MAÂMORA FOREST, MOROCCO

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The innovative methods and the analysis and conclusions expressed in this publication do not necessarily reflect the views of the international experts involved in the project but only that of the author and the Moroccan national team that validated them during a validation meeting held in Rabat, Morocco on the 18th of February 2016.

WHAT IS THE PROBLEM?

Forests play an important economic and social role in Morocco. Their multi-functional nature means that they produce goods and services that benefit both the rural population, which is strongly dependent on the forest, and other beneficiaries such as local authorities and urban communities. The conservation and sustainable management of forests remains a major challenge. There are still lasting problems, such as collective usage rights, the non-commercial nature of most forest goods and services, the inadequacy of assessments in quantifying non-commercial goods and services and ongoing illegal, informal and unorganised exploitation, in a context where the economic exploitation of a significant number of forest goods and services is difficult.

The lack of management guided by the desire to optimise the economic yield of forests, which takes into account the main forest goods and services, leads to benefits only being partially calculated, which reduces the real benefits of work for the conservation and sustainable management of forest ecosystems.

Pilot site description

This study was carried out between 2013 and 2015 thanks to funding from the French Global Environment Facility (FGEF), in collaboration with the Moroccan High Commission for Water and Forests and Combating Desertification (HCEFLCD). Maâmora Forest was chosen as a pilot site in order to assess the economic value of forest goods and services and to illustrate the importance of management that takes into account the simultaneous production of the main goods and services in Moroccan forests. Eight forest goods and services were assessed with the aim of incorporating these results into calculations to establish the rate of return on the investments planned as part of the implementation of the future forest development plan (2016-2035). This rate of return was calculated and two analysis variants were compared, highlighting the differences between a partial calculation method and an extended calculation method covering eight forest goods and services.

Goods and services selected

The economic assessment carried out for Maâmora focused on eight goods and services that have been identified as priorities:

Goods and services	Beneficiaries
Wood	Rural population, local authorities and HCEFLCD
Cork	Local authorities and HCEFLCD
Fodder	Rural population
Recreation	Urban population of neighbouring cities
Acorns	Rural population
Truffles	Rural population
Tannins	Local authorities and HCEFLCD
Nectar (honey production)	Local beekeepers and herders

These services were selected by forest managers by setting priorities according to the economic significance of these services at a local and national level, and their sensitivity to management and operating methods and climate change.

A TWO-STEP ASSESSMENT: ECONOMIC VALUE AND COST-BENEFIT ANALYSIS

Socio-economic assessment in baseline conditions

Economic assessment was carried out by considering the economic value as a reflection of both the potential opportunities for the use and future exploitation of goods and services, and the preferences detected via the behaviour displayed by the direct beneficiaries of these goods and services.

The data used came from a number of sources, in particular: (i) preparatory studies performed as part of work to draw up the forest development plan (forest inventory, socio-economic study, etc.); (ii) the Maâmora management plan (2016-2035); (iii) data from the Ministry of Agriculture; (iv) records of wood auctions (2004-2014); (v) semi-structured interviews and direct surveys with the beneficiaries of goods and services; (vi) estimations provided by forest managers; and (vii) data from empirical research carried out in Maâmora.

- **Truffles:** Itruffle production was assessed by differentiating between truffles produced around pine forest stands and truffles produced around cork oak forest stands (Baseline year: 2014).

  Truffle production among pine forest stands was at 22,566 kg, with 3,915 kg among cork oak stands. The net benefit produced by Maâmora has a gross value of €165,792 after deducting the collection opportunity costs (€50,659). The net unit value of Maâmora truffles was therefore calculated at €3.80 per kg. This is the equivalent of €138 per ha for pine stands and €22.83 per ha for cork oak.

Item name		Monetary value (€)
Net unit value of forest truffles	per kg	3.80
	per ha of oak trees	22.83
	per ha of pine trees	138.11

- **Wood:** the assessment differentiated between the various qualities and uses (industrial wood, timber and firewood) of different species. The mean value of auction quantities and sale prices over a period of ten years was used. The intermediary costs of silvicultural actions and operation and any taxes paid prior to wood purchase were deducted in order to assess the value of each type of wood.

  The economic assessment estimated the total net value of wood in 2015, after deducting operating costs (€718,430.50) and taxes (€5.9 million), at €10.5 million. Most of this value (96%) comes from industrial wood and timber, primarily taken from eucalyptus (89%). The remainder (4%) comes from firewood produced by the various species. The silvicultural operations in each plot are very different for each species and each year. The mean value per hectare could therefore not be estimated.

- **Fodder:** fodder production was estimated on the basis of mean annual production in fodder units according to mean yield values for the ten grazing parks in Maâmora. The fact that a fodder unit is of an equivalent value to a kilogramme of barley was used to calculate the monetary value of fodder.

  Fodder production in Maâmora's ten grazing parks (131,808 ha) was estimated at 39 million fodder units, resulting in a net benefit of €18 million, for a mean production value of €138.20 per ha. The contribution of the various grazing parks vary from one to another and this value fluctuates from €115 per ha in the least productive parks to €161 per ha in the most productive parks.

Surface area (ha)	Total production (UF)	Value (€1000)	Value (€/ha)
131,808.00	39,012,400.00	17,966.50	138.2 [115, 161]

- **Cork:** the assessment differentiated between the value of virgin cork and the value of reproduction cork. Quantities were calculated according to their estimated annual production, using the weighted mean value for productions collected at the end of each operating period (period of 27 years for virgin cork and 10 years for reproduction cork). The costs associated with storage, transport and cork auctions fees were deducted from the sales value.

  A total value of approximately €138,159.70 was calculated for cork production, primarily from the exploitation of reproduction cork. The net value of virgin cork production is no more than €1,145. A net cork unit value after deducting costs and taxes, was estimated at €19.90 per stere for reproduction cork and €13.60 per stere for virgin cork.

- **Cork oak acorns:** there are no measurements for the actual quantities collected. Data was therefore estimated as follows: the volume produced and exploited for commercial purposes, or for the in situ grazing of livestock and home consumption by local communities, was based on the mean production value for a surface unit according to the mean production of a tree and the density of cork oak stands. The opportunity costs associated with the collection of acorns, estimated in human labour units, were deducted from the sales value. The prices used (price paid to collectors) were based on surveys carried out during the socio-economic study performed for drawing up the development plan.

  The net benefit from cork oak acorn production in Maâmora, after deducting any costs, was calculated at €9.4 million. The collection opportunity costs were estimated at €1.1 million. The average net unit value after deducting the cost of labour is €0.37 per kg.

	Total net value (€)	Monetary valuation	
		€/kg	€/ha
Collection costs	1,125,694	0.04	15.95
Value of acorns	9,404,530	0.37	133.26

- **Nectar:** nectar production was calculated using analysis of two beekeeping methods (modern and traditional). The value of nectar was obtained from the market price of eucalyptus honey, which is the leading product in Maâmora (Baseline year: 2013). The economic value of nectar was calculated using the sale price, after deducting the production costs and depreciation costs of all investments for an average sized unit for each production method.

  In Maâmora, the production of nectar used for honey production can generate an average annual benefit of €6 million (i.e. €25.33 per ha), which varies according to the climate conditions, with a minimum value of €4.6 million (€19.40 per ha) and a maximum value of €6.7 million (€28.40 per ha).

- **Acacia bark tannin:** the economic value of the tannin contained in acacia bark was calculated by finding the difference between the sale price of bark on the wholesale market and all intermediary costs and fees. The tannin concentration in the bark was calculated from the estimated volume of bark using an econometric model. Tannin was not really exploited during the baseline year (2015), so the quantities produced were estimated. The residual value of bark after extracting the tannin was considered zero given that there is no further exploitation.

  Acacia tannin production was calculated at a total volume of 486.8 T for 2015, generating a total net benefit of €128,949. The unit value of tannin is €269.60 per T, with a value varying from €36.50 per ha to €37.90 per ha depending on the age of the trees in the various acacia plantations in Maâmora.

- **Recreation :** the three most visited sites in the forest were assessed: Sidi Amira, Saknia and Taïcha. The travel cost method was used to estimate the individual surplus and the individual surplus per visit. The total economic value of recreation was calculated using the estimated number of visitors on each site during the baseline year (2015).

  Exploitation of Maâmora for recreational purposes was assessed by calculating the consumer surplus, which is at €28.60 per visit on the Sidi Amira site, €7 per visit on the Saknia site and €3.40 per visit on the Taïcha site. Annual visits to the three sites generate a total benefit of €120 million for Sidi Amira, €3.4 million for Saknia and €4.5 million for Taïcha.

Item name	Values (€)		
	For the modern "Sed" method	For the modern "Trshm" method	For the traditional method
Total number of hives	4 145	461	249
Total forest surface area (Eucalyptus)	21 866		
Unit value of nectar (€ per kg of honey)			
Mean value	2,9	2,8	1,9
Minimum value	2,2	2,2	-1,1
Maximum value	3,2	3,2	5,3
Total value of nectar in Maâmora (€/year)			
Mean value	5 776 351	211 778	25 725
Minimum value	4 467 926	162 237	-14 473
Maximum value	6 430 564	236 548	71 665
Total value of nectar for the entire Maâmora forest (€ per year)			
Mean value	6 013 854		
Minimum value	4 615 690		
Maximum value	6 738 778		

Cost-Benefit Analysis (CBA) of management scenarios

Forest management scenarios selected

Analysis used a scenario which assumed the implementation of all planned management and development operations over a 20-year period (2016-2035). The approach used was the with and without projects approach. The profitability indicators calculated are the internal rate of return, the net present value and the ROI. Future cost-benefit ratios are also calculated to provide an idea of the future progression of these ratios. The sensitivity of the net present value depending on the choice of discount rate is suggested to calculate the potential difference between the various possible rates (3%, 5%, 6% and 10%).

Management options selected:

- Baseline scenario: progression without a development plan
- Alternative scenario: progression with development and managementL'analyse des scénarios de gestion par la méthode des Coûts-Bénéfices

Cost-benefit analysis of the forest management scenarios

Cost-benefit analysis demonstrates that the planned management and development in Maâmora for the next twenty years (2016-2035) could have guaranteed profitability if all goods and services are considered.

The rate of return for a single investment can vary from 30% if only cork and wood production is taken into account, to 188% if six other goods and services are taken into account. The net discounted value of a present investment of €9.5 million increases from €11.2 million to €295 million at this same discount rate.

Calculating forest goods and services other than wood and cork also better reflects the proportionality of costs with regard to the benefits of a development project. The benefit-cost ratio falls from around 60% to 2% or 3% when the total value of goods and services is taken into account.

Cost-benefit analysis illustrated the contribution of forest management and development operations in terms of benefits and also demonstrated the benefit of calculating goods and services that are usually neglected or not quantified. The results obtained reveal that, for Maâmora, taking these goods and services into account demonstrated significant profitability.

RECOMMENDATIONS AND MAIN LESSONS LEARNED

Study contributions and limitations

Many lessons can be learned from the assessment. It showed that the net value of forest goods and services is high despite significant expenses and high operating and marketing costs. Therefore, as in the example of truffles, where declarations by collectors may be exaggerated, it is important to encourage research to improve knowledge and produce more precise and reliable data.

The choice to differentiate between types of wood (industrial wood, timber, firewood) and cork (virgin cork and reproduction cork) proved useful in making estimations more precise and in recording changes in the economic value of these ecosystem services at different stages of forest stand growth. This could lead to suggestions to substantially improve forest management with an approach that takes into account the production of benefits from the various forest goods and services.

ASSESSMENT STRENGTHS

- Study coincides with drawing up of the Maâmora Development Plan and Management Plan;
- Cooperation and availability of the various HCEFLCD departments;
- Organisation of various information-sharing and discussion meetings with other project components.

ASSESSMENT LIMITATIONS

- Relative precision of estimations in the absence of sufficiently precise data (biophysical and bioclimatic links, etc.);
- Difficulty developing a realistic scenario without development, while precisely taking into account all the details associated with development and management for a scenario with project;
- Difficulty quantifying the real consumption of some G&S due to their nature or illegal consumption.

How economic assessment of goods and services could impact decision-making and public policies?

The assessment shows us that understanding of the development and management work in Maâmora can be considerably improved by calculating the goods and services produced. The results can serve as a basis for arguing in favour of attracting the funding needed to conserve and improve the forest. Identifying the benefits and beneficiaries will also help better organise and manage the exploitation of forest products in order to strike a compromise between sustainable forest management and improved revenues for the rural population. This requires judicious development and management decisions, which assumes that operations are optimised so as to maximise the economic value of the various forest goods and services. Introducing monitoring of the production of forest goods and services, periodically updating the economic values and standardising assessment methods at a national level for the most important goods and services could open up opportunities for new, much more inclusive, forms of governance and the implementation of incentive tools for sustainable management and improved ecological conditions for forest ecosystems. Payment for Environmental Services (PES) is an example of a tool with a high chance of success.

For more information please see full publication:

El Mokaddem A. (2016). *Estimation de la valeur économique et sociale des services rendus par les écosystèmes forestiers méditerranéens, Forêt de la Maâmora, Maroc*. Plan Bleu, Valbonne.

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