Framework for forest resource accounting: factoring in the intangibles

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SUMMARY

Under-valuation of forest resources in India is causing immense losses to the sector and to the economic system. The current national accounting system under-records tangible benefits and ignores the contribution of intangible ecological services by forests. Thus, the values charged for diverting forest land for non-forestry purposes consider only the market value of, for example, timber and some non-timber forest products. The many ecological services also lost in use diversions have never been considered. It is also not really known how to put a value on such services, when a region is reforested. This paper is an attempt to develop a valuation and accounting framework for intangibles from forests, to reflect the true contribution of the forestry sector to the Indian economy. This framework would also help the forestry sector obtain its due share of budgetary allocations and encourage investment in the sustainable management of forests.

Keywords: ecological services, non-marketed values, accounting framework, forest capital, budget allocation.

Structure pour une comptabilité des ressources forestières: introduire les facteurs impondérables

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Une sous-valuation des ressources forestières en Inde est responsable de pertes immenses dans le secteur et dans le système économique. Le système national de comptabilité actuel fait diminuer les bénéfices tangibles et ignore la contribution des systèmes écologiques impondérables des forêts. Ainsi, les valeurs prélevées pour détourner la zone de forêt à des fins étrangères à la foresterie n'ont été décidées qu'en considérant la valeur de marché, ou, par exemple, de bois et de certains produits de la forêt autres que le bois. Les nombreux services écologiques également perdus dans les détournements d'usage n'ont jamais été considérés. Personne ne sait vraiment comment donner une valeur à ces services quand une région est reboisée. Cet article est un essai de développer une structure d'évaluation et de comptabilité pour les impondérables des forêts, pour refléter la véritable contribution du secteur de la foresterie dans l'économie indienne. Cette structure aiderait également le secteur de la foresterie à obtenir la part qui lui revient des allocations budgétaires, et encouragerait l'investissement dans la gestion durable des forêts.

Marco para la contabilidad en cuanto a los recursos forestales: inclusión de factores intangibles

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La subvaloración de los recursos forestales en la India está causando pérdidas enormes para el sector y para el sistema económico en general. El actual sistema nacional de contabilidad no da importancia suficiente a los beneficios tangibles y hace caso omiso de la aportación de servicios intangibles por parte de los bosques. Por eso los valores cobrados por la conversión de tierras forestales a usos no forestales toman en cuenta , por ejemplo, solamente el valor de mercado de la madera y de algunos productos forestales no madereros. Nunca se han tomado en cuenta los múltiples servicios ecológicos que se pierden en este tipo de cambio del uso de la tierra, ni tampoco se sabe realmente valorar estos servicios a la hora de la reforestación de una zona. Este estudio constituye un intento de desarrollar un marco conceptual para la valoración y contabilidad en cuanto a los intangibles forestales, para así reflejar la verdadera contribución del sector forestal a la economía india. Este marco ayudaría también al sector forestal a obtener su parte debida de las asignaciones presupuestarias y a fomentar la inversión en el manejo forestal sostenible.

INTRODUCTION

Forests and their linkages

Forests play a vital role in the social, cultural, historical, economic and industrial development of any country and in maintaining its ecological balance. They are the resource base for the sustenance of its population and the repository of biodiversity. Forests are one of the most important

components of the terrestrial environmental system and a complete resource base. Through their vast array of ecosystem services, they provide various goods like timber, fuelwood, pulpwood, fodder and fibre grass and non-wood forest produce. They also support industrial and commercial activities and provide a large number of ecological services, for instance, humus production, maintaining of soil quality, the moisture regime, the ecological balance and the life-support systems essential for food production, health and clean air production. Indeed, forests support the development of all humankind.

Forests exercise control over the wealth of adjoining land use systems, such as agriculture and animal husbandry, and also the wealth of urban areas. Forests have very high resource interconnections in developing countries, and the dynamics of an economic system is heavily dependent on the existence or non-existence of forests. As tree cover is reduced, so the soil loses wind shelter; water runoff increases in the absence of rehabilitation. Both affect soil fertility and land productivity (Pearce and Turner 1990). The immediate impact of forest degradation is loss of forest cover, loss of timber and fuelwood, fodder and non-timber forest produce, but over time there is actually an immense loss in terms of ecological services like watershed benefits, carbon sequestration, ecotourism, biodiversity benefits, which are felt more by far in the communities and regions. Degraded forests result into impoverished agriculture and horticulture and, in turn, trigger migration of dependent communities to urban areas where they end up in low-paid, unsecured, informal-sector jobs. Lack of availability of fodder in such degraded forests also reduces the productivity of the livestock population and forces transboundary movements.

Forest is the second-largest land-based resource after agriculture with the potential to reduce poverty in India; it supports the poor, and has helped them to meet their basic requirements over the long and chequered history of the country. If managed properly, forests can play a very important role in addressing the Millennium Development Goals (MDGs)[1]. Empirical evidence is available in India to the effect that the household incomes of marginalised communities owe more to the forests than to their privately owned property. Furthermore, the common property resources of forest are also used to transform the private property resources of communities and provide a larger array of outputs of various kinds, like forest grounds for private livestock, biomass, fuelwood for energy and farm needs, leaves and mud for housing, etc.

The Millennium Ecosystem Assessment (MEA)[2], carried out between 2001 and 2005, was an effort to report on the health of various ecosystems of the world. It also demonstrated the dependence of the human population on forests and other ecosystems for their multiple needs. It identified provisioning, regulating, cultural and supporting services as the four major services that the ecosystems provide to human beings for their livelihood security; it placed human well-being as the central focus for assessment and stressed the need for a detailed analysis of the full costs, risks, and benefits of forests (Millennium Ecosystem Assessment, 2005). The four categories of ecosystem services pertaining to the forest that are addressed in the assessment are shown in *Table 1*.

The MEA provides the first comprehensive assessment of the planet's ecosystems. The assessment mentions that about 60 percent of the ecosystem services examined are being degraded or used in ways that cannot be sustained. It further states that what may appear to be a net gain shows up as a debit where the service has been exploited elsewhere. It shows the linkages between changes in the quality of ecosystem services and human health, economies and

TABLE 1 *Forest ecosystem services*

Provisioning	**Regulating**	**Cultural**
Firewood, pulpwood, fodder, timber, non-edible oils, medicines, fibres and flosses, resins, lac, tendu and other leaves, bamboos and canes, raw materials for clothing etc. raw materials for manufacturing, etc. and construction, biochemicals, water habitat (indigenous people and wildlife), recreation	Soil conservation, protection and regulation of water supplies, amelioration of climate, sediment control, shelter from hot and cold winds, absorption of dust and noise, maintenance of genetic pool, maintenance of visual quality of the environment, maintenance of carbon dioxide balance in the atmosphere.	Aesthetic, artistic spiritual, historic, scientific, educational, inspirational, symbolic
Supporting nutrient cycling, soil formation, primary production		

[1] The Millennium Development Goals (MDGs), set in the year 2000, are the world's time-bound and quantified targets for addressing extreme poverty in its many dimensions: income poverty, hunger, disease, lack of adequate shelter, and exclusion, while promoting gender equality, education, and environmental sustainability. They are also basic human rights: the rights of each person on the planet to health, education, shelter, and security.

[2] Millennium Ecosystem Assessment (MEA) 2005. The largest assessment ever undertaken of the health of ecosystems which was done by 1 360 experts from 95 countries. The MEA has the consensus of the world's scientists and was designed to meet the needs of decision makers in government, business, civil society, and is based on goods and services and their sustainability.

security systems. It substantiates the need for identifying and valuing ecosystem services, as understanding the full range of values should create better-informed policy. It takes note of the fact that although humans protect what they value most, they have failed to value and protect the services of nature because these have been viewed as free and limitless; it thus provides a framework for understanding and valuing ecosystem services.

Importance of forests as natural capital

Traditionally, most of the natural resources are taken as "free gifts of nature". Though people are aware of their uses but not their value, resources have not only been used but overused, misused and finally abused. This fact was highlighted in the very first attempt to calculate a global value for natural resources, when a team of researchers from the United States, Argentina, and the Netherlands led by Robert Costanza, put an average price tag of US$33 trillion a year on these fundamental services from various ecosystems. (Costanza 1997). The neoclassical economists introduced the term "natural capital" alongside "man-made capital" and, in assessing the value of resources, recognised the changes in natural capital such as depletion, degradation or regeneration that occur as a result of human interference. Whereas man-made capital has established markets and thus the values generated by them enter into the accounting system of the country, most of the goods and services provided by forests do not have markets and thus do not find a place there. In the current scenario the tangible values are under-estimated and the intangibles are completely ignored by the prevalent accounting system. Therefore it becomes necessary to reflect the true contribution of forests in a country's accounting system by incorporating its total economic value such that the sector receives due credit in the planning and decision-making process and an appropriate budgetary allocation is established for its sustainable management.

CONTRIBUTION OF FORESTS TO THE GDP OF INDIA

Contribution of forestry sector to the national income

Despite making a considerable contribution to India's economic and ecological systems, the forests of the country receive no recognition of their contribution to the national income (GNP) of the country. The present system of national accounts (SNA) is primarily focused on growth rates of gross domestic product (GDP) which has for a long time been the key indicator for macro-economic policymaking, although it fails to capture several important elements of natural wealth, both qualitatively and quantitatively. The value of forest reflected in the SNA represents less than 10 percent of its real value. In 2002–2003, forests contributed US$6 000 million to India's GDP at current prices, which was 1.2 percent of the GDP. The contribution of forest to India's GDP has varied from 1–1.5 percent over the nine–year period from 1993–1994 to 2002–2003. Similarly, the contribution of forestry and logging to India's net domestic product (NDP) varied from 1.6 to 1.3 percent during the same period (CSO 2006).

Non-recording of intangibles in the current accounting framework

Because of the absence of any framework for estimating the intangible values of forests, the present system of income accounting in the forestry sector takes note only of contributions such as industrial wood, fuelwood and minor forest products. Recorded removals are accounted for, which are a very small portion of actual removals; however, no valuation and accounting is carried out for unrecorded tangible values and the whole stream of intangible values (i.e., ecological services from forests). In India, forests meet nearly 40 percent of the energy needs of the country, of which more than 80 percent is utilised in the rural areas and about 30 percent of fodder needs of the cattle population; they provide a large number of ecological and environmental services but do not find any place in the current system of national accounting. The current system of recording of NDP from the forestry sector which incorporates only the marketed benefits is shown in value terms in *Table 2*.

TABLE 2 *Net domestic product from forestry and logging at market prices (in million US$*)*

1999–00	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	Item
4 976	5 111	5 267	5 303	5 241	5 324	5 412	1. Value of output
454	451	619	549	394	387	384	1.1 Industrial wood
4 009	4 178	4 184	4 298	4 413	4 448	4 542	1.2 Firewood
513	482	464	456	434	489	486	1.3 Minor forest products
498	511	527	530	524	532	541	2. Less: repair maintenance and other operational costs
4 478	4 600	4 740	4 773	4 717	4 792	4 871	Gross domestic product
178	177	183	187	195	200	205	Less: consumption of fixed capital
4 300	4 423	4 557	4 586	4 522	4 592	4 666	Net domestic product

*Note: 1US$ = ~40 INR
Source: CSO (2006)

FACTORING INTANGIBLES INTO THE SYSTEM OF NATIONAL ACCOUNTS

Unrecorded values of forests

There is a lack of understanding of the true role of forests in the well-being of the people; forest lands have become degraded because of overuse and mismanagement; investment in the sector has not kept pace with the removals, and the resources of the forestry sector are often put to non-productive uses. Meanwhile, investment in man-made and financial capital is on the rise, while the forestry sector, because of a lack of appreciation of its true and total value, has always been less appreciated and has thus received less budgetary allocation and investment. Low investment in the sector is clearly manifested by its low annual growth compared with other sectors of the economy.

Similarly, the value charged for converting forest land for non-forestry purposes takes into account only the market value of items like timber and non-timber. The whole array of ecological services—the positive externalities that are lost on account of conversion—have not been considered. These externalities represent the economic impacts that occur when those who take the decision to fell trees or change land use do not bear all the costs of their action. When a piece of forest land is ploughed, for example, the conversion makes sense to the land owner, but it also damages fisheries downstream, increases flooding and chokes rivers and dams with sediment, so creating costs for others. Moreover, such actions actually reduce, rather than add to, a country's total wealth. The loss of a forest is fundamentally economic in nature. It is for that reason that conservation needs to be addressed in economic terms. For forests to be conserved, they need to be perceived as being more valuable than the usual, standard utilities they provide; if all such direct and indirect contributions from Indian forests are quantified, the standing forests of India would be worth US$1 480 000 million. The value was projected for the entire forest area of the India based on the per hectare total economic value estimated by the author for the state of Himachal Pradesh (HP), India.

As a matter of fact, the current system of national economic accounts does not sufficiently account for the tangible benefits either. There has been a complete non-recording of intangible benefits, non-recording of illegal removal of forest produce, insufficient recording of authorised removals from the forests and insufficient recording of losses in the forests. Above all, there is no system of flow and stock accounting. To reflect the true contribution of the forest to Indian national income, such that proper budget allocation can be made in relation to its contribution, it is imperative to value such contributions and to set up an integrated system of economic and environmental accounting of the forests of India.

Recent policy directions for factoring in the intangibles

The recent national environment policy (NEP 2006), the first umbrella policy for various natural resources, relates to current perceptions of key environmental challenges like conservation of critical environmental resources and enhancing of resources for environmental conservation. The policy recommends the use of economic principles in environmental decision making. It states that "it is necessary that the costs associated with the degradation and depletion of natural resources be incorporated into the decisions of economic actors at various levels, to reverse the tendency to treat these resources as 'free goods' and to pass the costs of degradation to other sections of society, or to future generations of the country". Thus to correct the situation, the NEP recommends the following actions:

a) Strengthen, including through capacity building, the initiatives taken by the Central Statistical Organisation in the area of natural resource accounting, with a view to their adoption in the system of national income accounts. Further strengthen in all respects, the system of collection, collation and analysis of all significant and relevant environmental monitoring data.
b) Develop and promote the use of standardised environmental accounting practices and norms in the preparation of statutory financial statements for large industrial enterprises, in order to encourage greater environmental responsibility in investment decision making, management practices, and public scrutiny.
c) Facilitate the integration of environmental values into cost-benefit analysis, to encourage more efficient allocation of resources when making public investment decisions.

SYSTEM OF ENVIRONMENTAL AND ECONOMIC ACCOUNTING (SEEA)

Basic framework of SEEA

To reflect the true value of forests to the nation's national income, it is imperative to conduct natural resource accounting (NRA) in India. NRA is a revaluation of the national income accounts of a country, adjusting for the values of natural resources used in various economic activities during the past "fiscal year". The changes in both "stock" and "flow" of forests need to be accounted for. There are three alternative methods to NRA, namely, (i) SEEA (i.e., satellite system for environmental accounting) and (ii) input–output-based SEEA proposed by the UN Statistics Division (UNSTAT) and (iii) to account for depletion of natural resources using either the user cost method or depreciation or net price method.

In the satellite system for environmental accounting (*Figure 1*) the satellite accounts (of which physical accounts are one example) are linked to the SNA, but do not change either the calculation of key indicators or the central framework of the accounts. The advantage of satellite accounts is that they allow the accountants to violate some of the conventions of the SNA in ways quite useful for environmental data, without threatening the consistency of the information in the conventional accounts. However, these accounts do not change GNP or GDP, and as such do not correct the distortions inherent in those indicators.

In the alternate method of SEEA which is based on the input-output model the net national product *is* arrived at by the summing (Σ) value of consumption of normal goods and services + value of production of nature collected (such

as fuelwood, biomass) + value of environmental amenities provided by environmental resource stocks (such as clean air, top soil) + value of leisure enjoyed (say, aesthetic beauty of wildlife reserve) + value of net additions to production capital (natural growth) + value of net additions to natural capital stocks (such as plantations in forests, or depletion of exhaustible resource) + value of additions to stock of defensive capital (such as water purifier).

Using the forest-economy linkages and interactions, and defining forest-related production in the context of the output in the rest of the economy, Vincent (1999) defines the adjustments required to be made in NDP, conventional GDP and in the level of GDP. Vincent (1999) suggests the following adjustments in the conventional system of national accounts: adjusted NDP = conventional GDP + non-market values to be added to GDP - depreciation of human-made capital + net accumulation of natural capital. He mentions further that the consensus at the international level is that "complete accounting of forest related economic benefits may turn out to be impossible in any single country. Making the adjustments every year might turn out to be impossible too". Thus "a pragmatic recommendation is to orient the accounting effort towards those values of forests that are of obvious economic significance now and are likely to remain so in the future and to prepare adjusted national accounts as a special product every few years". He recommends upward adjustment for the household consumption of non-market, non-timber products and forest amenities and no adjustments for the production externalities (e.g., hydrological services to agriculture) which imply reallocation of sectoral value added within GDP.

Stock and flow framework

To incorporate the stocks and flows, the system of forest resource accounting (FRA) proposed by (Zhi X. *et al.* 1994) presents a holistic framework of FRA comprising:

(i) **Actual capacity accounts**, which measure the current flow of goods and services from the forest ecosystem to the economy, like timber products, non-timber products, mineral, water, forage, wildlife and fish, recreation and environmental services, etc. This flow can be assessed by the construction of asset accounts—both physical and monetary asset accounts.

(ii) **Potential capacity accounts,** which record the various ecosystem features like plants/flora, animal, land and soul, water, air and climate, ecosystem processes, ecosystem integrity, etc. These determine both the actual capacity and potential flow of benefits of those features, based on various ecosystem quality indices.

(iii) **Linkage accounts**, which try to link together the actual capacity accounts and potential capacity accounts, and consist of estimates of the costs of the various ecological imperatives required to maintain some ecological indicators at a specified level or to avoid losses in the flow of future goods and services (potential benefits). The linkage between these three accounts is depicted in *Figure 2*.

Components of FRA

According to the UN Division of Statistics (UNSD 2003), forest resource accounting may be defined as a process of identifying and measuring various benefits and costs of forest, putting value tags on them, and recording them in appropriate sets of accounts/statements. It comprises both physical and monetary accounts and their integration with national accounts, as follows:

(a) **Physical accounts** of forest stocks, flows, changes in stocks and factor affecting changes in stocks. The basic structure of these accounts is illustrated in *Table 3*. The physical accounts framework adopted for constructing

FIGURE 1 Satellite system of integrated environmental and economic accounting (SEEA 1993)

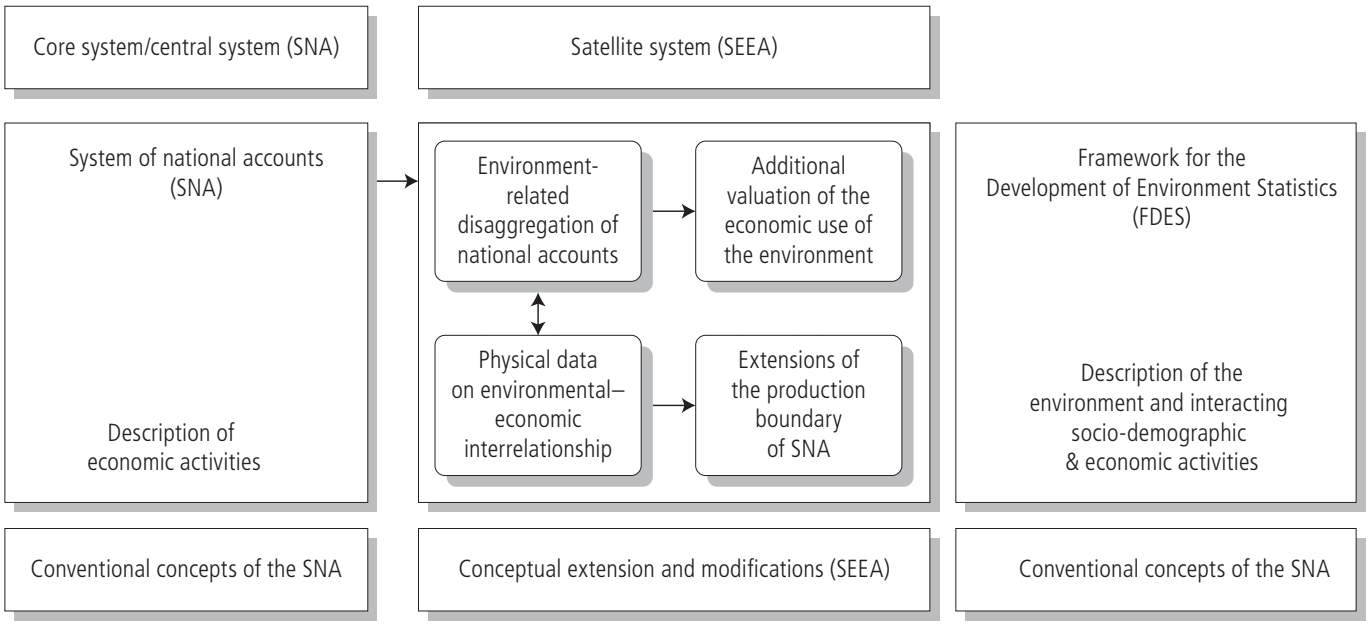
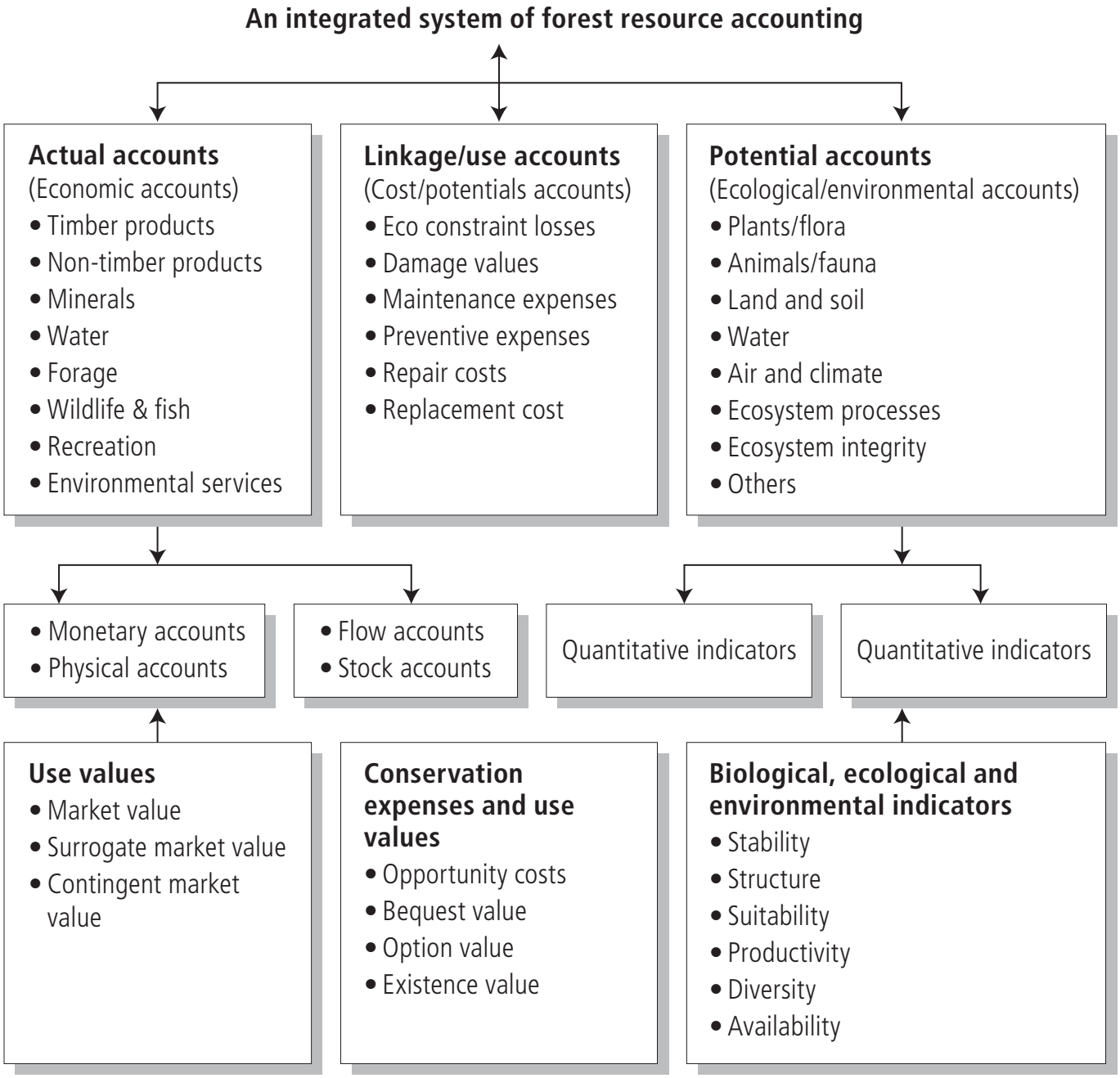


FIGURE 2 *An integrated system of forest resource accounting*



the volume and area accounts in physical terms is as follows:

1. Opening stocks
2. Changes due to economic activity (-)(net of deletions and afforestation)
3. Net other volume changes (net of additions and reductions)
4. Other accumulations (encroachment and transfer of and to other activities)
5. Net volume changes (5=2+3+4)

(b) **Monetary accounts** depict the monetary values of changes in stocks and flows. To be comparative with the standard measures of economic performance, physical accounts need to be converted into monetary accounts through valuation of physical accounts. The entries correspond to the physical accounts but contain an additional entry for revaluation, which records the change in asset value due to changes in prices between the beginning and end of the period. The national accounts data are mainly based on market prices, while most non-market valuation techniques include the consumer surplus, mainly used for valuation of non-timber forest products utilised directly by the households after being collected/processed. Ideally, forest accounts would identify three components of the forest goods and services:

- The output or production value;
- The value added part or added value; and
- And the in situ value of a resource.

TABLE 3 *Components of the forest resource accounts*

1: Asset accounts: (two components) i) **Wooded land**: land area and economic value of land by main species, natural and cultivated forest land, available for wood supply/not available, etc. ii) **Standing timber**: volume and monetary value of the main spp., natural and planted forest land, available for wood supply or not available, etc. Depletion and depreciation of standing timber.
2: **Flow accounts**: forest goods and services(volume and economic value) i) **Forestry and logging products**: market and non market production ii) **Non timber products**: output of game, edible plants, medicinal plants, etc. iii) **Forest ecosystem services**: direct intermediate inputs to other sectors, e.g. Livestock grazing Recreation and tourism Carbon sequestration Protective services: Biodiversity and habitat preservation iv) **Supply and use tables for wood products, forestry and related industries** v) **Degradation of forests** due to forestry and non-forestry activities. vi) **Environmental degradation** caused by forest-related activities
3: **Expenditure on forests management and protection** i) Government expenditures ii) Private sector expenditures
4: **Macroeconomic aggregates** i) Value of forest depletion and degradation ii) Measures of national wealth, national savings and net domestic product adjusted for forest depletion/accumulation.
5. **Memorandum items**: i) Employment, income, exports from non-timber goods and services ii) Number of household dependent on NTFP. iii) Rights and concessions of forest exploitation iv) Stumpage fees and other taxes/subsidies for forestry and related industries v) Manufactured assets like roads. Buildings and equipment for forestry, logging. vi) Tourism and other uses of forestry.

Outcome of FRA system

At the end of the process of forest resource accounting system the following are the major outputs:

- Physical asset accounts - commercial working;
- Physical asset accounts - volume and area;
- Monetary asset accounts - volume and area;
- Flow accounts - goods and services;
- Degradation and depletion account - physical and monetary;
- Expenditure for forestry management and protection; and
- Accounting matrix for ecological services/amenities.

PROPOSED METHODOLOGY TO ESTIMATE TOTAL ECONOMIC VALUE OF INDIA'S FORESTS, INCLUDING INTANGIBLES

Many valuable ecosystem services, as mentioned above, are finally gaining some attention. Today, governments, companies and citizens are increasingly recognising the value of the wide range of services our forest ecosystems provide (Jenkins 2002). A number of independent studies have been done using various techniques to estimate various economic values of forests, and these have greatly helped in bringing environmental considerations into economic planning. The following section provides the proposed framework based on the methodology developed and data generated in the natural resource accounting project for the Central Statistical Organisation at the Indian Institute of Forest Management by Verma *et al.* (2006a) for annual values from forests; the probable cost estimates were provided through the report entitled, *Estimating the economic value of forest land: A methodology* (Verma 2006b)[3] to the Institute of Economic Growth, Delhi, for the Ministry of Environment and Forests, Government of India–sponsored project in 2006 on estimating the economic value of forests. The values generated through examples from the state of Himachal Pradesh have been incorporated in the integrated system of forest resource accounting which is presented in the next section.

[3] The study responded to the following terms of reference: (i) To identify the definite parameters on the basis of which categories of values of forest should be estimated; (ii) To formulate a practical approach/ methodology to different forest zones of India; (iii) To illustratively apply this methodology; (iv) To determine on the basis of established principle who should pay the cost with respect to which category of values and to whom.

Estimation of annual benefits and costs[4]

1. ***Timber logging, TDR***[5]***/Nistar***[6] *and salvage*
   For annual benefit: long-run stumpage value approach or stumpage price of mature timber and salvaged timber
   For annual cost: costs of production (departmental), extraction and transport
2. ***Fuelwood***
   For annual benefit: total value of fuel wood collected in a normal year = number of rural households collecting fuelwood from forest in last 365 days × average value of collection per collecting household (the value to be used is the relevant price in the nearest local market).
   Annual cost: cost of collecting fuelwood = (number of rural households) × (total annual time cost of collection per household valued at 15 percent of average agricultural wage rate).
3. ***Fodder and grazing***
   Fodder
   For annual benefit: total value of fodder collected in a normal year = number of rural households collecting x fodder from forest in last 365 days × average value of collection per collecting household (the value to be used is the relevant price in the nearest local market).
   Annual cost: cost of collecting fodder = (number of rural households) × (total annual time cost of collection per household valued at 15 percent of average agricultural wage rate).
   Grazing
   For annual benefit: total number of livestock grazing in state forest × total fodder receipt
   For annual cost: management cost
4. ***Non-timber forest products (including grasses)***
   Extraction method
   For annual benefit: per hectare value of NTFP collected in each circle —value of NTFP in each circle/net forest area in each circle. Value of NTFP in each circle = value of NTFP collected in a normal year per household × number of rural households (value to be used is the relevant price in the nearest local market) or cost function to get actual market value of medicinal herbs based on the royalty or permit value collected.
   For annual cost: cost of collecting NTFP = (number of rural households) × (total annual time cost of collection per household valued at 15 percent of average agricultural wage rate).
   Consumption method
   For annual benefit: household survey using village input–output model
   For annual cost: wage rate for labour inputs
5. ***Carbon Sequestration***
   For annual benefit: value of carbon stock = carbon content × market rate of carbon. Where carbon content = biomass × IPCC-GPG[7] default value (2003 guidelines).
   Biomass = growing stock × conversion factor
   Calculation of living biomass with general formulas and conversion factors. As no specific biomass functions were available, the following general formulas were used for calculating biomass from growing stock figures:

→ SB = GS × WD (1)
→ AGB = SB × BEF (2)
→ BGB = AGB × R (3)

where

→ SB = stem biomass (tonnes)
→ GS = growing stock (volume) overbark (m^3)
→ WD = wood density (dry weight/green volume expressed in tonnes/m^3)
→ AGB = above-ground biomass (tonnes)
→ BGB = below-ground biomass (tonnes)
→ BEF = biomass expansion factor (above-ground biomass/stem biomass)
→ R = root–shoot ratio (below-ground biomass/above-ground biomass)

   For annual cost: no direct costs.
   The vale of the carbon sticks can be calculated as per the following process:
   Value of carbon stocks = carbon stocks × market rate for carbon dioxide.
   For estimating the value of carbon stock in monetary terms, the price of certified emission reduction (CER) (i.e., US$6 per tonne of carbon) has been used (one CER = one tonne of carbon dioxide).
6. ***Ecotourism/landscape beauty***
   For annual benefit: per hectare value of eco-tourism in the forest management unit = total value of eco-tourism in each forest management unit/net forest area in each forest management unit.
   Value of eco-tourism dependent on forest ecosystems = number of people visiting different circles per year mainly because of their natural beauty × average expenditure incurred per person
   For annual cost: costs incurred by the forest department in the maintenance, preservation and development of national parks and wildlife sanctuaries. The per hectare costs were calculated to arrive at costs for each circle.
7. ***Watershed function: soil building, nutrient movement, hydrological and climate regulations, floodplain benefits***
   For annual benefit: value per hectare for specific watershed function based on site-specific secondary studies.
   For annual cost: as per site-specific secondary studies
8. ***Biodiversity/bioprospecting***

(i) Actual value approach

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[4] The value for fodder, fuelwood and NTFP are based on the report of the NSSO 54th-round survey on common property resources in India
[5] TDR, transfer of development rights
[6] *Nistar* rights, the traditional right of the people of the area to procure commodities necessary for living from the surrounding area and forests
[7] IPCC-GPG, Intergovernmental Panel on Climate Change, good practice guidance

For annual benefit: potential value of drugs that can be obtained from the bio-diversity present in forests
For annual cost: cost of collection

(ii) Option value approach

For annual benefit: insurance premium paid to ensure the supply of an asset, the availability of which otherwise would be uncertain
For annual cost: R&D costs

ILLUSTRATION OF INTEGRATED SYSTEM OF FOREST RESOURCE ACCOUNTING (FRA) IN HIMACHAL PRADESH STATE OF INDIA

FRA of state of HP as developed under Central Statistical Office (CSO) project executed by the Indian Institute of Forest Management (IIFM) (2003–2005)

Asset accounts

Based on the United Nations system of environmental-economic accounting (SEEA) framework, the asset accounts of forest resources of Himachal Pradesh in physical terms for the year 2001–2002 have been developed in *Table 4* and the corresponding monetary value account which records the change in asset value due to changes in prices between the beginning and end of the period are given in *Table 5*.

Flow accounts

The values of annual flows like timber, fuel wood, fodder and NTFPs have been measured using the above mentioned methodology which also values products extracted for self-consumption. The estimated values are provided in the following section.

Environmental services account

These accounts depict the direct intermediate inputs to other sectors like livestock grazing, recreation and tourism, carbon sequestration, watershed protection services and biodiversity and habitat preservation. This section exemplifies construction of carbon sequestration accounts from the state of Himachal Pradesh based on the methodologies developed in the IIFM–CSO project (*Table 6*).

Estimating total economic value of forests of India—the case of the forests of Himachal Pradesh

Having estimated the tangible and intangible and direct and indirect values from the forests of Himachal Pradesh, per hectare values have been calculated from the 2001–2002

TABLE 4 *Asset accounts of different categories of forests in Himachal Pradesh 2001–2002 (volume in '000 m^3)*

Activity/Forest types	Pine	Deodar	Fir/spruce	Other species	Total
(1) Opening stocks [standing volume]	89 232.40	54 225.70	137 889.10	58 073.80	339 421.00
(2) Changes due to economic activity (–)					
Depletion (--)	488.77	297.055	755.32	318.11	1 859.27
Timber Logging/harvest	97.70	59.40	151.00	63.60	371.70
Fuelwood extraction	370.56	225.18	572.61	241.16	1 409.52
Illegal logging	9.77	5.94	15.10	6.36	37.17
Logging damage	10.74	6.53	16.61	6.99	40.88
Afforestation (+)	21.18	10.30	21.82	13.78	67.08
Net changes (net of depletion and afforestation)	-467.59	-286.75	-733.50	-304.33	-1 792.19
(3) Other volume changes					
Additions (+)					
Natural growth (Mean annual increment)	1 487.20	723.00	1 532.10	967.89	4 710.19
Regeneration	1.89	0.91	1.95	1.23	5.99
Total	+1 489.09	+723.91	+1 534.05	+969.12	+4 716.18
Reductions (--)					
Forest fires	2.71	1.32	2.79	1.76	8.57
Stand mortality/insects and other diseases	00	00	00	00	00
Animal grazing	118.61	57.11	122.37	77.19	375.91
Total	121.32	58.42	125.16	78.95	384.48
Net volume changes (net of additions and reductions)	+1 367.32	+665.49	+1 408.89	890.17	+4 331.70
(4) Other accumulations (–)					
Encroachment on forest land	3.21	1.95	4.96	2.09	12.22
Transfer of land to other activities	4.10	2.49	6.34	2.67	15.61
(5) Net volume change (5=2+3+4)	+892.42	+374.30	+664.09	+581.08	+2 511.68
(6) Closing Stocks (6=1+5)	90 124.82	54 599.30	138 553.19	58 654.88	341 932.68

TABLE 5 *Volume (monetary accounts) of different categories of forests in Himachal Pradesh 2001–2002 (in million US$*)*

Activity/forest types	Pine	Deodar	Fir/spruce	Other species	Total
(1) Opening stocks [standing volume]	2 051.00	3 350.00	994.80	419.00	6 815.90
(2) Changes due to economic activity(--)					
Depletion (--)	11.00	17.90	53.25	2.24	36.51
Timber Logging/harvest	89.80	3.65	1.08	0.46	7.46
Fuelwood extraction	8.50	13.91	4.13	1.74	28.30
Illegal logging	0.20	0.36	0.10	0.45	0.74
Logging damage					
Afforestation (+)	19.50	0.635	0.16	0.09	1.38
Net changes (net of depletion and afforestation)	-10.50	-17.31	-5.17	-2.10	-351.35
(3) Other volume changes					
Additions (+)					
Natural growth (mean annual increment)	34.17	44.73	110.50	6.98	96.90
Regeneration	0.04	0.05	0.01	0.008	0.12
Total	34.22	44.73	11.06	6.99	97.00
Reductions (--)					
Forest fires	0.06	0.08	0.02	6.99	0.17
Stand mortality/insects and other diseases	0.00	0.00	0.00	0.00	
Animal grazing	2.72	3.52	0.88	0.55	7.69
Total	2.78	3.60	0.90	0.56	7.87
Net volume changes (net of additions and reductions)	31.45	41.10	10.16	6.42	89.15
(4) Other accumulations (--)					
Encroachment on forest land	0.07	0.12	0.35	0.01	0.24
Transfer of land to other activities	0.09	0.15	0.04	0.01	0.31
Net Value change (5=2+3+4)	20.70	23.53	4.91	4.24	53.45
(6) Closing Stocks (6=1+5)	2 072.14	3 374.20	999.77	423.20	6 869.45

*Note: 1US$ = ~40 INR

accounting year and show a marked difference from the department's currently recorded values (*Table 7*).

It is also useful to mention in this regard a pioneering study on forest resource accounting for the state of Himachal Pradesh carried out by the author, which shows that the estimated total economic value of HP state to be 2.61 times the value of the growing stock, 980 times the total expenditure incurred in the forestry sector of Himachal Pradesh and 2 607 times the revenue realised by forests annually. This comparison proved to be a gross underestimation of forestry sector's contribution to the economy of the state. When the gross state domestic product (GSDP) of HP is corrected for total economic value calculated through the current study, the contribution of forestry sector increased from 5.26 percent to 92.40 percent of GSDP. Using the per hectare values from the study, the state of HP issued a notification in August 2002 of the imposition of an environmental levy on user agencies to compensate for the loss of environmental values when forest lands are diverted for non-forest use. This one-time levy was fixed at US$200 000 per ha where forest density is above 10 percent, and US$125 000 per hectare for other forest areas where density is less than 10 percent. This levy was in addition to the compensatory afforestation and cost of catchment area treatment and rehabilitation of dumping sites, wherever applicable.

DEVELOPING MARKETS AND INCENTIVE-BASED MECHANISMS FOR ECOSYSTEM SERVICES FROM FORESTS

With the increasing degradation of the natural resource base causing a potential global environmental crisis, there is a growing appreciation of the role of forest systems in providing not just goods but also vital environmental services such as carbon sequestration, landscape beauty, biodiversity conservation and watershed protection. As many of these services are facing increasing threats, there is recognition that existing, traditional regulatory approaches and public expenditures alone may not suffice to ensure their protection

TABLE 6 *Carbon stock accounting for Himachal Pradesh forest 2001–2002*

			4 = 2/3		6= 2*5		8= 6*7
Species	Growing stock volume ('000 m^3)	Area km^2	Volume/km^2	Basic density (tonnes/m^3)	Stem biomass ('000 tonnes)	Biomass expansion Factor	Above ground biomass ('000 tonnes)
1	2	3	4	5	6	7	8
Deodar	54 225.70	593.40	91 381.36	0.59	31 993.16	1.30	41 591.11
Fir/spruce	137 889.10	810.90	170 044.50	0.36	49 640.08	1.30	64 532.10
Pine	89 232.40	1 445.20	61743.97	0.59	52 647.12	1.30	68 441.25
Other species	58 073.80	11 503.50	5 048.36	0.50	29 036.90	3.40	98 725.46
All species Total	339 421.00	14 353.00	23 648.09		50 528.26		273 289.93
	9.00	10=8*9	11=8+10	12=11*0.5	13=12*3.67	14=13*$6	
Species	Root : shoot ratio	Below-ground biomass ('000 tonnes)	Total living biomass ('000 tonnes)	Carbon content ('000 tonnes (0.5*TLB)	Carbon dioxide in ('000 tonnes)	Value of carbon stock* (in US$)	
		10	11	12	13	14	
Deodar	9.00	9 981.87	51 572.98	25 786.49	94 636.42	567 818.50	
Fir/spruce	0.24	15 487.70	80 019.80	40 009.90	146 836.30	881 018.03	
Pine	0.24	16 425.90	84 867.15	42 433.58	155 731.20	934 387.33	
Other species	0.24	26 655.87	125 381.30	62 690.67	230 074.70	1 380 448.49	
All species Total	0.27	68 551.34	341 841.23	170 920.61	627 278.70	3 763 672.35	

Note:* = value of carbon stock @ US$6 per tonne of carbon dioxide

and sustained flow. Thus, in many parts of the world, explicit value is being placed on these services and real payments are being generated for forest owners and managers that are acting as incentives for conservation. In many cases, poor communities residing in upstream catchments in and around forests have an important role to play as stewards of the area. The increased incentives for undertaking conservation therefore hold a huge potential for directly improving their livelihoods. This is very much the case for many states of India like Himachal Pradesh, Uttarakhand, Madhya Pradesh, Chattisgarh and many states in the northeastern region where the forest is so important to those living not only within these states but also in downstream regions. Thus, various organisations and communities like the forest department, downstream users, forest-conserving communities providing the service and the funding agencies investing in forest capital have very high stakes in conserving the forests of the state.

Another significant change is the paradigm shift from the regulatory, centralised and command-and-control type approaches to managing the natural resources to the alternative and complementary approaches such as payments for environmental services (PES), where the beneficiaries of an ecosystem services pay to the provider of the ecosystem service. Such PES mechanisms offer the potential for addressing both conservation and livelihood concerns. It is no longer a case of the polluter-pays principle, but of rewarding or compensating the conserving communities and the suppliers of such services. This is particularly true in the case of above-mentioned forested states where one- to two-thirds of the state's total geographical area is to be kept as forests. Such mechanisms are vital for such states, where the cost of conservation is borne by the forest-conserving local communities and large benefits are reaped by other key stakeholders. The need to introduce enough incentives for all forest conserving communities specially the 12 064 *Van Panchayats*[8] in the state of Uttarakhand conserving 523 289 hectare area and similarly large number of joint forest management (JFM) committees in Madhya Pradesh, Chattisgarh, Himachal Pradesh, Jharkhand states etc.

There has been an increasing trend in setting up PES mechanisms. A recent global survey found almost 300 new

[8] Forest *Panchayats* popularly known as *Van Panchayats* (VP) were constituted in 1931 in Uttaranchal to enable the people to manage a portion of revenue forests lying in the vicinity of their villages. Later, in 1976 the Uttar Pradesh (UP) government made amendment to the VP Act to bring VPs within the ambit of the Indian Forest Act and framed a set of rules to govern their area. The Uttaranchal Forest Rules, 2001, made a further amendment to the VP Act that has given greater control to the forest department (FD) in the management of these forests.

TABLE 7 *Per hectare values for Himachal Pradesh forest goods and services 2001–2002*

Per hectare economic value of direct and indirect benefits			Present value
Benefit and its TOTAL value (in million US$)	For total recorded forest area (37 033 km^2) per ha in US$)	Area under forest cover (14 353 km^2) per ha in US$)	Present value for 20 years @ 5% discount rate per ha in US$*)
1. Total growing stock = 6 816	-	-	-
I. Direct benefits			
A. Direct consumption benefits			
2. Timber logging = 8.2	2.21	7.22	11.06
3. Fuel wood = 28.3	7.65	20.02	38.11
4. Fodder (collection = 20.3)	5.47	14.14	27.33
5. Grazing (livestock) = 96.75	26.10	67.41	130.27
6. Minor forest produce = 7.25	1.95	5.04	9.75
Total direct consumption benefits = 160.80	43.43	112.07	216.53
B. Direct non-consumption benefits			
7. Ecotourism Indian = 113.6 Foreigners = 7.75	30.67 2.10	79.15 5.40	152.95 10.44
I. Total direct benefits(A+B) = 282.15	76.19	196.59	163.40
II. Indirect benefits			
8. Watershed = 18 493	4 993.65	12 884.41	24 900.82
9. Microclimatic factors = 36.25	9.78	2.52	48.81
10. Carbon stock = 4 123.1 Carbon flux = 24.25	1 113.30 0.65	2 872.64 16.90	5 551.75 32.66
11. Biodiversity/endangered species = 1 036	279.75	7218.00	1394.97
12. Employment generation = 6.25	1.68	4.35	8.14
II. Total indirect benefits (8-12) = 23 718.85	6 404.79	16 525.37	32 697.31
Total economic value (I+II) = 24 001.0	6 480.98	16 721.95	33 077.25

Framework adopted from Verma (2000)
*Note: 1US$ = ~40 INR

cases of such payments across the world. For example, a private Costa Rican utility company voluntarily pays into a fund that provides money for private upstream landholders to increase forest cover. This reduces sedimentation, thus providing sufficient water flow for hydroelectricity generation. In Paraguay, AES, an international power company, has paid US$2 million to form a protective reserve for one of South America's last remaining areas of undisturbed dense tropical forest. This helps to offset carbon emissions. In the state of Kerala, India, a benefit-sharing model for biodiversity protection has been developed under which the local community, the Kani tribe, has been involved in forest protection, thereby increasing its financial stake in the forest. A marketable drug has been developed by scientists for a fruit named arogyapacha grown in the understorey of mature forest. The fruit is now a popular herbal remedy for energy and agility. The Kani tribal is sharing the licence fee and royalties for the drug with a local botanical garden, and this has provided sustainable livelihood for tribe people (MA Toolkit 2007). In Karnataka state, India, farmers have formed a fund with the assistance of a non-governmental institution (NGO), the Government of India and the Swiss Agency for Development Cooperation to help other local farmers with watershed protection activities, such as regenerating forest and maintaining fallow land. Similarly, in the Kuhan micro-catchment of Kangra district of Himachal Pradesh, where agreements have been made between the upper and lower villages of the catchment to curb the silt load from the upper catchment region that leads to silting up of the downstream reservoir. In accordance with the agreement, the upper village has closed a small patch of sloping land adjacent to the stream, identified as a high erosion potential zone, to grazing for eight years, to allow regrowth and reduce erosion. In exchange the downstream villagers along with children from newly formed eco clubs, have made checkdams in tributaries to the main drainage to prevent silt from flowing downstream. Similarly Suan catchment in the district has a decades-old history of upstream–downstream collaboration: the downsteam Suan village diverted project investment for planting tree saplings

to the upstream Bhodi area, and contributed labour. Bhodi in exchange protected the planted area, which eventually led to increased summer flow in the main stream.

LIMITATIONS OF VALUING AND PAYING FOR ECOSYSTEM SERVICES

Lack of standardised methodology for valuing and aggregative ecosystem services

The system is beset with various problems like lack of organised data in the form of forest stocks and flows, the problem of double counting on use and non-use values and various intangibles like carbon storage, biodiversity, ecotourism, landscape values that exist on account of each other, the problem of aggregation of values based on two distinct approaches, namely, "revealed preference" values and "stated preference" values etc.

Problem of long- and short-term benefits

Welfare benefits from preservation of forests have a long stream of benefits, and such benefits cannot easily be written off under current income or welfare streams; thus, the need for separate estimation arises.

Problem of double counting

Timber, after felling from the forest, has a price reflecting its use or utility value. But timber has its origins in past carbon sequestration functions; its contribution to abating global climate change. Similar problems are faced regarding other values like biodiversity and recreation.

Benefit-sharing mechanism

Once the payment for ecosystem services is generated in the system, the major task that remains is that of distributing such benefits. The formula for distribution is based on a 2006 NPV committee report on the extent of benefits accruing to various stakeholders: (i) local—100 percent of NTFP, fuelwood and fodder values; 50 percent of watershed services and 45 percent of biodiversity values; (ii) state—100 percent of ecotourism and timber values; 50 percent of watershed services, 90 percent of carbon and 45 percent of biodiversity values; (iii) national—10 percent of carbon and 10 percent of biodiversity value.

Based on the earlier estimates, the 12th finance commission of India has already compensated the states of Madhya Pradesh and Himachal Pradesh by US$50 million over a period of five years for management of their forest and Uttarakhand state which has large geographical areas under forest by US$8.75 million for five years. Further transfers for afforestation will be effected by the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), but the allocation of the rewards of conserving communities and afflicted communities is yet to be worked out.

LIMITATIONS OF FACTORING IN THE INTANGIBLES

Despite the availability of various frameworks to develop physical and monetary accounts to create forest resource accounting, the system is beset with various problems especially in the developing country context and mainly on account of: (i) valuation problems due to a vast array of forestry resources requiring individual approaches to valuation and value itself being a perception-based estimate in many cases; (ii) lack of organised data in the form of forest stocks and flows; (iii) problem of double counting on use and non-use values and various intangibles like carbon storage, biodiversity, ecotourism, landscape values that exist on account of each otherl (iv) problem of aggregation of values based on two distinct approaches, namely, revealed preference values and stated preference values; and (v) data gaps in the biophysical measurement and economic valuation of ecological services from forests and how to account for them in national accounts.

CONCLUSIONS

While the current FRA scenario is less visible, attempts are being made to develop an integrated system of forest resource accounting in India. The Central Statistical Organisation's environment statistics division at the Ministry of Statistics and Programme Implementation of the Government of India, has taken the lead in developing a standardised methodology for valuation and accounting of forest resources. The project, awarded to the Indian Institute of Forest Management in 2003, was an attempt to develop a detailed and usable methodology that can be understood by all concerned as well as easy to implement. The data gaps, however, are a major impediment to the use of the methodology, as are inconsistent data from different sources and the lack of resource inventory data. Further, it is recommended that a manual to facilitate operationalisation of FRA should be prepared and that the FRA exercise should become a component of working plans. As the working plan is prepared every 8–10 years, the relevant information for FRA can also be generated at this time. Such FRA exercises would, in turn, provide important policy signals for equitable budgetary allocations and sustainable management of the forestry sector of the country.

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