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Towards an Economic Approach to Sustainable Forest Development

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ABSTRACT

Sustainable Forest Development aims at use and conservation of forest resources while at the same time meeting the development goals of an economy. At present, in India, this objective is met almost entirely through the use of legal & administrative controls rather than encouraging voluntary compliance. In this context, need has been felt to evolve an integrated strategy so that the contribution and requirements of various stakeholders in management of forests are incorporated. This would also require appropriate valuation of forests to account for the broader dimensions of benefits and costs incurred by the people and concerned institutions.

It is suggested that a holistic approach for valuation of forests is essential while examining the issue of compensation for expansion and maintenance of forest cover. There is need to identify the set of people/institutions that bear the cost vis-à-vis the beneficiaries in order to develop an appropriate incentive mechanism. Here, the involvement of local people is of paramount importance. Since benefits from forestry are widespread, stakeholders that bear greater costs should be suitably compensated. For this, the modus-operandi in the Indian context needs to be worked out.

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1. Introduction

Sustainable development implies use of natural resources such that the future generations can attain the same level of well being as enjoyed by the present generation. It is in context of the need for conservation of the stock of natural resources that sustainable management of forests (SFM) has gained importance. Sustainable Forest Management ensures that values derived from forests meet present day requirements and at the same time the quantity and quality of long term development goals are maintained.

In this context, need has been felt to evolve a multi-sectoral integrated strategy so that contributions and requirements of various stakeholders for sustainable management of forest resources are incorporated. Further, it is essential to overcome market failures, price all transactions of forest products through proper valuation techniques and at the same time, making all stake holders accountable for the action to achieve SFM. Involvement of local people is crucial in this regard.

Some of the states in the country have raised the issue of compensation for maintenance of forest cover at levels higher than national average. This, it is alleged, is adversely affecting their development activity vis-à-vis the states that have minimal forest cover. It is suggested that there is a need for appropriate valuation of forests to account for the benefits and costs while considering the scope for compensation.

It is felt that the issue of compensation has wider implications than simply linking it with the valuation of forests. There are complex issues relating to identifying the set of beneficiaries as against those who bear the cost of maintenance, particularly in relation to broader benefits of forests like carbon sequestration, watershed benefits, eco-tourism, apart from the purely ecological benefits. The other issue concerns the plausible mechanism for compensation

with support from international financial institutions or Central Government or even cross-payments for funding amongst states.

The present paper looks at the various dimensions of contributions by forests in the context of the Indian economy. Based on a detailed review of literature on importance and valuation of forests, some policy implications on the issue of compensation to states undertaking afforestation programmes have been analysed. Certain other unanswered issues have been flagged for wider consultation including the modus operandi for compensation to stakeholders to encourage expansion of forest cover in the country. The paper is divided into ten sections. Section 2 looks at importance of forest cover, section 3 at valuation of forest cover, section 4 at costs on forestry, section 5 at methods for valuing forest benefits, section 6 at empirical studies on valuation of forests, section 7 at forests resources in India, section 8 at wastelands for expansion of forest cover, section 9 at issues of compensation, and finally section 10 gives certain concluding remarks.

2. Importance of Forest Cover

There has been increasing realisation that forests provide numerous benefits to mankind including improvement of the quality of environment. Forests provide goods and services and maintain life support systems like timber, fuelwood, fodder, and a wide range of non-timber products. Further, forests are a source of natural habitat for biodiversity and repository of genetic wealth, provide means for recreation and opportunity for eco-tourism. In addition, forests help in watershed development, regulate water regime, conserve soil, and control floods. They contribute to process of carbon sequestration and act as carbon sink, which is important for reduction of green house gases and global warming. In ecologically sensitive areas like mountains, as well as river catchments, forests play an important role for prevention of floods, etc. Degradation of forest resources has a detrimental effect on soil, water and climate, which in turn affects human and animal life. This has created global concern for protection and preservation of forests.

It is important to recognize that the benefits of natural forests are rather different than man-made forests. The ecological benefits of natural forests are difficult to replicate in a man-made forest. Functions like carbon-sequestration, would depend on topography, soil conditions, density of forests, etc. The functions of forests both for the natural system as well as the social dimensions can be briefly seen in the following statement. It may be mentioned that while natural forests provide for all these functions, only some of these benefits may arise from man-made forests.

Functions of Forests

For the natural system	For the social system
Protective:	
- soil protection by absorption and deflection, radiation, precipitation and wind. - conservation of humidity and carbon dioxide by decreasing wind velocity. - sheltering and providing required conditions for plants and animal species.	- sheltering agricultural crops against drought, wind, cold, radiation. - conserving soil and water. - shielding man against nuisances (noise, sights, smells, fumes).
Regulative:	
- absorption, storage and release of CO_2, O_2 and mineral elements - absorption of aerosols and sound. - absorption, storage and release of water. - absorption and transformation of radiant and thermal energy.	- improvement of atmospheric conditions in residential and recreational areas. - improvement of temperature regimes in residential areas (roadside, trees, parks). - improvement of biotype value and amenity of landscapes.
Productive	
- efficient storage of energy in utilizable form in phyto and zoo mass. - self regulating and regenerative processes of wood bark, fruit and leaf production. - production of a wide array of chemical compounds, such as resins, alkaloids, essential oils, latex, pharmaceuticals etc.	- supply of a wide array of raw materials to meet man's growing demands. - source of employment.

Source Verma, 2000.

It has been seen that many of functions mentioned above, were not accounted for in the earlier literature. The flow of benefits was primarily restricted to timber and a few non-timber forest products. However, the analysis in recent times has attempted to put values on a large number of functions viz., carbon-sequestration, eco-tourism, watershed benefits, etc. This is examined in the next section.

3. Valuation of Forest Cover

While the value of any resource can be assessed by its demand behaviour, in case of forests, markets may not exist for all types of products while forest 'services' providing public goods have no market place at all. Moreover, they have the peculiarity of inter-generational use. As a result of this, standard static economic analysis may not serve the purpose of decision making on issues regarding pricing and distribution of forest products. Also, such resources are subjected to a variety of property rights systems, different from individual or private property rights. In such a scenario alternative methods are required to value the forests.

There are externalities associated with forest resources and hence there is a gap between the value and notional price. The positive externalities are generally in terms of various ecological, biological and aesthetic benefits and very little price is paid. Most of the externalities are not accounted for and this results in gross under-estimation of environmental value of forests. It is mostly the value of timber that gets reflected in the contribution of forests in state domestic product. Such an under-valuation often leads to inadequate allocation of funds for maintaining the forests. It is due to these reasons that there is need to take complete stock of forest resources and assign economic value to all intangibles including goods and services, soil erosion and agricultural productivity, health, etc.

In the case of natural and environmental resources a concept of Total Economic Value (TEV) is perhaps the most complete measure to express the full range of value of benefits – both tangible and intangible. Natural resources provide a variety of goods and services to the users for their current or future benefits or welfare and are said to have use values. Examples include timber from forests, water from rivers or underground, coal from fossilized earth, etc. Use values (UV) can be further broadly classified into three groups; viz. direct, indirect and option values.

Direct use values (DUV) refer to the current use (consumption) of the resources and services provided, directly by natural and environmental resources. Direct use value can be either consumptive or non-consumptive. Forests provide timber, fuelwood, fodder, medicinal plants, fruits, etc., to the people and thereby generate direct consumptive use values. Recreation, education, research etc., are examples of direct non-consumptive use values. Indirect use values (IUV) generally are referred to the ecological functions that the forests provide. These can be broadly classified into three groups: watershed values, ecosystem services and evolutionary processes. Watershed values include flood control, regulation of stream flows, recharging of ground water, effect of upstream or downstream; the ecosystem services include fixing of nitrogen, assimilation of waste, carbon sequestration, gene pool; and evolutionary processes include life support, biodiversity preservation, etc. Option value (OV) is associated with the benefits received by retaining the option of using a resource in the future by protecting or preserving it today.

Non-use values (NUV) are generated without any direct link with the use of natural resource under question. These values are often revealed through peoples' perceptions and concerns towards conservation, culture, aesthetics and so on. The bequest value (BV) originates when people are willing to pay to conserve a resource for the use of future generations. Existence value (EV) is a concept associated with peoples' willingness to pay simply for the pleasure they derive from knowing that a natural area or particular species or characteristic exist, irrespective of any plans they may have to use these resources. People's

willingness to pay for the preservation of endangered species is an example of existence value.

The Total Economic Value is the sum of use values and non-use values. This can be expressed as :

TEV = UV+NUV = (DUV+IUV+OV) + (BV+EV)

While the above classification would help to estimate the total economic value of natural and environmental resources, it is possible that some of the goods and services may fall in more than one category, and hence it is in such cases that it is essential to avoid double counting.

Economic value measures provide a common metric of value for the different services provided by the forests viz., timber, biodiversity, carbon sequestration, watershed values, etc. in monetary units, say Rs/hectare. All types of values mentioned above are converted into monetary terms in order to help in decision making on alternative scenarios for the use of forests.

4. Costs on Forestry

In most valuation studies, while the benefits from forestry have been well documented, the costs incurred on its cultivation, maintenance, restoration, depreciation and other miscellaneous costs to obtain the timber, non-timber forest products, eco-tourism and other benefits are often not accounted for. Here, opportunity costs are also ignored. Restoration cost are incurred for reproducing the original level of benefits. Certain expenditures are required to prevent degradation of the forests. Further, input costs are incurred on plantation, extraction cost, marketing expenses for forestry products, especially log wood and other NTFPs. Direct expenditure on afforestation includes land preparation, pitting, planting, watering, fencing, trenching, apart from purchase of seedlings, fertilizers, after care cost, etc.

Apart from the direct costs, there are certain indirect costs that are required to be incurred in order to reap the larger benefits associated with forests.

Some of these costs would include infrastructure cost for promoting eco-tourism, markets for timber and NTFPs, etc. It is, however, important to note that most of these are in the nature of joint costs and attributing these costs exclusively to forestry activities could be misleading.

Most of the investment/expenditure in forests is undertaken by public agencies. Hence it is also important to look at the opportunity cost of land under forests or proposed for afforestation. This would require estimation of opportunity cost of alternative uses of the land such as grazing, agriculture, horticulture, habitation, industry, etc. The opportunity cost would reflect all economic outputs foregone or precluded by maintaining land under forest cover. Maintenance of existing natural forests would imply prospective benefits foregone from agriculture or other alternative uses of land as mentioned above. Thus, opportunity cost of sustainable forest management is the amount that could be earned from forest exploitation and various forms of land utilization. In case of converting wasteland under the afforestation programmes, the opportunity cost could be in terms of restricted availability of grazing and pasture land, etc. Opportunity cost of benefits from forest would also indicate the shadow price of benefits arising from watershed catchment protection and soil conservation, nutrient cycling, maintenance of soil fertility amongst others.

The other issue relates to social costs that are associated with existence of forests on the local people. Such social costs could take the form of damage to resilience of forest eco-system, natural resource depletion, pollution on account of forest fires, etc. Another widespread cost results from crop damage caused to local farmers by animals and birds dwelling in nearby forests.

5. Methods for Valuing Forest Benefits

A number of studies have been undertaken in recent years to develop methods for valuing non-market benefits of forests in monetary terms. These methods attempt to express such benefits in monetary terms, i.e. the willingness to pay (WTP) of consumers for a particular non-marketed benefit or their willingness to accept (WTA) monetary compensation for the loss of the same.

Techniques for estimating non-market or non-timber forest values vary in their theoretical validity, their data requirements and their relevance to different countries. The different techniques can be divided into five broad groups:

(a) Market price valuation, including methods to estimate the benefits of subsistence production and consumption;

(b) Surrogate market approaches, including travel cost method, hedonic pricing and the substitute goods approach;

(c) Production function approaches, which focus on biophysical relationships between forest functions and market activities;

(d) Stated preference approaches, mainly the contingent valuation method and variants; and

(e) Cost-based approaches, including replacement cost and defensive expenditure.

The simplest valuation methods generally rely on the market prices. Many goods and services from forests are traded, either in local markets or internationally. For the products that are commercially traded, market prices can be used to value the forest land use options. The market prices, however, do not always reflect the appropriate prices for the valuation of various forest products. In addition, there are many services provided by the forests for which there are no prices or it is difficult to have information about their prices. Consequently, a number of surrogate methods have been developed to value the forests.

The travel cost method is based on the assumption that consumers value a forest site in terms of the cost of getting there, including all direct transport costs as well as the opportunity cost of time spent travelling to the site (i.e. foregone earnings). This survey-based method has been used extensively to estimate the value of recreational aspects of forests. This method may, however, be an under estimate as this could exclude tourism benefits accrued to the linking towns/cities. Broadly, travel cost method involves three basic steps. First, it involves undertaking a survey of a sample of individuals visiting the site to determine the cost incurred. These costs include travel time, financial expenditure involved in going to the site. In addition, information on certain basic

socio-economic factors such as income of the individual is generally required. These are used to derive a demand equation for the site.

Hedonic pricing attempts to isolate the specific influence of an environmental amenity or risk on the market price of a good or service. Hedonic pricing is based on the assumption that the value of an asset is related to attributes it possesses or the stream of net benefits derived from it. A particular buyer may be willing to pay for certain environmental attributes in some area that he may not be willing to pay in another area.

Another valuation method involves an attempt to relate human well-being or the incremental output of a marketed good or service to a measurable change in the quality or quantity of a natural resource. Such method is variously called production function approach or dose-response or input-output method. This approach involves a two-step procedure. First, the physical effects of changes in the environment on economic activity are determined. This can be done by laboratory or field research, observation or controlled experiments, or statistical techniques. The second step consists of valuing these changes usually using certain monetary measures including market prices. An essential requirement of the approach is the availability of reliable information on the physical relationship between the state of the environmental resource and the economic activity or asset it supports.

Surrogate market and production function approaches mentioned so far rely on price (revealed preference) to estimate the value of the forest goods and services. These methods try to estimate the value of an environmental good on the assumption that such good exists. An alternative is to ask consumers to state their preferences directly, in terms of hypothetical markets. Here, information on the value of an environmental benefit is obtained by posing direct question to consumers about their willingness to pay for it or, alternatively, their willingness to accept cash compensation for losing the benefit. The most widely used technique in this category is the contingent valuation method (CVM).

CVM elicits the responses regarding the value of an environmental amenity from individuals for specified increases or decreases in the quantity or quality of such good. Valuations produced by CVM are contingent because value estimates are contingent on the occurrence of a hypothetical situation. In forestry, CVM has been used to value wildlife and recreational benefits of protected areas. Several recent studies have demonstrated the feasibility of applying CVM to forest land use.

Contingent ranking (CR) is a variant of contingent valuation, and it involves asking respondents to rank a series of alternative non-market goods. One advantage of contingent ranking is that monetary bids may or may not be used.

In addition to the methods described above for estimating WTP or WTA for non-market forest benefits, some other cost-based approaches are used to estimate cost of maintaining non-market forest benefits, or trade-offs with market values. Three alternative methods focus on the cost of providing, maintaining or restoring environmental goods and services.

- replacement cost methods, which measure environmental values by estimating the cost of reproducing the original level of benefits with an alternative good or service;
- preventive expenditure methods, which estimate the cost of preventing the degradation of the environment; and
- opportunity cost approaches, which use estimated production costs of an alternative as a rough proxy for the value of non-market benefits.

Methods for Valuing Forests

Valuation Method	Relevant forest benefits	Strengths &Weaknesses
Market Prices: Use data from surveys of producers and consumers, adjusted if necessary, to account for seasonal variation, value-added processing and/or public policy distortions.	Price-based valuation is commonly applied to non-timber forest products which are partly or informally traded, in order to estimate subsistence and / or unrecorded consumption.	Market prices clearly reflect consumer preferences, but often need adjustment to account for public policy distortions or market failures. Aggregation or extrapolation of values based on potential production is not valid effects (elasticity of demand).
Surrogate Markets: Travel cost – use survey data on direct cost (e.g. fares, accommodation) and, in some cases, opportunity costs of time spent traveling to and from a site, evaluated at some fraction of the average wage rate.	Travel cost is often used to estimate demand for forest recreation at specific locations. Related methods used mainly in developing countries estimate the value of non-marketed, non-timber forest products in terms of the opportunity cost of time spent collecting and/or processing them.	Provided the relation between the benefit being valued and the surrogate market is correctly specified, and prices in the surrogate market are not generally reliable.
Hedonic pricing – use statistical methods to correlate variation in the price of a marketed good to changes in the level of a related, non-marketed environmental amenity.	Hedonic pricing is used to estimate the impact of proximity to forested land and/or logging on the prices of residential and commercial property.	Travel cost estimates may need to account for various objectives (benefits) in a single trip.
Substitute goods – use market prices of substitutes for non-marketed benefits.	Substitute goods approaches may be used whenever close market substitutes for non-timber benefits exists.	Hedonic pricing requires large data sets, in order to isolate the influence of a non-market benefit on market price, relative to other factors.
Production Function: Change in production method - use data on the physical relation between level (or quality) of non-market benefit and level (or quality) of output of a marketed good/service.	Change in production (or "input-output" or "dose-response") methods are used to estimate both on- and off-site impacts of land use change, e.g. the effect of logging on hunting, downstream water users, fisheries climate.	Change in production methods require good data on biophysical relationships (dose-response).
Stated preference Contingent valuation method – use consumer surveys to elicit hypothetical individual willingness to pay for a benefit, or willingness to accept compensation for the loss of that benefit.	Recreational values are often estimated using contingent valuation.	Contingent valuation estimates are generally considered reliable if strict procedural rules are followed.
Contingent ranking /focus groups –use participatory techniques in group setting to elicit preferences for non-market benefits, either in relative terms (ranking) or in monetary terms.	Stated preference methods such as CVM are the only generally accepted way to estimate non-use values, e.g. Landscape or biodiversity values, for which price data do not exist and/or links to marketed goods cannot easily be established. Contingent ranking may be used where target groups are unfamiliar with cash valuation.	Participatory techniques are more experimental and not widely used to estimate non-market forest benefits. They are good at eliciting qualitative or "contextual" information, but there are doubts about their reliability for estimating willingness to pay.
Cost-based approaches: Uses data on the costs of measures taken to secure, maintain and/or replace forest goods and services.	Cost-based approaches include replacement/relocation cost, defensive expenditure and opportunity cost analysis; may be used (with caution) to value any type of forest benefit.	Cost based approaches are usually considered less reliable than other methods. One test of validity is evidence that people are prepared to incur costs to secure relevant benefits.

Source: IIED (2003)

In many cases, the above suggested methods are unable to arrive at a reasonable values for certain stake holders. This is particularly relevant in case of villagers and tribals whose livelihood is considerably dependent on various benefits from forests. In such situations technique like Multi Criteria Analysis (MCA) have to be used. MCA uses mathematical programming techniques to select option based on objective functions including weighted goals of decision-maker, with explicit consideration of constraints and cost. The following statement gives the relevant techniques that can be used to measure specific benefits of the forests.

Selected economic valuation methods for intangible benefits

Benefits	Methodology for economic valuation	
	Direct method	Indirect method
Direct – Non-consumptive (1) Eco-tourism/recreation (2) Education and research (3) Human habitat (4) Other non-consumptive uses	1. Contingent valuation method 2. Experiments	1. Travel cost method
Indirect (A) Watershed benefits 1. Agriculture productivity 2. Soil conservation 3. Recharging of ground water 4. Regulation of stream flows 5. Other watershed benefits	1. Contingent valuation method 2. Experiments	1. Change-in-productivity approach 2. Replacement cost approach
(B) Eco-system services 1. Nitrogen fixing 2. Waste assimilation 3. Carbon store 4. Microclimatic functions 5. Other ecosystem services	1. Contingent valuation methods 2. Experiments	1. Replacement cost approach 2. Indirect estimates derived from experiments
(c) Evolutionary processes 1. Global life support 2. Biodiversity	Contingent valuation methods	Indirect estimates derived from experimental data
Non-use values	Contingent valuation methods	

It is important to note that environmental protection is often incompatible with other social and economic objectives. There is need to make a choice between preservation of forests vis-à-vis alternative uses of land resources, viz. timber production, conversion to agriculture etc. It may, therefore, be seen that economic valuation of forest benefits can provide only part of the total picture, and that economic efficiency must be considered alongside other criteria such as social and cultural value, historical claims, distributional impacts and other political factors. This is partly also on account of the fact that valuation methods for estimating non-use values in monetary terms are imperfectly developed.

Change in the relative importance of different forest values can have important distributional implications particularly where these values are conflicting. For instance the categorization of forests as protected areas are often a means by which certain interest groups secure recreational or some non-use values. This may result in significant loss to another group, like subsistence farmers who rely on forest land for extraction of non-timber forest products, or for shifting agriculture. In addition, spatial dimensions of distribution of benefits/costs are relevant. For instance maintenance of forest in a region is likely to have major implications in adjoining areas apart from other benefits percolating to distant places.

6. Empirical Studies on Valuation of Forests

There have been a large number of studies to examine the direct and indirect contribution of various forests of the world using different valuation techniques. A few selected case studies pertaining to certain forests in Africa, Latin America and South East Asia are discussed here.[1] In addition, a number of valuation studies on various Indian forests are also examined here briefly.

Bennett & Reynolds (1993) undertook a financial CBA to evaluate the case for maintaining Sarawak Mangroves Forest Reserve, Malaysia, versus its

[1] Some of these are as reported in the IIED (2003).

conversion for oil palm plantations and prawn ponds. The study looked at market value of commercial forestry products extracted from the Reserve in 1989 and revenues from fishing and tourism in the area for 1989. The direct and indirect use values for several products including mangrove products, charcoal, tourism and also oil palm plantation products & prawn pond products were examined for their economic values. Indirect benefits for conservation of wild species, mitigation of flood risk/damage, prevention of coastal erosion and protection of adjacent agricultural land were also included. At the same time, the substantial tourism losses with conversion due to the nearby coral reefs were also accounted for. The findings suggested that the returns to conversion were outweighed by the foregone benefits of conservation.

A study by Almeida and Uhl. (1995), on sustainable reserves-use planning in the Brazilian Amazon, looked at the comparative CBA of logging, ranching and rainfed crop production in the county of Paragominas, northeastern Brazil. The costs and benefits of these activities were considered under alternative management systems. The alternative land uses were compared in terms of their gross returns, profits, tax payments, start-up capital requirement and employment generation per hectare. They concluded that more intensive land use systems generate higher financial returns, although forest management for timber and extensive cattle ranching were not found viable when capital costs were included.

A study of alternative land uses in the Mantadia National Park, in eastern Madagascar by Kramer, Munasinghe, Sharma, Mercer & Shyamsunder (1992), looked at principal land use options including subsistence (shifting) cultivation, extraction of fuel wood and other non-timber products by local population and tourism by foreigners. This was based on a survey among 351 households (1,598 people) in 17 villages located within a 7.5 km. radius of the park boundaries. The CBA analysis estimated direct use values associated with potential subsistence and tourism benefits from the forest area. It was found that the subsistence benefits foregone in terms of opportunity cost were US $ 758,446 and contingent valuation was US $ 451,400. Further, the total tourism benefits and contingent valuation was US $ 2,535,000. Here respondents were asked their willingness to

accept (WTA) compensation for loss of access to land taken for the Mantadia NP. Expressed in terms of an annual in-kind payment of rice, the mean WTA was 200 kg. of rice per year per household (worth about US $ 61). An alternative estimate of the opportunity cost of the park calculates agricultural and other subsistence benefits foregone at US $ 120 per household per year. In the tourist survey, the mean WTP expressed by survey respondents was US $ 65 per trip. The authors also distinguished between impacts primarily affecting the poor and those affecting better off groups. The authors noted that estimates of WTP or WTA inevitably reflect ability to pay and may discriminate against the poor.

Another paper by Kramer, Sharma, and Munasinghe, (1995), summarised the results of four studies which employed a range of techniques to estimate the direct use, indirect use and non-use values associated with creation of the Mantadia National Park in Madagascar. The research illustrates the potentially significant WTP of foreigners for recreational benefits and for rainforest conservation. The study suggested that the NPV was US $ 566,000 or US $ 91/household/year in terms of direct use value to local communities (timber & NTFPs, and agriculture) apart from other use values including flood control for downstream rice farmers, tourism and rainforest conservation.

A study by P. Howard, (1995) looked at financial and economic cost benefit analysis (CBA) from the government's perspective for Uganda's protected area system, including National Protected Areas, Game Reserves and Forest Reserves. The financial analysis yielded a positive net present value (NPV) of US $ 37.20 per hectare. However, once non-cost and other benefits were like tourism, carbon sequestration and option value of future spending by pharmaceutical and agro-chemical companies for the use of protected genetic material, the economic CBA produces a negative NPV. Here, both the financial and economic CBA used a discount rate of 5% and assumed a 25 year planning horizon. This study showed that from a macro-perspective, it is likely that some protected areas are more easily justified in economic terms than others, e.g. the forgone benefits of agriculture will be lower in relatively infertile or remote areas.

A study by Hadker, Sharma, David, and Muraleedharan (1997), entitled "Willingness-to-pay for Borivili National Park: Evidence from a Contingent Valuation" tried to assess the willingness to pay (WTP) of residents of Bombay (Mumbai) for conservation of the Borivilli National Protected Area. Average household WTP was estimated at US $ 0.23 per month or about US $ 31.6 million in aggregate present value terms, which far exceeded the current budget of US $ 520,000 to maintain the area. The main direct use value of the area is for recreation and the indirect use values may be associated with the area's role as a source of Bombay's drinking water and as home to many endangered animals.

A study carried out by G. Hodgson, and J.A. Dixon, (1988), attempted to carry out an economic CBA of a proposed logging ban in the Bacuit Bay coastal zone of Palawan, Philippines, in terms of impacts on the forestry, fisheries and tourism industries. The authors estimated total losses in tourism and fishing (US $ 17.5-22.6 million) due to sedimentation associated with logging that far outweighed the potential benefits from timber production. In this study on-site (logging) and off-site (tourism and fishing) benefits were assessed under two scenarios: with and without logging. Other off-site values beyond those captured by estimates of impacts on tourism and fishing have been described in qualitative terms, e.g. employment generation, job training, infrastructure development, flood protection and wildlife conservation.

A number of studies on intangible benefits using various valuation techniques have been conducted for Indian forests. Chopra & Kadekodi (1997) examined the ecological functions of the Yamuna Basin using the contingent method and suggested an annual value of Rs.624 per hectare as the intangible benefit of forests. The same authors in another study of this region suggested watershed value of Rs.2 lakh per hectare metric soil using an indirect method of reduced cost of alternate technology.

Similarly, value of carbon store was examined by Kadekodi & Ravindranath in a 1997 study at the All India level and suggested Rs.1.2 lakh per

hectare benefit using indirect estimates. Haripriya (1999) estimated value of carbon store at Rs.20125 per hectare and aggregate of Rs.1292 billion from Indian forests using species miscellaneous forest inventory data.

In other studies using travel cost and contingent valuation method, the recreation and eco-tourism benefits have been estimated for various national parks like the Periyar Tiger Reserve and the Bharatpur Keoladeo National Park etc. Chopra (1998) in a study of Keoladeo National Park considered two approaches for valuation of biodiversity both in terms of market linkages and existence of values outside the markets. A travel cost method is used to capture the market-linked valuation of tourism and recreation. The consumer's surplus for entry to the park is estimated to be Rs.427 for Indians and Rs.432 for foreigners. It found that demand for tourism services is fairly insensitive to price. An increase in entry fee and redistribution of proceeds (to enable cross subsidization of different stakeholders) could help to improve the financial and physical management of the park. The study also used multi-criteria analysis to arrive at value ranking by different stakeholders. Here, a fair degree of congruence with respect to ecological function value and livelihood value is found to exist in the perceptions of diverse groups. This perceived congruence suggests, in turn policy instruments for management, in particular local-level committees of stakeholders. The results of some studies are given in the following statement.

Economic values of intangible benefits of forests - Indian case studies

Intangible benefit	Annual value	Location	Methodology used	Source
Recreation/ Eco-tourism	Rs.16197/hectare (Rs.427.04/Indian visitor and Rs.432.04/foreign visitor)	Keoladeo National Park, Bharatpur	Travel cost method	Chopra (1998)
Recreation/ Eco-tourism	Rs.20944/hectare (Rs.519/Indian visitor and Rs.495/foreign visitor	Keoladeo National Park	Contingent valuation method	Murthy & Menkhuas (1994)
Recreation/ Eco-tourism & other benefits	Rs.23300/hectare (Rs.90 per household per year)	Boriveli National Park, Mumbai	Contingent valuation method	Hadker et.al (1995)
Eco-tourism	Rs.2.95 million (Rs.34.68 per local visitor)	Kalakadu Mundanthurai Tiger Reserve, Tamil Nadu	Contingent valuation method	Manoharan and Dutt (1999)
Eco-tourism	Rs.676/hectare (for locals) (Rs.9.5 per local (Kerala visitor)	Periyar Tiger Reserve, Kerala	Contingent valuation method, Travel cost method	Manoharan (1996)
Water supply	Annual rental = Rs.4745/hectare	Almora Forests	Indirect methods	Chathurvedi (1992)
Soil conservation	Cost of soil erosion Rs.21583/hectare	Doon Valley	Replacement cost approach	Kumar, P. (2000)
Ecological functions (use value) for local residents	Rs.624/hectare	Yamuna Basin	Contingent valuation method	Chopra and Kadekodi (1997)
Carbon store	Rs.1,292 billion (total forests) (Rs.20125/hectare)	Indian forests	Species wise forest inventory data	Haripriya (1999)
Carbon store	Rs.1.2 lakh/hectare	All India	Indirect estimates	Kadekodi & Ravindranath (1997)
Watershed Values (soil conservation)	Rs.2.0 lakh/hectare metre of soil	Lower Siwalikh (Yamuna Basin)	Indirect method (reduced cost of alternate technology)	Chopra & Kadekodi (1997)

Source : Manoharan (2000)

Manoharan (2000) has further suggested the following economic values of various kinds of forest-land in India, after accounting for selected tangible and intangible benefits.

S. No.	Nature of Forest land	Selected economic benefit	Value of annual flow of goods & services per hectare (Rs.)		Present value of goods & services per hectare (Rs.)	
			Mini.	Max.	Mini.	Max.
1.	Plantation/Single species forest (teak, sal forests, etc.) (Crown density < 40%)	Timber	2701	9270	33660	115525
2.	Multi-species plantation/open forests (Crown density 10-40%)	Timber + NTFP	3239	12227	40365	152375
3.	Dense forests (Crown density > 40%)	NTFP + Ecological functions + Carbon store	21287	322957	265283	4024758
4.	Protected Areas	Eco tourism + ecological functions + carbon store	21425	340444	267003	4242685

* At 5% rate for a period of 20 years.

Another study by IGIDR, Mumbai (1999) on Forest Resource Accounts of Maharashtra revealed that forests in India represent a huge resource in economic terms. If all direct benefits are accounted for, forest resources contribute around 2.9% to the adjusted Net Domestic Produce for the country as a whole.

A study by D.V. Singh (1996) attempted to work out the role played by forests in the livestock rearing, vegetable farming, fruit farming and food grain production in Himachal Prasdesh. The study revealed that number of livestock kept per household in hills is mainly determined by the available forest & grazing land in the area. Further, since 80% area of food grain crops is under dry land farming and are dependent heavily on natural resources in the form of direct rainwater & moisture circulation from forestlands. Forests contribute in enrichment of soil by way of fallen leaves & other composting material and also provide fencing material and wood for farm improvements. All these inputs constitute 19% of the total cost of food grain production.

A study by Madhu Verma (2000) examined the contribution of forests of Himachal Pradesh in sustaining livelihood of rural population, provisions for urban markets in local & external regions in terms of direct consumptive & non-consumptive benefits. Apart from direct consumptive benefits from growing various species of forest stock, value of the forest growing stock, salvage, timber drawn by right holders, fuelwood requirement, grasses & grazing, and minor forest produce. The study also accounted for direct non-consumptive & indirect benefits from Himachal Pradesh in terms of eco-tourism & recreation benefits, watershed benefits, micro-climatic factors, carbon sink, biodiversity, and employment generation through forestry works and suggested total economic value of forests of Himachal Pradesh at Rs.2.89 lakh per hectare. The economic value of forests of Himachal Pradesh is Rs.2.89 lakhs per hectare of goods/services in terms of total geographic area of forests, and Rs.7.43 lakhs per hectare of goods/services in terms of area under tree cover and scrub forest. The study suggested that the annual indirect benefits far exceed the direct benefits of forests which are just Rs.21,000 per hectare and Rs.53,000 per hectare respectively. Hence, if the GSDP of the state is corrected for total economic value, as calculated in the current study, the contribution of forestry sector increases from 5.26% of GSDP to 92.40% of GSDP.

It may be observed from these studies that there are large number of direct and indirect benefits of forests. Using different methods for valuation across regions, different estimates of economic values of tangible and intangible benefits are obtained. The variations in the estimates could be partly on account of methodology followed and the scope of the study. It is suggested that a comprehensive valuation of contribution from forests on the lines of the System of National Accounts.

7. Forests Resources in India

According to the State of Forest Report 2001, forests account for around 67 million hectares i.e. nearly 20.6% of the total land area in India. In addition, there is another 2.5% of land in the country under tree cover. Thus 23% of the

country is under forest and tree cover. Of the total forest cover, nearly 61.7% are categorised as dense forests. This can be seen from Table-1.

Table-1 : Forest Cover in Different States in India

(as % of geographical area)

	States/UTs	1987	1989	1997	1999	2001
1	Andhra Pradesh	18.2	17.4	15.7	16.1	16.2
2	Arunachal Pradesh	72.2	82.1	81.9	82.2	81.3
3	Assam	33.6	33.2	30.4	30.2	35.3
4	Bihar	16.5	15.5	15.3	15.2	16.3
5	Goa	34.7	35.1	33.8	33.8	56.6
6	Gujarat	6.9	6.0	6.4	6.6	7.7
7	Haryana	1.5	1.3	1.4	2.2	4.0
8	Himachal Pradesh	23.1	24.0	22.5	23.5	25.8
9	Jammu and Kashmir	9.4	9.2	9.2	9.2	9.6
10	Karnataka	16.8	16.7	16.9	16.9	19.3
11	Kerala	26.8	26.1	26.6	26.6	40.0
12	Madhya Pradesh	28.8	30.0	29.6	29.7	30.2
13	Maharashtra	15.4	14.3	15.0	15.2	15.4
14	Manipur	79.2	80.1	78.0	77.9	75.8
15	Meghalaya	73.6	70.0	69.8	69.7	69.5
16	Mizoram	90.6	86.2	89.1	87.0	83.0
17	Nagaland	86.6	86.6	85.8	85.4	80.5
18	Orissa	34.1	30.3	30.1	30.2	31.4
19	Punjab	1.5	2.3	2.8	2.8	4.8
20	Rajasthan	3.6	3.8	3.9	4.1	4.8
21	Sikkim	40.0	44.0	44.1	43.9	45.0
22	Tamil Nadu	14.1	13.6	13.1	13.1	16.5
23	Tripura	54.8	50.8	52.9	54.8	67.4
24	Uttar Pradesh	10.7	11.5	11.5	11.6	12.8
25	West Bengal	9.9	9.5	9.4	9.4	12.0
26	Andaman & Nicobar Is.	92.2	92.4	92.3	92.2	84.0
27	Chandigarh	1.8	7.0	6.1	6.1	7.9
28	Dadra & Nagar Haveli	48.3	41.8	41.5	41.1	44.6
29	Daman and Diu	*	1.8	2.7	2.7	5.4
30	Delhi	1.0	1.5	1.8	5.9	7.5
31	Lakshadweep	-	-	0.0	0.0	84.4
32	Pondicherry	1.6	-	0.0	0.0	7.3
	All India	19.5	19.5	19.3	19.4	20.6

Note: * Included in Goa

Source: State of Forests, Forest Research Institute, Various reports

Bulk of the forests in the country is located in the Western Himalayas, East Deccan, North Eastern region and the Western Ghats. The inter-state distribution of forests is quite skewed. Table-2 gives the state wise distribution of geographical area, forest cover including that of dense forests.

Table-2 : State Area as a Percentage of Country's Area

	States/UTs	Geographical	Forest	Dense Forset
1	Andhra Pradesh	8.368	6.608	6.196
2	Arunachal Pradesh	2.547	10.073	12.939
3	Assam	2.386	4.103	3.798
4	Bihar	2.860	0.850	0.810
5	Chhatisgarh	4.112	8.360	9.090
6	Goa	0.113	0.310	0.428
7	Gujarat	5.963	2.243	2.081
8	Haryana	1.345	0.260	0.273
9	Himachal Pradesh	1.694	2.126	2.502
10	Jammu and Kashmir	6.760	3.144	2.843
11	Jharkhand	2.421	3.350	2.830
12	Karnataka	5.834	5.476	6.275
13	Kerala	1.182	2.303	2.824
14	Madhya Pradesh	9.380	11.440	10.648
15	Maharashtra	9.360	7.029	7.412
16	Manipur	0.679	2.506	1.370
17	Meghalaya	0.682	2.307	1.363
18	Mizoram	0.641	2.590	2.144
19	Nagaland	0.504	1.975	1.294
20	Orissa	4.737	7.229	6.711
21	Punjab	1.532	0.360	0.372
22	Rajasthan	10.411	2.423	1.517
23	Sikkim	0.216	0.473	0.574
24	Tamil Nadu	3.956	3.180	2.999
25	Tripura	0.319	1.046	0.831
26	Uttar Pradesh	7.332	2.030	2.150
27	Uttaranchal	1.630	3.540	4.560
28	West Bengal	2.700	1.583	1.523
29	Andaman & Nicobar Is.	0.251	1.026	1.582
30	Chandigarh	0.003	0.001	0.001
31	Dadra & Nagar Haveli	0.015	0.032	0.036
32	Daman and Diu	0.003	0.001	0.000
33	Delhi	0.045	0.016	0.009
34	Lakshadweep	0.001	0.004	0.006
35	Pondicherry	0.015	0.005	0.008
	All India	100.000	100.000	100.000

Note: * Included in Goa

Source: Based on State of Forests 2001, Forest Research Institute

It may be observed that Madhya Pradesh accounts for the maximum forest cover, contributing nearly 11.4% of the total forest area in the country while 9.4% of the country's geographical area is in this state. Arunachal Pradesh and Kerala have 2.5% and 1.2% of the country's area while accounting for 10.1% and 2.3% respectively of the forest cover. On the other hand, states like Rajasthan, Punjab, Haryana, Bihar, UP and Gujarat put together account for 8.2% of the country's forests while covering 29.4% of geographical area. Nearly 62% of India's forests are categorized as dense forests, i.e. forests with canopy cover of over 40%. Again, Madhya Pradesh, Chattishgarh and Arunachal Pradesh account for nearly 1/3rd of the dense forests in the country.

The Tenth Five Year Plan has proposed raising the forest and tree cover for the country to 25% in 2007 and 33% by 2012. This would imply bringing additional area under forest and tree cover to the extent of over 14 million hectares by 2007 and another 26 million hectares by 2012. Thus, bringing the total area under forest and tree cover to about 108 million hectares will require concerted efforts for maintenance and expansion.

8. Wastelands for Expansion of Forest Cover

It has been suggested that there are vast stretches of wastelands which could be brought under forest and tree cover. According to the Wastelands Atlas of India prepared by the Ministry of Rural Development and the National Remote Sensing Agency, 6,38518 Sq. Km is under wastelands accounting for roughly one-fifth of the total geographical area in the city. The state-wise distribution of different categories of wastelands is at Annexure-1. It may be observed that nearly 31% of area is under scrubs land and another 22% is under degraded notified forestland. Some of these wastelands could possibly be utilised for bringing additional area under forestland. These include basically land with/without scrub, waterlogged/marshy land, saline/alkaline area, shifting cultivation areas, deg. Notified forest land, deg. Pastures/grazing land, deg. Land under plantation crop, and steep sloping area.

Areas under gullied/ravenous land, sands-inland/coastal, mining/industrial wastelands, barren rocky area and snow/glacial area accounting for nearly 30% of the wasteland cannot be converted easily. It is important that some of these wastelands should be preserved for ecological reasons and consequent bearing on the existing climatic implications.

9. Issues of Compensation

In order to achieve the earlier stated targets of forest cover during the next decade, certain incentives and/or compensation issues have been raised. Maintenance of forests involves a cost to the States, not only in terms of direct costs of manpower and associated infrastructure but also the opportunity cost of maintenance. The direct benefits (in terms of timber & non-timber products) are relatively less than the total cost incurred by states. At the same time, the vast indirect benefits are not restricted to the state alone, but these spillover to the entire region. The states that are required to maintain the forest and tree cover in excess of say, the national average, suggest compensation for provision of this externality.

Economic valuation of forests has been used as an important tool to determine the form and extent of compensation as it also assigns monetary values to non-marketed or non-timber forest produce. It indicates the total flow of benefits from a particular forest area using various direct and indirect methods of estimation, as seen in the previous section.

Based on the current and expected future economic importance of the non-timber benefits of the forest, need has been felt to attempt surrogates for developing an incentive structure or some form of compensation principles. Innovative mechanisms for inter-state financial transfers for environmental benefits are required.

The studies on valuation of forests in India are quite restrictive in terms of coverage. The estimates of value of benefits vary widely depending on the aspects considered and the specific area. Thus even though it is clear that there

are vast net benefits from forestry activities, there are institutional barriers to developing principles of compensation across states. Some states that have forests also have substantial non-forest wasteland areas. At the same time, it may not be feasible to convert forest areas to agricultural lands in certain hilly tracts. In some other states that have negligible forest cover, soil and climatic conditions barely support dryland farming and are not conducive to development of forest cover. The extent of benefit of carbon sequestration in the vicinity of the forests and the adjoining areas would be related to the kind of geographical area in terms of topography and direction of air current around the forest cover. The watershed value of forests and the river basin across adjoining states has to be seen in terms of the flow of water on a case by case basis. These aspects are essential to assess the forestry regulation and pricing policy.

The above paragraphs point towards the importance of forests in sustainable development. Such development has to have a human face too, i.e. it should be just and equitable. In particular, the needs of the poorer sections of the society will have to be taken care of, without degrading the environment. It is in this context, the issue of land utilization, particularly the arable land, wasteland and forest land becomes crucial. The per capita availability of arable land and geographical land was 0.139 and 0.320 hectares respectively during 2001. The state-wise position is given in Annexure-2.

Annexure-3 gives the estimated average value of output per hectare of selected crops at the All-India level. This gives an oblique suggestion on the amount of possible benefits from production of suitable crops in a region. The economic value of forests, as obtained from some of the studies examined in the previous section, seem to suggest that the direct and indirect benefits invariably exceed the average value of output in agriculture (as seen above). Some of these benefits, in fact, contribute to enhanced agricultural productivity. Converting forest land to agriculture land may not be a very sound proposition. This would, of course, vary from area to area and would be related to the cropping pattern. This position remains so even if one were to exclude the benefits on account of carbon-sequestration.

It is against this background that the issue of compensation to stakeholders in maintenance and enhancement of forest cover has gained ground. Laying down sound economic principles for compensation based on existing literature on the subject appear to be a difficult proposition at this stage. However, in view of the substantial positive externalities of the forests, it would be prudent to lend financial support for sustainable forest management. The various stakeholders in this context would primarily include local people, and concerned states, national Government and international institutions. It is important to take cognizance that amongst these agencies, the set of benefactors would be different from those who are bearing the cost. A proper identification procedure is essential while handling the issue of compensation principles at different levels.

The local people residing in the forest area play an important role in the preservation of forests. At present, these people have restricted property rights in the forest area and are only subjected to certain negative principles. It is suggested that giving these people some property rights and/or environmental service payments would encourage their involvement in the afforestation programme and also compensate them for any likely loss of income. Support could also be provided through a policy of benefit sharing, whereby a proportion of revenues from forestry activities like eco-tourism be earmarked for basic infrastructure, education, micro-enterprise development, etc. The principles for compensation to people would vary depending on the kind of forests, i.e. natural forests or man-made forests. The restrictions on use of timber and non-timber products from cultivated forests will have to be less stringent than the natural forests. Alternatively, providing support directly to Panchayati institutions could also ensure grass-root involvement. In any case if states are to be provided funds, these could be channelised either directly through some formula or else as a centrally sponsored scheme.

The scope for cross-support across states for the afforestation programme by states that are either co-benefactors or are constrained to undertake the programme needs to be decided. This would be akin to ‘tradable permits’. These permits allow for conservation and development of forest in designated areas in exchange for development rights on land outside the restricted area. Such

permits could be sold or exchanged freely in the market. All these complex issues would require further debate amongst stakeholders and the Government of India apart from global funding agencies associated with the forestry & environment concerns. The exact modus operandi for support, however, needs to be worked out given the database as available.

It is suggested that while incentive for forests should account for local/domestic benefits, wider benefits from forests particularly in terms of bio-diversity and climate change should be funded by agencies like the Global Environment Facility (GEF). It may be mentioned that a project entitled Ecomarkets has been funded by GEF in Costa Rica. The objective of the project is to increase the production of environmental services in Costa Rica by supporting the development of markets and private sector providers for services supplied by privately owned forests, including protection of biological diversity, greenhouse gas mitigation, and provision of hydrological services, foster biodiversity conservation and preserve important forest ecosystems through conservation easements on privately-owned lands outside of protected areas in the Mesoamerican Biological Corridor in Costa Rica. The expected benefits include additional 50,000 hectares of privately owned land incorporated into Costa Rica's conservation easement programme, establishment of a financial instrument to support the conservation easements, an increase in number of providers of environmental services and greater participation of local people particularly women.

10. Concluding Remarks

It may thus be seen from the study that while the importance of forests is well recognised, valuation of forest goods and services like carbon sequestration, watershed benefits and soil conservation, bio-diversity and other ecological functions has not been fully accounted for. Similarly, some of the costs incurred on development and maintenance of forestry sector have been ignored. Moreover, the economic policies are not geared to encourage forestry activity as say, in the case of agriculture sector, thereby increasing the opportunity cost of sustainable forestry management.

A holistic approach for valuation of forests is essential while examining the issue of compensation for expansion and maintenance of forest cover. In this context, there is need to first identify the set of people/institutions that bear the cost vis-à-vis the beneficiaries from forestry in order to develop an appropriate incentive mechanism for various stakeholders. At present there is scarce literature available on this and considerable amount of work is required. It is, however, evident that opportunity costs would vary according to the property rights assigned to different stakeholders. At the same time, the involvement of local people is of paramount importance. Since benefits from forestry are widespread, stakeholders that bear greater costs over benefits should be suitably compensated. Although, a number of incentive mechanisms have been discussed, the modus-operandi in the Indian context needs to be sorted out along with an appropriate regulatory framework.

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In order to provide incentive to states to preserve and raise the forest and tree cover, a simple criterion of distribution has been proposed. Essentially, the criteria is based on four parameters viz., (i) forest cover in 2001, (ii) potential wastelands available for conversion as in 2000, (iii) total geographical area (iv) the population of the state in 2001. It may be mentioned that due to different data sources, there is some aggregation problem; this has been ignored for the present study. An index was developed as follows:

If

F_i = forest and tree cover in state i

ΣF_i = total forest area in country

W_i = potentially convertible wasteland in state i

ΣW_i = total potentially convertible wasteland in country

G_i = geographical area in state

ΣG_i = total geographical area in country

P_i = population in state i

ΣP_i = total population in country

and taking

$f = F_i / \Sigma F_i$

$w = W_i / \Sigma W_i$

$g = G_i / \Sigma G_i$

$p = P_i / \Sigma P_i$

Based on the above, an index is proposed as :

$I_i = \{(f / g) * 0.5 + (w / g) * 0.25 + (p) * 0.25) \}$

This index is normalized to 100.

It may be seen that the extent of forest cover in each state has been given a higher weightage. It is expected that this index covering both existing and potentially cultivable forest cover would give an appropriate criteria for compensating states for raising forest and tree cover, while also giving cognizance to the population in each state. The compensation principle is based on the premise that the Central Government would primarily bear the cost of promotion of forest and tree cover and would be related to the extent of

expansion programmes in the states. The exact method for sharing of taxes/cess for maintaining the fund will need to be finalized in consultation with the stakeholders.

Annexure-1

STATE-WISE AND CATEGORY-WISE WASTELANDS OF INDIA

(percentage)

	States/UTs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Andhra Pradesh	0.108	3.172	0.162	0.094	0.002	3.483	0.111	0.008	0.073	0.015	0.814	0.061	0.000	8.105
2	Arunachal Pradesh	0.000	0.521	0.006	0.000	0.484	0.222	0.334	0.001	0.048	0.000	0.198	0.001	1.054	2.870
3	Assam	0.000	0.132	0.256	0.000	1.314	0.487	0.347	0.000	0.590	0.000	0.009	0.000	0.000	3.135
4	Bihar	0.088	0.735	0.188	0.000	0.007	2.046	0.026	0.012	0.035	0.029	0.108	0.015	0.000	3.288
5	Goa	0.000	0.046	0.006	0.000	0.000	0.011	0.000	0.005	0.000	0.017	0.009	0.001	0.000	0.096
6	Gujarat	0.159	3.412	0.416	1.196	0.000	0.852	0.061	0.012	0.030	0.008	0.516	0.076	0.000	6.738
7	Haryana	0.008	0.155	0.037	0.045	0.000	0.115	0.113	0.021	0.073	0.002	0.016	0.000	0.000	0.585
8	Himachal Pradesh	0.019	0.322	0.002	0.000	0.000	0.719	0.670	0.385	0.016	0.013	0.604	0.240	1.967	4.958
9	Jammu and Kashmir	0.003	0.704	0.039	0.000	0.000	0.390	0.042	0.100	0.136	0.000	5.140	0.264	3.431	10.249
10	Karnataka	0.047	1.423	0.005	0.020	0.000	1.300	0.015	0.016	0.007	0.012	0.412	0.006	0.000	3.264
11	Kerala	0.000	0.056	0.021	0.000	0.000	0.095	0.001	0.004	0.004	0.000	0.023	0.022	0.000	0.227
12	Madhya Pradesh	1.185	5.791	0.008	0.025	0.000	3.201	0.047	0.143	0.004	0.022	0.462	0.029	0.000	10.918
13	Maharashtra	0.266	4.916	0.083	0.039	0.000	2.103	0.211	0.108	0.012	0.016	0.405	0.218	0.000	8.377
14	Manipur	0.000	0.000	0.051	0.000	1.882	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.028
15	Meghalaya	0.000	0.656	0.002	0.000	0.327	0.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.551
16	Mizoram	0.000	0.000	0.000	0.000	0.589	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.638
17	Nagaland	0.000	0.250	0.000	0.000	0.818	0.248	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.316
18	Orissa	0.029	1.309	0.059	0.008	0.018	1.568	0.002	0.030	0.033	0.006	0.247	0.033	0.000	3.342
19	Punjab	0.026	0.053	0.055	0.027	0.000	0.055	0.018	0.013	0.097	0.004	0.000	0.000	0.000	0.349
20	Rajasthan	0.776	4.252	0.045	0.426	0.000	1.964	1.912	0.003	6.365	0.020	0.752	0.029	0.000	16.544
21	Sikkim	0.000	0.168	0.000	0.000	0.000	0.166	0.000	0.000	0.000	0.000	0.002	0.000	0.223	0.559
22	Tamil Nadu	0.035	1.206	0.065	0.388	0.000	1.509	0.026	0.035	0.093	0.019	0.181	0.047	0.000	3.604
23	Tripura	0.000	0.045	0.000	0.000	0.063	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200
24	Uttar Pradesh	0.440	0.861	0.780	0.910	0.000	0.523	0.070	0.008	0.074	0.005	0.185	0.155	2.062	6.072
25	West Bengal	0.027	0.195	0.303	0.021	0.000	0.122	0.060	0.000	0.138	0.007	0.020	0.003	0.000	0.896
	All India	3.219	30.385	2.595	3.207	5.504	22.028	4.069	0.913	7.834	0.196	10.115	1.199	8.737	100.000

1. Gullied/Ravinous land
2. Land with/without scrub
3. Waterlogged/Marshy land
4. Saline/alkaline area
5. Shifting Cultivation area
6. Deg. notified forest land
7. Deg. pastures/grazing land
8. Deg. Land under plantation crop
9. Sands-Inland/Coastal
10. Mining/Industrial wastelands
11. Barren Rocky area
12. Steep Sloping area
13. Snow/Glacial area
14. Total Wastelands
15. Total Geog. Area

Note : Data on wastelands in UT s and small states not available

Source: Wastelands Atlas of India 2000

Annexure-2

PER CAPITA AVAILABILITY OF LAND

Year - 2001

Sl. No.	States/UTs	Per Capita NSA (Hectares)	Per Capita Geog. Area (Hectares)
1	AP	0.1450	0.3632
2	Arun. Pr.	0.1696	7.6750
3	Assam	0.1014	0.2945
4	Bihar	0.0677	0.1584
5	Goa	0.1057	0.2754
6	Gujarat	0.1912	0.3874
7	Haryana	0.1721	0.2097
8	H P	0.0903	0.9161
9	J and K	0.0728	2.2069
10	Karnataka	0.1989	0.3637
11	Kerala	0.0710	0.1221
12	M P	0.2444	0.5462
13	Maha	0.1833	0.3180
14	Manipur	0.0586	0.9347
15	Meghalaya	0.0958	0.9726
16	Mizoram	0.1223	2.3658
17	Nagaland	0.1312	0.8337
18	Orissa	0.1648	0.4242
19	Punjab	0.1745	0.2073
20	Rajasthan	0.2846	0.6060
21	Sikkim	0.1758	1.3129
22	TN	0.0907	0.2094
23	Tripura	0.0868	0.3286
24	UP	0.1008	0.1687
25	WB	0.0678	0.1106
26	A&N	0.1067	2.3154
27	Chandigarh	0.0022	0.0127
28	D&N H	0.1043	0.2227
29	D&D	0.0253	0.0709
30	Delhi	0.0030	0.0108
31	Lakshadweep	0.0495	0.0528
32	Pondicherry	0.0257	0.0506
	All India	0.1388	0.3201

NSA : Net Sown Area

Source :Based on Agricultural Statistics at a Glance, 2002.

Annexure - 3

ESTIMATED VALUATION FROM AGRICULTURE

	AREA			PRODUCTION			YIELD			MINIMUM SUPPORT PRICE			ESTIMATED AVERAGE VALUE		
	(milllion hectares)			(milllion tonnes)			(Kg. / Hectare)			(Rs./quintal)			(Rs./Hectare)		
	1999-00	2000-01	2001-02	1999-00	2000-01	2001-02	1999-00	2000-01	2001-02	1999-00	2000-01	2001-02	1999-00	2000-01	2001-02
Rice	44.5	44.9	44.8	86.1	86.9	89.2	1935.7	1936.0	1991.0	448.3	480.0	510.0	8678.2	9292.8	10154.1
Wheat	27.2	26.9	26.4	71.3	72.4	72.6	2617.7	2692.0	2752.0	535.0	580.0	603.3	14004.5	15613.6	16603.7
Pulses	22.5	21.7	21.0	13.8	13.1	12.6	612.0	604.3	596.0						
Jowar	10.3	10.0	10.0	8.2	8.2	8.0	801.0	823.3	798.7	388.3	416.7	448.3	3110.6	3430.6	3580.7
Maize	6.3	6.4	6.5	11.1	11.6	12.3	1766.7	1803.7	1877.3	388.3	416.7	448.3	6860.6	7515.3	8416.7
Bajra	9.3	9.3	9.4	6.8	6.5	7.0	729.7	695.3	737.7	388.3	416.7	448.3	2833.5	2897.2	3307.2
Gram	7.4	6.6	5.8	6.0	5.3	4.7	815.7	793.3	814.0	908.3	1003.3	1105.0	7409.0	7959.8	8994.7
Tur	3.4	3.5	3.5	2.4	2.5	2.4	708.0	730.3	695.0	988.3	1088.3	1208.3	6997.4	7948.5	8397.9
Oil seeds *	25.5	24.4	23.3	22.2	21.3	20.0	871.0	869.0	858.7						
Groundnut	7.1	6.9	6.6	7.2	6.9	6.3	1006.7	985.7	956.0	1058.3	1138.3	1238.3	10653.9	11220.2	11838.5
Rapeseed & mustard	6.5	5.7	5.2	5.4	5.2	5.0	832.7	921.7	964.7	1013.3	1100.0	1200.0	8437.7	10138.3	11576.0
Sugarcane	4.1	4.2	4.3	289.2	294.7	298.5	70978.3	70170.7	69222.0	52.4	56.1	59.2	37204.5	39365.7	40991.0
Cotton @	9.0	8.8	8.8	11.6	11.1	10.4	219.0	213.0	201.3	1448.3	1546.7	1625.0	3171.9	3294.4	3271.7
Jute #	0.8	0.8	0.8	9.4	9.2	9.8	1952.7	1968.7	2068.3	683.3	728.3	781.7	13343.2	14338.5	16167.5
Mesta #	0.2	0.2	0.2	1.1	1.1	1.2	1005.7	1081.3	1122.6						

Source : Agricultural Statistics at a Glance, various issues.