



**Methodological issues in monetary
valuation of ecosystem services**

*Valuation of forest ecosystem services
in senegal*

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ABSTRACT

Forest ecosystem goods and services, and the natural capital that produces them, provide important direct and indirect contributions to national economies and human well-being. Many attempts have been made to value them. In particular, over the last three decades, significant progress has been made in developing methods for valuing forest ecosystem services and including them in national accounts.

The studies carried out so far in the field of economic valuation of forest ecosystem services have many limitations in terms of the diversity of tools and methods used and the unavailability of some of the data needed for the valuation. This explains the fact that specialists often find it difficult to agree on non-market values. However, it should be emphasized that the efforts made are of definite value in that they help to understand the multifunctional roles of forest ecosystems and can contribute to the conservation and sustainability of forest resources.

The monetary valuation of ecosystem services for ecosystem accounting involves the use of exchange values to reflect, in monetary terms, the contribution of ecosystems to benefits used in economic and other human activities. The challenge in practice is that ecosystem services are generally not traded directly in markets and therefore their exchange values cannot be observed.

Therefore, the monetary valuation approach must rely on the use of technical valuation to impute appropriate exchange values.

The paper will discuss estimates of exchange values for each ecosystem service obtained by multiplying a measure of the service flow in quantitative terms by a unit price and will also show how the unit prices were obtained in Senegal.

INTRODUCTION

The overall objective of the study on the economic valuation of forest ecosystem services is to determine the contribution of forest ecosystem goods and services to the national economy in Senegal. Specifically, it aims to: (i) assess the annual flow of forest ecosystem goods and services (market and non-market) relevant to community well-being at the local and/or national level; (ii) assess the available forest capital stock; and (iii) determine the net contribution of forest ecosystem services to the national economy.

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This report is structured in three parts dealing with the situation of forests in Senegal, the methodology and the results obtained.

I. OVERVIEW OF THE STATE OF THE FOREST IN SENEGAL

The forest estate of Senegal includes a classified estate and a protected estate. The management of the classified domain is the responsibility of the Water and Forest Service, the National Parks Service and local communities in accordance with the texts of the 3rd phase of the Decentralization.

The national classified domain covers 35.7% of the national territory and includes classified forests, reforestation and restoration areas, integral nature reserves, national parks and special reserves and community reserves. The classified forests cover a total area of 7,135,617.5 ha, including seventeen (17) sylvo-pastoral reserves (914,580 ha) and seven (7) areas of hunting interest (1,445,115 ha).

The six (6) national parks and the single integral and special reserve cover a total area of 1,613,790 ha, or about 8% of the territory, and constitute the places where biodiversity is best conserved because of their status as fully protected areas.

II. EVALUATION METHOD OF FOREST ECOSYSTEMS SERVICES

II.1. Evaluation framework of forest ecosystem services

This study is based on an updated framework that refers to authoritative international documents in the field of economic valuation of ecosystem services (Eurostat 2002a, 2002b, United Nations et al., 2003, Millennium Ecosystem Assessment, 2003; FAO, 2004; Beijing Forest Assessment, Hou and Wu 2008). The framework distinguishes between assets (natural forest capital) and output (value of forest goods and services). Changes over time in the volume of forest assets provide an indication of the sustainability or otherwise of forest management. While the output of forest goods and services is the value that should be included in the Gross Domestic Product (GDP) measured from a supply perspective.

In the new valuation framework, the benefits that people derive from forest ecosystems are grouped into three (3) categories: (i) forest goods, (ii) forest ecosystems services and (iii) socio-cultural benefits. **Under assets**, the framework incorporates an additional and innovative category, namely forest environmental assets, which essentially include forest wildlife and forest carbon stock (not to be confused with carbon sequestration/trapping as a forest service).

In relation to forest goods, a distinction is made between products provided by forest ecosystems for domestic use or animal consumption. These are wood forest products (timber, service wood and energy wood) and non-timber forest products (NTFP). The NTFP are classified into NTFP of plant origin and NTFP of animal origin. The NTFP of plant origin include food, fodder, plant raw materials for the preparation of medicines and aromatic products, the preparation of dyes and dyeing, and the manufacture of utensils, handicrafts and construction objects, as well as ornamental plants, exudates and other plant products.

NTFP animal origin include live animals, hides, skins and trophies, wild honey and beeswax, bushmeat, animal raw materials for medicine and dye preparation, and other edible and non-edible animal products. Wild birds (e.g. guinea fowl and partridges) are the most commonly hunted animals. Wildlife products (skins, feathers, horns, teeth, etc.) are highly valued by local people for ritual and medicinal purposes. They are also used as raw material in the production of handicrafts for export via sales to tourists.

Forest Ecosystems Services include essentially regulating services that reproduce the capacity of forest ecosystems to modulate certain phenomena in a way that is favorable to humans (water conservation, soil protection, air purification/temperature regulation, carbon sequestration, etc.) and recreational services (use of forests for recreational purposes): the case of forest ecotourism.

Socio-cultural benefits refer to the other types of services that forests provide, which are no less important, namely aesthetic services, cultural/artistic services and spiritual and historical services

II.2. Category and valuation method

The economic valuation of selected forest ecosystem goods and services consists of methodically imputing values. It should be noted, however, that most of the tools available are based on advanced assumptions; the choice of methods being guided by the nature of the service to be valued and the availability of secondary data. Two main categories of methods can be distinguished in the evaluation of environmental goods and services

- ✓ **direct valuation methods** based either on preferences revealed in a real market (change in productivity, protection expenditure, substitutable goods) or in a reconstructed market (hedonic price method, travel cost method), or on preferences expressed in a fictitious market (contingent valuation method);
- ✓ **indirect valuation methods** (no preference): replacement cost

Contingent valuation: based on revealed preference (RP) and stated preference (SP) methods to determine the value of a service from hypothetical markets and surveys to obtain a direct revelation of preferences (direct surveys of populations to determine what they are willing to pay for a benefit or, conversely, what they are willing to receive to be compensated for the degradation of a resource, a deprivation or a nuisance suffered);

Hedonic pricing: a method used to determine the value of an environmental good from the prices of other goods (buildings, land, etc.) that may be influenced by the quality of the environment (air pollution, noise pollution, etc.) as a factor in consumer choice. It consists of determining the share of the observed price differences attributable to the environment (which makes it possible to evaluate the marginal willingness to pay for an improvement in the environmental characteristic studied) and then estimating the total benefit derived by all those affected by this improvement;

Travel cost valuation: used primarily in the valuation of recreational and cultural services. It allows the marginal willingness to pay of an agent to be evaluated by the cost (money, time, material depreciation, etc.) of his or her travel (round trip) and stay (accommodation) to visit a recreational site, based on surveys of visitors to the site (costs incurred by visiting the ecosystem, reasons for and frequency of visits, attributes of the site, socio-economic characteristics of the visitor (sex, age, origin, occupation, income, etc.);

Cost-based valuation: a method based on the assumption that the cost of maintaining an environmental benefit is a reasonable way to estimate its value. For example, the restoration cost method (RCM) which uses the cost of restoring ecosystem goods and services; the replacement cost method (RCM) based on the cost of substitutes for environmental goods and services; the resettlement cost method (RCC) based on the cost of resettling threatened communities.

III. RESULTS

In total, forestry capital is valued at 16.565 billion XOF in 2010. For the most part, this wealth is created by standing timber assets, which contribute 99.95% of the total value of assets, compared to only 0.05% for forest carbon. The economic value of forestry assets is quite significant in relation to the depreciation of forestry capital.

Table 1. Annual value of forestry assets by asset type

Forest Assets	Value (thousand XOF)	Contribution (%)
Forests		
Standing timber	16 565 000 000	99,95
Carbon stock	9 035 920	0,05
Total	16 574 035 920	100,00

With regard to the forest carbon stock, estimated at 9 035 920.118 XOF, most of the economic value comes from the forests of the protected domain and classified forests, which total 8 883 034 000 XOF, or 98% of the total value of the forest carbon stock.

Table 2. Annual value of forest carbon stock

Forest types	Forest area (1000ha)	Annual growth rate (t de ms/ha)	Annual biomass increase (Kt de ms)	Carbon content of dry matter (%)	Total carbon increase (1000t)	Carbon price (FCFA/tonn)	Carbon stock value (in thousand XOF)
	A	B	C = (A*B)	D	E= (C*D)	F	G = (E*F)
Plantations	9.2	3.6	33.1	0.5	16.5	680	11 242
Forest of domain protected	12872.9	1.3	16734.8	0.5	8367.4	680	5 689 822
Classified forests	6261.2	1.5	9391.8	0.5	4695.9	680	3 193 212
Pastures (Silvopastoral reserves)	833.2	0.5	416.6	0.5	208.3	680	141 644
	19976.5		26576.2		13288.1		9 035 920

Value of annual forest asset flows

Forest resources contribute significantly to rural livelihoods and the national economy in many countries. In Senegal, they represent a significant fraction of rural household cash income. However, the extent of income derived from forest resources is not well known, in the absence of a systematic and rigorous data collection system. In general, only a portion of the resources traded in markets are accounted for. The share of forest products in household consumption and in unrecorded (illicit and/or informal) trade goes largely unnoticed, which this study has attempted to correct.

The production of forest goods is estimated at 119.1 billion XOF at current prices in 2010. The bulk of this production is made up of forest products of plant origin with 115.5 billion FCFA, or 96.9%, while products of animal origin represent only 3.1% (3.6 billion XOF). The low share of animal products is due not only to the fact that several parts of the country are closed to hunting, but also to the difficulty of obtaining reliable data due to the illegality of much traditional hunting.

Table 3. Annual value of forest goods by category (in millions of XOF)

Wood charcoal	Forest products excluding charcoal	Forest products of vegetable origin	Forestry products of animal origin	Total
69 536.3	32 969.3	12 995.2	3 640.1	119 140.9
58.4%	27.7%	10.9%	3.0%	100.0%

The production of TFP is estimated at 102.5 billion XOF, or 86.0%, of which 58.4% is charcoal. The NTFP, with 16.6 billion XOF, represent only 14.0% of production, including 3.1% of animal origin. The production of NTFP is essentially from the Kolda and Tambacounda regions. These regions also provide the bulk of NTFP production of animal origin.

The value of forest goods production represents 2.1% of goods production, which is estimated in the national accounts at 5,559.5 billion XOF in 2010. Compared to the national accounts data, it appears

that the results obtained from the valuation of forestry goods are slightly higher than those provided by the national accounts: 119.1 billion versus 102.0 billion, a difference of 17.1 billion XOF.

This difference is mainly explained by the improvements made by the surveys carried out as part of the study, notably on the valuation prices of declared quantities but also on the estimates of uncontrolled quantities.

Value of annual flows of forest services

In total, the value of annual flows of forest services is estimated at 1397.6 billion XOF in 2010. The bulk of service production is provided by water conservation and biodiversity conservation services, which contribute 94% of the total economic value of services.

Table 4. Distribution of the annual value of forest services by type of service

Forestry services	Annual values	Contribution (%)
Water conservation	735 844 233 184	52,6
Biodiversity conservation	573 950 172 019	41,1
Soil protection	85 764 195 522	6,1
Forest ecotourism	2 074 710 770	0,1
Total	1 397 633 311 495	100,0

It should be noted, however, that forests play a leading role in the provision of water conservation services, contributing more than half (about 53%) of the total value of forest ecosystem services.

Total value of forest goods and services

Overall, the economic value of forest goods and services amounted to 1 516.8 billion in 2010, with forest services dominating, accounting for 92% of the total value of goods and services compared to about 8% for forest goods. These results support the finding that forest services account for at least 90% of the total economic value of forest ecosystem services within a given country.

Table 5. Value of annual flows of forest goods and services

Label	Value of annual flows	Contribution (%)
Goods forests	119 140 890 930	7,9
Forestry animal of vegetable origin	115 500 754 859	7,6
Forestry animal of animal origin	3 640 136 071	0,2
Forests services	1 397 633 311 495	92,1
Soil protection	85 764 195 522	5,7
Biodiversity conservation	573 950 172 019	37,8
Water conservation	735 844 233 184	48,5
Forest ecotourism	2 074 710 770	0,1
Total value of forest goods and services	1 516 774 202 425	100,0

Water conservation and biodiversity services are the most significant from an economic point of view, with nearly 49% and 39% of the total economic value of forest goods and services respectively. The work of Hou and Wu, relating to the evaluation of forest ecosystems in China in 2008, reports a contribution of 50% for water conservation services and 20% for biodiversity conservation.

CONCLUSION

Overall, the results of the economic evaluation of forest ecosystem services in Senegal are in line with the trends observed in certain reference studies such as the Millennium Ecosystem Assessment Report, UNDP 2005, according to which non-market forest services (regulation, recreation, cultural, etc.) represent 90% of the total economic value of the services provided by forest ecosystems as opposed to 10% for supply services (forest goods).

In fact, the results of this study show a total annual economic value of forest services (market and non-market) of 1 516.8 billion XOF, of which 8% is accounted for by market services (forest goods) and 92% by non-market services.

In light of the results, it appears that forest ecosystems constitute an important asset for Senegal. Thus, forests represent an important part of Senegal's heritage that can produce standing timber potentially equivalent to more than 2.7 times the current GDP. Because of its capacity to grow naturally and regenerate, this capital stock constitutes an opportunity for inclusive economic and social development for the benefit of all segments of the population. Therefore, in the interest of future generations, it is advisable, in perspective, to establish a sustainable management of forests, in particular in order to maintain their vitality and their capacity to satisfy, now and in the future, the relevant ecological, economic and social functions at the local, national and global levels, and that they do not cause damage to other ecosystems.

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