THE VALUE OF NON-TIMBER FOREST PRODUCTS: AN ESTIMATION FOR TROPICAL DECIDUOUS FORESTS IN INDIA[1]

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Chopra, Kanchan *(Institute of Economic Growth, University Enclave, Delhi 110 007, India).* THE VALUE OF NON-TIMBER FOREST PRODUCTS: AN ESTIMATION FOR TROPICAL DECIDUOUS FORESTS IN INDIA. *Economic Botany 47(3):251–257. 1993. Alteration of forested land to other uses incurs costs to a nation's economy that are frequently not calculated in estimates of national productivity. Alternative methods of value are discussed and employed to evaluate the non-timber products of India's tropical deciduous forests. Many undervalued resources found in these forests are described, and monetary value ascribed to them, to demonstrate the importance of the resources to the Indian economy.*

Key Words: non-timber forest products; tropical forests; India; economic valuation.

Forests constitute a significant component of the natural capital of an economy. There has been an accelerated conversion of forest land to other uses in countries across the globe, often prompted by development projects. River-valley projects, for example, result in loss of forest land through submersion of land and clearance of part of the catchment. Mining projects cause the loss of topsoil and biomass. Cattle-ranching results in diversion of large areas of land from forest. Such alterations in land use incur costs to the natural resource capital.

This paper attempts to estimate these costs in the context of non-timber forest products obtained from the tropical deciduous forests of India. Whereas the value of forest timber is reflected in the market economy and is well documented, non-timber forest products and their value constitute a relatively unexplored area (see, however, Peters, Gentry, and Mendelsohn 1989; Godoy and Lubowski 1993). Forested land as a category of resource use tends, therefore, to be under-valued.

The cost of using a resource is approximated by the loss of utility accruing from its consumption. Markets may or may not capture this value because they use the medium of price to reflect value. Price generally approximates the value of the resource in exchange and not its value in use (for an early distinction between value in use and value in exchange, see Smith 1937:28). A number of reasons may exist for a divergence between the two values. Imperfect markets may be one rationale: demand for a product may be artificially manipulated to increase or decrease its price. Asymmetry between preference patterns of different people may be another: utility arising out of a product may be person or group-specific so that a common idiom for exchange outside the group does not exist. Exchange value may not exist despite a high use value.

Exchange value also depends on the distribution of income and property rights. Subsistence users without much access to cash may not be able to impute a high exchange value to products that for them have a high assigned value. This problem can ostensibly be solved by examining their non-cash transactions. Such transactions usually take place at friendly prices and are affected by the existence of patron-client or other socially rooted interactions (see, for example, Brown [1990] for an analysis of value in the context of subsistence harvesters, in particular North Atlantic hunting communities). Exchange value determined by these interactions differs substantially from the value of the same product when sold in less imperfect markets. A

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range of exchange values may therefore exist for the same product.

Two other notions of value lately have been featured in the natural resource literature: existence value and option value (see Pearce and Turner [1990, chapter 9] for a discussion of these concepts). Resources such as forests have a special value if they are retained for future use. New options may emerge from technological changes. New uses for various species may be discovered. Consequently, the value to be attached to non-use in the present is more than in the case of other kinds of capital. Option value reflects this weight given to the future relative to the present.

Existence value is unrelated to any use, present or future. It has emerged out of the view that the natural habitat has a value ecological sustainability which is independent of the human agent. This view comes partly from the ecological philosophy called "deep ecology" which espouses the rights of non-human species; it is best kept out of quantitative evaluation if one is operating with an objective function that aims to maximize the utility of individuals in society. Of late, the focus on biodiversity as positively related to such utility has led to a few attempts at estimating existence value of resources or natural habitats (Dickson and Sherman 1990; Brookshire, Eubanks, and Randall 1983). The estimates obtained show great variation; the ratio of existence value to use value varies from 0.32–1.1 for wildlife resources to 60 for the Grand Canyon. The latter is, of course, perceived as an irreplaceable resource for which existence value is the larger part of total economic value.

A few analytical points arise from these estimates. Existence value is directly related to the extent to which the loss of a resource is irreversible and irreplaceable. If it is completely irreversible, existence value is infinite. Further, the existence of some resources is of global concern; the existence value for such resources would better be determined at the global level, independent of any use value that they may have for local economies. Management of the global economy to ensure that natural resources are maintained at a desirable level is a separate issue, and national and local governments must be involved in it. This is an area where management has to be at the local level because many micro-studies have shown that local management is more efficient. The implication of such an arrangement is that a transfer mechanism needs to be created to ensure that communities which preserve important resources get a return for the service they perform.

The Valuation of Non-timber Goods and Services

Non-timber forest products have had significant assigned value in the life of people living in and around forests. Fuelwood, fodder, medicinal herbs, fruits, game, and intermediate use goods (e.g., dyes, gum, latex) are some of the products which paradoxically have been referred to as "minor forest products" in India; the assumption, of course, is that timber is the major product. In addition, major environmental services are provided by forests, such as soil conservation, nutrient recycling through litter-fall, and preservation of biodiversity. Forests also help maintain the hydrological cycle, provide tourism and recreation, and have an aesthetic value. Once an option and existence value concept is used in arriving at the value of forests, there is no need to value these services. Doing both would amount to double counting. Concepts of value used in evaluating different goods and services determine, therefore, the method of approximation used for putting a monetary value on the flow of goods and services.

In this paper, we have used a mix of market and non-market approaches in the imputation of value. Wherever a good is marketed, as is the case of fuelwood, fodder and other minor forest products, its exchange value, approximated by market price, can be used as a measure of value. For approximating use value in the absence of markets, a number of alternatives are available. Table 1 contains a list of methods of approximation corresponding to different concepts of value adopted for non-timber forest products and services. The main approaches followed to estimate the value of goods and services produced by forests are:

(1) Change in productivity approach: When a product has more than one use, either intermediate or final, the value of putting it to one use is the loss of productivity in some other use. The use value of fuelwood, for instance, can be estimated by the loss of marginal product in agriculture on account of the diversion of dung to use as fuel in the case of unavailability of fuelwood.

(2) Alternative technology approach: If alter-

native technologies for producing the same good or service are available, the cost of obtaining a certain good or service by using one technology is a measure of the use-value of resources required to produce it by means of the other. If an afforestation project results in soil conservation, the value of this can be measured by the cost of the nutrients required to be added to restore onsite productivity and by the cost of downstream dredging or desilting to obviate the effect of soil erosion.

(3) Opportunity cost of labor time approach: If labor time is the major input required in the accrual of a good or service, its opportunity cost can be treated as an approximation of the use value of the product. Naturally regenerating forest products or fodder would fall in this category.

(4) Experimental data: Experimental data may sometimes provide an estimate of the value of some kinds of environmental function. For example, experimental values of nutrient recycling through litter fall in different kinds of forests may provide the estimate of one kind of environmental function provided by a forest.

(5) Secondary data: National accounts provide data on expenditure incurred on different kinds of services and can be used for arriving at the exchange or market value of services, such as tourism or recreation.

The stock of natural capital must be maintained if the forests are to continue providing the goods and services listed above. In order to maintain this capital and ensure the continued availability of the services, some part of the total economic value of the forest must be set aside that would yield the same income during the expected life of the resource and after the current stock of the resource has been used up. This set-aside portion is the cost of maintaining the option of continued availability of goods and services, i.e., the option value of the forest resource. This part of the value that should be set aside to ensure sustainability has been identified (Brookshire, Eubanks, and Randall 1983) as:

$$\frac{X}{R} = 1 - \frac{1}{(1 + r)^{n+1}}$$

where X: use income, R: total non-timber receipts, r: rate of discount, n: number of years assumed to be the life of the asset. In this calculation, the ratio of the income from resource use (X) to the value of non-timber income (R) is a function of the discount rate (r) and the life expectancy of the forest (n). If the value of the non-timber receipts is taken to be the present value of the goods and services which are to be maintained,

$$\frac{R}{(1 + r)^{n+1}}$$

is the cost of preserving the forest. This calculation can be taken as the option value or notional value of the benefit from preservation of the stock of forests in a situation where forests are treated as exhaustible. With r, the social rate of discount, at 12% and life expectancy of 30 years, this value is just 3% of the value of R. If, however, r is taken as a pure rate of time preference or 6%, then this figure amounts to about 16% of the value of R.

Option value as approximated above measures future use value. In contrast, existence value approximates values of components such as biodiversity which are crucial for the ecosystem and may be independent of use value. As suggested in section 1, this value should be determined at the global level. Here it is taken to be 91% of the total of use value and option value, the percentage being an average of available estimates of existence value of comparable natural resources, such as forests, fish, and wildlife (Pearce and Turner 1990).

Non-timber Goods and Services from Major Forest Types in India

India, with a geographical area of about 328 million hectares, has many forest types, ranging from tropical wet evergreen forests to tropical thorn forests and subtropical broadleaf hill forest to Himalayan dry temperate forests. Table 2 gives the land area under forests in India, its distribution in the tropical and sub-tropical zones, and the percentage of total forest area under each of the sixteen varieties of forest in India. Tropical moist deciduous forests and tropical dry deciduous forests together comprise 66.5% of the total forest area; furthermore, 99% of the forests in Madhya Pradesh, 50% in Haryana, 85% in Uttar Pradesh and 72% in West Bengal are either tropical moist deciduous or tropical dry deciduous forest. We therefore concentrate on tropical deciduous forests in the estimation of the value of non-timber goods and services from forests. The case studies on which approximations of value are made for different kinds of goods and services

TABLE 1. VALUE OF NON-TIMBER PRODUCTS OF FOREST LAND.

Good/service	Concept of value	Methods of approximation
Fuelwood & fodder	Use-value and/or exchange value	1) Market-price. 2) Loss of productivity in alternative use, e.g., marginal productivity in agriculture or manure diverted to burning in the absence of fuelwood. 3) Cost of alternative technology for fuel, e.g., market price of softcoke. 4) Opportunity cost of labor time in collection.
Forest products	Exchange value and/ or use value	1) Market-price. 2) Cost of labor time in collection.
Services of tourism	Recreation exchange value	Secondary data on spending.
Soil conservation	Use-value	1) Alternative technology for restoration of on-site productivity. 2) Downstream dredging: alternative technology off-site.
Nutrient recycling through litter fall	Use-value	Experimental data.
Maintaining hydrological cycle	Use-value in the present and future	1) Loss of productivity in the absence of service. 2) Cost of providing water by alternative means.
Preservation of biodiversity	Use-value in the future and in the present	1) Irreversible loss? 2) Premium on future vis-a-vis present.

Note: If existence value for forests can be determined, then services included in 4, 5, 6 and 7 are subsumed under it. No other approximation is needed. For details, see text.

are taken from these states and from areas where the forests under consideration belong to one or the other of these categories.

The value of the annual flow of non-timber products accruing from a hectare of tropical deciduous forests is shown in Table 3, as is the method of approximation used for each product or service. Where values obtained from two methods are given, both estimates are recorded. For fuelwood, for instance, the methods using the price of alternative technology and the cost of labor time in collection give different estimates. For soil conservation, the estimate of nutrients required to restore on-site productivity and the cost of dredging for downstream silt to restore off-site water-storage capacity of water bodies also provide alternative estimates. In the case of fodder, yield variation between established pasture and scrubland results in two estimates, both of which are recorded. For tourism and recreation, an increase in promotional activity with increased expenditure is taken into account by one of the estimates. Based on these

TABLE 2. FOREST TYPES IN INDIA AND THEIR DISTRIBUTION (AFTER BAJAJ 1990).

Forest type	Area/ million hectares	Percentage of total area under forests
Tropical wet	5.13	8.0
Tropical semi-evergreen	2.64	4.1
Tropical moist deciduous	23.68	37.0
Littoral and swamp	0.40	0.6
Tropical dry deciduous	18.36	28.6
Tropical thorn	1.65	2.6
Tropical dry evergreen	0.14	0.2
Sub-tropical broad-leaved hill	0.28	0.4
Sub-tropical pine	4.24	6.4
Sub-tropical dry evergreen	1.25	2.0
Montane wet temperate	2.34	3.6
Himalayan moist temperate	2.20	3.4
Himalayan dry temperate	0.03	–
Sub-alpine and alpine	1.86	2.9
Total	64.20	100

TABLE 3. VALUATION OF GOODS AND SERVICES FROM TROPICAL DECIDUOUS FORESTS.

Good/service	Method of approximation	Value of annual flow per hectare $US (Rs) Maximum	Minimum	Source
Fuelwood	Price of alternate technology (softcoke in this case).	$17.33 (520)	$9.50 (285)	Chopra (1987)
	Cost of labor time in collection.	$24.17 (725)	$18.87 (536)	Sharma and Bhatia (1986)
Fodder	Market value of fertilizer and milk output from cattle feeding on land (for established pasture and scrubland respectively).	$35.98 (1079.5)	$22.40 (672)	Fleming (1983)
Forest products, e.g., sal leaves, tassan cocoons, bidi leaves, lacquer, and dyes	Cost of labor time in collection.	$66.67 (2000)	$66.67 (2000)	Bajaj (1990)
Soil conservation	Value of nutrients to restore productivity on-site.	$188.40 (5652)	$79.30 (2379)	Hufschmidt et al. (1983) and Chopra, Kadekodi and Murty (1990)
	Dredging of down-stream silt off-site.	$188.4 (5652)	$79.30 (2379)	
Nutrient recycling	Experimental data.	$23.53 (706)	$23.53 (706)	Mishra (1969)
Tourism and recreation	Secondary data.	$1 (30)	$.53 (16)	Lal (1992)
Total		$357.08 (10 712.5)	$219.80 (6594)	

estimates the minimum and maximum values of the annual flow of non-timber goods and services from tropical deciduous forests are estimated at $219.80 (Rs 6594) and $357.08 (Rs 10 712.5) respectively. The net present value of this annual flow for a period of 30 years using a social discount rate of 12% has a minimum value of $1821 (Rs 54 640) and a maximum value of $3007 (Rs 90 210). Using the method of approximation suggested in section 1, corresponding minimum and maximum values of option value are $291 (Rs 8742) and $481 (Rs 14 438). Existence value, similarly, has values of Rs 57 677 and Rs 95 226. It is important to observe that these are broad orders of magnitude based on available data and micro-studies, but they are comparable with some other estimates. The net present value of sustainable fruit and latex obtained from a hectare of Amazonian rain forest, for example, has been estimated (Peters, Gentry, and Mendelsohn 1989) to be $6330 with a discount rate of 5%. The comparable figures in this case are a minimum of $1821 and a maximum of $3007 with a discount rate of 12%. Considering that they constitute an approximation for tropical deciduous forests, the difference seems acceptable.

Further, the alternative measures of value given in Table 4 (together with their U.S. dollar equivalents) can be interpreted in terms of their applicability. The use and option values constitute an approximation of the value of the resource for the national economy. They measure the present and future value of services accruing to the national economy. The existence value, on the other hand, measures value of forests to the global economy in terms of preservation of sustainable ecosystems, carbon sinks and preservers of bio-diversity (cf. Hall and Bawa 1993). This division into two kinds of value would be crucial in the context of any scheme for international transfers for bio-diversity preservation

TABLE 4. VALUE OF NON-TIMBER GOODS AND SERVICES FROM TROPICAL DECIDUOUS FORESTS.

	Value per hectare (Rs)		Value per hectare ($)[1]	
	Minimum	Maximum	Minimum	Maximum
Goods				
Fuelwood	2570	4834	85.67	161.14
Fodder	6060	9370	202.00	324.33
Forest products	18 036	18 036	601.20	601.20
Services				
Soil conservation	21 460	50 970	715.30	1699.00
Nutrient recycling	6370	6370	212.30	212.30
Tourism and recreation	144	270	4.80	9.00
Total use value	54 640	90 210	1821.03	3007.00
Option value (16%)	8742	14 434	291.04	481.00
Use and option values	63 382	104 644	2112.07[2]	3488.00
Existence value (0.91% of use & option values)	57 677	95 226	1922.06[3]	3174.00
Total value	121 059	199 870	4035	6662

Notes:
[1] Conversion at current rate of R 30 = 1$.
[2] This value accrues to India in the form of present and imputed future use value of non-timber goods and services.
[3] This value accrues to the global community.

or carbon absorption as well as for understanding the cost of using natural capital within national economies.

CONCLUSION

The total present value of non-timber goods and services available from a tropical deciduous forest in India varies from a minimum of $4034 to a maximum of $6662 per hectare, if use, option and existence value are all taken into account. The use value of non-timber products which accrues to local communities and the national economy is about 45% of this figure. Nevertheless, the use value of non-timber products has a significant impact upon income and consumption flows in local economies; in particular, this value may have strong implications for the welfare of communities which use these products for subsistence. The option and existence values of forests, on the other hand, relate primarily to the role that forests play in the global context. Option values become significant when accelerated deforestation begins to deplete forest resources. Existence value measures the value of forests as carbon sinks, and as preservers of biodiversity. In any plan for a global governance of the individual environmental resources of the planet, the relative importance of these two values and their implications for international agreements to promote forest preservation is evident. On the assumption that the market reflects the value of timber-related products and transactions, forests could be viewed primarily as producers of both goods and services with high market value. One could argue that these resources are the common inheritance of all the people on the planet; it thus becomes imperative to work out a well-structured plan for the governance and maintenance of these resources which integrates national sovereignty into a limited global governance.

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