The technique which allows determination of the most suitable use for any area of land is called land classification. A great number of systems of land classification are in use, varying mainly according to the purpose for which the land is classified. Land may be classified according to its present land use, its suitability for a specific crop under the existing forms of management, its capability for producing crops or combinations of crops under optimum management, or its suitability for non-agricultural types of land use. A good knowledge of the land capability and suitability combined with good understanding of the soil characteristics and management aspects are the keys to more productive and sustainable agriculture.

The purpose of land capability classification systems is to study and record all data relevant to finding the combination of agricultural and conservation measures which would permit the most intensive and appropriate agricultural use of the land without undue danger of soil degradation.

The best known of these systems is the United States Department of Agriculture system (Klingebiel and Montgomery, 1961). The USDA land classification system is interpretative, using the USDA soil survey map as a basis and classifying the individual soil map units in groups that have similar management requirements. At the highest of categorization, eight soil classes are distinguished, namely:

Class I soils have few limitations restricting their use. Erosion hazards on these soils are low; they are deep, productive and easily worked. For optimum production, these soils need ordinary management practices to maintain productivity, as regards both soil fertility and favorable physical soil properties.

Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices. Limitations of soils in Class II include (singly or in combination) the effect of gentle slopes, moderate susceptibility to erosion, less than ideal soil depth, somewhat unfavorable soil structure, slight to moderate correctable salinity, occasional damaging overflow, wetness correctable by drainage, slight climatic limitation. Soils in this class require more than ordinary management practices for obtaining optimum production and for maintaining productivity.

Class III soils have severe limitations that reduce the choice of plants or require special conservation practices. The limitation of soils in this class are those of Class II, but in higher degree; including additional limitations such as shallow depth, low moisture-holding capacity, and low fertility that is not easily corrected. Class III soils require considerable management inputs, but even so, choice of crops or cropping systems remains restricted because of inherent limiting factors.

Class IV soils have very severe limitations that restrict the choice of plants and or require very careful management. Restrictions, both in terms of choice of plants and or management and conservation practices are greater than in Class III to such an extent that production is often

marginal in relation to the inputs required. Limiting factors re of the same nature as in the previous classes but more severe and difficult to overcome. Several limitations such as steep slopes are a permanent feature of the land.

Some of the limitations due to sloppiness and erosion hazards in classes II to IV can be reduced by biological terracing as practiced in agroforestry and alley cropping.

In the USDA system, soils of classes V to VIII are generally not suited for cultivation, although certain of them may be made suitable for agricultural use with costly measures.

Class V soils have few or no erosion hazards but have other limitations, impracticable to remove, that restrict their use to pasture, range, woodland, or wildlife food and cover. Although they may be level or nearly level, many of these soils are subject to inundation or are stony or rocky.

Class VI soils have severe limitations- that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food cover. This class is a continuation of Class IV, with very severe limitations that cannot be corrected. They may serve for some kinds of crops, such as tree crops, provided unusually intensive management is practiced.

Class VII soils have very severe limitations that make them unsuited to cultivation and also, restrict their use largely to grazing, woodland, or wildlife. The limitations are such that these soils are not suited for any of the common crops.

Class VIII soils and land forms have limitations that preclude their use for commercial plant production.

ANNEX 2

International Forestry Developments

Articles from Forestry Principles

Article 2 (b): Forests and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations. These needs are for forest products and services, such as wood and wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks and reservoirs, and for other forest products.

Article 4: The vital role of all types of forests in maintaining the ecological processes and balance at the local, national, regional and global levels through, inter alia, their role in protecting fragile ecosystems, watersheds and freshwater resources and as rich storehouses of biodiversity and biological resources and sources of genetic material for biotechnology products, as well as photosynthesis, should be recognized.

Article 8 (e): Forest management should be integrated with management of adjacent areas so as to maintain ecological balance and sustainable productivity.

As a main message, FP requires forest land evaluation to be conducted at a landscape level in a holistic manner, as mentioned in various clauses before and implications drawn for the international implications of the land use decisions.

Important International Conventions

Besides Forestry Principles, three important Conventions have been agreed upon, of which India is a signatory and which have important bearing on forestry land use decisions.

United Nations Framework Convention on Climate Change (UNFCCC:
The stated objective of the Convention is "to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system". Degradation and conversion of forests in general, and tropical forests in particular, to other land uses are major cause of GHG emissions. It, therefore, becomes imperative to address deforestation of forests as part of an integrated strategy to reduce global GHG emissions. The concept now known as Reducing Emission From Deforestation and Degradation (REDD) in developing countries.

Convention on Biological Diversity

The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Forests, and tropical forests, in particular, make major contribution to the global biological diversity.

United Nations Convention to Combat Desertification:

The objective of this Convention is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach which is consistent with Agenda 21, with a view to contribute o the achievement of sustainable development in affected areas.

ANNEX III

Definitions and Classifications

1. Forest Survey of India

FSI definitions of forest and tree Cover are as follows*:*

Forest Cover
All lands, more than one hectare in area, with a tree canopy density of more than 10 percent irrespective of ownership and legal status. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm.

Tree Cover
It comprises tree patches outside the recorded forest area exclusive of forest cover and less than the minimum mappable area of 1 ha. Such small patches comprising block, linear and scattered trees are not delineated as forest cover during interpretation of satellite data. The areas of scattered trees are computed notionally. Forest Cover Classification based on remote sensing used by FSI is as follows**:**

Very Dense Forest	All lands with tree cover of canopy density of 40 percent and above.
Moderately Dense Forest	All lands with tree cover of canopy density of 40 percent and above.
Open Forest	All lands with tree cover of canopy density between 10 to 40 percent.
Mangrove	Salt tolerant forest ecosystem found mainly in tropical and sub-tropical inter-tidal regions.
Scrub	All lands with poor tree growth mainly of small or stunted trees having canopy density less than 10 percent.
Non-Forest	Any area not included in the above classes

2. FAO Global Forest Resources Assessment 1990

This report will make extensive use of concepts provided by FAO Global Forest Resources Assessment 1990, which defined forests as ecosystem with a minimum 10% of crown cover of trees and / or bamboos, and generally associated with wild flora, fauna and natural soil conditions; and not subject to agricultural practices". Forests were further distinguished on the basis of ecological zone and crop origin viz. natural or man-made. In this report use has been made of this definition as it seems nearest to the current concept of forests as an ecosystem.

FAO also carried out a remote sensing based survey of tropical forests using sampling of Landsat MSS / TM images of 3 dates viz. 1980, 1990 and 2000. The land cover classification included nine classes (main level classification, excluding the class **other non interpreted**). List of main and additional classes follows:

Main Classes		Additional Classes	
Closed Forest	(canopy cover >40%)	**High density**	(canopy cover >70%)
		Medium density	(canopy cover 40-70%)
Open Forest	(canopy cover 10-40%)		
Long Fallow (forest affected by long fallow shifting cultivation)			
Fragmented Forest (mosaic of forest / non-forest)		**Dense fragmented**	(forest fraction 40-70%)
		Sparse fragmented	(forest fraction 10-40%)
Shrubs		**Dense shrubs**	(canopy cover >40%)
		Sparse shrubs	(canopy cover 10-40%)
Short Fallow (agricultural areas with short fallow period)			
Other Land Cover			
Water			
Plantation (man-made woody vegetation)		**Forest plantation**	
		Agricultural plantation	

The land cover classes presented above have been used to estimate the pan-tropical forest cover and its changes during a ten-year period. However, since there is no single class that unequivocally represents "the" forest, it is essential to specify clearly which class groupings, or **definitions of forest** have been adopted and how such definitions affect the classification and estimation of forest changes, viz. deforestation, degradation, afforestation, etc.

The first four classes represent the forest under various conditions: grades of density (**closed** and **open**), spatial disturbance (**fragmented**) and temporal disturbance (**long fallow** shifting cultivation).

The above classes can be grouped to reach various definitions of forest, from the most strict one that includes only the class **closed forest** to the broadest one which includes all four classes. It is implicit, but not generally recognised that the definition of ***forest*** determines the definition of ***deforestation***.

A narrow concept of forest, composed of one class only, implies a wide concept of deforestation since any transition from that single class would represent deforestation.

A broad concept of forest, composed of several classes, implies a narrow concept of deforestation since only transitions *outside* that group of classes would be considered deforestation while the transitions *within* the group would be defined as degradation, fragmentation, amelioration, etc.

One important factor to be considered is that for a deeper analysis of forest area changes a broader definition of forest is preferable since it allows for finer differentiation among changes and a better description of their environmental impact.

The following definitions are being provided to show diversity of definition of forests given within the same agency. Among the earliest definition of forest is one (see below) given by FAO as a part of Global Forest Resources Assessment 1963.

Forest land: All lands bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or other forest products, of exerting an influence on the climate or on the water regime, or providing shelter for livestock and wild life.

Includes:

(i) Lands from which forest has been clear-cut or burned, but which will be reforested in the foreseeable future;
(ii) Public and private forests of any size;
(iii) Forest of slow growth and of dwarfed or stunted forms - e.g., subalpine;
(iv) Bamboo stands;
(v) All lands affected by shifting cultivation, other than those now being prepared or used for agricultural crops, which will become stocked with forest in the foreseeable future;
(vi) Savanna types with density averaging at least 0.05 {see definition of density below);
(vii) Wattle plantations (Acacia, spp.)
(viii) One-rotation plantations for production of timber;
(ix) Nurseries of forest trees;
(x) Forest roads and other small open areas that constitute an integral part of the forest.

Excludes:

(i) Areas occupied by orchards of fruit or nut trees, and plantations for non-forest crops such as rubber and cinchona;
(ii) Areas occupied by individual trees or lines or groups of trees - for example, along roadways, canals and streams, or in city parks, private gardens and pastures - too small to be managed as forest;

(iii) Areas of windbreak and shelterbelt trees that are in small groups or narrow strips, too small to be managed as forest;
(iv) Lands primarily managed for permanent agriculture;
(v) All lands under shifting cultivation being prepared or used for agricultural crops and such lands which will not return to forest in the foreseeable future.

FAO Global Forest Resources Assessment 2000 definitions follow:

Forest: Forest includes natural forests and forest plantations. It is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m. Young stands that have not yet but are expected to reach a crown density of 10 percent and tree height of 5 m are included under forest, as are temporarily unstocked areas. The term includes forests used for purposes of production, protection, multiple-use or conservation (i.e. forest in national parks, nature reserves and other protected areas), as well as forest stands on agricultural lands (e.g. windbreaks and shelterbelts of trees with a width of more than 20 m), and rubberwood plantations and cork oak stands. The term specifically excludes stands of trees established primarily for agricultural production, for example fruit tree plantations. It also excludes trees planted in agroforestry systems.

Natural forest: A forest composed of indigenous trees and not classified as forest plantation.

Plantation forests: A forest established by planting or/and seeding in the process of afforestation or reforestation. It consists of introduced species or, in some cases, indigenous species.

Other wooded Land: Land that has either a crown cover (or equivalent stocking level) of 5 to10 percent of trees able to reach a height of 5 m at maturity*;* or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity or with shrub or bush cover of more than 10 percent.