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Integrating forest resources into the system of national accounts in Maharashtra, India

G.S. HARIPRIYA
Indira Gandhi Institute of Development Research (IGIDR), Gen. A.K. Vaidya Marg,, Goregaon (East), Mumbai – 400 065, India, Tel: 91-22-8400919, Fax: 91-22-8402752, e-mail: sneha@igidr.ac.in

ABSTRACT. The objective of the study is to construct forest resource accounts for the state of Maharashtra in India and incorporate the value of depletion and degradation of forest resources into the system of national accounts (SNA). The net state domestic product (NSDP) is adjusted for the depletion of the forest resources to obtain Environmentally adjusted net state domestic product (ESDP). The results show that the value added by forests is 3.56 per cent of NSDP and the value of depletion is 19.8 per cent of the estimated value added. The ESDP of Maharashtra is found to be 99.3 per cent of the estimated NSDP. The study has demonstrated that, although the existing database needs further improvement, forest resource accounting is feasible for the state of Maharashtra in India and can serve as an indicator of economy's performance.

KEY WORDS: national accounts, forests, valuation, environmental accounting.

1. Introduction

The objectives of the paper are to develop forest resource accounts for one particular state of India (viz. Maharashtra) and incorporate them into the system of national accounts (SNA). Such an account would reflect forest resource enhancement or reduction during the period under consideration. To date, no such studies exist for India that adjusts the GDP for the depletion and degradation of forest capital.

Under the SNA, ordinary net state domestic product (NSDP) equals gross state domestic product (GSDP) minus consumption of fixed capital in the form of produced assets. The paper adjusts NSDP in two ways. First, it adjusts value added in the forest sector to include non-market produc-

The author is a Research scholar at the Indira Gandhi Institute of Development Research (IGIDR), Mumbai, India. The paper is a part of the Ph.D. dissertation, which she pursued at the institute and has been presented at the First World Congress of the Resource and Environmental Economists, 25–27 June 1998, Venice, Italy. At the institute I, the author would like to thank Prof. Jyoti K. Parikh, Prof. Kirit S. Parikh and Dr. V.K. Sharma from IGIDR for their valuable comments on the work. She would also like to thank the anonymous referees for their valuable suggestions. Her special thanks to Dr. Vinish Kathuria for correcting the preliminary draft. The usual disclaimer applies.

tion of timber, fuelwood and non-timber forest products left out of NSDP. This converts NSDP to adjusted NSDP (ANSDP). Second, it adjusts ANSDP for the depletion and degradation of forest assets. This yields environmentally adjusted net state domestic product (ESDP).

The forest accounts developed in the study are limited to incorporating monetary benefits like timber, fuelwood and non-timber forest products like fodder, minor forest products and pharmaceuticals (together referred as ntfps) and does not consider changes due to environmental degradation. Further, the degradation of forest resources due to change in the quality of assets is not considered, as it needs a separate treatment. The paper is organised as follows. A brief overview of SEEA framework is presented in section 2. Section 3 describes how to operationalise the SEEA framework, which includes construction of physical accounts and monetary accounts. The implementation of the SEEA framework is given in section 4 and the paper concludes with section 5.

2. The SEEA framework

The United Nations has developed a Satellite System of Integrated Environmental and Economic Accounts (SEEA—United Nations 1993) that provides an essential framework for environmental accounts (see Uno and Bartelmus (eds.), 1998 for some of the recent studies related to these efforts). The SEEA proposes a multi-step process for creating satellite environmental accounts. It identifies three types of natural assets: produced, non-produced economic assets and non-produced environmental assets. Produced assets are those assets that are 'produced' and include only those assets that result in future benefits to their owners. In the category of produced assets, the natural assets consist of all those whose growth is controlled by man through the process of cultivation, including vineyards, orchards, timber tracts and other plantations, inventories of agricultural crops standing on the land after harvesting, etc. Non-produced economic assets are those natural assets that are currently exploitable, or likely to be so, for economic purposes, even if no explicit ownership or control is currently exerted over these resources, and have a market price so they can be exploited. For example, fish in oceans or commercially exploitable timber in tropical forests. 'Non-produced environmental assets' are those assets for which neither ownership rights are enforced nor direct monetary benefits are derived from their use. For example, forests provide other environmental services, like global climate balance, which are not commercially exploitable. Such types of assets, which provide only environmental services but cannot be commercially exploited, come under this category. They are assets such as air, land and terrestrial ecosystems (excluding forests), forests and forest land in the wilderness, rare and endangered species of fauna and flora, water and aquatic ecosystems.

In the first step, the SEEA suggest establishing physical accounts that contain information on opening stocks, depletion, other volume changes and closing stocks. In the next step the SEEA suggests valuing 'opening stocks' by multiplying them by the net price of the resource at the beginning of the period. Similarly, the SEEA suggest multiplying 'other volume

changes ' by average net price of the resource during the period and 'closing stocks' by net price at the end of the period. For valuing non-market environmental assets, the SEEA advocates using 'maintenance costs', the costs which would have been incurred if the environment had been used in such a way that its future use would not have been affected (see Bartelmus and van Tongeren, 1994: 16). Finally, the SEEA proposes calculating a 'revaluation' term as the residual difference between the value of closing stock, value of depletion, other volume changes and opening stocks. Although revaluation should in principle be estimated directly, rather than a residual, in practice the residual approach might be the most feasible one. It also ensures that opening and closing values are in balance (Bartelmus, 1998).

In order to incorporate the asset accounts into the SNA, the SEEA proposes making existing environmental and resource-related information in the SNA more distinct by disaggregating the current accounts and asset accounts, without changing their basic structure. Regarding the asset accounts, the SEEA proposes reclassifying the information on 'other changes in volume' for non-produced economic and environmental assets into four categories (Bartelmus and van Tongeren, 1994: 7). These categories are:

(i) depletion: reductions in the quantity of assets, due to economic uses (e.g., timber harvesting)
(ii) degradation: positive or negative changes in the quality of assets, due to economic decisions (e.g., productivity loss of forests due to soil erosion)
(iii) other accumulation: additions or reductions in the quantity of assets, due to economic decisions (e.g., transfer of forests to non-forest uses like agriculture or afforestation, etc.)
(iv) other volume changes: quantitative or qualitative changes in assets not caused by economic decisions (e.g., destruction of forests by natural fires, etc.)

These modifications simply involve 'repackaging' existing information provided in the SNA, without modifying the links between the current and asset accounts.

In the next step, the SEEA proposes incorporating the information on 'depletion', 'degradation' and 'other accumulation' in the asset accounts and current accounts. In the asset accounts it proposes adjusting 'gross capital formation' of non-produced economic and environmental assets for 'depletion', 'degradation' and 'other accumulation', to give 'net capital accumulation'. In the current accounts it proposes subtracting 'depletion' and 'degradation' from NDP to yield an 'environmentally adjusted estimate of NDP (EDP)'. In the next section, the scope of implementation of the SEEA framework is illustrated for the state of Maharashtra.

3. Operationalising the SEEA framework

3.1 Scope and coverage

The SEEA framework involves compilation of physical and monetary accounts for both produced and non-produced assets of forest resources.

In the present study only the forest trees in the natural forests are considered and all the forest resources are treated as non-produced economic assets.[1] This is because the available data do not make clear distinction between the forests that are unexploitable, due to various factors, and the forests which can be exploited. The study area considered in the paper and the forest resources covered in the region are discussed in the next subsection.

3.2 Profile of forests in Maharashtra

Maharashtra has a total land area of 307,690 sq. km: around 14.3 per cent (43,859 sq. km) is classified as forestland (Forest Survey of India (FSI), 1995), of which 58 per cent of the forests are closed forest (crown density greater than 40 per cent) and 41 per cent are open forests (crown density from 10 to 40 per cent); the remaining are all mangroves. The total growing stock of the state as assessed by the FSI is 225,554 thousand cubic metres (cum) and average volume per ha is 51.43 cum. The districts with significant forest cover are Chandrapur (54 per cent), Ratnagiri (43 per cent), Bhandara (31 per cent), Thane (25 per cent), Kolaba (23 per cent) and Amaravati (23 per cent).

In Maharashtra, teak is the dominant stratum accounting for 52 per cent of the forest resources. Hence, the physical accounts constructed in this study focus on two categories of strata: teak and non-teak. Non-teak includes sal, salai, westernghat evergreen, westernghat semi-evergreen and other miscellaneous strata. In addition the accounts are also constructed for bamboo, which is considered as a minor forest product because of its contribution to the economy as a substitute for timber and also as a raw material for the pulp and paper industry.

3.3 Sources of data

The information on inventory of forest resources is obtained from the FSI for the period 1991–3. It is the first time that Indian remote sensing satellite (IRS—1B) has been used by the FSI for the assessment of total growing stock in the country, and unfortunately, this is also the latest available information. Hence, the study is confined to developing physical and monetary resource accounts for a one-year period. Due to non-availability of data, no comparisons could be made with previous years. Other major data sources used in the study include the State of forest report (SFR, 1995), Indian council of forest research and education (ICFRAE, 1995), Centre for monitoring the Indian economy (CMIE, 1995), National account statistics (NAS, 1995) and Economic survey (1996).

3.4 Compilation of asset accounts

The compilation of asset accounts for forest resources involve construction of both physical accounts and monetary accounts. The asset accounts include the volume accounts (see table 1) and area accounts (see table 2) of teak, non-teak and bamboo forests for the year 1993–4.

[1] A similar assumption has been made for Mexico (see van Tongeren *et al*., 1993) and Philippines (Domingo, 1998).

Table 1. *Volume accounts of different forests in Maharashtra, 1993–4 (Volume in 000 cum.)*

Activity / Forest type	*Teak*	*Non-Teak*	*Bamboo*	*Total*
Opening stocks (1)	***110,308.00***	***110,090.00***	***5,156.00***	***225,554.00***
Changes due to economic activity (−) (2)	*3,618.15*	*3,567.93*	*349.51*	*7,535.59*
Depletion (−)	3,640.84	3,633.65	434.79	7,709.28
Logging/harvest	300.80	300.20	359.34	960.34
Illegal logging	3,009.06	3,003.11	35.93	6,048.10
Logging damage	330.99	330.33	39.53	700.84
Afforestation (+)	22.69	65.71	85.29	173.69
Other volume changes (1) (3)	***3,006.41***	***2,298.70***	***116.29***	***5,421.40***
Additions (+)	3,194.82	2,475.66	149.57	5,820.04
Natural growth (Mean annual increment)	2,758.00	2,121.00	129.00	5,008.00
Regeneration	436.82	354.66	20.57	812.04
Reductions (−)	188.41	176.96	33.28	398.64
Forest fires	18.38	16.81	4.23	39.43
Stand mortality, insects and diseases	55.15	55.05	2.58	112.78
Animal grazing	114.88	105.09	26.46	246.43
Other accumulations (−) (4)	***43.83***	***43.71***	***5.05***	***92.59***
Transfer of land to other activities	43.83	43.71	5.05	92.59
Net volume change (5 = 2 + 3 + 4)	**−655.57**	**−1312.94**	**−238.27**	**−2206.78**
Closing stocks (6 = 1 + 5)	***109,652.43***	***10,8777.06***	***4,917.73***	***22,3347.22***

Source: Computed.

Table 2. *Area accounts of forest resources in Maharashtra, 1993–4 (area in sq. km).*

Activity / Forest type	*Teak*	*Non-teak*	*Bamboo*	*Total*
Opening area (1)	***22,751.00***	***20,151.00***	***857.00***	***4,3859.00***
Area subject to logging (—) (2)	*750.92*	*665.11*	*84.80*	*1,500.83*
Logging/harvest	62.04	54.95	72.26	189.25
Illegal logging	620.62	549.69	5.97	1,176.28
Damage due to logging	68.27	60.46	6.57	135.30
Net area afforested and regenerated (3)	*3,829.23*	*3,821.56*	*705.70*	*8,372.49*
Area afforested	189.07	597.40	568.58	1,355.05
Area regenerated	3,640.16	3,224.16	137.12	7,017.44
Area subject to natural disturbances	*19,110.84*	*16,926.84*	*719.88*	*36,841.56*
Area subject to forest fires	*910.04*	*806.04*	*34.28*	*1,754.36*
Area subject to grazing	18,200.80	16,120.80	685.60	35,087.20
Transfer of land for nonforest purposes (4)	*9.04*	*8.00*	*0.34*	*17.42*
Closing area (5 = 1 − 4)	***22,741.96***	***20,143.00***	***856.66***	***43,841.58***

Source: Refer text.

3.4.1 Construction of physical accounts

The framework adopted for constructing the volume accounts in physical terms is explained below.

Opening stocks

The opening stocks represent the growing stock of resources present at the beginning of the accounting period. The opening stocks are taken as the total growing stocks in Maharashtra as per the 1991–3 assessment made by the FSI. The total opening volume is 225,554,000 cubic metres. Different strata are grouped to obtain the three main categories: teak, non-teak and bamboo. The total forest area present in Maharashtra at the beginning of the period is 43,859 sq. km.

Changes due to economic activity

Changes due to economic activity refer to the human production activities such as logging/harvest, logging damage, illegal logging and afforestation that affect (decrease/increase) the stock of forests. The volume of timber decreased due to logging is derived from the production statistics of timber, fuelwood and bamboo for the year 1993–4. Total production in cubic metres of timber and fuel wood[2] is available but the species-wise output is not available. The break-up is based on the percentage of teak and non-teak in the total growing stock (excluding bamboo). In the case of bamboo, only the amount of revenue generated in lakhs of rupees is available. Using the information on average price of bamboo, the quantity of bamboo harvested is derived from the revenue statistics. Area subjected to logging is not available but is derived from the volume accounts by dividing the total volume harvested with the growing stock per sq. km.

Statistics on the number of trees cut illicitly and the loss in revenue due to illicit logging is provided by the state forest department (SFD). Revenue generated from the seizure of illegal material is recorded in the production statistics. However, a considerable amount of timber and fuelwood still goes unnoticed. Hence for timber, the central statistical organisation (CSO) norm of 10 per cent of the total recorded production of industrial roundwood is taken, but for fuelwood 12.5 times[3] that of the recorded production of fuel wood is taken as illegal logging. For Bamboo also 10 per cent of the recorded production is taken as the norm for illegal logging. Damage due to logging is assumed to be 10 per cent of the volume of timber logged from both recorded and unrecorded production.[4] The total area afforested in Maharashtra is 1355 sq. km (information provided by the

[2] These production figures do not take into account off-cuts, sawdust and leaf biomass being used as firewood.

[3] Based on the figures of consumption of fuelwood (FSI, 1987) it is assumed that 50 per cent comes by cutting down the trees and the rest comes from fallen twigs, community and farm lands, canal-side and road-side plantations and agricultural residues. Hence, 12.5 times the recorded value is taken as illegal logging in the present study instead of the CSO norm of ten times the recorded production of fuelwood.

[4] The figure is based on the information provided by the state forest department (visited on 28 May 1997).

SFD). The volume additions due to afforestation is arrived at by multiplying the area afforested with the mean annual increment per sq. km.

Other volume changes

Other volume changes comprise additions to stock (due to natural growth and regeneration) and reductions (due to stand mortality, insect infestation, forest fires and natural calamities). The mean annual increment of different species is taken from the statistics published by the FSI (1995). The total annual increment in the state of Maharashtra according to 1993 assessment is 50,08,000 cum. Volume added due to regeneration is computed by multiplying the area regenerated[5] with the mean annual increment per sq. km of different species (teak, non-teak and bamboo). The volume of forest stock affected by forest fire is derived by multiplying the naturally regenerated volume and the afforested volume with the percentage of area affected by the forest fire.[6] Past statistics reveal that average volume rendered unusable annually due to attack of insects/pests is around 0.05 per cent (Indian forest statistics, various issues for the years 1947–70). The volume lost due to grazing is derived by multiplying naturally regenerated volume and the afforested volume with the percentage of area subject to heavy grazing.[7]

Other accumulations

Other accumulations indicate the transfer of forestland for non-forest uses (e.g., for agriculture, residential or industrial purposes) and land encroachments. The total area transferred in the state was 17.42 sq. km for the year 1993–4. The volume reductions due to transfer of land for non-forest purposes is derived by multiplying the area transferred with the growing stock per sq. km. Disturbance of forest volume due to encroachment is not accounted for in the volume accounts as there is no change in the area encroached from the previous year (ICFRAE, 1995).

Closing stocks

The closing stocks are computed as opening stocks less reductions plus additions. In practice, closing stocks are the actual stocks available at the end of the period and any difference in the computed closing stock and

[5] As a result of frequent fires and heavy grazing only 16 per cent of the total forest area has regeneration potential of important species (SFR, 1995). However, statistics on stratum-wise regeneration is not available but are derived by multiplying the area regenerated with the corresponding weights of the forest strata. The percentage of the area under different strata is used as weights.

[6] Around 4 per cent of the total forest area in Maharashtra are prone to frequent forest fires and 51 per cent to occasional forest fires (SFR, 1995). As occasional fires is not an annual feature, only the forest area that is prone to frequent forest fires is considered in this study. Further, only regenerated volume and afforested volume is considered affected by forest fire, as it is only the young saplings, which are generally affected by fire.

[7] In the state around 25 per cent of the total forest area is subject to heavy grazing, 35 per cent to medium grazing and 30 per cent to light grazing (SFR, 1995). In the construction of physical resource accounts only the forest area subjected to heavy grazing is considered as it leads to the destruction of stumpage trees. It is assumed that moderate and light grazing does not cause much damage to the forests.

actual growing stocks are accounted as statistical discrepancy. But as no other assessment on growing stock had been made after the 1991–3 assessment, the closing stocks are the derived stocks.

3.4.2 Construction of economic accounts

The SEEA proposes several methods for valuing the natural resources. Accordingly, three different basic versions of the SEEA are proposed (see Bartelmus and van Tongeren, 1994 for description of these versions). In this paper the SEEA version using market valuation has been employed.

Timber and fuelwood are valued using the net price method (see Haripriya, 1998 for detailed analysis of price of various species and their extraction costs). This method assumes that the value of resource at the beginning of period t, (V_t) is the volume of the opening stock (R_t) multiplied with the difference (N_t) between average market value per unit of the resource (P_t) and the per unit marginal cost of extraction, development and exploration (C_t) and is given by

$$V_t = (P_t - C_t)\, R_t = N_t R_t.$$

Under usual assumptions, the net price method gives an upper limit to the economic depreciation (Bartelmus, 1998).

The value of the mfps per hectare is also taken from the statistics provided by the SFD. The value of mfps, as recorded by the SFD, does not give a correct picture as the revenue is generated through royalties. As the royalties do not in general fully reflect the value of the product, the value of the mfps is taken to be ten times the value recorded by the SFD (see CSO, 1989). The value of mfps as recorded in the national accounts is Rs. 5,016 million (average of 1991–3, excluding bamboo). Hence, the value of the mfps obtained per hectare is found to be Rs. 1,143. In the study, it is assumed that the production of mfps is sustainable and prices and costs are also stable.[8] If the prices and costs fluctuate during the accounting period, there will be an additional term revaluation in the monetary accounts of non-timber forest products which takes into account the price and cost variation between the opening stocks and closing stocks. The present value is obtained by dividing the value of mfps generated in the first year by the social discount rate, which is assumed to be 4 per cent (refer to World Bank, 1997), and is found to be Rs. 28,575 per hectare.[9] Four per cent was used to make comparison across studies. Here a social discount rate is used since the concern of the government is to choose in allocating resources across generations in its quest for sustainable development.

Fodder obtained from the forests is valued using the cost of allotting

[8] The production of mfps is assumed to be sustainable as the production figures recorded in the national accounts represent only the production with the maximum sustainable limits. The unsustainable production is not recorded in the national accounts.

[9] In case the production of mfps is not sustainable, then they are similar to exhaustible resources and in this case the net present value generated by mfps will be less depending on the time period at which the resource gets exhausted.

alternate acreage. In the absence of a well-developed cultivated market, the value of fodder obtained from forests is determined as the opportunity cost of allotting acreage to the agricultural land (Munshi and Parikh, 1990). This is equivalent to the loss in revenue from agriculture due to cultivating an equivalent amount of fodder obtained from forests on agricultural land. In order to estimate the value of fodder, it has been assumed in this paper that the total leaf fodder in the country is 4.9 tons of dry matter per hectare and the grass production is 3 tons per hectare (see, Tewari, 1994). Further, the study makes the assumptions that only 2 per cent of the leafy biomass is utilised as fodder (NCA, 1976) and only 86 per cent of the forest area in Maharashtra is available for grazing (FSI, 1995). Under these assumptions the total fodder produced in the forests and pastures (under forest department) of Maharashtra is 11.6 millions tonnes. The report on the Committee on Livestock Feeds and Fodder, NCA (1976) estimated fodder yields as 50 tons/ha of irrigated land and 25 tons/ha of unirrigated land. The ratio of the irrigated area to the total gross area for the years 1992–3 and 1993–4 in Maharashtra is 15.6 (Economic Survey, 1996). The amount of land required to grow fodder produced in forests is computed using the above assumption. The net revenue of land is derived as the agricultural GDP to the gross sown area ratio in each year. The value of the fodder obtained from the forests is around Rs. 650 per hectare. The present value of fodder lost due to conversion for non-forest purposes is Rs. 16,772 per hectare (assuming a discount rate of 4 per cent).

The value of pharmaceuticals is obtained by using the option value approach. A major argument for the preservation of biological diversity, when many species and their properties remain unknown, is the potential value of drugs that can be obtained from these resources.

Option value can be conceptualised similar to an insurance premium paid to ensure the supply of an asset, the availability of which would otherwise be uncertain. The option value of pharmaceuticals derived from genetic material in India's forests is estimated using a model developed by Pearce and Purushottam (1990). For any given area, say a hectare, there will be some probability, p, that the biodiversity 'supported' by that land will yield successful drug D. Let V/n be the average value of drugs developed (n is the number of drugs developed). The average value takes into account the variations in the price of the drugs as some life-saving drugs are more valuable than the others. Since, there are many other factors of production producing value in the drug, let r be the royalty that could be commanded if the host country could capture all the royalty value. Finally, let c be the coefficient of rent capture. Then the pharmaceutical value of a hectare of biodiversity land supporting N species is

$$Vp\ (L) = \{N.p.r.c.v/n\}/H \text{ per year}$$

Principe (1991) estimated that the probability that a given plant species gives rise to a successful drug in tropical forests is between 1 in 10,000 and 1 in 1,000. In this paper an average estimate of 0.0005 is used. Findeisen (1991) reports that royalties are usually negotiated for plant material to be used in a drug that is near to being marketed and is usually between 5–20 per cent. We assume a royalty rate of 5 per cent. Ruitenbeek (1989) sug-

gests a range for *c* to be between 0.1 and 1. In this study the appropriation rate is taken to be the median estimate of 0.5. In order to find out the average value of drugs developed we used a sectoral study of Indian medicinal plants done by the EXIM (1997).

The option value of pharmaceuticals for the state of Maharashtra is derived by multiplying the per hectare value with the total forest area in Maharashtra. The option value is estimated to be Rs. 23.5 million. As one hectare of forest continues to give benefits throughout its life, a hectare loss in forests would result in the loss of the benefits derived throughout the life of the forest. Hence, the present value is derived by dividing the option value of pharmaceuticals with the discount rate of 4 per cent and is found to be Rs. 136 per hectare.

Monetary accounts for timber and fuelwood are derived by multiplying the volume accounts with the net price of the timber and fuelwood and are given in table 3. The opening stocks are multiplied with the net price of the previous year, and depletion and other volume changes by the average net price of that particular year. In monetary accounts there is an item called revaluation, which takes into account the price differences between the beginning and end of the accounting period. The difference between the opening stocks and closing stocks adjusted for depletion gives the value of revaluation. From table 3 it can be seen that there is negative change in the value of the timber and fuelwood assets. The monetary accounts of ntfps, fodder and pharmaceuticals (see table 4) are derived by multiplying the area accounts with the present value per hectare of the products. The opening value of the asset is computed by multiplying the opening area (as given in table 3) with the present value per hectare, as the values are generated throughout the life of the asset. When forests are logged for timber and fuelwood, the minor forest products generated from the forests are lost forever. Hence, the area subjected to logging is multiplied with the value of the minor forest products lost. The gain in value due to afforestation is obtained by multiplying the area gained due to afforestation with one-fourth of the present value per hectare of these products (as timber and fuelwood are already accounted for in the monetary accounts of timber).[10] As the fires considered in the study are only ground fires affecting the young plants, shrubs and herbs, the loss in value due to forest fires is taken as the probable loss in pharmaceuticals. From table 4 it can be seen that, due to logging of forests for timber and fuelwood and transfer to non-forest purposes, there is a loss in value of the ntfps obtained from forests.

The next section describes how to incorporate asset accounts into the SEEA framework.

[10] It is only in case of afforestation that there is a gain in forestland, due to which there is an increase in the opening area. In case of regeneration there is no additional gain in forestland. The study assumes that only one-fourth of the present value is captured, as the afforested species take a minimum of 20 years before they start yielding the minor forest products, and in the study it is assumed that only 25 per cent of the area is subject to animal grazing.

Table 3. *Monetary accounts of timber and fuelwood for the state of Maharashtra, 1993–4 (in 000 million rupees)*

Activity/Forest type	*Teak*	*Non-teak*	*Bamboo*	*Total*
Opening stocks (1)	***377.365***	***153.484***	***0.703***	***531.552***
Changes due to economic activity (−) (2)	*20.038*	*5.663*	*0.064*	*25.765*
Depletion (−)	20.164	5.768	0.079	26.011
Logging/harvest	1.666	0.477	0.066	2.208
Illegal logging	16.665	4.767	0.007	21.438
Logging damage	1.833	0.524	0.007	2.365
Afforestation (+)	0.126	0.104	0.016	0.246
Other Volume Changes (+) (3)	*16.650*	*3.649*	*0.021*	*20.320*
Additions (+)	17.694	3.930	0.027	21.650
Natural growth (Mean annual increment)	15.274	3.367	0.024	18.665
Regeneration	2.419	0.563	0.004	2.986
Reductions (−)	1.043	0.281	0.006	1.330
Forest fires	0.102	0.027	0.001	0.129
Stand Mortality, insects and diseases	0.305	0.087	0.000	0.393
Animal grazing	0.636	0.167	0.005	0.808
Other Accumulations (−) (4)	*0.243*	*0.069*	*0.001*	*0.313*
Transfer of land to other activities	0.243	0.069	0.001	0.313
Net volume change (5) =(2 + 3 + 4)	***−3.631***	***−2.084***	***−0.044***	***−5.758***
Revaluation (6)	***1.388***	***0.254***	***0.011***	***1.653***
Closing stocks (7) = (1 + 5 + 6)	***375.122***	***151.654***	***0.671***	***527.446***

Source: Computed.

Table 4. *Monetary accounts of forests with respect to the nonmarketed products provided by the forests (value in million rupees)*

Activity / Forest type	*Total*
Value of opening stocks	**197,238**
Net loss of ntfps due to logging of timber and fuelwood	4,288.6
Value of ntfps gained due to afforestation and regeneration	1,506.07
Value of pharmaceuticals lost due to forest fires	23.90
Loss in ntfps due to transfer of forests for nonforest purposes	78.34
Value of closing stocks	**193,600**

Source: Computed.

4. Implementation of the SEEA framework

The value added by timber, fuelwood, ntfps obtained in this study is Rs. 35,245.65 millions as against Rs. 14,080 millions in the GSDP according to the SNA. The difference in estimates of value added in SNA and the

present study is mainly due to the more complete coverage of timber, fuelwood and ntfps derived from forests in the present study. As a result, the current economic contribution of forests is 3.56 per cent according to the ANSDP as against 1.46 per cent according to NSDP.

In the asset accounts, the difference between the value of the opening stocks, the closing stocks and other volume changes in forest accounts gives the depletion of non-produced forest assets that has to be subtracted from the ANSDP to arrive at ESDP. The depletion value is Rs. 6989 millions, which is 19.8 per cent of the estimated forestry value added. Using this estimate, the computed ESDP equals 99.3 per cent of ANSDP in 1993–4.

5. Concluding remarks

Owing to inadequacy in data, the present study has made several assumptions concerning the valuation of forest products, which may not reflect the actual value. Due to the limitations of the study, the conclusions are tentative and, hence, any policy implications based on this study must be drawn carefully. Nevertheless, the study has demonstrated that forest resource accounting is feasible for the state of Maharashtra in India and shows that the ratio of ESDP to ANSDP is around 99.3 per cent. It seems that the subtraction of the value of depletion of forest resources from the national accounts has a very meagre impact on the measurement of net state domestic product. But one should keep in view the fact that the study covers only the monetary benefits provided by forests and does not consider the degradation of forests due to loss of services like carbon sequestration, watershed protection, etc. Further, when forests are converted to other uses, forest-related benefits are lost but benefits generated by new land uses are gained. The paper adjusts the SNA for the former loss but not the latter gain. For this reason, the difference between ANSDP and ESDP may be smaller than the paper reports.

The study illustrates the need to value forest resources more accurately and fill in the gaps in the existing data. When the limitations of the current data on production and prices are taken care of, value added by forestry in Maharashtra is found to be much higher than official estimates indicate. A proper accounting framework would better reflect not only the long-run value of the state's natural wealth in the asset accounts but also its immediate contribution to the state economy in the current accounts.

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