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From failure to value: economic valuation for a selected set of products and services from Mediterranean forests

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Abstract

Aim of study: the paper estimates the economic value of a selected range of forest products and services, i.e. roundwood, non-wood forest products (NWFPs), and carbon-related services.

Area of study: the research covers 21 Mediterranean countries, distinguished into four sub-regions.

Material and methods: data have been gathered from official statistical sources (e.g. FAOSTAT), scientific literature and technical reports. Different estimation approaches based on market-price have been used for different products/services.

Main results: the estimated value ranges between €10,512 and €11,158 million (M). Wood products represent more than 85% of the total value. Within them, industrial timber is the most relevant component (65%). Figures for NWFPs are likely to be underestimated because data are available only for some products and countries. When using alternative estimates for pine nuts, pine resin and cork, figures show a €36.8-572 M increase. In geographical terms, the economic value of Mediterranean forests is highly concentrated: North-West Mediterranean countries account for 70%, and nearly 90% is in just four countries (France, Spain, Turkey and Italy).

Research highlights: enhancing the offer of Mediterranean forest products and increasing their role in the rural economy could help to reduce the costs of forest protection: a well-structured forest economy ensuring stable flows of incomes can provide a fundamental set of public non-market services and social values to both local people and the whole community. Understanding the true value of natural resources, then, is an essential step for promoting their protection and sustainable use.

Keywords: timber; firewood; non-wood forest products; carbon; estimate; green accounting.

Abbreviations: Bln: billion; CUM: cubic meter; EM: East Mediterranean; FAO: Food and Agriculture Organisation of the United Nations; FRA: Forest Resource Assessment; ha: hectare; M: million; NEM: North-East Mediterranean; NWFP: non-wood forest product; NWM: North-West Mediterranean; SM: South Mediterranean.

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Introduction

Forests are critically important ecosystems in relation to the multitude of services they provide. Some of these services (e.g. timber and some non-wood forest products, NWFPs) are formally or informally traded on the markets and generate direct income to forest owners/managers, while others (e.g. watershed protection, carbon fixation, soil creation, biodiversity conservation) have limited or no market access. Nevertheless, they are very important for the functioning of the forest systems and human well-being. In economic terms they are a public good and often qualify as ex-

ternalities too, and economists normally refer to them as examples of 'market failures' (Samuelson, 1954; Coase, 1960; Buchanan, 1988). Assigning a proper value to ecosystem services is functional to the management and maintenance of ecosystems that provide them (MEA, 2005). On the contrary, the failure in assigning proper values to forest services may result in ecosystem degradation or the abandoning of management activities: while users might be encouraged towards free riding (Engel *et al.*, 2008), owners/managers might manage resources below the social optimum (Coase, 1960; Pearce & Turner, 1990). The ultimate consequence may be a consistent loss of public values.

Within the international forest context, the above dynamics characterise forest resources and landscapes in the Mediterranean basin. Interrelations between natural resources and major landscapes in the region, and the human activities that have been shaping them for thousands of years are closer than in any other area in the world (Thirgood, 1981; Pons & Quézel, 1985; Matvejevic, 1999; Abulafia, 2011). The relationship between humans and the Mediterranean forests has developed over time, but anthropogenic activities have very often led to overexploitation, with negative impacts in terms of resource depletion (Thirgood, 1981; Tsoumis, 1986; Garavaglia & Besacier, 2014.). Many potential drivers for land use change and forest degradation can be mentioned, including the global climate change, the growing demographic pressure, the conversion of natural areas to farming and urban development, the introduction of invasive alien species, the pollution or over-exploitation of resources such as water and soils and the harvesting of wild plants and animals at unsustainable rates (Thirgood, 1981; Schröter *et al.*, 2005; Palahi *et al.*, 2008; Regato, 2008; UNEP/MAP-Plan Bleu, 2009; FAO, 2013a). In the South Mediterranean sub-region the ecosystems - fragile and vulnerable due to the reigning environmental and climatic conditions - are particularly exposed to increasing human pressure of clearing and cultivation in marginal lands, overexploitation of firewood and overgrazing. Although for several centuries Mediterranean forests have demonstrated their strong resilience to changes of human origin (Regato, 2008; FAO, 2013a), they are today characterised by common features of fragility, instability and frequent degradation (M'Hirit, 1999; Palahi *et al.*, 2008). Pressure on forests is sometimes connected to illegal practices. Relevant illegal logging levels are reported for many Mediterranean countries, including the most forested ones such as Turkey (Gunes & Elvan, 2005) and Morocco. Figures on illegal practices are mostly available via informal channels¹ and empirical evidence suggests these processes can strongly affect local forest resources, in terms of both quality and quantity. Evidence of illegal practices has also been reported for many North-East Mediterranean countries, including Albania, Bosnia and Herzegovina and Serbia (Buriad, 2005; Markus-Johansson *et al.*, 2010). Illegal harvesting is normally not discussed as an issue in North-West Mediterranean countries where forest crimes seem to be a negligible problem (Ottitsch *et al.*, 2007), nevertheless Pettenella *et al.* (2012) have highlighted that illegality might also strongly affect the forestry sector in this region

and does not just involve wood harvesting. Moreover, recent occurrences, ranging from the global financial crisis, to the dramatic events that took place during the 'Arab spring' and the Syrian civil war strongly affected the natural resources of some countries in the region. In addition to booming demographics and food insecurity due to global changes (Werrel & Femia, 2013), also these events had huge actual impacts on forests and their conservation.

Mediterranean forest products and services have represented a fundamental factor in the life of local inhabitants for centuries, but few studies have focused on them on a large scale, (UNEP/MAP-Plan Bleu, 2009; FAO, 2013a) especially with regards to Southern areas. Although Mediterranean forests are now gaining in relevance on the international policy and research agenda (Besacier, 2014), little attention has been given by international organizations and individual scholars to the economic evaluation of their role in providing basic market goods and services. This lack of interest might be connected with the declining role of market products, which - however - when linked to sustainable practices could play an important role to reduce the costs of forest protection and maintain natural resources able to provide a fundamental set of public services and social values to both local and global communities. A first valuation of the Total Economic Value (TEV) of Mediterranean forests was performed by Merlo & Croitoru (2005) and estimated an average value of 133 €/ha, with huge differences among services and countries. Although that work can still be considered as the most complete study trying to evaluate TEV for Mediterranean forests, the editors themselves recognised that the estimate was '[...] a substantial underestimate as important forest benefits [were] not estimated for many countries' (p.61). New elements have also appeared since it was published, including: new forest/ecosystem valuation studies and projects at national and international scale (e.g. MEA, 2005; Braat *et al.*, 2008; Chiabai *et al.*, 2009; Kumar, 2010), more recent FAO forest data at international (FAO, 2010a) and Mediterranean level (FAO, 2013a), growing attention on ecosystem services and their emerging markets (e.g. the Payments for Environmental Services schemes - Wunder, 2005), the greater relevance of Mediterranean forests in the international policy and research agenda (Palahi *et al.*, 2008; Besacier, 2014), and changes in international environmental accounting frameworks (UNSTATS, 2011).

This paper aims to give an up-to-date picture of the state of Mediterranean forest resources, and estimations

¹ See for example: The Independent, 10th May 2011, Cedar mafia threatens Morocco's cherished wood.

of the economic value for a selected set of Mediterranean forest products (timber and NWFPs) and services (carbon-related services). The paper does not aim to estimate the TEV for Mediterranean forests and is not taking into consideration some of the potential direct (e.g. hunting, grazing, recreation, etc.) and indirect (e.g. watershed protection, soil formation, etc.) use values, as well as non-use values (e.g. biodiversity). While all of them are recognised as values of paramount importance, the rationale of the study is to provide some preliminary estimations with regard to both traditional products and products/services that are currently outside the market. Future research is needed to complete TEV computation and include further values.

Materials and methods

In line with the etymology of the word ‘Mediterranean’, which derives from the Latin *medius terrae*, i.e. surrounded by land, and following the approach adopted by the UNEP/MAP Plan Bleu initiative, the Mediterranean Action Plan (MAP) (1975) and the related Barcelona Convention (1976) promoted by UNEP, the Mediterranean region has been considered as made up of the twenty-one countries bordering the Mediterranean sea and falling within the limits of the Mediterranean bioclimatic domain as well as the Mediterranean catchment area. It should be specified that due to the lack of specific and reliable data on Mediterranean

forest ecosystems, the paper deals with forests in Mediterranean countries rather than Mediterranean forest types *sensu stricto*.

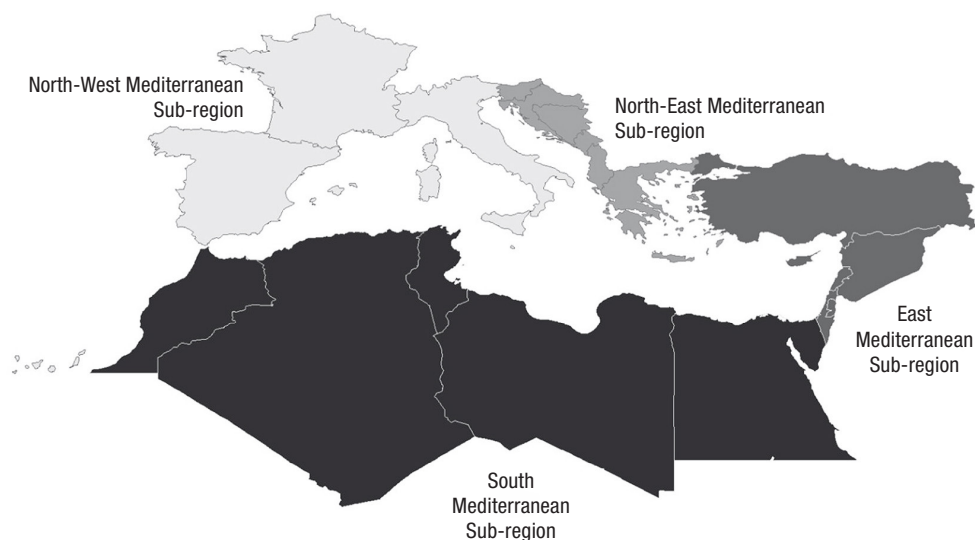
The twenty-one countries have been grouped into four sub-regions (Figure 1)¹:

- Southern Mediterranean (SM), i.e. Algeria, Egypt, Libya, Morocco and Tunisia;
- Eastern Mediterranean (EM), i.e. Cyprus, Israel, Occupied Palestinian Territories, Syria and Turkey;
- North-Eastern Mediterranean (NEM), i.e. Albania, Bosnia and Herzegovina, Croatia, Greece, Montenegro and Slovenia;
- North-Western Mediterranean (NWM), i.e. France, Italy, Malta and Spain.

Table 1 provides a summary of the different methodologies adopted for the valuation of the selected products and services: additional information is provided below. For all selected products and services average annual flows were computed and monetary values were converted into €2010 values.

a. Roundwood

Data for the product aggregate ‘Roundwood’ have been gathered from FAO FORESTAT database for the 1990-2010 period. The aggregate includes all round-



Source: own elaboration.

Figure 1. Mediterranean sub-regions as defined within the scope of the paper.

² Due to their small size, negligible relevance in forestry terms and lack of detailed information regarding the forest sector, states like Monaco, San Marino and Vatican City have not been included as such: it can be assumed they are covered by data referring to France and Italy respectively. The same considerations can be made for Andorra (France and Spain) as well as for territories like Gibraltar (Spain), Ceuta and Melilla (Morocco), and Akrotiri and Dhekelia (Cyprus).

Table 1. Overview of different valuation methodologies and sources used in the study

Product/Service	Short description	Methodology	Main sources
Timber and firewood	Roundwood, i.e. all roundwood felled or otherwise harvested and removed	Market price (Giergiczny <i>et al.</i> , 2008)	FAO FORESTAT
NWFPs	NWFPs as categorised by FAO FRA 2010	Market price	FAO 2010 National Reports and additional literature
Carbon	Average annual carbon-stock capacity in above- and below-ground biomass.	Market price	FAO, 2010a; Peters-Stanley <i>et al.</i> , 2013; van den Bijgaart <i>et al.</i> , 2013

Source: own elaboration.

wood reported as felled or otherwise harvested and removed (FAO, 2013b). It comprises all wood obtained from removals, i.e. the quantities removed from forests and from trees outside the forest, including wood recovered from natural losses, felling and logging during the period, calendar year or forest year. In the production statistics, roundwood is inclusive of the following categories: (a) “Wood Fuel, including Wood for Charcoal”, (b) “Sawlogs and Veneer logs”, (c) “Pulpwood, Round and Split”, (d) “Industrial Roundwood - Wood in the Rough” and (e) “Other Industrial Roundwood”. In the trade statistics, the aggregate represents the sum of: “Industrial Roundwood-Wood in the rough”, and “Wood fuel, including wood for charcoal” (FAO, 2012). For the purposes of this paper a general distinction was made into two broad categories, i.e. *firewood* (Roundwood category a) and *timber* (Roundwood categories b to e). Some adjustments were made for the following countries/areas:

- Egypt: annual firewood production data reported by FAO (2013b) for the 1990-2010 period indicate a production level ranging between 14 and 17.5 million cubic meters (MCUM). It is believed such data are largely overestimated, because the forest area in Egypt is very limited (70,000 ha) and reported figures would result in an annual production level of twice the total growing stock of the country as reported by FAO (2010a). Therefore, firewood production for Egypt was estimated by calculating the yearly average firewood *pro-capita* consumption for SM sub-region and multiplying this value by the corresponding Egyptian population figures reported by FAO (2013b). This estimate was repeated for every single year between 1990 and 2010;
- Former Yugoslavia Socialist Federal Republic (SFR) member countries: 1990 and 1991 data have been estimated on the basis of average figures, taking into consideration the total figures for Yugoslavia SFR as reported in FAO (2013b)

and dividing them proportionally among different countries. For this purpose, average relative proportions were calculated on the basis of post-1992 figures. For Montenegro, data have been calculated based on 1993-2005 figures for Serbia and Montenegro, considering the average proportion of Montenegro and Serbia figures for 2006-2010.

The economic value of roundwood production has been estimated according to the two-step approach described in (1):

$$TV_i = \frac{1}{2} \sum_{k=1}^{20} \left[\left(\frac{EV_k}{Eq_i} + \frac{IV_k}{Iq_i} \right) \cdot P_i \right] \cdot \frac{1}{20} \quad (1)$$

where:

TV_i = total value by country i
 EV_k = roundwood export value per year k by country i
 Eq_i = roundwood export quantity per year k by country i
 IV_k = roundwood import value per year k by country i
 Iq_i = roundwood import quantity per year k by country i
 P_i = annual roundwood quantity produced in country i, distinguishing between timber and firewood
 i = country
 k = year

(i) unit values (i.e. Euro per m³) were computed for the period 1990-2010 according to the approach adopted in the EXIOPOL project and reported by Giergiczny *et al.* (2008). This corresponds to average of the export and import value of the product. Since results showed oscillations over time and to avoid the problem of selecting one year as the representative one, an average value was computed for the selected period and used for further calculations; (ii) average unit values were calculated separately for timber and firewood and then used to calculate the value of total production per country, according to annual roundwood quantity pro-

duced in each country. Total values (TV_i) were finally divided by forest area in each country as reported by FAO (2010a), in order to obtain unit values per hectare and year.

Reference to import/export values was not intended to neglect domestic timber markets, rather to assure reference to a common source and comparable figures. Furthermore data on domestic removals provided by national statistics are sometimes not reliable since they might strongly underestimate removed volumes (FAO 2010b). Finally, this approach is consistent with the Law of One Price that has been tested for forest product trade (Buongiorno & Uusi-vuori, 1992; Jung & Torodian, 1994; Chander *et al.*, 2006) including the roundwood market in Mediterranean countries (Zafeiriou *et al.*, 2012). Moreover, there is empirical evidence of a well integrated regional market both for timber and firewood products (e.g. between Italy and Spain, or between Italy and many Balkan countries): although the Mediterranean region is a net importer of wood and wood products, internal exchanges exist and mostly involve roundwood (FAO, 2013a).

b. NWFPs

Production data (quantity and value) on NWFPs were collected from FAO Forest Resource Assessment (FRA) 2010 national reports and converted into €2010 using Euro foreign exchange reference rates provided by the European Central Bank. Data were classified according to the 16 NWFP categories identified by FAO FRA 2010. However FAO FRA data for NWFPs only date back to 2005, cover just fourteen out of twenty-one countries within the region and seem to be incomplete or slightly unclear for some product categories. For example data for argan oil in Morocco are missing, data for pine resin are reported only for Spain and data for cork are reported under different NWFP categories, depending on the country. In the light of this, and assuming there is a risk that data on NWFPs are underestimated, additional estimates have been performed for three selected NWFP categories - i.e. pine nuts, pine resin, and cork - by means of data and information available from the existing literature. For the purposes of this an extensive literature review was conducted to identify papers, studies and reports on pine nuts, pine resin, and cork production and trade in Mediterranean countries. Grey literature was included as well. Results from this additional review were then summarised and analysed, and compared to data gathered from FAO FRA 2010 national reports.

c. Carbon

The value of carbon was calculated taking into consideration the average annual change of carbon stock in living biomass (above and below soil) during the 1990-2010 period (FAO, 2010a). Annual carbon stock variations were corrected using a biomass expansion factor (BEF) equal to 1.35 for conversion of merchantable volume to aboveground tree biomass. This value is consistent with average BEF values for temperate conifer and broadleaved forests recommended by IPCC (2006).

A price range for carbon credits was identified considering a lower value, taken from Ecosystem Marketplace's State of the Forest Carbon Markets (Peters-Stanley *et al.*, 2013) as 2011 average price on global markets converted into €2010 (on average: €4.18/tCO₂e), and a higher value taken from van den Bijgaart *et al.* (2013) as the median social cost of carbon (€15/tCO₂e). The second value coincides with the mean unit value assumed by Merlo & Croitoru (2005).

The total value for carbon at country level was then computed by multiplying the average annual change of carbon stock by the abovementioned price levels: as a consequence for each country a maximum and minimum total value were identified.

Results

Altogether the 21 countries/territories included within the research cover about 858.3 Mha, i.e. 6.6% of land worldwide, with a population of nearly 495 M people, equivalent to 7.2% of the total world population (FAO, 2013a; UN, 2013). The study area contains a variety of forest types growing on a combined area of more than 74 Mha and covering about 9% of the land in the region (FAO, 2010a).

In recent times forest land cover dynamics have shown different patterns in Northern and South-Eastern Mediterranean countries: while forests in the North are expanding mostly because of the abandoning of marginal areas and agriculture practices, in the South-East human pressure in terms of forest degradation due to direct consumption of forest goods is still very high. As a result, forest area distribution is uneven across the Mediterranean. Around 73% of forests are concentrated in the Northern sub-regions (58% just in the NWM sub-region), while 16% lie in the EM and nearly 11% in the SM sub-regions. More than 63% of the total forest area is in only four countries of the Northern sub-regions: Spain, France, Italy and Greece. Outside these areas, Turkey and Morocco are the only countries with relevant forest areas: they represent

more than 80% of the forest cover outside the Northern sub-regions, with Turkey alone having around 92% of the overall forest area in the EM sub-region.

Differences in distribution of forests reflect on different concentration of forest biomass and stocks. The Northern sub-regions contain nearly 79% of the total wood volume and 75% of the total biomass in the Mediterranean basin. These high stock figures are partly due to the fact that many of the countries in the Northern sub-regions (e.g. Croatia, France, Italy, Slovenia and Spain), include relevant areas of temperate forests. NWM sub-region also accounts for more than 54% of the total carbon stock in living forest biomass: if Turkey is included this figure rises to 74% (FAO, 2010a). With few exceptions, in both SM and EM sub-regions forests mainly consist of sparse, pre-desert shrub vegetation, with low wood volume and biomass. Excluding Morocco (11%), the SM sub-region has the lowest forest cover rates: 0.6% for Algeria, around 0.1% for Libya and Egypt. The higher rates can be found in the Balkans - Slovenia with 62%, Bosnia and Herzegovina 43% and Montenegro 39% - and in Spain (36%). Outside the Northern sub-regions no country has a forest cover rate higher than 20%, while only four (Cyprus, Turkey, Lebanon and Morocco) have more than 10%.

According to FAO (2013a) there was no significant net change in the total area of Mediterranean forests between 1990 and 2005. This trend is generally confirmed by the FAO FRA data for the 1990-2010 period (FAO, 2010a). During the last twenty years almost all the countries in the Northern sub-regions experienced a huge increase in forest area, with annual rates of up to 1% (or even higher) for Italy and Spain. This is related to a decline of agriculture and grazing activities, and the consequent abandonment of marginal areas that are being colonised by new forest formations. Another reason for the increasing trend is due to reforestation campaigns, especially in flat areas and new forest plantations for both protective and productive purposes. Exceptions can be found in some NEM countries: Albania and, to a certain extent, Bosnia and Herzegovina show a decline in their forest area that is particularly evident in the 1990-2000 period. Apart from few cases (Algeria and - for 2005-2010 - Israel), FAO figures confirm an increase in forest areas also for SM and EM sub-regions.

However, although the global picture shows a stable to expanding trend in forest area, the considerable gains and losses detected at lower scale indicate that forest cover in the Mediterranean area is evolving (FAO, 2013a). Overuse, fires, overgrazing, illegal logging and competition from other forms of land use hamper productivity and reduce the environmental services pro-

vided by the region's remaining forests. Over the past two decades, Algeria lost more than 10% of its forest cover (Van Acoleyen & Khelladi, 2011) and its deforestation rate was 0.6% per year during 2005-2010 (FAO, 2010a). In many countries, forest degradation is likely to be a more important problem than deforestation (CIFOR, 2009). Overall, the cost of deforestation and forest degradation can be high: 0.2% of the GDP in Morocco (Ellatifi, 2005). While land use change and related forest degradation are more evident in Southern Mediterranean countries (Croitoru & Liagre, 2013), similar dynamics can be observed in Northern ones. For example, Marchetti *et al.* (2012) reported about 7,000 ha of forest-lands converted annually into other land uses in Italy during the 1990-2008 period.

The provision of products and services by Mediterranean forests is consistent with the described state of forest resources, confirming, as it will be seen in the following pages, a dualism in the structure of Mediterranean forestry also in terms of economic importance of the supply of forest goods.

a. Roundwood

On average a total of 139.8 MCUM were produced every year between 1990 and 2010. Total production slightly decreased (-3%) as the net result of a 7% increase in timber and 10% decrease in firewood. The proportion between timber and firewood production changed over time: in the early nineties around 50% of the overall wood production in the region was for firewood, but this then decreased in both absolute and relative terms. Since 1994 timber production has exceeded firewood and in 2010 about 125 MCUM of roundwood were produced, 55% of which was timber and 45% firewood. This amount is equivalent to less than 2% of the total growing stock in the region. More than 62% of wood production is concentrated in NWM countries that play a leading role with regard to both timber (64% of overall production in the area) and firewood (62%). About 82% of timber production is based in three countries only –France, Spain and Turkey– while four countries –France, Algeria, Turkey, and Italy– account for 85% of firewood production

The estimated total value for roundwood production in the Mediterranean region is €9,440.36 M (2010), 76% of which is industrial timber. The average unit value is €136.28/ha, corresponding to €104.17/ha and €32.11/ha for industrial timber and firewood respectively. For the overall roundwood category, the EM (€158.15/ha) and NWM sub-regions (€150/ha) show the highest average unit values, while the SM sub-region the lowest (€40.71/ha) (Table 2).

Table 2. Estimated value of selected forest products and services in Mediterranean countries/sub-regions (2010), €1,000

Countries and sub-regions	Roundwood		c. NWFP	d. Carbon		Total (Tot = a + b + c + d)				Unit value (€/ha)	
	a. Timber	b. Firewood		(A) €4.18/tCO _{2e}	(B) €15/tCO _{2e}	(A)		(B)		(A)	(B)
			Total			%	Total	%			
Algeria	12,150.76	135,689.24	3,025.56	-2,257.20	-8,100.00	148,608.36	1.41%	142,765.56	1.28%	99.60	95.69
Egypt	3,142.94	28,777.06	1,001.72	846.45	3,037.50	33,768.17	0.32%	35,959.22	0.32%	482.40	513.70
Libya	13,735.65	15,794.35	na	na	na	29,530.00	0.28%	29,530.00	0.26%	136.08	136.08
Morocco	44,069.13	6,820.87	7,462.56	9,310.95	33,412.50	67,663.51	0.64%	91,765.06	0.82%	13.19	17.88
Tunisia	25,816.94	36,253.06	7,933.60	846.45	3,037.50	70,850.05	0.67%	73,041.10	0.65%	70.43	72.61
SM	98,915.42	223,334.58	19,423.44	8,746.65	31,387.50	350,420.09	3.33%	373,060.94	3.34%	44.27	47.13
Cyprus	624.59	65.41	85.34	na	na	775.34	0.01%	775.34	0.01%	4.48	4.48
Israel	2,933.06	36.94	na	na	na	2,970.00	0.03%	2,970.00	0.03%	19.29	19.29
Lebanon	839.30	340.70	33,779.59	na	na	34,959.59	0.33%	34,959.59	0.31%	255.18	255.18
Syria	4,681.61	508.39	na	na	na	5,190.00	0.05%	5,190.00	0.05%	10.57	10.57
Turkey	1,846,894.13	87,965.87	980.15	38,372.40	137,700.00	1,974,212.55	18.78%	2,073,540.15	18.58%	174.18	182.95
EM	1,855,972.69	88,917.31	34,845.08	38,372.40	137,700.00	2,018,107.48	19.20%	2,117,435.08	18.98%	164.10	172.18
Albania	5,130.22	8,449.78	4,296.71	na	na	17,876.71	0.17%	17,876.71	0.16%	23.04	23.04
Bosnia and Herzegovina	150,935.16	30,414.84	21,968.77	6,207.30	22,275.00	209,526.07	1.99%	225,593.77	2.02%	95.89	103.25
Croatia	219,349.49	25,490.51	1,214.52	17,775.45	63,787.50	263,829.97	2.51%	309,842.02	2.78%	137.41	161.38
Greece	60,784.93	19,185.07	na	3,385.80	12,150.00	83,355.80	0.79%	92,120.00	0.83%	21.36	23.60
Montenegro	13,334.88	3,765.12	na	na	na	17,100.00	0.16%	17,100.00	0.15%	31.49	31.49
Slovenia	118,069.44	26,650.56	8948.96	17,493.30	62,775.00	171,162.26	1.63%	216,443.96	1.94%	136.60	172.74
NEM	567,604.12	113,955.88	36,428.96	44,861.85	160,987.50	762,850.81	7.26%	878,976.46	7.88%	72.10	83.08
France	3,050,401.43	1,421,518.57	103,621.81	68,562.45	246,037.50	4,644,104.26	44.18%	4,821,579.31	43.21%	291.09	302.22
Italy	251,416.27	262,813.73	245,622.02	51,633.45	185,287.50	811,485.47	7.72%	945,139.52	8.47%	88.70	103.31
Spain	1,370,768.91	134,691.09	382,498.36	37,525.95	134,662.50	1,925,484.31	18.32%	2,022,620.86	18.13%	105.95	111.30
NWM	4,672,586.61	1,819,023.38	731,742.19	157,721.85	565,987.50	7,381,074.03	70.21%	7,789,339.68	69.80%	170.56	179.99
Total Mediterranean	7,195,078.84	2,245,231.15	822,439.67	249,702.75	896,062.50	10,512,452.41	100.00%	11,158,812.16	100.00%	141.93	150.65

na = not available; no data available for Malta and the Occupied Palestinian Territories.

Source: own elaboration.

The total value for roundwood production in the Mediterranean region fluctuated over time with different trends in the sub-regions. SM sub-region remained more or less stable in 2005 and 2010, with a slight decrease (-1.3%) with respect to the 1990 estimated value. EM sub-region is the only one with a continuous positive trend for both unit and total value. The role of Turkey strongly influenced this: it is the only country to have expanding values without any flexion, with a huge increase between 2005 and 2010. All the other countries in the sub-region showed decreasing unit values over time, reflected by diminishing or stable total values. The relative incidence of the EM sub-region on total Mediterranean wood production value doubled between 1990 and 2010, passing from 10 to 20%. NEM countries showed a decreasing trend between 1990 and 2005, with a slight recovery between 2005 and 2010. As regards NWM countries, they showed a decreasing (-24%) trend for unit values between 1990 and 2010. The total value for the sub-region increased between 1990 and 2000, then diminished between 2000 and 2005 followed by a slight increase

between 2005 and 2010. The relative incidence of the NWM sub-region on total Mediterranean wood production value reflects its dominant position in terms of total production. The incidence, however, remained stable (75%) between 1990 and 2000, then diminished to 67% in 2010.

b. NWFPs

The estimated total value for NWFP production by Mediterranean forests is €822.4 M. About 90% of this is concentrated in the NWM sub-region, with Spain, Italy and France being by far the most important producers (Table 2). Outside the NWM region Lebanon and Bosnia and Herzegovina are the only countries contributing more than 2% of the total regional production value. On average the unit value corresponds to €11.96/ha, ranging from €16.91/ha for the NWM to €2.52/ha for the SM sub-region. As regards the contribution by single product categories, acorns and nuts³ represent more than 25% of the total value, followed by animal

³ i.e. chestnuts and hazelnuts.

products⁴ (21%), cork (15%), mushrooms and truffles (15%), and honey (12%). In general product types are differently distributed among sub-regions: for example aromatic and medicinal herbs, as well as nuts, are relevant in the EM sub-region, while cork is concentrated in SM and NWM sub-regions, and animal products are mainly in NEM and NWM sub-regions (Table 3).

The total value estimated for NWFPs corresponds to 9% of the total value estimated for timber production. Relative figures, however, change from country to country. Lebanon shows the highest relative incidence of NWFPs (97%) - mostly due to the low value of domestic timber production. Apart from Lebanon, only Italy and Spain show relative values higher than 20%, while just ten countries show relative values higher than 10%. When comparing the incidence of NWFPs on the value of industrial timber production only, relative figures can be very high. Forest Europe (2011), for example, reported percentages higher than 150% for Italy and 50% for Spain.

Alternative estimates were performed for pine nuts, pine resin and cork based on the available literature (Table 4). For pine nuts (*Pinus pinea*) two production scenarios have been assumed, i.e. the minimum (based on INC, 2012) and maximum (based on Mutke *et al.* 2012). In the case of Lebanon reference has been made to Sfeir (2011). The total value for pine nuts in the shell ranges between €8.3 M and €30 M, while that of shelled pine nuts is between €83.8M and almost €454.8 M. Considering current retail prices, the same quantities would correspond to a total value ranging between €258.7 M and €1,127.5 M. With regard to 2005 figures, FAO estimated a total value of €48.7 M for pine nuts produced by four Mediterranean countries (i.e. Italy, Lebanon, Spain and Turkey). This value is quite close to estimates made assuming the minimum production scenario for the same countries, but almost 8 times lower than those made according to the maximum production scenario. As regards the relative importance of producing countries, Lebanon and Tunisia show the best performance within the minimum production scenario, while Spain leads under the maximum production scenario. In the case of Tunisia the economic value of Aleppo pine nuts should also be included, with some additional €1.38 M.

For resin production, CESEFOR (2009) figures were used for Spain and SFS (2012) for Greece and Turkey. No data have been found for Italy or France. Results indicate a total value of between €2.6 M and €3.2 M. With regard to 2005 figures, FAO estimated a total value of €0.9 M at Mediterranean scale, reporting data only for Spain. This value is between 2.8 and 3.5 times

lower than the estimate made according to data collected from the literature. It should be underlined that data for Greece and Turkey are likely to be overestimated, because they refer to figures dating back to some years ago, but it should also be noted that potential production value is probably higher than the estimated one because only a minor part of potential pine forests are used for resin tapping. For example in the case of Spain, MAGRAMA (2011) reports that only 3.257 ha are exploited for production, i.e. less than 1% of total Maritime pine area in the country.

For the purposes of estimating cork production value in Mediterranean countries, quantities reported by APCOR (2012) were taken into consideration. A price range of €1-2.3/kg (APCOR, 2012) was assumed for France, Italy and Spain, while for North-African countries an average value of €0.35/kg was derived from Daly *et al.* (2012). Total cork production value would therefore range between €120.5 M and €261.9 M, with Spain responsible for 73 to 78% of the overall value. FAO 2005 figures estimated a total value of €163.3 M for cork within the Mediterranean region, covering France, Italy, Morocco, Spain and Tunisia. This value lies between those estimated according to alternative sources, being 1.3 times higher than the lower estimate and 1.6 times lower than the higher one.

c. Carbon

According to FAO (2010a) figures, in 2010 living biomass in Mediterranean forests stocked around 4Bln tons carbon⁵, i.e. on average 56 tons/ha. NWM sub-region accounts for more than 54% of the total: when adding Turkey this figure rises to 74%. Almost all countries in the region show a stable or positive variation of carbon stock during the 1990-2010 period. The only exception is Algeria that shows a decrease (-10%). Globally, the total forest carbon stock in the region increased by about 0.9 Bln tons between 1990 and 2010, at an average rate of 1.4% per year. This trend seems to be in contrast to the general decrease in world forest carbon stock during the same period, as well as the average process of sink saturation described by Nabuurs *et al.* (2013) for European forests. According to the latter, this saturation is the effect of a combination of factors, including increasing ageing of forests, reduced nitrogen deposition from the atmosphere and decreased summer air humidity, localised deforestation due to infrastructure expansion, and susceptibility to natural disturbances such as fires, storms and insects.

⁴ i.e. meat, skins and trophies.

⁵ Data for Lebanon, Occupied Palestinian Territories, Syria and Malta are not available.

Table 3. Estimated value of NWFPs in Mediterranean countries/sub-regions (2010), €1,000

Countries and sub-regions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	% on Total
Algeria	0.00	0.00	3,025.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,025.56	0.4%
Egypt	1,001.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,001.72	0.1%
Morocco*	0.00	0.00	582.18	0.00	0.00	0.00	0.00	6,880.38	0.00	0.00	0.00	0.00	0.00	6,880.38	0.00	7,462.56	0.9%
Tunisia	50.41	0.00	135.36	0.00	49.02	0.00	0.00	7,421.54	0.00	0.00	0.00	277.26	0.00	7,421.54	0.00	7,933.60	1.0%
SM	1,052.13	0.00	717.54	0.00	49.02	0.00	0.00	14,301.92	0.00	0.00	0.00	277.26	0.00	14,301.92	0.00	19,423.43	2.4%
Cyprus	0.00	0.00	0.16	0.00	0.00	0.00	0.00	85.18	0.00	0.00	0.00	0.00	0.00	85.18	0.00	85.34	0.0%
Lebanon	33,756.05	0.00	23.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33,779.59	4.1%
Turkey	767.16	0.00	0.00	0.00	0.00	2.12	0.00	0.00	0.00	210.87	0.00	0.00	0.00	0.00	0.00	980.15	0.1%
EM	34,523.21	0.00	23.70	0.00	0.00	2.12	0.00	85.18	0.00	210.87	0.00	0.00	0.00	85.18	0.00	34,845.08	4.2%
Albania	437.50	0.00	3,847.02	4.03	8.06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	4,296.71	0.5%
B. Herzegovina	16,057.18	0.00	5,745.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	165.95	0.00	0.00	0.00	21,968.77	2.7%
Croatia	49.62	0.00	1.24	0.00	0.00	115.67	0.00	371.70	0.00	344.43	331.00	0.86	0.00	371.70	0.00	1,214.52	0.1%
Slovenia	890.07	0.00	0.00	0.00	0.00	929.38	0.00	0.00	0.00	4,367.13	2,762.37	0.00	0.00	0.00	0.00	8,948.96	1.1%
NEM	17,434.38	0.00	9,593.91	4.03	8.06	1,045.06	0.00	371.70	0.00	4,711.56	3,093.37	166.91	0.00	371.70	0.00	36,428.96	4.4%
France	33,602.31	0.00	5,106.88	0.00	1,546.12	0.00	0.00	0.00	0.00	0.00	63,366.50	0.00	0.00	0.00	0.00	103,621.81	12.6%
Italy	237,161.47	0.00	0.00	0.00	8,460.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	245,622.02	29.9%
Spain	172,148.46	0.00	41.64	0.00	3.99	0.00	846.77	103,850.46	105,607.04	0.00	0.00	0.00	846.77	103,850.46	105,607.04	382,498.36	46.5%
NHM	442,912.23	0.00	5,148.52	0.00	10,010.66	0.00	846.77	103,850.46	105,607.04	0.00	63,366.50	0.00	846.77	103,850.46	105,607.04	731,742.18	89.0%
Total	495,921.95	0.00	15,483.66	4.03	10,067.73	1,047.18	846.77	118,609.26	105,607.04	4,922.43	66,459.87	444.17	846.77	118,609.26	105,607.04	822,439.65	100.0%
% on Total	60.3%	0.0%	1.9%	0.0%	1.2%	0.1%	0.1%	14.4%	12.8%	0.6%	8.1%	0.1%	0.1%	14.4%	12.8%	100.0%	

(1) Food; (2) Fodder; (3) Raw material for medicine and aromatic products; (4) Raw material for colorants and dyes; (5) Raw material for utensils, handicrafts & construction; (6) Ornamental plants; (7) Exudates; (8) Other plant products; (9) Living animals; (10) Hides, skins and trophies; (11) Wild honey and beeswax; (12) Wild meat; (13) Raw material for medicine; (14) Raw material for colorants; (15) Other edible animal products

Source: own elaboration from FAO, 2010.

Table 4. Alternative economic valuations for selected NWFPs from forests in Mediterranean countries (2010)

Source	Pine nuts ^(a)		Pine resin ^(b)		Cork ^(c)	
	Production (tons)	Value (M€)	Production (tons)	Value (M€)	Production (tons)	Value (M€)
FAO FRA 2010	16,545	48.7	1,705	0.9	101,428	163.3
Alternative Min	5,295	83.8	8,343	2.6	142,300	142.3
Alternative Max	18,992	307.7	9,821	3.2	142,300	327.3

Source: own elaboration from ^(a) Perez *et al.*, 2004; INC 2012; Mutke *et al.*, 2012 and 2013; Sfeir, 2011; Daly *et al.*, 2012; GDF, 2009; ^(b) IGN, 2013; Spanos *et al.*, 2010; CESEFOR, 2009; MAGRAMA, 2011; GDF, 2009; Satil *et al.*, 2011; ^(c) APCOR, 2012; Daly *et al.*, 2012.

The value of carbon was calculated taking into consideration the average annual change of carbon stock in living biomass during the 1990-2010 period (FAO, 2010a). It was decided to use this reference time frame in line with the approach used for timber products. It should be noted, however, that when considering the 2000-2005 period annual changes in carbon stock would result negative not only for Algeria, but also for Morocco and, as a consequence, for the entire SM sub-region. This suggests there could be a decline in carbon stocking capacity in the area due to forest degradation and clearing, and this trend would deserve special attention.

The total value of the carbon-related services provided by Mediterranean forests ranges between about €0.25 Bln and about €0.90 Bln, depending on the unit price (Table 2). More than 63% of the estimated value is concentrated in the NWM sub-region, with another 15% covered by the EM sub-region, i.e. Turkey. France and Italy together cover almost 50% of the overall value of the service, while, with the only exception of Morocco, the role of SM countries is very limited or -as in the case of Algeria- even negative. NEM sub-region contributes about 18% of the total value, mostly thanks to Croatian and Slovenian forests. As for unit value per hectare of forest, it ranges between €3.51/ha and €12.61/ha.

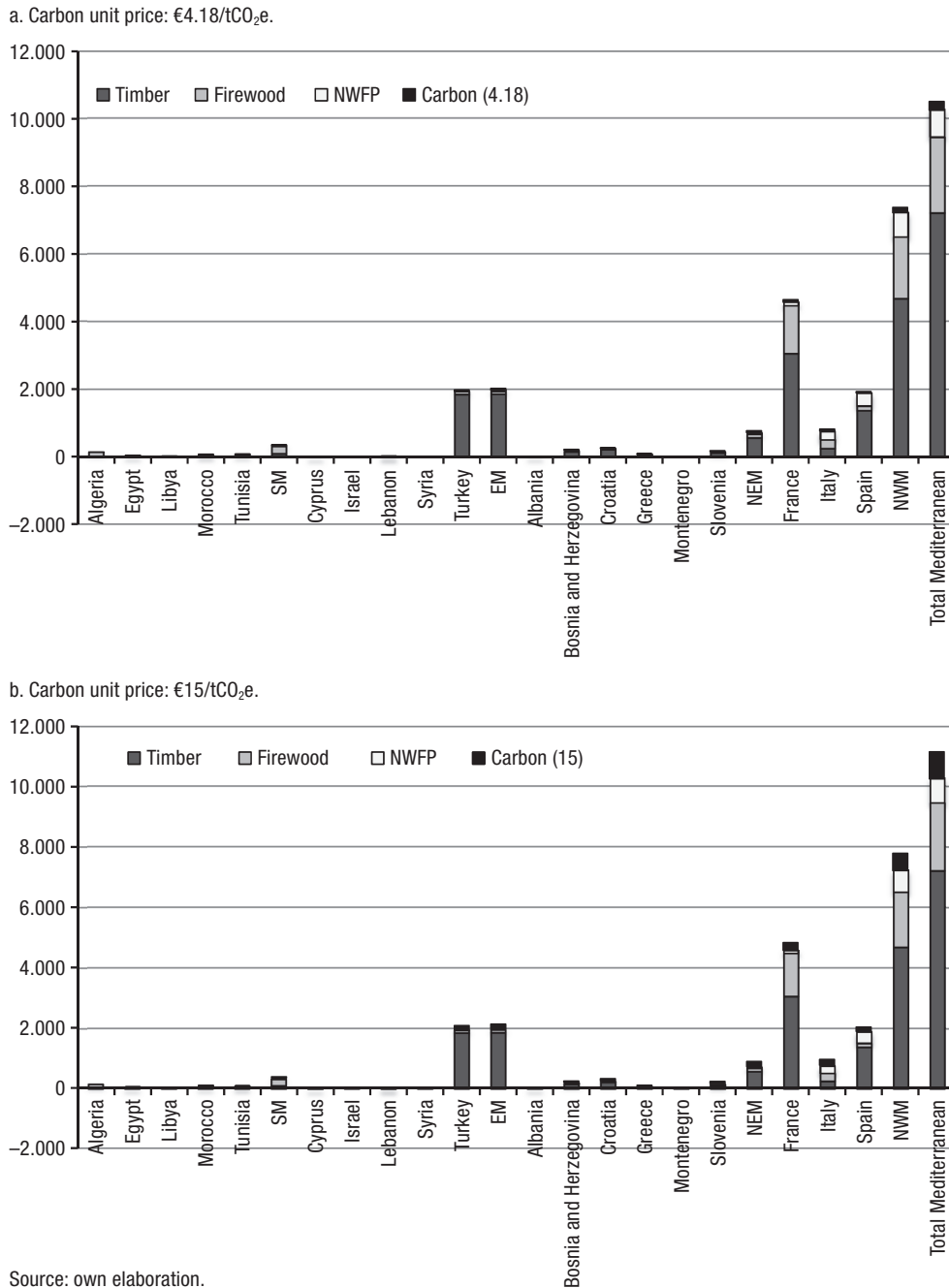
d. Total value for selected products/services

A summary value assessment of selected products and services at regional level led to a total estimation of between €10,512 M and €11,158 M, depending on the unit price for carbon adopted. Roundwood prevails over other products/services, representing 85-90% of the total value (Table 2). Within the roundwood category, industrial timber is the most relevant component, equivalent to about 64-68% of the total value estimated for selected products/services and about 76% of the total value for roundwood only, while the remainder is covered by firewood. The estimated value for NWFPs corresponds to 7-8% of the total value estimated for selected products/services. It should be noted, however, that figures for NWFPs are likely to be underestimated

because data are not available for all product categories and countries. Indeed, when using alternative estimation methodologies/sources - as tested for pine nuts, pine resin and cork - the estimated value could increase by €36.8-572.4 M. Such a big gap reflects different sources taken into account by alternative estimates and do not allow to take these figures into consideration as such. Nevertheless it suggests different estimations might be performed and numbers might result higher than reported by official statistics. Finally, carbon-related services range between 2.4 and 8% of the total estimated value depending on the unit price for carbon.

NWM sub-region accounts for up to 81% of the total value for firewood and 98% for NWFPs in the Mediterranean region. It also prevails with regard to timber and carbon, but with lower rates (65% and 63% respectively). The contribution of timber also prevails in the case of EM (88-92% of total value basically due to Turkey) and NEM (65-74%) sub-regions, while it has a minor role (24-25%) in SM sub-region, where the main forest product is firewood (60-64%). These figures seem to confirm the relevance of forestry resources for local rural communities especially in the South, but also raise concerns about potential risks for these resources in terms of over-exploitation and/or illegal harvesting. NEM sub-region accounts for 7.3-7.9% of the total estimated value at regional level, with Croatia, Bosnia and Herzegovina, and Greece as main contributors (85% of sub-regional total, 6% at Mediterranean scale). In the case of Croatia up to 95% of the total value calculated at national level is linked to timber and firewood production.

When studying data at country level a high concentration can be observed: nearly 90% of the total value estimated is in just four Northern Mediterranean countries, with different profiles (Figure 2a and 2b): France, Spain, Turkey and Italy. France plays a major role, contributing 43% of the total value for the entire Mediterranean region. About 96% of the value for this country is due to timber products, including both industrial timber (66% of the overall value for the Mediterranean region) and firewood (30%), while NWFPs show lower incidence at national level (2%) but a still relevant role at both sub-regional (14.2%) and regional level (12.6%). Carbon-related services represent only 1 to



Source: own elaboration.

Figure 2. Estimated value of selected forest products and services in Mediterranean countries/sub-regions (2010), M€.

5% of the total national value for forests, but 28% of carbon-related value at Mediterranean level. Similarly, in Spain (18% of total value) timber has a predominant role (68-71% of the total value of estimated products/services at national level), but NWFPs are much more relevant, covering about 19-20% of the total value. Timber also provides a prevalent contribution (89-94%) in the case of Turkey, which accounts for 26% of the total Mediterranean timber production. Firewood covers 4% of the value computed at national level, while carbon contributes 2-7%. Italy (8% of total value) differs

from the three previous countries because timber is not the main component in terms of value. In Italy timber, firewood and NWFPs are well balanced (each between 30 and 32%) and together cover about 94% of the total estimated value at national level.

Discussion

All in all values estimated in this paper are higher than those estimated by Merlo & Croitoru (2005). This

is particularly evident for roundwood –the estimated total value of which is 2.7 times higher than the value estimated by Merlo and Croitoru, with exceptions for Egypt, Morocco, Lebanon, Occupied Palestinian Territories and Greece – and carbon values. There might be many reasons behind this, including for example differences in countries covered by the two studies (e.g. Bosnia and Herzegovina and Montenegro are considered here, while Portugal is not) and the use of up-to-date data and sources. For example total forest area for the selected countries based on FAO 2000 figures (used by Merlo & Croitoru) was 69.7 Mha, while FAO 2010 figures considered for this research report a total of 74Mha. Furthermore the present research does not refer to Mediterranean forest ecosystems *sensu stricto*, but rather to all forests in Mediterranean countries, including temperate and even alpine forests.

As for NWFPs, values found by this research are very similar to those by Merlo & Croitoru (2005) with differences in the 2-5% range. Merlo & Croitoru (2005) provide values that are systematically higher with the only exceptions of Italy and Spain.

Differences can also be identified with regard to countries and regions: Morocco, Egypt and Turkey, for example, present higher estimated values in Merlo & Croitoru (2005). Same results can be observed for the whole SE Mediterranean region with regard to NWFPs and carbon. Especially in the case of NWFPs this can be ascribed to the largely informal nature of the sector, which is poorly reflected in official statistics and can be better addressed with direct support from local experts (as done by Merlo & Croitoru, 2005) rather than based on official figures only.

When looking at research results it can be noticed that while in NWM Countries (in particular Italy and Spain) forest values are well distributed within the different types of products/services, in other sub-regions some values tend to prevail. This situation would become even more evident if an additional forest service like grazing was taken into account. The value of grazing activities in Mediterranean forests could be estimated according to the substitution cost approach⁶ as done by Merlo & Croitoru (2005), and Croitoru (2007), using barley as a substitute input and assuming that 1 forage unit (FU) has the same metabolic energy of one kilogram of barley (INRA, 1978). Data on forest grazing area and potential FUs production are available

from FAO Country Pasture/Forage Resource Profiles⁷ and from additional studies for single countries e.g. Özturk *et al.* (2009), Daly *et al.* (2012) etc.; data on barley prices can be found in FAOSTAT (FAO, 2013c). Based on these sources and values the total estimated value for grazing would range between 10 and 11% of the total estimated value at regional scale, i.e. almost twice the estimated value for NWFPs (6%). In countries like Algeria and Greece grazing could account up to 73% of the total value provided by forest services taken into account. However, while literature confirms the relevance (as well as potential impacts) of forest grazing for rural communities, especially in SWM and NEM countries (Cyprus Department of Forests, 2006; Hadri & Guellouz, 2011; Campos, 2012; Mounir & Naggat, 2012), we are aware that such an approach likely overestimates the service and this is the main reason for not including grazing within the estimation exercise presented in this paper.

Differences in the sharing of different forest values are somehow reflected in forest policies that in Northern Mediterranean Countries tend to favour the joint production of both commercial and environmental goods, while in Eastern and Southern ones management is largely influenced by the need to supply raw materials, food and basic livelihood to rural people (Campos, 2012).

Policy and research attention on the value of Mediterranean forests is recommendable for many reasons as well documented in the special issue of *Unasylva* journal (FAO, 2014), including the fact that: (i) the region is highly sensitive to climate change effects; (ii) forest ecosystems supply goods and services of mixed, private and public, nature; (iii) the area is also dynamic in socio-economic terms, with abrupt changes taking place and many links and interdependences between Northern and Southern countries.

An up-to-date estimate of the economic value of Mediterranean forests represents preliminary information for future policies aiming at the conservation of the many public values implicit in these ecosystems, and the creation of new opportunities for rural development in the region. Economic value estimation *per se*, however, is not enough to turn potential values into marketable ones. Enhancing the economic value of forest goods and services is not just a technical issue, but has strong policy implications. On the one hand

⁶ In some cases the value of grazing activities could have been estimated on the basis of token tax paid by forest users or similar mechanisms. In some countries (e.g. Greece) grazing access to forests is subject to fees, in others (e.g. Morocco) the protection of natural forest regeneration (e.g. by fencing) implies local communities are compensated by the State. As observed by Merlo & Croitoru (2005), however, making reference to fees or compensation money is likely to underestimate the real value of the forest service, because they are administered prices and do not originate from interaction between supply and demand.

⁷ See: <http://www.fao.org/ag/AGP/AGPC/doc/pasture/forage.htm>.

this implies the development of proper mechanisms for remunerating service providers, i.e. forest owners and managers, on the other it requires the definition of specific tools to ensure equity and avoid resources being overexploited and depleted. In South and East Mediterranean sub-regions, the difficult socio-economic conditions, the land tenure systems (mainly public forests with some access rights for grazing and forest products collection), competition from other land uses (agriculture, urbanisation, etc.), together with the lack of awareness of the value of non-market forest services, and the absence of markets and compensation measures for them prevent forests from being managed in a sustainable way and fail to protect them from being converted to other land uses.

Forest management, especially in SM and partly EM sub-regions, is largely implemented through a top-down approach, using policing methods rather than a collaborative approach (Pswarayi-Riddihough, 2002). In this context, as observed by the EFIMED 2010-2020 Mediterranean Forest Research Agenda (MFRA) “[...] *the traditional command and control type of policies used in the region have been confirmed to have numerous drawbacks*” (p.15). Moreover decentralisation of forest policy and the increased dependence of forest resources on other sector policies (biodiversity protection, renewable resources, tourism development, climate, etc.) do not favour the process of sharing knowledge from all the positive and negative experiences gained in dealing with the above-mentioned problems.

When studying economic values, governance issues should also be analysed. Mediterranean forests do not just provide many public values, but they are also subject to different types of land ownership and management mechanisms, and affect a wide variety of stakeholders. As a consequence a broad range of policy, research, and management tools is needed to promote the sustainable stewardship of Mediterranean forest resources.

Conclusions

The paper presents an overview of values for selected forest products and services from Mediterranean forests. Results highlight a strong concentration of value in traditional roundwood production and, from a geographical point of view, the NWM sub-region. The economic value of Mediterranean forest goods and services however is only partly reflected on the market and recorded by official statistics. This is true both for ‘traditional’ products - such as wood and some NWFPs - and new ones. Underestimation by existing statistics might be due to several reasons, including: (i) the

public-good nature of many products/services and consequent difficulties in estimating them; (ii) the fact that data recorded for official statistics are not always complete (for example they do not always cover all countries in the region or - such as in the case of NWFPs - all product types); and (iii) the fact that a certain proportion of the TEV is not mirrored by official data because some products are traded through informal channels and markets. When taken together, these aspects confirm the importance and the urgency of improving the quality of available data and performing an appropriate estimate of the TEV of Mediterranean forests.

Enhancing the offer of Mediterranean market products and increasing their role in the rural economy could help to reduce the costs of forest protection: a well-structured forest economy able to provide stable flows of incomes can provide a fundamental set of public non-market services and social values to both local people and the whole community. Understanding the true value of natural resources, for both land users and policymakers, is an essential step for promoting their protection and sustainable use. Since markets do not reflect all values flowing from Mediterranean forests, further research is needed to better understand the link between ecosystem functioning and the delivery of services, as well as their appropriate economic evaluation. As a final point, we are aware that synergies and trade-offs exist between market products and non-market services, as well as among different ecosystem services. Accurate TEV estimations would significantly contribute to the identification of management conditions and choices, as well as the setting of priorities that allow a social optimum to be achieved.

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