Total social income and capital of forest ecosystem

Recaman project

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1. INTRODUCTION

The economics of montes in the world have similarities and differences motivated by natural, social, and economic reasons which are present in different regions, all of which can be analyzed through the perspective of common economic accounts and valuation approaches. The countries in the Mediterranean basin are good examples of the situation of the montes in the world, if we exclude the extreme uniqueness of deforestation in tropical countries. In the countries of Mediterranean Europe, the public policies of montes tend to favor the joint production of commercial and environmental goods, and in this sense we can speak of a management of governments oriented for the *economics of conservation and preservation* of the natural environment (Campos and López, 1998; and Campos and Carrera, 2007). In the Middle East and Mediterranean Africa montes management is conditioned by the need to provide rural populations basic food and energy for the livelihood of families (Campos, 2004 and Campos *et al.*, 2008). In Mediterranean Europe the governments implement monte public policies with conservation regulations and important public spending on the improvement of threatened biodiversity, with increased supply of public environmental services, and to fight against forest fires; while governments of the eastern and southern shores of the Mediterranean fail to implement sufficient spending to mitigate the rate of biodiversity loss and to promote monte conservation. In spite of the existence of active policies of different degrees of conservation of the natural environment in the countries of the Mediterranean basin, the published lists of *threatened biodiversity* continue to show many endemic species of the Mediterranean monte among the most endangered in the world.

There exists a general consensus of the global character that it should now acquire a governance of monte, which requires, simultaneously, attaining the satisfaction of the demands of the local populations more affected by conservation policies and to mitigate, at a tolerable cost to the current generations, the irreversible destruction of the unique natural and cultural heritage of the montes. This search for new global monte policies manifests itself in all international governmental and non-governmental institutions, being from the economic point of view an important strategy of proposed development by the Organization for Economic Cooperation and Development (OECD) based in the concept of *green development*:

> *"*Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. It catalyses investment and innovation which will underpin sustained growth and give rise to new economic opportunities*"* (Mountford, 2001, p. 3).

In the green development strategy the *governments* are active economic agents through the implementation of policies that expand the market and the management of direct activities to meet the growing demands of citizens for public environmental goods and services of montes. The governments of Mediterranean countries already incur significant direct management costs from fighting forests fires, the conservation of biotic and abiotic natural varieties threatened with extinction, the provision of public recreation, the monitoring of regulatory compliance, etc. Despite the importance achieved by direct public spending by the government for monte management[1], the public spending is not included in the economic accounting calculation of the total income of the monte. This omission is important because the public expenditure data for montes is required to evaluate the efficiency and social profitability of government investments. This information is also important to convey to the divided opinion of the

[1] In Spain the public spending in the direct governmental management of montes in 2008 rose by 58€/ha, and 48% of this expenditure was devoted to the fight against forest fires (SECF, 2011, p. 265).

public[2] of the countries in the European Union the economic benefits provided by the costs incurred by the government on projects that try to avoid permanent damage, such as biodiversity loss.

In the formulation of policies for green development of the OECD and the European Union the need to develop a *new methodology for green national accounting* is recognized, one that enables the measurement of total Hicksian income and to facilitate the design of policies with international cooperation that have *equity* in the overall distribution of benefits and costs of the conservation and natural and cultural heritage (European Commission, 1994; CCE, 2009; OECD, 2010; Mountford, 2011; Stiglitz *et al*., 2009; and World Bank, 2011).

The total Hicksian income (TI) is supported by the conventional system of national accounts (SNA)[3] as the true concept of sustainable income that caused the production of commercial goods and services. The EUROSTAT *Economic accounts for agriculture and forestry* (EAA/EAF)[4] recognizes the total Hicksian income:

> "Income can be defined as the maximum amount which the beneficiary can consume over a given period without reducing the volume of his/her asset. It can also be defined as being the total of the consumption and change in value of the assets held over a given period, all other things being equal, and income represents what *could have been consumed*" (EUROSTAT, 2000, p. 87).

The applications for the countries of the SNA are limited to measure an incomplete and inconsistent concept, from an economic theory point of view, of the net value added (NVA) or the net domestic product (NDP) of the nation. This reality of resignation to the measurement of national economic income is recognized, by refer to an illuminating example, by the methodology of national accounts in the United States:

> "Some economic theorists have broadly defined income as the maximum amount that a household, or other economic unit, can consume without reducing its net worth; saving is then defined as the actual change in net worth. In the NIPAs, the definition of income is narrower, reflecting the goal of measuring current production" (BEA, 2010, p. 18).

In practice, the concept of "current production" of natural resources of the SNA, in any of their applications to renewable natural resources, is limited to the estimation of the net value added of the extractions, ignoring the annual natural growth in the final output; and does not include in the cost the utilization of working in progress like wood and hunting animals[5]. In other words, the actual SNA should be reformed towards a system of national green accounting that is consistent with the marginal value of market goods and services (BEA, 2000).

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[2] 41% of European Union citizens give priority to the development of economic activities in protected areas that involve loss of biodiversity if the benefits outweigh the costs of the destruction of habitats and species. By contrast, 48% give priority to the conservation of nature against the development of economic activities that cause damage to biodiversity (European Commission, 2010a, p. 15).

[3] The most recent official handbook is the *System of National Accounts 2008* (SNA 2008) (European Communities *et al*., 2009).

[4] The Economic Accounts for Agriculture and Forestry (EAA/EAF) 97 (EUROSTAT, 2000) — are the adaptation of the agricultural sector of the Integrated European System of Accounts (ESA) (EUROSTAT, 1996)—.

[5] In the EAA/EAF there is only one exception to this general rule in the case of the livestock. This activity includes changes in the inventory of animals in the final production, so that in livestock ranching the net value added of the EAA/EAF (NVA_{EAA}) incorporates the capital gain of livestock. Notwithstanding the NVA_{EAA} does not include the value of intermediate production of the pasture and the natural fruits consumed by livestock grazing in the cost of livestock production.

It has been noted above that the strategy of green growth needs to overcome the limitations of the estimated added net value by the SNA (NVA_{SNA}) to be able to offer an accurate figure of the Hicksian total income (TI) of the economic activities of the country. In the process of the development of economic accounts of montes the most important acquired measurements are the working in progress used (extractions) of wood and hunting animals, the annual net natural growth of woody and animals that remain at the end of the year (accounting period) in the monte, the valuation of environmental outputs and costs, and the value of the capital gain derived from the revaluations and the destruction of natural and manufactured economic wealth of the monte in the accounting period. These changes to the system of national accounts (SNA) assume the redefinition of the concepts of economic outputs and costs, and consequently, the concept of total commercial income has to be expanded to include the estimate of the total environmental income.

The real concern for the global governance of natural ecosystems is reflected in the case of montes in the concept of the *economics of ecosystem goods and services* which is being formulated into projects that are being developed by international institutions interested in the implementation of green accounting of natural ecosystems by governments, as in the case of the methodological developments in preparation for the SEEA (2012 vol.1 and 2013 vol.2), TEEB (2010), UK NEA (2011), WAVES (2011), and others[6]. These projects tend to incorporate economics environmental goods and services that are produced and the changes in the values of stock of natural assets that take place in the considered accounting period in the economic valuation of natural ecosystems.

The development of the conceptual structure of an *agroforestry accounting system* (AAS) is the simplest part, relatively speaking, of the process of estimating the total income of a monte. However, the difficulties of reaching an operational conceptualization of the AAS system remain notable. Just remember that it is required a theory of *total economic value* (TEV), to apply a system of *economic accounting* that distinguishes, on one hand, the *current production* (account of production) and, on the other hand, the *changes* in the value of *capital goods* (account of capital balance) in the year, and, finally, a theory of the consistent integration of commercial and environmental economic values with the theory of national income, based on the criterion of the *real exchange value* (commercial values) or *simulated exchange value* (economic non-commercial environmental values[7]) (Caparrós *et al*., 2003, Campos and Caparrós, 2006 and 2009, Campos *et al*., 2007 and 2008).

Estimates of the price and quantity of environmental goods and scarce non-commercial economic services, which henceforth are environmental, present difficulties in terms of obtaining information and methodologies for accurate cost estimations. And, from this point of view, environmental valuations, specifically in the cases of ecosystem services and threatened biodiversity, are still not free of economic controversy (Atkinson, 2010, Bateman *et al*., 2010 and Pearce, 2007). Sometimes, more often outside the scope of

[6] The concept of ecosystem services (by convention it incorporates also tangible benefits) includes the concept of ecosystem economic goods and services and other non-economic benefits that humans demand active and passively from natural ecosystems (MA, 2005 and Haines-Young and Potschin, 2010).

[7] The mention of "non-commercial environmental" values is relevant because the definition of the *System of Economic and Environmental Accounts* (SEEA) of environmental assets includes commercial natural resources, so that commercial natural resources are simultaneously classified as environmental and commercial economic assets (UNCEEA, 2011a, par. 8, p. 5). That is to say that the classification of SEEA 2012 of commercial and environmental assets is not exclusive, but on the other hand commercial natural resources are included only among commercial assets in RECAMAN.

economics, “alternative” non SNA values of *ecosystem services*[8] are published. These valuations are estimated without being consistent to the criterion of exchange values of the SNA, so it is difficult to understand the economic income and capital meanings of these environmental values measurements:

> “Some of the case studies utilize data from the illicit literature on ecosystem valuation such as that of Costanza et al. (1997)” (Pearce, 2007, p. 223).

Thus, a proper valuation of environmental goods and services of the monte has to split from the knowledge of *environmental demands* of non-industrial owners, of individual consumers, and of society as a whole. It has to confront these demands with *joint production functions of ecosystems* in order to reach an estimate of the price of the simulated *environmental good or service*, this marginal price multiplied by the total amount that would be consumed at that price gets the total simulated exchange value (marginal price time total quantity). The *consumer surplus* differs from *exchange value* by representing the former a fraction of *total value* of environmental demand that is not included in the total exchange *value* of commercial goods and services (Campos and Caparrós, 2009).

In previous paragraphs we have been using the term monte and forest ecosystem indiscriminately, considering that the first term is exclusively a Spanish word. The concept of *monte* in Spanish law requires clarification of content in terms of internationally widespread concepts of *forest land* and forest ecosystem. The definition of *forest land* from the United Nations Food and Agriculture Organization (FAO) is accepted by governments and international specialized agencies, with the exception of Spain (FAO, 2010). The legal Spanish definitions of monte and *forest area* are equivalents (BOE, 2003). The concept of monte differs from the FAO’s concept of forest land in that the monte also includes *natural grassland* (including natural meadows and areas of uncultivated pastureland), as well as *wooded* areas and *shrub land* make up the FAO’s definition of forest land. The concept of the monte in Spanish legislation is synonymous with the concept of an ecosystem in *Millennium Ecosystem Assessment* (MA):

> “An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit” (MA, 2005, p. v).

The inclusion of natural grassland in the concept of the monte is appropriate for a perspective of green accounts of multiple goods and services of the Mediterranean montes, due to the greater importance of pastures and acorns in the commercial and environmental economies of the Mediterranean monte, which contrasts with the minor commercial importance of wood production in the Mediterranean monte in relation to the montes in other temperate climates.

Regardless of the different concept of forest land that Spain and other countries use, the system of economic account for forestry (EAF) does not value all the economic goods and services of forest land, because it is limited to measuring the net value added (NVA) of an official list of products extracted from the forest land (EUROSTAT, 2000). The estimated NVA in the EAF system, which, as stated before, is also inconsistent with the concept of total national income, does not value the natural growth of woody forest biomass in the accounting year of the monte. It also only takes

[8] MA defines ecosystem services as “the benefits people obtain from ecosystems” (MA, 2005, p. v). In RECAMAN is estimated the exchange value of monte economic commercial and environmental benefits. In addition, RECAMAN offers physical measures of commercial outputs where these become *free* environmental outputs. That is, these are outputs without *in situ* economic value, as they could be the cases for acorns, pine nut, grazing resources, natural water, etc.

into account the commercial extraction of wood from forest trees, such as logging, the firewood of pruning and felling of trees, and the extraction of cork. The only annual forest production that is considered is the commercial extraction of nut, like in the case of chestnuts, pine nuts, and other minor nuts sold by the owners of the montes. The pastures and acorns of the Spanish montes, traditionally used by grazing for livestock and game species, are not valued in the NVA of montes by the official statistics of the EAF[9] on the basis that grazing resources are not collected directly by humans for trading. In other words, grazing resources are no considered by EAF system "intra-consumption" outputs.

In the context of new projects undertaken by international organizations, governments, and research centers for the development and implementation of the green economic accounts nation's natural ecosystems, the *General Directorate of Natural Environments Management* of the *Department of Natural Environment* of the *Andalucía Government* is been developing the *Income and Capital of the Montes of Andalucía* green accounts project since 2008 (RECAMAN). The RECAMAN concepts of economic values, green agroforestry system of accounts, and valuations of goods and services estimated in the montes of Andalucía are discussed in detail in the following sections. Section 2 presents the theory of green agroforestry system of accounts. Section 3 presents a summary of international and national projects for the development and the valuation of forest ecosystems goods and services. Section 4 describes the work of the ongoing valuations beyond EAF of the RECAMAN project. Finally, section 5 concludes with the main RECAMAN green accounting expected methodological advances and the new public policies needed for the implementation of the green agroforestry accounting system in the montes of Andalucía.

2. GREEN TOTAL INCOME AND CAPITAL OF FOREST ECOSYSTEMS

2.1 Introduction

The economic flows and stocks of a monte are made up of *scarce goods and services* (EGS) for which a person and/or a institutional entity is willing to pay a sum of money (numerarie) to access its use and/or property. The economic goods and services are classified in commercial (EGS_C) and environmental (EGS_E), the latter being separated in public environmental ($EGS_{PU,E}$) and private environmental ($EGS_{PR,E}$). Los EGS_C are composed of *scarce goods and services* for which a person and/or institutional entity is willing to pay a sum of money to ensure their access to its use and/or property, and the person/institutional entity usually gains access by a payment of a sum of money through a *market transaction*. The EGS_E generated by the monte are formed by the scarce goods and services that are usually non-commercial that a person or institutional entity owns and self-consumes ($EGS_{PR,E}$) and that are non-proprietary with free access to their use and ownership ($EGS_{PU,E}$), and for which people are willing to pay a sum of money to unsure their consumption and/or exclusive ownership.

The montes produce natural goods and services depending on circumstances of *demand*, *location* and *property rights*, among others, which are *economic* (EGS_N), or the same goods and services are *non-economic* or *free* (FGS_N) in other places and circumstances. That is to say, they are non-economic when the owner of the monte does not find a person and/or institutional entity willing to pay a sum of money for its

[9] The application of EAF by the National Institute of Statistics to the Spanish montes offers a private gross added value (GVA_{EAF}) at factor prices (it includes operating subsidies net of taxes on production) for the period of 2000 to 2006 that amounts of 64€/ha per year of monte at 2009 constant prices (SECF, 2011, p. 261).

consumption and/or appropriation. In RECAMAN the natural production of acorns, grass and pine nut that livestock, game species and people do not consume are considered free environmental goods, and therefore in these cases they are non-economic natural goods. Also the natural forestry water which is regularly consumed in excess over natural grasslands by woody vegetation and the flow of natural forestry water that reaches the reservoirs are considered by RECAMAN free environmental goods. Other free environmental goods and services which are not objects of economic demand in Andalusian montes are not taken into account by RECAMAN, since it only estimates the physical output of goods that still have economic uses for a fraction of their total outputs.

The flows and stocks of economic goods and services of a monte depending on the way in which they are produced, they can be classified as natural resources (NRs) and manufactured resources (MRs). Among the NRs are natural fixed capital (FC_N), which are composed of *land* (FCl), *biological resources* (FCbr) and other natural (FCo_N); *natural raw materials* (RM_N); *natural work in progress* (WP_N); and *natural services used* (SS_N). The MRs can be grouped into *manufactured fixed capital* (FC_M), which are composed of constructions (FCco), equipments and machinery (FCe), plantations (FCp) and other manufactured (FCo_M); *manufactured raw materials* (RM_M); *manufactured work in progress* (WP_M); *manufactured services* (SS_M); and *labor costs* (LC), formed by employees (LCe) and self-employed (LCne). Thus, the *Hicksian total income* (TI) extended to the economic environmental values of the monte can be expressed by the equation [1]:

$$TI = f(NR, MR) = f(RM, SS, LC, WP, FC) \quad [1]$$

The equation [1] contains all the information needed to estimate the Hicksian total income (TI) for any scale of territory (nation, region, natural ecosystem, vegetation, etc.). The green agroforestry accounts system (AAS) provides the information of *economic activities* of the monte in a *production account* organized to estimate the *net valued added* (NVA), named too *operating income*. The economic resources that remain in the territorial economic unit for more than a year are organized in a capital balance account in order to measure the *capital gain* (CG). The measurement of total income (TI) is resolved with the aggregation of both *net valued added* (NVA) and capital gains (CG) (Eisner, 1989, p. 17 and BEA, 2010, p. 18):

$$TI = NVA + CG \quad [2]$$

The measurements of commercial total output (TO_C) and commercial total cost (TC_C) which are organized in the production account of the *conventional system of national accounts* (SNA) contributes to a commercial database, but with relevant data omission, whose objective is measuring the commercial net domestic product (NDP_{SNA}) or commercial net value added (NVA_{SNA}) of commercial activities that are developed within the territory of a nation (EURTOSTAT, 1996 and European Commission *et al*., 2009). The SNA system estimates the the NVA_{SNA} both at market prices ($NVAmp_{SNA}$), that is without operating subsidies net o taxes on production (OSN) and at factor prices ($NVAfp_{SNA}$), in this measurement OSN are included.

The SNA indicator most widespread and used at the national, regional and sectoral scale is the *gross domestic product* (GDP_{SNA}) or gross value added (GVA_{SNA}). The GVA_{SNA} is not an accurate indicator of operating income, because it includes the cost of consumption of fixed capital (CFC), and in its measurement it omits the work in progress used (WP_U) and the natural growth of woody vegetation and game animals (NG). The GVA_{SNA} is an indicator that represents the NVA_{SNA} before subtracting the cost of the consumption of manufactured fixed capital (CFC_{SNA}) [3]:

$$GVA_{SNA} = NVA_{SNA} + CFC_{SNA} \quad [3]$$

While the GVA_{SNA} is not the suitable indicator of the operating income that originates in the accounting year, its widespread use is due to the interest of governments in knowing the annual variation of the annual *commercial economic activity* measured by the difference between the value of final commercial output (FO_{SNA}) and the commercial intermediate consumption (IC_{SNA}), the latter is composed of raw materials (RM_{SNA}) and services (SS_{SNA}) used [4]:

$$GVA_{SNA} = FO_{SNA} - IC_{SNA} \quad [4]$$

Criticism of the use of GVA_{SNA} as an indicator of a level of economic well-being comes from international economic institutions, governments (Comisión de las Comunidades Europeas, 2009 and Stiglitz *et al*., 2009[10]) and national income experts (Eisner, 1989). The widespread acceptance of the theoretical consistency of this criticism of the SNA has not prevented the new revision of the NSA to remain immune to change from the viewpoints of avoiding the omission of commercial and environmental natural resources (European Communities *et al*., 2009). Critics of the SNA from the point of view of *commercial renewable natural resources* focus on the fact that it omits estimates of *natural growth* of biological resources, as well as the *destruction* and/or the *degradation* of *natural capital*, and the fact that the *consumption of natural resources* is considered an *income*, instead of a *cost* of *production* of the natural ecosystem as work in progress used. A limitation to incorporate these measurements in the green SNA is that they require an understanding of the functions of production of EGS_E of natural ecosystems. This green accounting should extend the conventional NSA with the income of the omitted commercial goods and services, the environmental net value added, and capital gains (BEA, 2010, p. 18; Eisner, 1989, pp. 12-20; EUROSTAT, 2000, p. 87; Nordhaus and Kokkelenberg, 1999, pp. 183-193; and European Commission *et al*., 2009, para. 3.93, p. 47 and para. 8.25, p. 160).

The SNA justifies the omission of the environmental goods and services (EGS_E) for lack of observable quantity and price through market transactions. This should not be a cause for the exclusion of the EGS_E in the conventional SNA, since the free public goods and services that are provided to citizens by governments are included in the conventional SNA[11]. The criticism of the green national accounting system that there is a weakness in the methods of environmental valuation is significant (Aaheim and Nyborg, 1995, Alfsen, 1996 and Nordhaus and Kokkelenberg, 1999).

The science of economics is developing methods of environmental valuation that simulate the quantities and prices associated with the production and consumption of EGS_E, that have in some cases a comparable consistency to the criteria of valuation of the SNA. They need the information of supply and demand to come reach an estimate of the partial equilibrium price that corresponds to the amount of supply of environmental goods or services that they want to assess. Thus the total amount consumed/produced multiplied by its marginal price offers a total environmental economic value consistent with the commercial value of market goods and services of the SNA. In recent years there has been progress towards improving the techniques of environmental valuation based on individual preferences both revealed and stated by the population, but it is worth noting the few occasions in which they have tried to consistently use these techniques in green national accounting.

[10] For example, in France the government of Sarkosy has promoted the report of Stiglitz-Sen-Fitoussi (2009) which aims to create an indicator of economic well-being to replace the inappropriate use of GDP for this purpose.

[11] Clearly, the principle of the SNA which states that theoretically one should only include market goods and services is not met in practice. In the majority of countries a significant part of economic activity of the governmental is free to citizens, and certainly in this case there is not a market price, nor any measured supply of the offered goods and services provided for free. The government simply decides to “attribute” the free public supply of goods and services that are consumed by citizens in a specific period of time an imputed market value equal to the cost of its production.

2.2 Green agroforestry ecosystem production and capital accounts

2.2.1 Production account

Total production (TP) and total cost (TC) are distributed among *economic activities* that occur in the monte by the organization of annual data records in the *production account*. The residual value of the *production account* that balances resources and uses is the *net operating margin* (NOM), which is estimated in the *agroforestry accounting system* (AAS) for each individual activity and for the aggregate total of activities of the monte. The flows of TP and TC are recorded in the *economic activities* that take place in the monte which are organized based on a list of classification, the national statistics of commercial economic activities (EUROSTAT, 2000), and expands this list to non-commercial environmental goods and services of the monte (Haines-Young and Potschin, 2010).

The production account of the AAS groups the economic activities into forestry (FOR), *game* (GAM), *service* (SER), *livestock* (LIV), *agricultural* (AGR) and *other* (Table 1). FOR, GAM, and LIV activities are separated into two sub-activities: FOR into silviculture (SIL) and harvest (HAR), GAM breeding (GBR) and recreational hunting (GRH) and LIV into breeding (LBR) and feeding (LFE).

The total output (TO) that is registered in the production account of the AAF is classified in intermediate output (IO) and final output (FO) that are derived from the application of the theory of total economic value (TEV) of agroforestry activities in a monte [5]:

$$TO = IO + FO \quad [5]$$

The total output (TO) must be separated into *intermediate output* (IO) and *final output* (FO). The IO is formed by the economic goods and services generated in the monte in the accounting year and that are used as intermediate consumption (IC) in the same accounting year in the production of other goods and services of the monte. The intermediate output (IO) is classified in intermediate raw materials (IRM) and intermediate services (ISS).

The final output (FO) is composed for goods and services sold (FOs), the on *own account gross fixed capital formation* (GFCFoa), the gross work in progress formation (GWPF), non-industrial land owner goods and services auto-consumption (FOa), the public free consumption of environmental goods and services ($FO_{PU,E}$) by the public and the society as whole, and other final output (FOo), among which include donations of final output (FOod), payments in kind of final output (FOok), and poaching (FOop).

The final output on *own account gross fixed capital formation* (GFCFoa) is integrated by natural growth of trees with repeated products during the total cycle (GFCFtr), game reproductive female (GFCFga), reproductive livestock (GFCFli), plantations (GFCFp), constructions (GFCFco) and equipments (GFCFe), and they are registered with some of the previously mentioned activities which will principally be used in services in the future.

The gross work in progress formation (GWPF) is composed by natural growth (NG) of goods that need more than one year to be finished, as they are timber, firewood, cork, game animals (except female breeding for reproductive function), non-reproductive and draught livestock, crops in the field, etc.

The non-industrial land owner auto-consumption (FOa) is formed by commercial ($FOa_{PR,C}$) and environmental ($FOa_{PR,E}$) final goods and services enjoyed by land owner and his family.

Table 1. Agroforestry ecosystem production account

Class	Forestry (FOR) 1	Service (SER) 2	Game (GAM) 3	Livestock (LIV) 4	Agricultural (AGR) 5	Other (OTH) 6	Total (TOT) 7
1. Total output (TO)							
1.1 Intermediate output (IO)							
Intermediate raw materials (IRM)							
Intermediate Services (ISS)							
1.2 Final output (FO)							
Sale of final output (FOs)							
Own account gross fixed capital formation (GFCFoa)							
Gross work in progress formation (GWPF)							
Auto-consumption (FOa)							
Public environmental final output ($FO_{PU,E}$)							
Other final outputs (FOo)							
2. Total cost (TC)							
2.1 Intermediate consumption (IC)							
Raw materials (RM)							
Own raw materials (RMo)							
Bought raw materials (RMb)							
Services (SS)							
Own services (SSio)							
Bought services (SSp)							
Working in progress used (WPu)							
2.2 Labor Cost (LC)							
Employee labor cost (LCe)							
Employed labor cost (LCne)							
2.3 Consumption of fixed capital (CFC)							
3. Net operating margin (NOM = TO – TC)							

The public environmental goods and services free consumption ($FO_{PU,E}$) by the public and the society as whole, and it is integrated by the public collection of mushrooms ($FOm_{PU,E}$), the public environmental recreational service ($PFr_{PU,E}$), forest landscape conservation ($PFl_{PU,E}$), threatened biodiversity preservation ($FOb_{PU,E}$), and gross carbon fixation ($FOc_{PU,E}$).

Other final output (FOo) includes the remaining final outputs produced in the year omitted in the previous final outputs classification.

The aggregate TO of a monte of the AAF system incurs double counting of the IO since the latter incorporates in the intermediate consumption (IC) of the year which is implicitly transferred to the value of the FO of the year. It should be noted that this double counting of the IO in the TO does not affect the net operating margin (NOM) and their inclusion is a prerequisite for estimating the NOM of individual activities that generate an IO unique for the use of a third activity, and the latter has to be considered a cost of intermediate consumption to estimate the NOM (Campos *et al.*, 2008).

The *environmental free total output* (TO_F) considered in RECAMAN composes of the natural outputs of *environmental free intermediate output* (IO_F) and *environmental free final production* (FO_F) that theirs economic values are zero, as they are the cases of part of the outputs of grazing resources, acorns and pine nut; and the natural water from monte area consumed by forestry and agricultural vegetations, and natural water that reaches the watersheds rivers. The IO_F is employed in the accounting year as physical inputs of *environmental free intermediate consumption* (IC_F). The physical quantification of the TO_F gives an understanding of its contribution in *physical quantity* to the total commercial and environmental economic total output (TO) of the monte.

The AAS total cost (TC) is classified by expanding the criteria of the SNA in *intermediate consumption* (IC) of raw materials (RM), services (SS) and works in progress used (WPu), *labor costs* (LC) and the *consumption of fixed capital* (CFC) [6]:

$$TC = IC + LC + CFC = RM + SS + WPu + LC + CFC \quad [6]$$

2.2.2 Capital accounts

The capital account of the monte organizes the capital goods (C) classified in the balance of working in progress and the balance of fixed capital. The balance of working in progress incorporates the changes in the stock of non-finished goods that remain in the monte in preparation during more than one accounting period, and it distinguishes between the stocks of produced goods in progress (WPp) at the beginning of the year and expected working in progress (WPe) in future years of the current production cycles (Table 2).

The balance of fixed capital includes finished durable goods that provide services to the production of the monte whose lifespan exceeds a year (Table 2). Fixed capital (FC) consists of *land*, biological resources, *plantations*, constructions, *equipments* and *other*.

(1) *Land* (FCl). The conventional SNA distinguishes between land and other assets supported by land:

> "Land consists of the ground, including the soil covering and any associated surface waters, over which ownership rights are enforced and from which economic benefits can be derived by their owners by holding or using them. The value of land excludes any buildings or other structures situated on it or running through it; cultivated crops, trees and animals; mineral and energy resources; non-cultivated biological resources and water resources below the ground. The associated surface water includes any inland waters (reservoirs, lakes, rivers, etc.) over which

Table 2. Agroforestry ecosystems capital account

Class	Initial	Entries				Withdrawals				Revaluation	Final
		Bought	Own	Other	Total	Used	Destruction	Other	Total		
	(Ci)	(Cb)	(Co)	(Coe)	(Ci)	(Cu)	(Cd)	(Cwo)	(Cw)	(Cr)	(Cf)
Capital (C) (1+2)											
1. Working in progress (WP)											
Timber and firewood (WPtf)											
Cork (WPco)											
Game (WPgam)											
Livestock (WPliv)											
Other (WPo)											
2. Fixed Capital (FC)											
Land (FCl)											
Biological resources (FCbr)											
Plantation (FCp)											
Contruction and equipment (FCcoe)											
Other fixed capital (FCo)											

ownership rights can be exercised and that can, therefore, be the subject of transactions between institutional units. However, water bodies from which water is regularly extracted, against payment, for use in production (including for irrigation) are included not in water associated with land but in water resources" (European Communities et al., 2009, para. 10.175, p. 214).

RECAMAN land expected value (FCl) is estimated discounting the resource rent ("economic rent") from indefinite cycles after current cycles of wood, cork, nuts (acorns, pine cones, chestnuts, etc.), grazing, game, private environmental auto-consumption, mushrooms, carbon, commercial recreation, the public environmental recreation, landscape, biodiversity, and others.

(2) *Biological resources* (FCbr). Biological resources yielding repeat products includes expected timber, firewood and cork discounting resource rents do no incorporated in land and work in progress balance, trees nuts (acorn, chestnut, pine nut, etc.), timber trees without scheduled cut, draught and breeding reproductive livestock, reproductive big game females (except wild boar females), and other biological resources.

(3) Tree *plantations* that imply an improvement of consumable forest (FCp).

(4) *Constructions* (FCc) and *equipments* (FCe).

(5) *Other* fixed capital (FCo).

The capital account in the accounting year presents the opening (Co) and closing (Cc) stocks of capital, entries of capital (Ce) integrated through purchases of capital (Cp), its own capital (Co), and other entries of capital (Ceo), and withdrawals of capital (Cw) made up of used capital (Cu), the destruction of capital (Cd) and other withdrawals of capital (Cwo). The *revaluation of capital* (Cr) is the residual value of the balance of fixed capital that equals the values between the resources and the uses of the capital goods for the year (Table 2).

In a monte there is a singular interest for the measurement of variations of total capital in an accounting period taken into account the interrelationships between production account and capital accounts (work in progress account and fixed capital account) (Figure 1). The production account provides the own account gross fixed capital formation (GFCFoa) and the gross work in progress formation (GWPF) to the entries of the fixed capital account and the work in progress account, respectively. These own entries of fixed capital (FCo = GFCFoa) and the final output of works in progress (WPo = GWPF) are completed with the respective external entries of FCee and WPee. The fixed capital account provides the fixed capital use (FCu) to the own entry of the WPo. The fixed capital account contributes to the intermediate consumption of the production account with the output of work in progress used (WPu). In the capital accounts individual goods and services are established according with the production account, so that commercial capital and environmental capital goods and services are also distinguished.

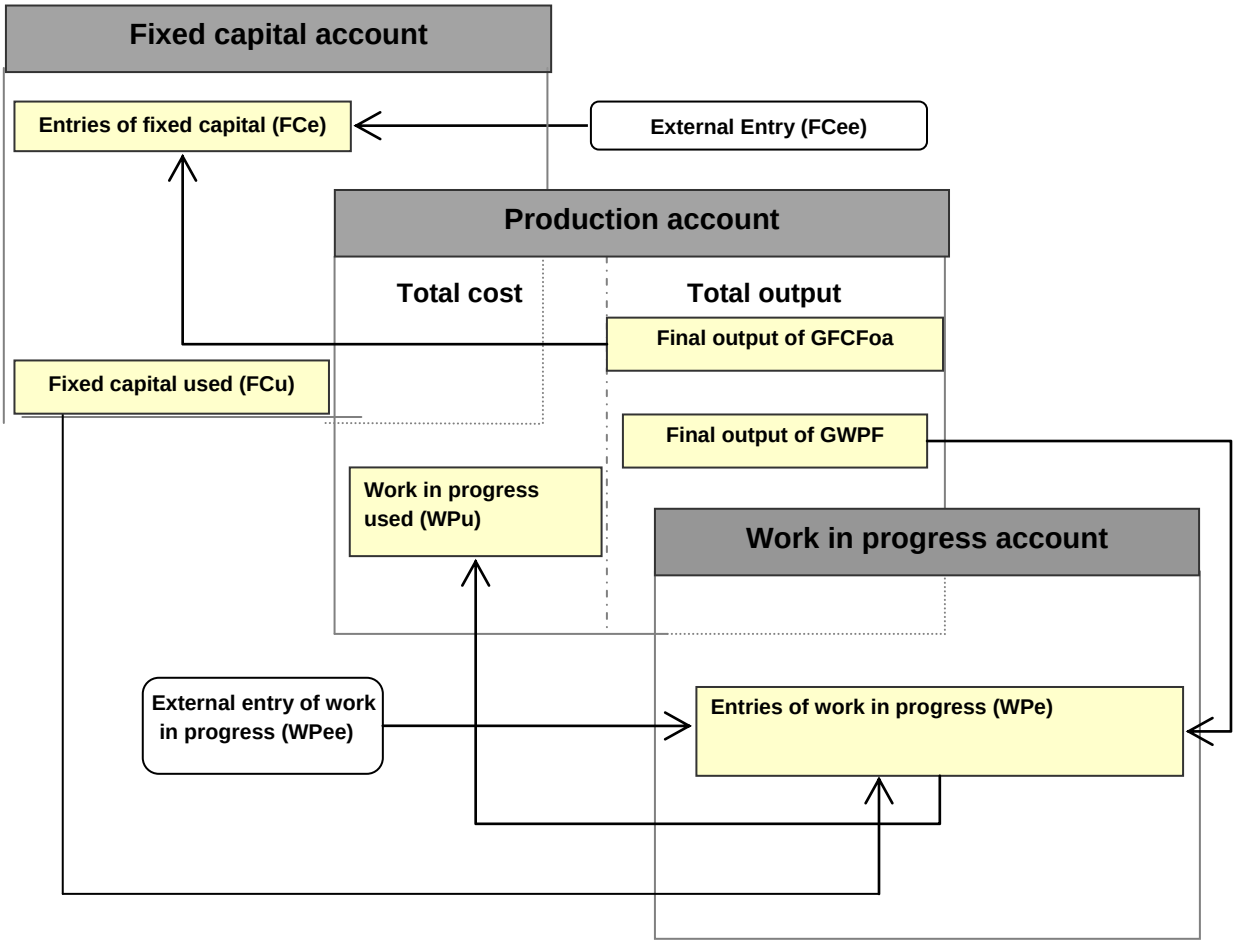
2.3 Green total income measurement

2.3.1 Total economic value

The economic valuations of a monte have the ultimate aim of estimating the Hicksian total income (TI), and to achieve this objective it is required to, in advance, value the stocks and movements of natural capital and manufactured capital in the accounting period. To achieve this objective there exists a widespread consensus among environmental economists that the total economic value (TEV) of the monte is a framework of the theory of suitable economic value (Pearce, 1993; CBD, 2009, Bateman *et al*., 2010, and TEEB, 2010). The TEV includes all the sources that motivate

individuals and/or institutional entities to attribute economic value to scarce goods and services (EGS) that are consumed and/or appropriated (Table 3). The clearer motivations of why people attribute an economic value to *final and intermediate* EGS are due to their *current active use.* Another reason why people assign economic value to known scarce sources is the motivation of ensuring the option of their future use. This *option value* emerges when the current generations are worried about the future supply of particular services for which they prefer to not put the persistence and/or provision of the desired service at risk. The option value is manifested in the availability of the current generations to include an additional management cost of the monte as a way to ensure that in the future the preferred capital endowment is reached. The payment is justified, either due to avoiding the degradation of the supply of services of the monte that originate from its current management, or because they prefer to have a future supply that is equal or superior to the current services.

Figure 1 Interrelationships between production and capital accounts of agroforestry ecosystems



Source: Campos *et al*. (2008) modified.

People and institutional entities also can give economic value to *passive use* (existence value) to try to mitigate habitat loss and the extinction of threatened species. The concept of *existence value* of an ecosystem has led to a lively controversy, which is not yet fully resolved, over the difficulty of the valuation of the unique concept of passive use[12]. The economic science that underlies an existence value is based on the observation that humans spend economic resources on an individual or collective level in an attempt to prevent non-replaceable ecosystems, biological varieties, and *unique* cultural values from disappearing forever (once they disappear they cannot be

[12] Or non-use, as it is called by others, although this form of reference to passive use is nominally inconsistent with the theory of the consumer.

Table 3. Total economic value of agroforestry ecosystems

Active Use			Passive Use
Current value		Option value	Existence value
Final	Intermediate	Final	Final
Exchange value of ecosystems goods and services that are consumed or invested in the accounting year	Exchange value of ecosystems goods and services used as intermediate consumption (input) of another output in the same accounting year	Consumers or institutions willingness to pay an additional premium payment to the ordinary price of ecosystems goods and services to ensure its conservation and future uses.	Consumers or institutions willingness to pay with the exclusive purpose of preventing the future extinction of a uniqueness feature in the relevant total area of the forest ecosystem.
Examples: - Commercial goods and services of forestry, livestock, or game activities. - Public recreational services - Collection of mushrooms, plants and wildlife. - Carbon services. - Etc.	Examples: - Natural grass and fruits consumed by livestock and wildlife grazing animals. - Forestry intermediate services supplied to landscape and threatened activities. - Crop plants and seeds for planting and sowing. - Controlled dead animals consumed by wild animals. - Etc.	Examples: - Conservation of biological resources for research of new drugs and for the biological control of pests. - Continuity of the future supply of goods and services of traditional activities in the forest ecosystems. - Etc.	Examples: - Preservation of the forestry ecosystem as whole or a single genetic species variety threatened. - Preservation of architectural heritage or cultural institutions of the ecosystems that is threatened. - Etc.

Source: Campos (2010) modified.

reproduced). This behavior occurs even in situations when the passive user only knows these unique assets are threatened by readings, conversations with other people and audiovisual mediums, and without the requirement of the foresight of the future active use they still express the willingness to pay for the possibility of their future existence (Pearce, 1993 and Campos, 2010).

The economic values of both active and passive uses which made up the utilitarian exchange total economic value are additives, although they can appear errors and/or double-counting in the application and inconsistency of the value of services, unless you have taken into account the criteria of *double counting* and of *exchange value* of environmental services measurements.

Some analysts attribute "intrinsic worth" to nature other than human animals to be confronted this non economic value with utilitarian exchange total economic value. This is to say that "intrinsic worth" is a non utilitarian value that support that everything in nature has an *absolute worth*. Opposite, TEV concept assumes that only human species has "an end in itself"[13], and from this it follows that to those other nature things different of human beings, might become to receive from people a "mere *relative worth*" (a price), but they do not have by their-self an intrinsic value. Kant in 1785 established with smart intelligence the difference between intrinsic worth (an absolute worth) and price (a relative worth)[14]:

> "Everything has either a *price* or a *dignity*. Whatever has a price can be replaced by something else as its equivalent; on the other hand, what- ever is above all price, and therefore admits of no equivalent, has a dignity. But that which constitutes the condition under which alone something can be an end in itself does not have mere relative worth, i.e., a price, but an intrinsic worth, i.e., a dignity (Kant 1959 [1785]: 53, italics in original)"[15].

2.3.2 Net value added

The *net value added of a monte* at market prices (NVAmp)[16] is the *operating income* that originates from commercial and environmental economic activities of the monte in an accounting year. The NVAmp is calculated in the production account by the difference between the total output (TO) and the intermediate consumption (IC) and the consumption of fixed capital (CFC) [7]:

$$NVAmp = TO - IC - CFC \quad [7]$$

The NVAmp represents the remuneration of services provided by labor costs (LC) and the operating capital income or net operating margin (NOM) that the owner of the monte and the public and society as a whole obtain [8]:

$$NVAmp = LC + NOM \quad [8]$$

[13] The relativism doctrine was originated in classic Greek by Protagoras that stated "man is the measurement of everything". Quoted by Aristoteles (1985, p. 295).

[14] In valuing ecosystems goods and services, some policy makers and ecologists qualify as "foolish" analysts those that they do not distinguish between intrinsic worth and price, understanding that the intrinsic value is the ecosystems goods and services true worth supply to people. Above it was admitted that "illicit" ecosystems economic valuations exist (Pearce, 2007), but it admitted also that ecosystems utilitarian total economic value is considered by the mainstream of economics as a consistent economic valuation in progress approach.

[15] Quoted by TEEB (2010, pp. 142-143).

[16] The records of economic goods and services are recorded in the production account and in the capital account of the AAS not including the governmental subsidies and taxed on production related to the monte.

When you add to the NVAmp the operating subsidies net of taxes related to the goods and services of the production account (OSN) the net value added at factor prices is estimated [9]:

NVAfp = NVAmp + OSN [9]

2.3.3. Net operating margin and surplus

Private owners, the public and the global society as owners of the commercial and environmental uses of the monte obtain an operating capital income from the investment of immobilized capital in the economic activities of the monte. This net operating margin (NOM) is the difference between the values of total output and total cost (Table 1), before operating subsidies net of taxes (OSN) related to the account of production are included [10]:

NOM = TO – TC [10]

The monte provides a net operating surplus (NOS) at factor prices, which results from adding to the NOM the operating subsidies net of taxes (NOS) related to the account of production [11]:

NOS = NOM + OSN [11]

2.3.4 Capital gain

Capital gain at market prices (CGmp) of the monte represents the part of the capital income of the owner that comes from changes that occurred during the accounting year in the capital account. The measurement of capital gains depends on (1) the reevaluations arising from changes in the current and future prices of the goods of the capital balance, (2) destruction of capital (normal and extraordinarydestructions) in the accounting year and in the future, (3) the consumption of fixed capital by use and technical obsolescence, (4) the changes in the interest rate/discount, and (5) adjustments of the deviations of the actual entries and withdrawals of natural resources over the initially expected amount of entries and withdrawals.

The estimation of the CGmp involves the development of a capital account composed by the balances of *work in progress* and *fixed capital accounts* (Table 2). The capital account balance requires a full functional classification of the goods and services of the monte, its physical quantification and economic valuation of the capital goods and services non-traded of the monte. While it lacks a real market price, the public *natural environmental capital* value can be estimated by the method of the net present value (NPV) of the natural resource rent (economic rent) which is estimated and generated in the indefinite time horizon.

The movements of flows of entries and withdrawals of the aggrated capital balance that are involved in estimating the capital gain at market prices (CGmp) of the monte are *capital revaluation* (Cr), the net *destruction of capital* (Cd) and the inclusion of capital adjustments (Caj)[17] [12]:

CGmp = Cr – Cd + Caj [12]

[17] These last few should be reclassified as the production expected to produce *timber, firewood, and cork natural growth* (NGtcof) by its value at the beginning of the year, the adjustment in other capital entries (Ceoa) and withdrawals (Cwoa) by deviations in the year of actual game catches compared to the average of the previous three years, and finally the aggregate *consumption of fixed capital* (CFC) to avoid double counting, the latter being the net of the revaluation of the consumption of fixed capital of plantations, constructions, and equipment (CFCrpce): Caj = – NGtfc + Ceoa – Cwoa + CFC – CFCrpce.

The capital gain factor prices (CGfp) are estimated by the summation of the capital subsidies net of taxes related to capital goods and services (CSN) and the CGmp [13]:

$$CGfp = CGmp + CSN \quad [13]$$

The *revaluation of capital* is estimated as a residual value between the final capital (Cf) and the withdrawals (Cw) minus the initial capital (Ci) and the entries (Ce) during the period [14]:

$$Cr = Cf + Cw - Ci - Ce \quad [14]$$

2.3.5 Green total income measurement

The Hicksian total income at market prices (TImp) of a monte has previously noted to require to record the economic data on a *production account* for estimating the *net value added* at market prices (NVAmp) and a *capital account* to calculate the *capital gain* (CGmp) [15]:

$$TImp = NVAmp + CGmp \quad [15]$$

The total income of factor prices (TIfp) is estimated by adding operating and capital subsidies net of taxes (SN = OSN + CSN) to the TImp [16]:

$$TIpf = TImp + SN \quad [16]$$

The concept of TImp of a monte that has been exposed shows that it cannot be quantified without adding the *commercial net value added* ($NVAmp_c$)[18], the *environmental net value added* ($NVAmp_E$), the *commercial capital gain* ($CGmp_C$) and the *environmental capital gain* ($CGmp_E$) of its economic activities and the use of capital in the accounting year [17]:

$$TImp = NVAmp_c + NVAmp_E + CGmp_C + CGmp_E \quad [17]$$

2.3.6 Total capital stock measuremet

It has been noted previously that the capital stock of the monte is formed by the works in progress and the finished durable goods (fixed capital) used in the generation of the total production of the monte. The activities of manufactured commercial capital typically offer direct transactions at market prices. This may not be the case for natural *commercial* assets, since in practice these prices tend to be highly opaque or they present aggregate values that do not directly express the price of individual natural capital assets. This is the case of the joint evaluation of pasture and acorns consumed by controlled grazing animals, since its capital value is incorporated in the price of the land along with private capital income of the remaining natural resources of the monte. In these cases and in the public environmental capital goods, it has to apply the net present value (NPV) to the future streams of natural resources rents:

> *"In the SEEA future returns are defined using the concept of economic rent. Economic rent is best considered as the surplus value accruing to the extractor or user of an asset calculated after all costs and normal returns have been taken into account. The surplus value, referred to as resource rent in the context of environmental assets, can be considered as the return attributable to the asset itself. The logic of NPV [net present value] requires estimating the stream of resource rents that are expected to be earned in the future and then discounting these resource rents back to the present accounting period. This*

[18] The lack of estimations in the EAF system of natural commercial growth in the final output, the consumption of commercial natural resources in the intermediate consumption cost, and the commercial capital gain hinders the understanding of the total commercial income of the monte.

provides an estimate of the value of the asset at that point in time" (SEEA 2012, Draft Chapter 5, paras. 107 and 108, p. 23).

The price of a unit of capital (P_C) is the present discounted value of the future flow of capital income (CI) that is generated until its total consumption, in the case of land its duration can be accepted as infinite based on its fertile soil, although the CI as an expression of the natural productivity of fertile soil may be finite. In addition to the difficulty in estimating the aggregate and individual CI of capital activities, in the case of non-commercial environmental capital goods the analyst choice of the discount rate (r)[19] give place to the subjective valuation of environmental capital on the part of the expert responsible for the assessment. Thus the most consistent valuation of environmental capital is the value of environmental capital income based on independent valuations that the analyst subjectively computes. For the simplification of the estimation, CI is assumed constant and indefinite, and the asset price is estimated by the ratio of the following equation [18]:

$$P_C = CI/r \quad [18]$$

The *total value of capital* (C) of the monte is obtained by multiplying the quantity (Q_C) by the price (P_C) [19]:

$$C = Q_C \times P_C \quad [19]$$

The value of capital (C) of the monte may be influenced by the subsidies net of taxes (SN), although the uncertainty of the future stability of the perception of the SN by the government makes it difficult to estimate what proportion of the CI has to be considered to estimate the unit price that corresponds to the total quantity of the good exchanged in the market.

2.3.7 Profitability rate measurement

The rate of economic return of the monte represents the monetary benefit (euros) that the owner of the monte obtains in a year for each monetary unit (euro) that, on average, has been immobilized during every day of the year in the monte.

The calculation of *immobilized capital at market prices* (IMCmp) is affected by the cost of purchased raw materials (RMp), bought services (SSb), employee labor cost (LCe), sale of final output (FOs), initial capital stock (Ci), bought capital (Cb), and sales of capital (Cs) [20]:

$$IMCmp = Ci + c_1*RMp + c_2*SSb + c_3*LCe + c_4*Cb - c_5*FOs - c_6*Cs \quad [20]$$

The estimation of *immobilicez capital at factor costs* (IMCfc) is obtained by subtracting the subsidies net of taxes (SN) from the IMCmp [21]:

$$IMCfc = IMCmp - c_7*SN \quad [21]$$

The parameter c_i that weighs the annual flows of revenues and expenditure represents the factor that converts the working capital into an equivalent fixed annual amount of stock during the year, and add this with the stock of initial capital (Ci), being $0 \leq c_i < 1$.

The calculation of the rate of economic return (r) results by dividing the CI by the IMC, assuming a constant and indefinite capital income [22]:

$$r = CI/IMC \quad [22]$$

[19] For simplicity it also does not refer to the discount rate where appropriate.

The types of rates of economic return can be given in the AAS for an individual good or service for which it has complete production and capital accounts, and which is aggregated in the territorial economic unit considered for the operating capital income, capital gain and total capital income, the latter as a sum of the two previous. The equations [23]-[28] show a selection[20] of different partial and total social profitability rates of the monte:

- Social operating profitability rate at market prices (rmp_o) [23]:

  rmp_o =NOM/IMCmp [23]

- Social operating profitability rate at factor prices (rfp_o) [24]:

  rfc_o = NOS/IMCfc [24]

- Social capital gain rate at market prices (gmp_g) [25]:

  gmp_g = CGmp/IMCmp [25]

- Social capital gain rate at factor prices (gfp_g) [26]:

  gfc_g = CGfp / IMCfp [26]

- Social total profitability rate at market prices (rmp_t) [27]:

  rmp_t = CImp/IMCmp [27]

- Social total profitability rate at factor prices (rfp_t) [28]:

  rfp_t = CIfp/ IMCfp [28]

3. PROGRESS ON NATURAL ECOSYSTEMS TOTAL VALUATION

3.1 Introduction

The limitations that the system of national accounts (SNA) present to measure the total income of a forest ecosystem have motivated in the past three decades an ongoing debate on the amendments to be introduced[21] in order to build green accounts of natural ecosystems. The developments applied to the green accounts of the monte based on the extension of economic accounts of forestry (EAF) are limited to a small number of pilot publications. There exist numerous academic and institutional studies about the economic and environmental values of forest ecosystems that do not follow the criterion of double-entry and exchange value of the EAF, and for these reasons they are irrelevant to the knowledge of the total income and capital of the monte.

In the last few years there has been progress in developing methodological approaches to wood accounts (Vincent, 1999 and Caparrós et al., 2003). However, these advances have not to date led to the implementation by governments of a new

[20] Commercial, environmental, private and activities profitability rates are omitted because simplicity reason.

[21] The leadership of the Department of Statistics of the United Nations (UNDS) through the Committee of Economic and Environmental Accounts (UNCEEA) in this review process continues to be produced with the voluntary participation of international economic institutions, national statistic offices, national and regional governments, non-governmental organizations and scientific institutions, both public and private.

method of production and capital accounts of wood. If this is the situation for timber production, it should not be a surprise that international projects on green accounts of montes are still in the preliminary stages (EUROSTAT, 2002, UNCEEA, 2011a).

The international projects mentioned below on the contribution of goods and services of natural ecosystems to human welfare differ in objectives and methodologies[22]. The project CREEA has interest in implementing a consistent classification of forest land and timber accounts of the SEEA 2012 at the national level, and although this exclusive timber objective is limited to the needs of the assessment of total income and capital of montes, it no doubt remains a priority to know the commercial production of wood and the physical and economic capital accounts at national scale.

The SEEA and IEEAF accounts systems, and the CREEA project, present methodological proposals of commercial accounts of the montes based on the conventional SNA. The WAVES project has the additional objective of estimating the total income and total capital incorporating the measurement of environmental goods and services on the basis of SNA and the CICES approaches (Haines-Young and Potschin, 2010). The TEEB project has its objectives oriented towards the collection and analysis of environmental assessments of global biological resources. The TEEB has not made a new methodological proposal on green accounts of the natural ecosystems; nevertheless, their point of view of the environmental valuation of the natural ecosystem services is favorable to the application of the concept of total economic value, while recognizing the interest for the design of public environmental policies of other non-economic metrics (Ring *et al*., 2010). The UK NEA project has its origin in the approach of the *Millenium Ecosystem Assessment* (MA) and has evolved into an economic goods and services valuation of the natural ecosystems based in the total economic value.

The European Environment Agency (EEA) is behind the EURECA project with the purpose of serving as a forum and exchange for the national projects focusing on MA approach, although these projects post-MA are still developing.

In this international framework of initiatives for the commercial and environmental valuation of forest ecosystems and other natural ecosystems, the Environmental Economics Group (GEA) of IPP-CSIC is carrying out the application and initiated the dissemination of the RECAMAN project. The GEA participates in the meetings of experts on commercial and environmental accounts for the reform of the SEEA and the development of accounts of ecosystems. Among the latter, the accounts of montes have a clear relevance. The RECAMAN project has been presented, among other meetings, in the seminars (1) *Expert Meeting on Ecosystem Accounting* held on the 11th – 13th of May, 2011, in *Copenhagen* (Campos and Caparrós, 2011a) and organized, jointly, by the European Environment Agency (EEA), the UNCEEA and the WB; and in the (2) *17th Meeting* del *London Group on Environmental and Economic Accounting*[23], organized by the *Office Statistics Sweden*, *Stockholm,* the 12th-15th of September, 2011 (Campos and Caparrós, 2011b).

[22] The studies selection showed refers to the international projects that have for various reasons interest in the RECAMAN project, although this does not mean that others omitted studies cannot also have interest too, such as the case of the national project *Valuation of Spanish natural assets* (VANE) promoted by the Spanish Department of Environment, Rural and Marine Natural Environment (MARM) (Azqueta and Tirado, 2008; Esteban, 2010; and Voces *et al.*, 2010). The sample selection of international projects is considered adequate from the point of view of the comparing the project RECAMAN with other international projects of economic and environmental valuation of forest ecosystems.

[23] The *London Group on Environmental Accounting* (LG) is formed by the community of experts in national accounting which advice the UNCEEA around the SEEA revision process.

3.2 Natural ecosystems total valuation projects

3.2.1 SEEA

The project expected to have more influence on governments for the future development of the methodology of green national accounting is being developed by the *United Nations Committee of Experts of Economic and Environmental Accounts* (UNCEEA)[24] of the United Nations Statistics Department (UNSD) that, in cooperation with the European Commission, the World Bank and the Organization for Economic Cooperation and Development (OECD), published in 1993 the *System of Economic and Environmental Accounts* (SEEA), revised in 2003 and is in the current phase of a new revision with the advice of the *London Group on Environmental Accounting* (LG).

In the revision of the SEEA there have occurred advances in the development of the physical links of the use of natural resources in the function of economic production, but the subjection of the SEEA 2012 to the SCN 2008 prevents the SEEA to so far represent a green extension of the SNA. Nevertheless, from the perspective of the montes the SEEA represents a significant methodological advance in the capital account of commercial timber (UNCEEA, 2011a,b), and it could result in the SEEA 2013 seeing the light of the first methodological guide integrating commercial and environmental valuations in the green accounts of the forest[25].

3.2.2 IEEAF

The European Commission has recognized the need for statistical accounting at the scale of a farm of the monte, and in the distant 1988 it proposed the extension of the *Farm Accountancy Data Network* (FADN[26]) in order to incorporate multiple use agroforestry of the monte and other similar European systems (CEC, 1988).

The *European Commission* published in 1994 its strategy for the development of studies of national environmental accounting (European Commission, 1994). Since then, more than three decades have passed without any advances in incorporating environmental income measures in the measures of national income. EUROSTAT has published pilot studies about the *integrated economic and environmental accounts of the forest* (IEEAF), although their pilot results have limited to the production and capital accounts of commercial timber of a group of countries located in central and northern European Union (EUROSTAT, 1999 and 2002).

[24] The UNCEEA has the responsibility for the current revision of the SEEA. In the area of the forest ecosystems green accounting the UNCEEA plans to publish in 2012 a methodological guide for capital accounts of wood (SEEA vol. 1). In 2013 it plans to publish the methodology of forest ecosystem accounts with monetary valuations of commercial and environmental goods and services (SEEA vol. 2).

[25] *The World Bank* (WB) has an active contribution to the SEEA on the development of the methodology of the valuation of ecosystem services (London Group, 2010 and Atkinson, 2010, LG, 2010).

[26] The *Farm Accountancy Data Network* (FADN) – in Spanish *Red Contable Agraría Nacional (RECAN)* (European Commission, 2010b) – was designed since its first version in 1965 to facilitate economic and financial information of farms and commercial livestock for the design of the common agricultural policy (CAP) of the then European Economic Community, that historically has resulted in the regulation and economic incentives of the common organization of agricultural and livestock markets. Actually the FADN still does not incorporate the forest sector for member countries of the European Union, on the grounds that the forestry sector is of exclusive national jurisdiction, which is why to date the EU lacks an active common forestry policy.

3.2.3 TEEB

The environmental ministers of the G8+5 proposed to develop a global study on the future economic consequences of biodiversity loss (Postdam, Alemania, 2007). In response to this initiative agreed-upon in Postdam, Germany, the European Commission, the United Nations Environmental Program (UNEP) and other governments and institutions promote the study on *The Economics of Ecosystems and Biodiversity* (TEEB), headed by economist Pavan Sukhdev, special advisor to the UNEP (Ring *et al*., 2010 and Wittmer *et al*., 2010). The TEEB aims to integrate at a global scale the monetary valuations of the environmental services of ecosystems, albeit on the basis of insufficient available information (TEEB, 2010 and EEA, 2010). The *European Environmental Agency* (EEA) contributes to the development of the TEEB project, among other initiatives, with the *Common International Classification of Ecosystem Services* (CICES), that it conceptualizes of *resource, sinks and services* functions provided by ecosystems to satisfy human demands (Haines-Young and Potschin, 2010).

3.2.4 WAVES

The World Bank (WB) is initiating the international project *Wealth Accounting and the Valuation of Ecosystem Services* (WAVES). The WAVES project is directed by the expert economist in natural and environmental resources *Glenn-Marie Lange*. The WAVES project aims to develop the methodology of green national accounting to estimate the total income and capital of natural ecosystems and other non-economic ecosystem services on the basis of SEEA and CICES framework (WB, 2011). This initiative can be a turning point in the current situation and, if successful in their national and regional pilot applications, it would be more feasible for governments to decide to implement in the near future green national accounting of natural and environmental resources, as a useful tool for the development of *green growth strategy in the global economy* that promotes the OECD (OCDE, 2010, Mountford, 2011).

3.2.5 EURECA

The evaluation of ecosystems goods and services in Europe based on the concepts of ecosystems and functions from the *Millennium Ecosystems Assessment* (MA) project of United Nations (MA, 2005). In the post-MEA context of the UNEP (MA-II), the European Environmental Agency (EEA) started in 2008 a *European Ecosystem Assessment* project (EURECA) in order to provide a platform for sharing knowledge and information on national assessments of the European Millennium (Graham *et al*., 2010, p. 9). The results of the implementation of the Millennium in the 38 countries of the EEA show that only Portugal has completed the evaluation (Pereira *et al.*, 2003), 3 countries are in the process of the study (Spain, the United Kingdom, and Switzerland) and 11 countries are in an exploratory phase (Germany, Austria, Belgium, Bulgaria, Finland, France, Holland, Montenegro, Norway, the Czech Republic and Sweden) (Graham *et al*., 2010, p. 16).

The MA (2005) classifies the ecosystems goods and services in *provisioning* resources*, regulating* services, *cultural* services and *supporting* services. This classification has undergone recent changes by CICES proposal, that it has integrated the supporting services in regulating services with the aim of avoid double-counting (Haines-Young and Potschin, 2010). The initial critics of the methodology of the MEA (2005) have pointed out, among others, the methodological and applicable weaknesses of the economic valuations caused be inconsistencies and double counting (Boyd, J. and Banzhaf, S., 2007). Recently, progress is being made on the developments of SEEA and WAVES project that tends to redefine the separation between economic intermediate and final goods and services, and those that are non-economic, avoiding overlap and double counting, and are notable improvements in the techniques of integration of environmental valuation applied to consistent aggregation

of scarce goods and services of ecosystems (Campos and Caparrós, 2009, Haines-Young and Potschin, 2010, Bateman, *et al*., 2010).

Among the cases of implementation of the MA-II assessments in Europe they often express the purpose of using economic evaluations for the development of environmental accounts of ecosystems (Graham *et al*., 2010, p. 6), although this objective has not materialized in a common methodological guide, and in some cases rejects the environmental economic valuation (Montes and Lomas, 2010). The research groups of the MA-II assessments in Europe tend to be academic initiatives and are over-represented by scientists in the natural sciences (Graham *et al*., 2010, p. 6), although this is not the case of the valuation of the Millennium in the United Kingdom (Bateman *et al*., 2010 and UK NEA, 2011).

The *Millennium Ecosystems Assessment in Spain* (MEE) project has been developed in the context of the MEA-II of the EURECA program. MEE is coordinated by the biologist Carlos Montes from the Autonomous University of Madrid (UAM). The MEE has funding from the Biodiversity Foundation of the Spanish Department of Environment, Rural and Marine Natural Environment (MARM) and other autonomous Spanish governments administrations.

In contrast with the UK NEA and other EURECA studiy cases (Graham *et al*., 2010), the MEE project does not have as an objective the economic valuation of public and private environmental services of natural ecosystems:

> *"MEE rejects the TEV as a framework to also determine the monetary contributions, very relevant in terms of indirect drivers of change, involving the services of ecosystems, understanding that only one can calculate the monetary benefit of those ecosystem services that have a real market value, through actual prices directly linked to these ecosystem services. This calculation does not involve consideration of the value of services is that, but it is understood as the benefit linked to its exchange value, that is, the monetary benefit actually obtained for these services, leaving other dimensions of value to study by other methods, in a context outside of TEV such as the Multi-criteria Evaluation" (Montes and Lomas, 2010, p. 69).*

The authors of the MEE recognize also the difficulty of incorporating economic analysis in evaluating Spanish ecosystems because of the "major gaps of information and general data about… monetary flows of services captured by markets" in Spanish ecosystems (Montes and Lomas, 2010, p. 74), and where there is "no data" in certain physical and monetary trends in qualitative analysis of the use of ecosystem resources the MEE intends to resort to the "criterion of the experts" (Montes and Lomas, 2010, p. 70).

The aim of use a multi-criteria evaluation as an alternative approach to the environmental valuation approach in the EME project is a misunderstanding perspective; and, by contrary, both methodologies are mutually reinforcing. Only in presence of irreversibility threats situations, the environmental valuation of public services of ecosystems threatened of extinction could have lack of relevance, and therefore in pursuing the preservation of unique environmental assets in danger of extinction, then could become of higher interest the safe minimum standard (SMS), multicriteria evaluation (MCE) and societal tolerable cost (STC) approaches. In other cases, beyond irreversibility situations, missing the environmental valuation reduces the availability of accurate data for better design of conservation policies on natural environment (Fisher *et al*., 2008).

The *General Directorate for Sustainable Development and Environmental Information* of the *Department of Natural Environment* of the *Andalucía Government* has launched the project *Ecosystems Assessment of the Millennium of Andalucía* (EMA) as a regional component of the MEE. The EMA project, also coordinated by the UAM, has a

purpose focused on the ecological management of natural ecosystems and their links to human well-being[27]:

> "To generate scientific information on the status of Andalusian ecosystems for politicians, managers, private sector and the public sector in general can deepen the close links that exist between the conservation and the welfare of the Andalusian pople" (Junta de Andalucía, 2011b).

The EMA and RECAMAN projects have in common the study of forest ecosystems in Andalucía and differ in their objectives and methodologies, so that there is no overlap between the two projects but might have positive synergies. The EMA is a project whose objective is not oriented towards the environmental economic valuation of the forest ecosystem services. RECAMAN, as explained in detail in the next section, is a project whose main objective is the total economic valuation of the forest ecosystem based mainly on self-generation of commercial information and environmental economics of the Andalucian montes.

3.2.6 UK NEA

The *UK National Ecosystem Assessment* (UK NEA, 2011) project is financed by the *Department for Environment, Food and Rural Affairs* (Defra), and other institutions, and it collaborates with some 500 experts in natural, economic and social sciences. The UK NEA is coordinated by Robert Watson (Defra's Chief Scientific Advisor and Strategic Director of the Tyndall Center of the University of Easy Anglia) and Steve Albon of the James Hutton Institute. This investigation team has met and analyzed a large volume of public information about the environment of the United Kingdom and has generated new tools to assess the environment, in both economic and non-economic terms. The economic valuation of the UK NEA is based in the theory of total economic value (TEV) and is focused in the final provision of goods and services of United Kingdom ecosystems in terms of economic wellbeing, so it has not yet developed a proposal for a green economic account of ecosystems integrating all the economic goods and services in a manner consistent with the exchange value of commercial goods and services (Bateman *et al*., 2010).

3.2.7 CREEA

The *Compiling and Refining Environmental and Economic Accounts* (CREEA) project is financed by the 7th Research Framework Program for the Environment in the European Union (UE FP7)[28]. The general objective of the CREEA project is to develop the concepts and the homogenization of the classifications of the physical environmental accounts of the sectors of water, waste, and the forest. The principal researcher of forest accounts is Viveka Palm of the *Sweden Office of Statistics* and her contract duration is 2011-2014[29]. In the case of the forest the objective of the valuation of commercial timber extraction is expanded to capital account using the system of physical and monetary capital account of timber developed by Muukkonen (2009) and the SEEA 2012 (UNCEEA, 2011a,b) and could be used as a database on which to build national case studies in which the classifications of the timber capital account fit within the boundaries of the conventional SNA.

The CREEA project is being developed by various groups of experts of northern and central Europe associated with the *London Group on Environmental Accounting* (LG)

[27] In contrast, the RECAMAN project, which only focuses on economic valuation, both commercial and environmental, of the montes of Andalucía.

[28] Notification FP7 ENV.2010.4.2.2-1 *Development of integrated economic and environmental accounts*.

[29] Available on line: http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&RCN=97380.

with the purpose of contributing to the review process of the SSEA and its perspective of the economic valuation of timber is limited by the narrow framework of the economic valuation of the SEEA 2012. Thus, the CREEA project proposes as an objective the economic valuation of capital account derived from the commercial extraction of timber and certain non-timber products harvested from the forest on which official statistics are available.

New interesting results are expected on forests for the international standardization of concepts and classifications of forest areas, physical and monetary balances of standing timber and balances of carbon based on FAO statistics (2010). CREEA does not have as an objective the advancement of the development and application of new methodologies of commercial and environmental integrated economic accounts of the forest, and therefore are not expected a significant influence in the advancement of the methodology of integration consistent with the monetary valuation of commercial and environmental values of the forest.

4. RECAMAN PROJECT

4.1 Introduction

The evidence presented in the previous section favor the tendency of incorporating in international and domestic governmental policies interest in the total economic value of goods and services of ecosystems and, in the case of the SEEA and WAVES projects, they are gradually pursuing the implementation by the government of green accounts of natural ecosystems. The Mediterranean monte, although as noted in the first paragraph has the need to implement the green accounts in common with the world's first ecosystems, it parts with the additional merits of its high biological variety by adding its important economic contribution to the local population and the mitigation of the loss of global biodiversity services.

The *Income and Capital of the Montes of Andalucía* (RECAMAN) project is promoted by the *General Directorate for Natural Environment Management* of the *Department of Natural Environment* of the *Andalusian Government*. The scientific direction of RECAMAN project is developed by the Environmental Economics Group (GEA) of the Institute of Public Goods and Policies of the Spanish National Research Council (IPP-CSIC). RECAMAN benefits from the contribution of the Agency for Natural Environment and Water of the Andalusian Government on fields works and applying GIS tools required by RECAMAN project (see Appendix).

The green agroforestry accounting system (AAS) is applied in RECAMAN, on the one hand, (1) in 58 predominately montes surface estates that show typical forest vegetation most widespread in the montes of Andalucía and in which all economic commercial and environmental activities are valued, including agricultural and livestock activities; and, on the other hand, (2) a regional scale, to all surfaces of the montes of Andalucía by montes vegetation types, excluding in this regional scale the agricultural and livestock activities.

The RECAMAN project general objective is the estimation of the Hicksian green total income and capital of the montes in Andalucía by applying the AAS system that extends the methodology of the conventional economic accounts of forestry (EAF).

Although in the past the scientific controversy over the methods of environmental valuation may have influenced the passivity of governments to develop and implement national green accounting, the persistence of gaps and inadequacies of the EAF, unable to provide actual estimates of the total income of the montes, today could be resolved by applying the green national accounting in a sufficient degree turning to

advances taking place in recent years in the consistent integration of commercial and environmental values, so that the failure of available official economic data can be attributed more to the lack of political priority of governments to implement green national accounting.

The *global economic and environmental crisis* currently favors a new impetus to develop a methodology of national green accounting by international economic organizations interested in the economic development oriented towards a *green growth strategy* that reduces the environmental deterioration of the Earth, and, consequently, governments could be more willing to allocate a majority of public spending on the future respect of what we dedicated in the past to implement the measurement of the *total green income* of natural ecosystems[30].

In this new context of international incentives on green accounting, the RECAMAN project aims to develop a methodological guide that makes it possible to implement a system of green economic statistics to a micro and macro scale of the montes of Andalucía, whose surface is about 54% of the total geographical area of the Andalucía (Table 4).

The measurement of the total income of the monte, like that of any other natural ecosystem, can be in practice an unattainable goal in a comprehensive manner because of the presence of uncertain environmental uses and/or impossible valuations[31].

The estimation of the total income of the montes of Andalucía that is accurately being performed by the RECAMAN project, on one hand, identifies which are the goods and services produced and consumed for which commercial transactions are observed and, on the other hand, the observation and/or inference of current and/or future uses of environmental goods and services, so called because they produce no transactions.

The Andalucian montes offer to a private owner, to the public and to society a wide range of goods and services that are omitted in the official accounting of the forest income of the EAF (EUROSTAT, 2000, and European Commission, 2010b). The RECAMAN project measures at a regional scale of Andalucía a large group of goods and services by the EAF system in the measurement of the total income of montes classified in goods like woody trees outputs[32], herbaceous goods[33], fruits, commercial services[34], private environmental auto-consumption services[35], public recreational services, carbon fixation, annual quantity of forest water free consumption, forest landscape conservation, threatened biodiversity and others.

[30] In the European Union the implementation of national green accounting of forest ecosystems could be, simultaneously, a micro-scale of *agroforestry exploitation* (expanding the FADN), and a macro-scale of the montes both *national* and *regional* (modifying and expanding the EAA/EAF).

[31] The public and private users may refuse to declare the rate of replacement of a equivalent good or service by any other at a relative value, making it impossible in this case to value it (Spash and Hanley, 1995).

[32] As they are natural growth of tree multi-product in the cycle, wood, firewood and cork.

[33] Nowadays is exceptional to cultivate crops in quercus forest area, and, therefore to collect own straw production.

[34] Among commercial services, additionally to recreational hunting, they are nature tourism, and the activities associate to the latter.

[35] The private environmental auto-consumption is composed by forest owner and family enjoyment from recreational services, landscape, threatened biodiversity, and other environmental services accruing from the forest to them.

4.2 Classifications of total outputs and costs

Table 5 presents the summarized RECAMAN production account. The rows show, for each of the activities carried out in the columns, the total output and total cost, by distinguishing between the commercial and environmental, and as too the public and private. The columns represent the activities that have complete production and capital accounts, and therefore their income and capital can be estimated.

In RECAMAN an activity whose ordinary most important output is environmental is called an environmental activity. It should be noted that an environmental activity can supply own account commercial gross fixed capital formation and generate commercial costs. Thus, an environmental activity could generate a mixed environmental and commercial total income, and this mixed total income could be separated into environmental income and commercial income depending on the activity. Another distinct feature of RECAMAN is that a commercial activity can generate a mixed private and public total income, which can be separated into private income and public income depending on the activity. In other words, the total income of the monte can be classified in RECAMAN, by the criterion of ownership, in public and private, and, by the criterion of the market, in commercial and environmental. When subsidies net of taxes on production and capital goods are not taken into account, the Hicksian green total income is also called green total social income in RECAMAN.

The *total output* (TO) of the monte is classified in RECAMAN, on the one hand, in total *commercial* output (TO_C) and total *environmental output* (TO_E), and, on the other hand, in total *private* output (TO_{PR}) and total *public* output (TO_{PU}) (Table 5). The TO_C is estimated by the sum of total *private commercial* output ($TO_{PR,C}$) and the total *public commercial* output ($TO_{PU,C}$). The $TO_{PU,C}$ consists of the own account public commercial gross fixed capital formation ($GFCFoa_{PU,C}$) generated by the government management spending associated with the TO of the monte[36].

The *private environmental goods and services auto-consumption final output* ($FOa_{PR,E}$) generated in a monte consists of all the flows of *scarce goods and services* for what a non-industrial forest owner is *willing* to pay a sum of money (numerarie) to guarantee its auto-consumption by holding exclusive property of the monte. The $FOa_{PR,E}$, as has been previously noted, is not traded as a flow, but requires that its capital value is internalized by the potential market transaction of land.

The total *public environmental output* ($PO_{PU,E}$) generated in a monte consists of all the flows of non-commercial *scarce goods* and *services* not usually traded to which a consumer and/or institutional entity non-owner has free access, and for which the person and/or institutional entity is willing to pay a sum of money (numerary) to guarantee their consumption and/or exclusive ownership.

The *private total output* (TO_{PR}) results by adding the *private commercial total output* ($TO_{PR,C}$) and the *private environmental total output* ($TO_{PR,E}$), and, equally, the *public total output* (TO_{PU}) is estimated by the sum of the *commercial* ($TP_{PU,C}$) and *environmental* ($PT_{PU,E}$) public outputs.

Also the total cost (TC), in the same way as the total output (TO), can be disaggregated into commercial (TC_C) and environmental (TC_E), and, also, into private (TC_{PR}) and public (TC_{PU}). The private total cost (TC_{PR}) coincides with the private

[36] The allocation of the GFCFoa of government spending on the monte to activities that benefit of their future services assume that environmental activities include in their total output a proportional part of the own account public commercial GFCFoa in plantations, natural growth of multiproduct trees, constructions and equipment.

Table 4. Vegetations and land uses in the montes of Andalucía (2005)

Class	Total are of monte by province (hectare)									Percentage
	Almería	Cádiz	Córdoba	Granada	Huelva	Jaén	Málaga	Sevilla	Total	Total (%)
Forest	182.988	240.010	565.706	306.828	581.256	434.761	208.792	314.714	2.835.057	60,6
Oaks	66.729	124.912	484.695	135.084	315.758	247.491	90.047	258.576	1.723.292	36,8
Oaks (dense forest)	*13.012*	*83.599*	*226.444*	*39.989*	*153.327*	*67.523*	*42.906*	*140.107*	*766.907*	*16,4*
Oaks (dispersed forest)	*22.466*	*37.887*	*246.546*	*49.426*	*149.104*	*112.428*	*35.428*	*114.885*	*768.170*	*16,4*
Mixture of oaks and conifers	*31.251*	*3.332*	*11.542*	*45.667*	*7.506*	*67.470*	*11.646*	*2.713*	*181.126*	*3,9*
Mixture of oaks and other broadleaves		*94*	*163*	*3*	*5.821*	*70*	*67*	*871*	*7.088*	*0,2*
Other broadleaves	19.135	57.299	6.257	10.803	125.440	3.166	23.472	28.727	274.298	5,9
Conifers	94.041	18.563	67.475	149.567	128.520	174.363	78.998	19.151	730.677	15,6
Conifers (dense forest)	*67.456*	*14.369*	*50.251*	*101.984*	*84.855*	*119.501*	*44.975*	*12.755*	*496.146*	*10,6*
Conifers (dispersed forest)	*26.579*	*3.943*	*16.409*	*47.527*	*32.287*	*54.770*	*33.757*	*4.992*	*220.263*	*4,7*
Mixture of conifers and other broadleaves	*7*	*251*	*816*	*55*	*11.378*	*93*	*266*	*1.403*	*14.268*	*0,3*
Other forest	3.084	39.237	7.279	11.374	11.539	9.741	16.275	8.260	106.789	2,3
Treeless monte	400.899	109.368	91.118	330.436	130.036	181.168	139.059	93.243	1.475.327	31,5
Shrubland	108.255	32.219	41.105	100.786	65.188	60.518	50.806	34.259	493.135	10,5
Pastureland	82.886	63.014	32.403	95.268	44.452	62.461	38.346	41.790	460.621	9,8
Mixture of shrubland and pastureland	209.758	14.134	17.610	134.382	20.396	58.189	49.907	17.195	521.571	11,1
Other montes	70.564	23.193	30.006	61.760	64.724	37.028	44.657	39.265	371.196	7,9
Total montes	654.451	372.571	686.830	699.024	776.016	652.957	392.508	447.222	4.681.580	100,0

(1) Preliminary data

Source: RECAMAN project (in progress) based on the *System of Information of Occupation of Land in Spain* (SIOSE). Andalucía (Junta de Andalucía, 2011a).

commercial total cost ($TC_{PR,C}$), and the public total cost (TC_{PU}) is the aggregation of public commercial total cost ($TC_{PU,C}$) derived from governmental public spending in the monte and the environmental total cost (TC_E[37]), taking into account that there is not private environmental cost internalization in Andalusian montes.

In RECAMAN the disaggregated estimation of government spending on the public management of the Andalusian montes allows its full integration into the AAS account system in a way that is consistent with the concepts of commercial output and costs of the conventional SNA. The contribution of government spending in the montes ecosystems and the commercial output, as well as the environmental output, and, also, to the private and public outputs, could be estimated by AAS (Table 5). These classifications are achieved by building comprehensive private and public accounts, and, as the sum of both, we obtain the social accounts of the montes of Andalucía.

4.3 RECAMAN private goods and services measurements beyond *EAF*

4.3.1 Timber, cork and firewood

Table 4 shows that oak woodlands form the dominant group of forest surfaces of Andalucía, providing 2.4 times more area than coniferous woodland. The wooded area of oak trees is most widespread in the *dehesa formation*[38]. At a farm scale, dehesa formation is often accompanied by treeless monte surfaces and agriculture, thus constituting farms of Mediterranean montes [39] dominated by agroforestry systems[40] most emblematic of the southwest and central Iberian Peninsula, called the *dehesa*[41] in Spain and *montado* in Portugal. The dehesa is one of the habitats with greater biological variety, with as many indigenous livestock breeds (Molina, 2010) and threatened domestic plants as plants and wild birds in danger of extinction that inhabit it, and also one of the various commercial and economic environmental goods generated to local and global populations, compared with other agroforestry systems in the Earth.

The forest management of the dehesa was directed still three decades ago to encourage the production of grasses, acorns, cork, firewood and grains. This interest of private owners, although it may favor the oak in areas of good fruit production, usually in the past gave priority to the economy of grasslands, in a context of continuous development of extensive livestock and agricultural crops. Researchers who have focused on the evolution of Mediterranean oaks in Spain have shown that the concern for the conservation of trees has fallen mainly on the side of public administrations,

[37] In the RECAMAN project environmental costs of carbon emissions from woody vegetation are considered and the consumption of green environmental water by woody vegetation is valued at a price of zero over the consumption of natural grassland.

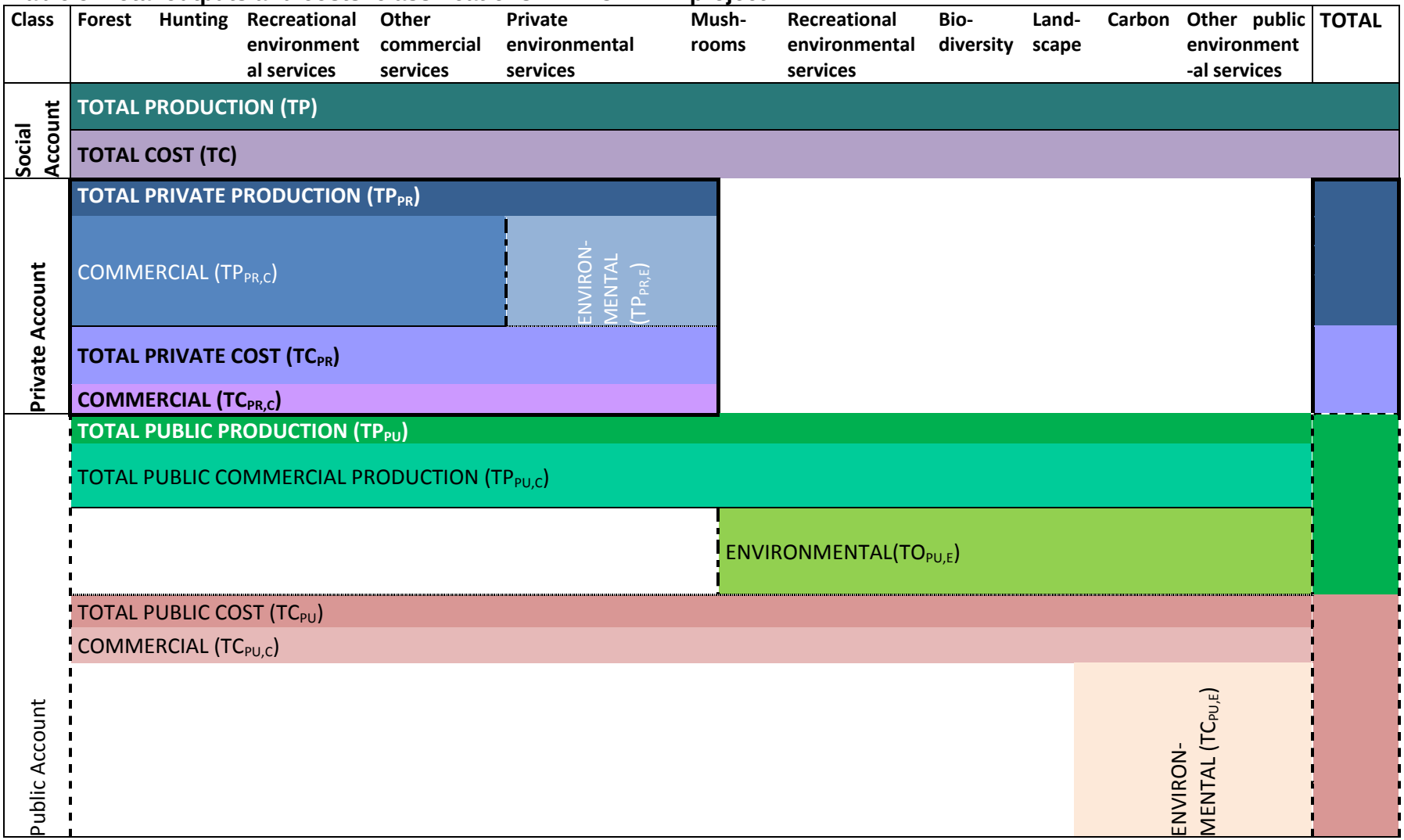
[38] "Dehesa formation: forest area occupied by a layer of trees, with a canopy cover (floor area covered by the projection of the canopy) between 5% and 75%, composed mainly of holm oaks, cork oaks, Algerian and Lusitanian oaks, or wild olive trees [Mediterranean broadleaves], and occasionally by *other* trees, allowing the development of a layer that is essentially herbaceous (grass) for utilization by livestock or game species" (BOJA, 2010, Art. 2a, p. 8).

[39] Forest experts use the term Mediterranean monte in another sense of the word, attaching it to a non-dehesa use. In RECAMAN it has been noted that the term monte and Mediterranean monte are used as a synonym for a forest area as defined under the Spanish montes Law (BOE, 2003).

[40] The rinsing and staking of native shrubs throughout history have intensely shaped the working forest landscape in Mediterranean forests.

[41] "Dehesa: Exploitation consisting mostly [>50%] of *dehesa formation*, subjected to a system of use and land management based principally on the extensive grazing that takes advantage of the pasture, fruits and tree browsing, and other forest uses, hunting or farming" (BOJA, 2010, Art. 2 b, p. 8).

Table 5. Total outputs and costs classifications in RECAMAN project



and, although with a few exceptions to this general rule, today it remains like this, as can be seen in the forest laws (BOE, 2003 and BOJA, 2010) and the management of the dehesa (Linares and Zapata, 2003). Generally, researchers and institutions agree in qualifying deficiency in the natural regeneration of the dehesa as the main cause of forest degradation in the medium and long term (Pulido *et al*., 2003). An example of where the political relevance that has reached the degradations of holm oak and cork oak is shown in the report of the *Report on the protection of the dehesa ecosystem* of the Spanish Senate, which in 2010 concluded that the crisis of natural regeneration of trees is one of the most pressing environmental problems of the dehesa (Senado, 2010). The widespread recognition of the problem of tree aging has not motivated the Spanish government and other regional governments in the area of the dehesa to assess the economic effects that are hidden behind this aging tree problem[42].

Table 6. RECAMAN data and valuation methods of beyond EAF

Class	Unit	Quantity	Price
1. Live trees (tl)	tr	NFI/AAS	M/PDV
2. Natural death of trees (td)	tr	PF/AAS	M/ PDV
3. Tree natural growth of timber and firewood (NGtf)	m^3	PF/AAS	M/ PDV
4. Natural growth of cork (NGc)	kg	PF/ AAS	M/ PDV
5. Grazing of acorns (IOa)	kg	PF/S/ AAS	S/ PDV
6. Grazing of natural grass (IOng)	kg	PF/S/ AAS	S/ PDV
7. Capital game (Cga)	he	PF/S/AAS	S/PDV
8. Recreational hunting extractions (FOega)	he	PF/S/AAS/CV	S/CV
9. Commercial recreational service (FOr_C)	vi	S/AAS	S/M/PDV
10. Private environmental auto-consumption ($FOa_{PR,E}$)	ha	AAS/S/CV	S/CV/PDV
11. Private land ($FCl_{PR,C}$)	ha	S/AAS	S/CV/PDV
12. Free public collection of mushrooms ($FOm_{PU,E}$)	kg	S	S/CV/PDV
13. Forest carbon output ($FOc_{PU,E}$)	t	NFI/PF/AAS	M/PDV
14. Free forest water total output ($TOwa_F$)	m^3	AMAyA/PF	PF
15. Public environmental recreation service ($FOr_{PU,E}$)	vi	S/AAS	CV/PF
16. Forest landscape ($FOl_{PU,E}$)	ha	CE/PF	CE/PF
17. Threatened biodiversity ($FOb_{PU,E}$)	n	DNE/AAS	CV/CE/PF
18. Forest management public expenditures ($PE_{PU,C}$)	ha	DNE/AAS	S/M/PDV

Abbreviations not defined above:

AMAyA: Andalusian Agency for Natural Environment and Water; tr: tree; he: animal head; AAS: green agroforestry accounting system; ha: hectare; DNE: Department of Natural Environment of Andalusian Administration; CE: choice experiment; S: *ad hoc* surveys; PF: production function; NFI: National Forest Inventory; kg: kilogram; M: market; m^3: cubic meter; n: total number of threatened species; t: metric ton; vi: visit; CV: contingent valuation; PDV: present discount value.

Source: RECAMAN project (in progress).

The conditions of natural productivity of forest soil in Andalucía do not favor the commercial profitability of timber silviculture. The historic repopulation of the conifers in Andalucía have been primarily the government's responsibility, and this public Administration direct forest investment has made Maritime pine, Aleppo pine, Scots pine, and Stone pine species reach a remarkable representation in the forests of Andalucía (Table 4). This forest plantation policy of the Spanish Administration, in the early nineties of the twentieth century was placed on the *dehesa*, significantly favoring for the first time the planting of holm and cork oaks[43].

[42] The potential exception could be the Andalusian Administration with the future application of Dehesa Law (BOJA, 2010) and the implementation of montes green agroforestry accounting system.

[43] This montes plantation by public incentives of grants to landowners comes from the agriculture policy of abandoned farmland in the European Union and not from forestry law.

The forest management of the monte is done in the context of a lack of economic statistics of full-cycle performance of timber, firewood and fruit products. Although this lack of economic information about the forest is common in all countries in the Mediterranean basin, in the case of Andalucía this circumstance uniquely highlights the significant expenditure of the public Administration designates to the fight against forest fires, forestry conservation, the preservation of threatened biodiversity and the extensive livestock grazing in the montes.

They have two official sources of statistical accounting data that could be *expanded* to adapt to the new demands of information that require the economic valuation of trees in the montes in Andalucía. On the one hand, the National Forest Inventory (NFI) provides the georeferenced tessellate[44] that provides the physical data of the woodland that is required for the calculation of the total income. This valuable physical information of the woodland is not used by the two EAA/EAF and FADN available official accounting systems in the scope of the European Union.

It only depends on a political decision by governments for extending the official accounting systems EAA/EAF and FADN to integrate physical data and prices to estimate the values of tree growth, the destruction of trees, the growth of timber, firewood and cork, the production of acorns, the carbon fixation and the free water consumption by trees, among others, as detailed below, and which are required to estimate the *total capital value* of woodlands in a monte. This total capital value of woodlands in a monte depends, on the one hand, *notably* on the *market prices and costs* of the commercial outputs of trees. On the other hand, there are other outputs of trees, clearly the environmental services of trees, which are inseparably associated with the soil and climate. To evaluate these services, environmental assessment methods are available such as the hedonic price, contingent valuation, choice experiment, production function and others. Table 6 shows a selected list of the sources of data and methods of valuation that are applied in the RECAMAN project to estimate the economic values ignored by the system of Economic Accounts for Forestry (EAF) of the montes in Andalucía, among which are the values of *living trees* (standing) and *destroyed* trees by *natural deaths*[45].

The capital value of *living trees* (standing) is estimated by the present discounted value (PDV) of its future natural resource rent (RR) streams of the current cycle. It should be kept in mind that a monte in RECAMAN has the capital value of its living trees of the current cycle classified by (1) *works in progress* of timber, firewood and cork (disaggregated in produced timber and expected timber to be produced in the future), including over matured timber oriented living trees without a timber cutting schedule[46]; and (2) *fixed capital* of *biological resources* of subsequent turns of timber and cork from trees with multiproduct in the current cycle, and non-timber oriented trees with repeated annual products as acorns, wild olive, pine nut and chestnuts (Table 6).

The calculation of the value of live trees (current cycle) and the value of the land for other trees cycles in the future by the natural resource rents (RR) requires an estimation of *forestry natural growth* (NGfor) of the work in progress and fixed capital comes from the tree biomass which is counted as a natural growth of timber (NGt), firewood (GNf) and cork (NGc). The growth of timber and firewood of trees as a single product throughout the tree cycle are considered work in progress. The *natural growth of Andalusian oak trees* is considered as own account gross fixed capital formation

[44] Tessellate is the name given to the georeferenced plot in which data provided by the NFI is measured.

[45] The tree cutting and the stripping cork have been omitted from Table 6 because they are included in the EAF system.

[46] Trees over matured oriented to timber supply with a positive present discounted value and there is not legal impediment for cutting them.

(GFCFoa) whose resource rents are originated by the future flows of acorns[47], cork and wood.

The natural growth of *timber and firewood* is an annual final output of the monte also omitted in the official statistics and its value can be estimated with the data provided by the National Forest Inventory (NFI) and the observed prices directly from the market (M) and/or estimated by its discounted present value (DPV). When the firewood is cut, either from the pruning of branches, thinning or cultural thinning, and the cutting of dead trees, must be considered, simultaneously, a *cost* by its standing value and an output by its value at forest gate.

The sources of official information for the economic valuation of woodlands of the monte should come from the NFI and from the FADN modifications. The FADN currently has physical partial data on tree cover, although the latter statistic counts on the number of farms in the monte present in the sample are underrepresented[48]. It is required that the FADN be expanded to include information on the natural growth of biomass and cork, and the production of acorns which requires a commercial economic valuation. The AAS applied in the RECAMAN project estimates the total income of trees with the inclusion of the annual growth of timber, firewood, cork and fruits.

4.3.2 Natural pasture and acorns

The case of the quantification of private commercial outputs and costs of the monte presents the greatest difficulties of valuation of the most unique components, such as the acorns and natural pasture consumptions by livestock and big game animals. Natural pastures (IOnp)[49] and acorns (IOa) consumption are considered intermediate commercial outputs, and the data from these outputs are known only from scientific research. The measurement omission acorns and pasture implies that it is not possible to know the incomes of pastures and the livestock of the monte, since in the official statistics of the FADN and the EAA, the income of livestock activities do not consider the costs of the intermediate consumption of the pasture and acorns.

The number of forage units (FUs) of pastures and acorns consumed by livestock and big game can be estimated together by estimating the livestock and big game annual total FUs needed, and subtracting from this total consumption the FUs consumed in the form of supplements. The market pasture and acorn resource rent can be estimated individually by surface units, heads of livestock and live weight gained by Iberian pigs on the grazing season (montanera). In RECAMAN the data of leases of pasture and acorns come from a survey of 800 non-industrial owners of montes and a sample of 58 montes estates in Andalucía.

The production of pastures and acorns consumed by the non-game wildlife in RECAMAN are considered non-economic goods by assuming that the forest owner has no effective demand for a willingness to pay individuals or institutional entities. The physical quantities of this free consumption of pastures and acorns, when it is possible to count, are taken into account in the estimation of physical indicators in the RECAMAN project.

[47] The acorns are graced by Iberian pigs (montanera) and other livstock and wild animals.

[48] This is the result of the consultation held in 2010 at the service of the FADN of the Department of Natural Environment, Rural and Marine Environment (MARM) for the monte of Andalucía.

[49] Consumption *in situ* of pastures (grazing) by animals can come from natural grasses and/or forage grasses that are grown. Sometimes the natural grass and/or the cultivated forage are harvested as hay. The hay harvested can come from natural and/or green fodder.

4.3.3 Game goods and services

The hunting is a consolidated private economic activity in the Andalucian monte that is spreading in competition with livestock for the consumption of pasture and acorns. There is a lack of official standard of measurement for recreational hunting services of the monte. The available information in some cases, like big game hunting, only allows access to data about the number of heads captured during recreation hunting and fragmentary data of the value of the meat of game species. Recreational hunting extractions are all considered commercial, regardless if they are intended for sale, auto-consumption, donations, payments on kind and poaching.

Game capital (Cgam) of the monte explains a significant part of the higher price that farms can reach in hunting areas with big game compared to other montes with similar natural conditions, but with lower hunting species richness. The higher price also explains why the hunting income of the owner is incorporated into the price of the land, which does not occur with livestock income. Recreational hunting could be estimated using the income and natural capital with the applications of the EEA/EAF and FADN, as with all other commercial goods and services now ignored by the EAF (Table 6).

The RECAMAN project has designed two specific surveys, of 800 questions each, carried out face to face with hunters and owners of hunting estates of montes in Andalucía. Additionally they have the hunting activity information in 58 montes estates in Andalucía.

4.3.4 Environmental auto-consumption services

The commercialization in the Andalusian monte of recreational services, meals and accommodation are still in their infancy. The owner of a monte is aware that among private goods and services the market internalizes in the price of land the auto-consumed private environmental services[50]. The non-industrial private land owner[51] of the monte is evolving into the joint interest of commercial and environmental benefits. The commercial objective is satisfied with the result of a lower commercial profit, but associated with this is the objective of ensuring the owner a *lifestyle* that offers auto-consumption, exclusively[52], of the monte. The auto-consumption of these private environmental services, being able to go as far as accepting a lower commercial gain, is also a private economic service, while monetary visibility is only perceived explicitly in the higher market price that reaches the land in the time of the purchase-sale for providing the monte with environmental services to their owners. Thus, the omission of the private environmental income of the monte could lead to affirm the presence of an *economic paradox*, which would be based on the inconsistency between the *market price of the land* and its *low rate of commercial profitability*. This paradox disappears if the private total profitability of the monte is estimated as the aggregate result of the income of private commercial and environmental capital obtained by the owners of the monte. The sum of these two partial capital incomes could confirm that the monte is now a profitable operation in the short and medium terms for non-industrial private owners, although its current management may not be profitable for future generations, because this current competitive private profit does not take into account changes in

[50] The private owner of the monte also is aware of the increasing value of public environmental goods and services offered by the monte to the public visitors that access to the monte and society as a whole.

[51] The condition of "non-industrial" is linked here to a private owner who is interested in auto-consuming environmental services with family and friends through recreational enjoyment, transmission of land as at family legacy and other non-commercial economic flows. By contrast, a private industrial owner of a monte searches for commercial profit maximization, and does not have interest in the auto-consumption of environmental services of the monte, except that the latter were de source of monte off-site commercial benefits..

[52] The owner of the monte has the right to deny entry to all unauthorized persons by the law.

the woodland[53] and public expenditure ($PE_{PU,C}$) incurred by the government in the public management of the montes.

The valuations of annual flows of private environmental auoconsumption ($POa_{PR,E}$) and of its corresponding market land value ($FCa_{PR,C}$) are obtained in the RECAMAN project by a survey of contingent valuation (CV) of 800 face to face questionnaires to private non-industrial land owners of montes in Andalucía.

4.3.5 Other private goods and services

The Andalusian montes produce a wide range of other individual minor private commercial products such as pine nuts and chestnuts, commercial recreational facilities and others included in the SEEA into the goods and services that could be supplied by the forest ecosystems. Among the private goods and services of the monte is natural rainfall water that is managed by the owner of the monte with supply for the animals also controlled by the owner. In RECAMAN the cost of fixed capital and maintenance of fountains and ponds used as watering holes for animals are attributed directly to livestock and hunting activities and the cost of water for domestic uses are attributed to the activities of auto-consumption and other commercial activities. This private water produced is valued at own production cost following the criteria of the SNA.

There are in Andalusian montes other land owner minor uses but they are not taken into account in RECAMAN project. It is assumed that these uses generate negligible economic rent to the land owner. Nevertheless, the people that they collect minor forest product by paying economic rent to the land owner might be more in the near future, as it is expected in the case of mushrooms collection.

4.4 RECAMAN public environmental goods and services measurements

The free collection, that is, without paying an economic rent to the land owner, of wild plants, non-hunting wildlife, truffles, mushrooms, etc. might be reaching an increasing intensity in Andalusian montes. These montes minor goods, admitted that the montes occupy around 54% of the geographical area of Andalucía (Table 5), could offer a significant aggregated total output. For these free wild minor products, the cost of obtaining information through surveys is high in terms of both money expending and time consuming. The RECAMAN project is not going to obtain information from the collection of plants, animals or truffles, except is going to obtain information from the collection of mushrooms.

The RECAMAN project estimates the *public environmental income* and *capital* of the monte from the public recreational free-access visits, the conservation of current forest landscape, threatened biodiversity, the collection of mushrooms, and the tree and shrubland carbon fixation and emission. The RECAMAN project attributes the *public spending* that the administration of Andalucía performs in its management to these public environmental goods and services.

4.4.1 Mushrooms public collection

The experiences of regulation of property rights and gathering of mushrooms, protected by the Forest Law (BOE, 2003, art. 36.1), conducted in some regions in Spain, as they are cases of Castilla and Leon and Aragon, show the potential of the forest owners to be able to generate mycological resource rent, for example, through

[53] It could be the case that the market is "shortsighted" in not anticipating future capital losses on long-term gradual degradation and loss (natural death) or sudden (drought and other causes) of oak tress.

exclusive collection permits of the owner of the monte, which from here emerges the mycological resource rent as a new component of the market price of the land. However, the known reality of the Andalucian monte is that today there is free public access to the collection of mushrooms. Private forest land owners do not implement effective control access to avoid the current gathers free access.

In the RECAMAN project the estimation of the value of the annual quantity of mushrooms collected ($FOm_{PU,E}$) in the montes of Andalucía is carried out through a specific survey of contingent valuation (CV) of 4,000 telephone call questionnaires to households in Andalucía. The aim of the survey was to determine the amount and the willingness to pay of the mushroom pickers for the amount of mushrooms harvested in a year in the montes.

4.4.2 Trees and shrubs carbon fixation and emission

The RECAMAN project considers the sink role of the atmosphere as a natural capital belonging to the nation. The annual growth of trees and shrubs fix carbon and are simulated for the government or another economic agent to “buy” at market price of forestry carbon fixations and emissions. In contrast, the emission of carbon into the atmosphere is the cause of the declining function of the atmosphere as a sink, and this damage to the public natural capital is assumed to be produced by harvesting biomass (timber, firewood, cork and brush), so it is counted as a cost at the price fixed by the emerging market of carbon emissions. Therefore, the fixation and emission of carbon can add or subtract, respectively, public environmental income from the montes according to the management of woody biomass, wood, cork and brush.

The annual flows of fixation ($FOcf_{PU,E}$) and emission ($SSce_{PU,E}$) of carbon of woody vegetation (trees and shrubs) will result in a net operating margin of carbon derived from the forest management and changes with the ages of trees and shrubs.

In a hypothetical situation in which the *cuttings* and the *growth* of shrubs are close in quantity, it happens that the net operating margin tends to be zero, except that the woody vegetation can replace fossil fuel energy. In this case, when biomass is burned in a year it is the same amount that has grown that year, so that the monte stays the same in terms of the amount of woody biomass, the biomass consumption can also save fossil fuel emissions of carbon and therefore the savings in carbon emissions has the value as a service of global warming mitigation.

The land of the monte also has an environmental value of carbon as a greenhouse gas which is estimated by the present discounted value of all future flows of net growths or cuttings of forest biomass. Depending on the expected change in biomass, the environmental land of the monte may have positive or negative values over the years depending on the carbon as a greenhouse gas.

4.4.3 Regulated free environmental forest land water

The free natural forestry water regulated by Andalusian Water Agency consumed by forest woody vegetations in excess over water consumption of natural pasture, might attribute an environmental economic rent, taken into account the current Spanish water law property rights, only in the case that the total management cost, adding a normal profit to public water immobilized capital, is lower than the regulated water user willingness to pay (WTP). This user WTP for the consumption of regulated environmental water is unknown; therefore RECAMAN could not be able to estimate the forestry water environmental economic rent, at this stage, integrated in the AAS application to Andalusian montes. The current status of regulated water property rights

determines the condition of the free environmental good of the flow of forestry water reaching the reservoir in the year[54].

There is interest in estimate the physical total output of environmental free forestry water ($TOfw_L$) to show the physical consumption of free natural environmental forestry water that contributes to the economic outputs of the monte that comes from the intermediate production of free water ($IPfw_{E,L}$)[55] and also supplies the final output ($FOfw_L$).

The forest surface water that reaches the river is not considered by SEEA the water of the monte, but if it could be considered commercial water of the monte the green water consumed as a result of the forest improvements aimed at reducing the growth of forest biomass when the owner of the monte receives compensation from the agency responsible for regulating blue water retained in reservoirs in a context of pressing demand of water. These territorial contracts between the owner of the monte and the governmental agency of water do not exist in Spain and for this reason the water regulated that reaches the reservoirs from the mountains is treated in RECAMAN as an open environmental public good, and therefore its price is zero. In other words, property rights and the lack of contracts to compensate the forest land owner for changing the management to reduce green environmental forestry water consumption determines that the latter is now a non-economic environmental good.

In this situation of pressing demand of water in a basin it is possible to establish a forestry water market from the increased runoff caused by decreases in annual growth of vegetation (Bowes *et al*., 1984, Calder, 2007 and Birot *et al*., 2011)[56]. In an area of monte the minimum amount of rain water consumed corresponds to the area of natural grass surface. If the annual decline of woody vegetation growth produces no irreversible effects[57], it may be of interest among the economic agent who manages the water reservoir and the owner of the monte to negotiate an agreement that the first makes a payment towards increasing the amount of water in the reservoirs and the second, in addition to receiving revenues from the sale of water, could benefit from increased production of grazing forage units for controlled animals.

In the Andalucian monte the natural expansion of vegetation of shrub species that are of little or no consumption by domestic animals is frequent. In the past occasional clearings took place of bush in the monte obtaining energy sub-products (cinder and coal) and new lands for cultivation and grazing, until the invasive bush cycle ends with a subsequent cutting of the bush. The *natural expansion of shrubs* creates public costs because of the reduction of water in reservoirs, the likely reduction in local biological wealth, the increased risk of fire, and the reduction of forage units consumed by domestic livestock, game species and other wildlife. Increases in the surface cover and thickness of shrubs invading surfaces of pastures and forests also produces *public and private goods* such as the fixation of carbon and the facilitation of natural regeneration

[54] The agency that manages the regulated water and also the government directly can incur the costs of "hydrologic-forestry" restoration with the purpose of improving the quality of reservoir water and to reduce the annual entries of material to the reservoirs. These costs are costs of the water accounts of the government agency that assumes what takes place in the public domain of the rivers (SEEA 2012).

[55] The owner of a monte incurs recurring costs and the consumption of manufactured fixed capital of the intermediate and final production and forest water. In RECAMAN this private cost of production of forest water is incorporated directly as an intermediate consumption of the activity that uses water.

[56] Woody vegetation has positive effects on reducing the contribution of material by the runoff water to reservoirs before the use of natural pasture and agricultural crops. The economic valuation of these effects requires the measurements *in situ* throughout the affected watershed and complex modeling. In RECAMAN forest erosion is not valued, although modeling is performed in physical erosion on the basis of available information.

[57] Allocations of vegetation are assumed in quantity and quality about the threshold of vulnerability

of oak trees by hindering the growth of bushes that animals consume mitigating the shortcomings of natural regeneration of tree vegetation. This complexity between the costs and benefits arising from the variations of the shrub vegetation makes it difficult to estimate the changes in the monte income motivated by the consumption of water by woody vegetation in the monte. This complexity is resolved by integrating all the economic effects of change in the woody vegetation of the monte through the application of the AAS system.

So that a real water market can arise in the monte, a situation has to be produced in which society (government) gives priority to increasing the water reservoir and in which the water agency that manages the reservoirs is willing to pay the owner of the monte to alter a certain area of brush and/or perform pruning and other tree treatments. The water agency has a fixed capacity to store water and its total cost of exploitation of the reservoir is also fixed, so it is not influenced by the amount of water stored. Excess demand will increase the supply of water consumed which means the price may be higher than normal, and the water agency will pay, at least, an additional amount equal to the payment made to the owner of the monte by increasing the water in the reservoir. The owner of the monte will agree to make cuts to shrubs if the payment for the produced water that is received from the government agency *exceeds the profits loss* incurred by the lower stock and/or the growth of woody vegetation.

The RECAMAN project has simulated a hydrological model that estimates the variation of the annual flow of water regulated by the reservoirs when they produce a change in the area occupied by types of vegetation in the montes of Andalucía. The *Agency of Natural Environment and Water* (AMAyA) of Andalucía provides the information of the cost of the regulation of water reservoirs, but there are not simulated prices for pressing water demand. The current lack of territorial contracts in Andalucía or competitive water markets of regulated forest water justified the absence in RECAMAN of the measurement of the economic rent (RR) of forest water, so therefore RECAMAN only counts the annual total physical production of *regulated environmental free forestry water* that originates in the Andalucian montes that are in the area of the reservoirs regulated by the water agency of the Andalucian government.

4.4.4 Public environmental recreation services

As the public recreational enjoyment is an environmental service similar to other commercialized recreational forest enjoyments services, the simulation of the market in scientific terms is robust. The number of visits is easy to estimate with a household survey, at a minimum, *in situ* during the visits. The price of the public recreational service is estimated in RECAMAN, given the simulated market conditions of the visited natural space, in a point that satisfied the social profitability of costs of the public Administration incurred in the public recreational management of the natural space. The estimated price that maximizes the income of recreational capital of natural capital and manufactured capital is obtained from the total number of visits to the natural space which are taken into account in estimating the income of recreation capital of the natural space.

The value of the public recreational service ($FOr_{PU,E}$) that has free access in the monte of Andalucía is estimated in the RECAMAN project through specific survey of contingent valuation in households and even in natural spaces of the monte visited during the day. In the survey of *contingent valuation* (CV) of the RECAMAN project 5,600 questionnaires were conducted face to face in *households* in Spain, Portugal, France, Italy, Germany and England, and another 4,000 questionnaires *in situ* face to face to the *visitors* of the protected natural areas located in the montes of Andalucía.

4.4.5 Forest landscape conservation services

The value of the public forest landscape conservation services refers to the availability of the public to invest in native trees by planting and/or inducing natural regeneration to

ensure a desired amount of natural landscape in the future with the purpose of personal and/or third party enjoyment. People are willing to pay in exchange for a future service, and thus the public expect to increase their current wellbeing in a higher value than what they pay. In other words, the value of the forest landscape conservation is a type of *option value* applied in situations where the *woodland is not threatened*[58], so that it should not be incurred in double counting by adding the values of threatened biodiversity and the produced forest landscape. In contrast, the value of the landscape offers the possibility of double counting the value of the public recreational service, to take place as an active use on both types of services, the separation of the values in the simulation of public consumption is problematic.

The valuation of public forest landscapes ($FOl_{PU,E}$) produced with free access to natural areas located in the montes in the RECAMAN project have been valued by a specific survey of *choice experiment* (CE) in households and *in situ* Andalusian montes natural protected areas visited during the stay. In the survey of joint election 5,600 questionnaires were done face to face in *households* in Spain, Portugal, France, Italy, Germany and England, and onther 4,000 questionnaires *in situ* face to face to the *visitors* of the natural areas located in the montes of Andalucía.

4.4.6 Threatened biodiversity services

In RECAMAN the economic valuation of the biodiversity only considers the *existence value* of living species of the Andalusian montes recognized by the government and/or the scientific community as threatened (SEEA 2003, para. 8.236, p. 359). The economic valuation of threatened biodiversity of a monte is based on a system of physical preservation with criteria based on scarcity and a degree of threat to species and habitats at spatial scales requires for monetary (numerarie) valuation. The RECAMAN project is developing indexes of threatened species by habitat type in the Andalucian montes to enable the valuation of threatened biodiversity in each vegetation type and location.

The existence value noted above is based on the wellbeing that the public experiences through payments that mitigating and/or avoiding the disappearance of unique feature of a species whose populations are adequately low (near of safe minimum standard), in other words, that are threatened with some degree of risk of extinction, regardless of their current or future active use. The public, in exchange for the current wellbeing received by the preservation of living species, express the willingness to pay a specific amount of money (numerarie) to buy the right to reduce and/or not increase the number of threatened native species of the Andalusian monte, which in this case is a number higher than 220 animal and plant species[59]. The value of the final output of threatened biodiversity ($FOb_{PU,E}$) is obtained in RECAMAN by multiplying the total threatened species by the market marginal price simulated from the last species whose loss is avoided by proper management to which the public contributes to help finance the costs.

To choice the same marginal price for all threatened species is justified by the nature of thing valued. The thing valued is to mitigate the extinction of a non-reproductive unique genetic feature. In this situation the public has not preference for a single genetic variety from another one, and it follows that all genetic varieties are equivalent. There for, it assumes that the passive consumer has the same willingness to pay for any genetic variety threatened of extinction.

The threatened biological diversity also can provide other environmental values, distinct from threatened biodiversity, included in the AAS system, such as recreational use, landscape, pollination, etc.

[58] But its future supply of services is expected to be less than the desired in the absence of the declared payment by the public

[59] RECAMAN project (in progress).

The scientific knowledge of experts in nature conservation and the public administration provide the number of threatened species of the montes and from this list it can be designed an exercise of choice experiment (CE) that offer the possibility of constructing a demand curve of threatened biodiversity near a critical threshold of extinction (safe minimum standard) (EEA, 2010, p. 23). The valuation of threatened biodiversity based on declared preferences by the public for the passive use could be hindered by the negative potential of the public to accept the loss of biodiversity at any price, which makes it impossible in this case to economically assess threatened biodiversity, because the estimated economic value of endangered biodiversity could tend to be infinite, lacking the environmental valuation of any economic significance (Spash, and Hanley, 1995, and Nunes and Nijkamp, 2010). This is not the provided scenario in RECAMAN, as it is expected that the planned management of the future endangered species of the monte remain above from the threshold of extinction, so it is therefore expected that the value of the threatened biodiversity of the Andalucian montes are consistent with the constraints of the available income of those surveyed. However, it is recognized that there still remains a gap of scientific experimentation to achieve an estimate with high consistency of the economic value that humans are willing to pay individually or collectively (governments of private institutions) to avoid the irreversible loss of forest biodiversity.

The major shortcomings of the economic environmental valuation of natural ecosystems or species based in the social preferences have its basis in the cases of species threatened of extinction (such as the case of the Iberian lynx). These situations could demand the “policy metric”. This is justified by the precautionary principle, that is, is the public Administration which must decide how much will the expending for mitigate de irreversible loss of a threatened single genetic variety, that mitigation cost can be higher than the current generation wants to spend, although increased spending by a democratic government has to be tolerable for the current generations, thus the government is not guided by the criterion of maximizing the welfare of only the current population. In the absence of irreversible effects, the omission of the environmental valuation based on social demands may involve replacing the environmental valuation of the majority of society with the implicit environmental valuation by the elite minority of society, and without the application in this situation of the precautionary principle (Campos and Carrera, 2005 and Norton, 1987).

4.4.7 Other public environmental goods and services omitted

The monte offers free edible plants, medicinal and aromatic plants, animals that provide meat or animals that are enjoyed as pets in households, genetic resources for the pharmaceutical industry, etc. None of these uses are taken into account in RECAMAN. The cost of obtaining all that information, as well as the fact that these measurements by themselves would widen that which RECAMAN is measuring, is justified by the fact that sufficiently ambitious objectives were set forth in RECAMAN, ensuring the estimates of figures of income and capital are consistent with the economic theory of Hicksian total income and, in turn, reflect with high fidelity the private and public economic realities, as well as the commercial and environmental realities, of the montes of Andalucía.

4.5 AAS and EAF systems incomes comparisons

4.5.1 AAS and EAF systems green total income comparison

In the application of the AAS system, that includes the livestock and agricultural income of a sample of 58 montes estates in Andalucía, the relevant comparison of income is established between the AAS system and the SNA in the latter versions of the EAA/EAF systems (EUROSTAT, 2000). The comparisons of incomes that are shown below between the AAS and the EAF systems refer to the total area of the montes of

Andalucía and exclude income from livestock and agricultural activities offered on the surfaces of the Andalucian montes[60].

It has been noted previously that the EAF system provides an incomplete measurement of the net value added at market prices from the surface of the regional or national monte. The measurement of Hicksian total income at market prices (TI_{AAS})[61] of the Andalusian montes through the AAS is compatible with the continuity of the current incomplete measurements of net value added of the EAF system (NVA_{EAF})[62]. The relationship between Hicksian total income of the monte and the AAS and EAF systems are shown in the equations [29]-[43] and in Table 7.

The TI_{AAS} can be presented by adding to the NVA_{EAF} the omitted commercial net value added ($NVA_{C,O}$), the environmental net value added (NVA_E), the commercial capital gain (CG_C), and the environmental capital gain (CG_E) (Table 7) [29]:

$$TI_{AAS} = NVA_{EAF} + NVA_{C,O} + NVA_E + CG_C + CG_E \quad [29]$$

4.5.2 EAF net value added

The EAF system omits the measurement of intermediate output (IO), so that the EAF private net value added ($NVA_{PR,EAF}$) results in the private final production ($FO_{PR,EAF}$) minus private intermediate consumption ($IC_{PR,EAF}$) and the private consumption of manufactured fixed capital ($CFC_{PR,EAF}$). The cost of private intermediate consumption of the EAF system ($IC_{PR,EAF}$) is formed by the costs of private commercial raw materials $RM_{PR,EAF}$), bought $RMb_{PR,EAF}$) and own harvested ($RMoh_{PR,EAF}$) raw materials, and private bought services ($SSb_{PR,EAF}$) [30]:

$$NVA_{PR,EAF} = FO_{PR,EAF} - IC_{PR,EAF} - CFC_{PR,EAF} \quad [30]$$

The private final productions of the EAF (FO_{EAF}) consider the extraction of private timber ($FOet_{PR,EAF}$), private cork ($FOeco_{PR;EAF}$), and private firewood ($POef_{PR;EAF}$), the collection of private pine nuts ($FOepn_{PR;EAF}$) and private chestnuts ($FOecn_{PR,EAF}$), the private forest plantations ($GFCFp_{PR,EAF}$), the gross formation of their *own* private construction ($GFCFco_{PR,EAF}$), the gross formation of their *own* private equipment ($GFCFe_{PR,EAF}$) and other minor private commercial goods and services harvested normally intended for sale ($FOo_{PR,EAF}$) [31]:

$$FO_{PR,EAF} = FOet_{PR,EAF} + FOeco_{PR,EAF} + POef_{PR,EAF} + FOepn_{PR;EAF} + FOecn_{PR,EAF} + GFCFp_{PR,EAF} + GFCFco_{PR,EAF} + GFCFe_{PR,EAF} + FPo_{PR,EAF} \quad [31]$$

The private total cost of EAF ($TC_{PR;EAF}$) is obtained by adding the intermediate consumption ($IC_{PR,EAF}$), the private EAF labor cost ($LC_{PR,EAF}$)[63] and the cost of the services of private manufactured consumption of fixed capital ($CFC_{PR,EAF}$) [32]:

$$TC_{PR,EAF} = IC_{PR,EAF} + LC_{PR,EAF} + CFC_{PR,EAF} \quad [32]$$

[60] Exclusions from livestock and crop production is important in the case of the montes of Andalucía because they are still being cleared and cropping in normal multiannual surface rotations below oaks and in grass lands.

[61] Being different from the reasoning developed about the basis of values at market prices or at factor prices, of which is continued in subsection 4.4, is used for the concept of income at market prices, and for simplicity the notation “pm” is not used to indicate this.

[62] It is recalled that the EAF does not try to measure the income of a defined territory like a forest, but is limited to value a group of goods and services formally agreed upon as belonging to the national classification of economic activities in forestry.

[63] The EAF provides the cost of employee labor (LCe) and a mixed income that includes the remuneration of the employed labor costs (LCne) and the remuneration of services of capital of family businesses. For the sake of interest of the analysis of the measurement of income and capital it is assumed to be feasible to estimate the cost of the LCne of the activities considered by the EAF system.

The private EAF net operating margin ($NOM_{PR;EAF}$) is estimated as a residual value of the difference between the final output ($FO_{PR,EAF}$ and the TC_{EAF} [33]:

$$NOM_{PR;EAF} = FO_{PR;,EAF} – TC_{PR,EAF} \quad [33]$$

The factorial distribution of the net value added ($NVA_{PR,EAF}$) of the EAF system is estimated directly from the sum of the labor cost ($LC_{PR,EAF}$) and the net operating margin (NOM_{EAF}) [34]:

$$NVA_{PR,EAF} = LC_{PR,EAF} + NOM_{PR,EAF} \quad [34]$$

4.5.3 RECAMAN incomes measurements beyond the EAF

The *production account* of the EAF system omits or does not applied the measurements of *intermediate output* (IO), final output of forest timber, cork and firewood *natural growth* ($NGtcof_{PR;C}$), the public *commercial final output* ($FO_{PU,C}$), the private commercial game *final output* ($FOgam_{PR;C}$), and the *final environmental output* (FO_E). The EAF ignores the costs of private commercial *works in progress used* (WPu), the *total public commercial cost* ($TC_{PU,C}$), and the *total environmental cost* (TC_E).

(1) The estimation in RECAMAN of the commercial net value added at market prices omitted by EAF ($NVA_{C,O}$) requires the measurement[64] of private forest timber, cork and firwood natural growth ($NGtcof_{PR;C}$), the private commercial working in progress used ($WPu_{PR,C}$), the public (government) commercial net value added at market prices ($NVA_{PU,C}$)[65] and the private game net value added at market prices ($NVAgam_{PR,C}$) [35] (Table 7):

$$NVA_{C,O} = NGtcof_{PR;C} – WPu_{PR,C} + NVA_{PU,C} + NVAgam_{PR,C} \quad [35]$$

The commercial net value added (NVA_C) is estimated by the equation [36]:

$$NVA_C = VAN_{EAF} + NVA_{C,o}. \quad [36]$$

(2) The estimation of *environmental net value added at market prices* (NVA_E) in RECAMAN requires measurement of simulated exchange values from the total environmental output (TO_E), the cost of public environmental intermediate consumption ($IC_{PU,E}$)[66], that is formed by the environmental intermediate consumption of carbon emissions ($SSce_{PU,E}$), and the public environmental consumption of fixed capital ($CFC_{PU,E}$). The private *environmental* final output auto-consumption (PFa_E) represent together the aggregated value of the *recreations, landscape and existence* values of non-industrial forest land owners[67] [37]:

$$NVA_E = TO_E – IC_{PU,E} – CFC_{PU,E} = FOa_E + FO_{PU,E} – SSce_{PU,E} \quad [37]$$

[64] It is not necessary to calculate the *aggregated* net value added to the monte to include the intermediate commercial output ($IO_{PR,C}$) and the consumption of the own commercial intermediate consumption from intermediate output ($ICoio_{PR,C}$), since they are the same commercial forest goods and services seen, respectively, from the side of commercial forest production and cost of the activities that are consumed in the monte, and, as it is assumed that they have the same value, they thus cancel each other out in the calculation of omitted commercial net value added of the monte ($IO_{PR;C} = ICoio_{PR,C}$).

[65] Estimated by the difference between total public commercial production ($TP_{PU,C}$) and the total public commercial cost ($TC_{PU,C}$)

[66] The private environmental cost and consumption of fixed environmental capital have not been considered.

[67] RECAMAN, at this stage, has not taking into account the measurements of public environmental intermediate output ($IO_{PU,E}$) and the sole environmental cost estimated is the forest carbon emission ($SSce_{PU,E}$).

(3) The montes final public goods and services *environmental output* ($FO_{PU,E}$) is represented by the *public environmental recreational services* ($FOr_{PU,E}$) enjoyed free by the Spanish and European visitors, the *environmental forest landscape* ($FOl_{PU,E}$), the threatened biodiversity ($FOb_{PU,E}$), the collection of mushrooms by the public ($POm_{PU,E}$), and *carbon fixation* ($PFcf_{PU,E}$) [38]:

$$FO_{PU,E} = FOr_{PU,E} + FPl_{PU,E} + FPb_{PU,E} + PFm_{PU,E} + PFcf_{PU,E} \quad [38]$$

(4) The *public environmental net value added* at market prices ($NVA_{PU,E}$) must consider the total output of public environmental goods and services ($TO_{PU,E}$), the public environmental intermediate consumption used in the production of public goods and services ($IC_{PU,E}$) and the public environmental consumption of fixed capital ($CFC_{PU,E}$) [38]:

$$NVA_{PU,E} = TP_{PU,E} – IC_{PU,} – CFC_{PU,E} = FO_{PU,E} – SSce_{PU,E} \quad [39]$$

(5) The commercial capital gain at market prices (CG_C), measured by RECAMAN in the montes of Andalucía comes from fruits (acorns, pine, chestnuts, etc.), natural grass, firewood, wood, cork, hunting and other minor commercial products.

(6) The *environmental capital gain* at market prices (CG_E) measured by RECAMAN in the montes of Andalucía comes from the environmental auto-consumption, the public recreational service, the forest landscape service, the threatened biodiversity services, the fixation and emission of carbon, and the collection of mushrooms.

4.5.4 AAF and EAF systems private total incomes comparisons

The agroforestry accounting system (AAS) private total income ($TI_{PR,AAS}$) results from the sum of the total private incomes of the forest activity ($TIfor_{PR,AAS}$), the private game activity ($TIgam_{PR,AAS}$), the private environmental auto-consumption (TIa_E), and other total private incomes of minor activities ($TIoo_{PR}$) omitted by the economic account for forestry system (EAF) [40]:

$$TI_{PR,AAS} = TIfor_{PR,AAS} + TIgam_{PR,AAS} + TIa_{PR,E} + TIoo_{PR,AAS} \quad [40]$$

The private total forestry income ($TIfor_{PR,AAS}$) is is formed by the private forestry net value added ($NVAfor_{PR,AAS}$) and the private capital gain ($CGfor_{PR}$) [41]:

$$TIfor_{PR,AAS} = NVAfor_{PR,AAS} + CGfor_{PR} \quad [41]$$

The private forestry net value added ($NVAfor_{PR,AAS}$) can be estimated based on the net value added (NVA_{EAF}) of the EAF system by estimating the private forestry intermediate outputs ($IOfor_{PR}$) from consumption of acorns ($IOac_{PR}$), natural pastures ($IOnp_{PR}$) and other intermediate forestry outputs (IOo_{PR}), the natural growth of timber, cork and firewood ($NGtcof_{PR}$), and the forestry work in progress used ($WPufor_{PR}$) [42]:

$$NVAfor_{PR,AAS} = NVA_{EAF} + IOfor_{PR} + NGfor_{PR} – WPufor_{PR} \quad [42]$$

The equation [41] demonstrates that the total income of forestry activity of the montes cannot be estimated only by the forestry NVA_{EAF} of the EAF system. The latter value has to add the intermediate productions of pastures and acorns, and the final outputs of natural growth of timber, firewood and cork; and, conversely, it must subtract the value at the beginning of the accounting year of the forestry work in progress used (harvested) of timber, firewood and cork.

Other AAS and EAF comparisons could be described for other single activities and the aggregated total incomes. Table 7, as it was above said, shows the AAS and EAF systems aggregated total income comparison in RECAMAN.

Table 7. AAS and EAF systems green total incomes comparisons

Class	Commercial goods and services		Environmental goods and services	Total
	EAF	Omitted		AAF
	(1)	(2)	(3)	(4) =1+2+3
1. Total output (TO) (1.1+1.2)	TO_{EAF}	$TO_{C,O}$	TO_E	TO_{AAS}
1.1 Intermediate output (IP)		IO_C	IO_E	IO_{AAS}
1.1 Final output (FO)	FO_{EAF}	NGtcof + $FO_{PU,C}$ + FOgam	FOa_E + $FO_{PU,E}$	FO_{AAS}
2. Intermediate consumption (IC)	IC_{EAF}	WPu + IO_C + $IC_{PU,C}$ +ICgam	$IC_{PU,E}$	IC_{AAS}
3. Gross value added (GVA) (1-2)	GVA_{EAF}	$GVA_{C,O}$	GVA_E	GVA_{AAS}
4. Consumption of fixed capital (CFC)	CFC_{EAF}	$CFC_{PU,O}$ + CFCgam	$CFC_{PU,E}$	CFC_{AAS}
5. Net value added (NVA) (3-4)	NVA_{EAF}	$NVA_{C,O}$	NVA_e	NVA_{AAS}
6. Capital revaluation (Ca) (6.1+6.2)		Cr_C	Cr_E	Cr_{AAS}
6.1 Revaluation of work in progress (CPr)		WPr_C	WPr_E	WPr_{AAS}
6.2 Revaluation of fixed capital (FCr)		FCr_C	FCr_E	FCr_{AAS}
7. Destruction of capital (Cd) (7.1+7.2)		Cd_C	Cd_E	Cd_{AAS}
7.1 Destruction of work in progress (WPd)		WPd_C	WPd_E	WCd_{AAS}
7.2 Destruction of fixed capital (FCd)		FCd_C	FCd_E	FCd_{AAS}
8. Capital adjustments (Cad)		Cad_C	Cad_E	Cad_{AAS}
9. Capital gain (CG) (4+6-7+8)		CG_C	CG_E	CG_{AAS}
10. Total income at market prices (TI) (5+9)	NVA_{EAF}	$NVA_{C,O}$ + CG_C	NVA_E + CG_E	TI_{AAS}

Abbreviations not defined above:

AAS: agroforestry accounting system; EAF: system of economic accounts of forestry, FOa_E: environmental auto-consumption of final output; FOgam: private commercial game final output; $FO_{PU,C}$: public commercial final output; FO_E: private environmental final output auto-consumption; and $NGfor_{PR}$: private commercial final output of timber, cork and firewood natural growth. The subscripts added to the initials above indicate E: environmental; C: commercial; O: omitted; PR: private; and PU: public.

Source: RECAMAN project (in progress).

The estimated compared total private incomes of the AAF and EAF systems in the montes of Andalucía, taking into accounts the equations [39] and [41], are shown in the equation[68] [43]:

$$TI_{PR} = NVA_{EAF} + IOfor_{PR} + NGfor_{PR} - WPufor_{PR} + TIgam_{PR} + TIa_{E} + TIoo_{PR} \quad [43]$$

5. CONCLUSIONS

The AAF and EAS systems offer the same real estimation of the income from timber, cork and firewood of the monte, if they are in a steady state, that is, the natural growth and the annual extraction in physical terms are equal, and the prices and rates of interest remain constant. This is a situation that is rarely found in a monte in Mediterranean area. The equations developed in previous sections show that the EAF system is far from being able to offer a measurement close to the truth of the total income that a monte generates.

The known shortfalls for the robust implementation of the valuation of environmental services of forest landscapes and of threatened biodiversity should not be an excuse to not carry out the applications with sufficient consistency and operationally valuations of the *green national accounts* in order to estimate the *Hicksian total income* and the *green capital of the montes.* The more recent scientific advances have shown that the techniques of environmental valuation of environmental demands of the public can be adapted by the method of simulated exchange value to be confronted with the respective offers simulated and, thus, construct hypothetical markets based on actual revealed or stated people real consumptions that offer environmental exchange values that are consistent with the actual markets.

The Hicksian total income and the capital of the monte can be measured with sufficient theoretical consistency in relation to the EAF given the current state of scientific knowledge of environment valuation, thus avoiding the wait for the unpredictable *appearance of the golden rule* of environmental valuation, which otherwise may come too late.

The RECAMAN project shows the consistency of the *value of simulated change* in the aggregation of the economic commercial and environmental values, both at a *regional scale* as well as the *agroforestry monte estate scale* to estimate the Hicksian total income and the capital of the montes. In other words, for the non-commercial (environmental) goods and services, their simulated demands can be estimated and their simulated offers can be built, and it is feasible to add the environmental values of simulated change with the respective commercial estimated values of the montes.

In the coming years, governments have to face the responsibility of dedicating new resources that are required to overcome the shortcomings of the official economic statistics with the objective of estimating the *Hicksian total income* of the montes. In the European Union it is feasible to apply to the montes a methodology of green account types like AAS on the basis of *expanding* current methodologies of the FADN and the EAA/EAF, incorporating the *commercial and environmental net value added operating income),* and *capital gains at present omitted*. The AAS methodologies have interest, on the one hand, because they would allow knowledge of the total income and capital

[68] The EAF system presents simple accounts of production of timber, cork and firewood, in which natural growth (NG) and works in progress used (WPu) are omitted. The net value added ($NVAtcof_{EAF}$) of the EAF system of timber, cork and firewood in a steady state is the same value as the total income (TItcof). This result is shown in a steady state because it holds for woody vegetations that: WPu = NG + GC (Caparrós *et al.,* 2003).

of the montes[69], and, on the other hand, they would facilitate *new relevant information* for the *design* of *agriculture and natural environment policies* (AP) of the European Union with the aim to link the incentives of public policies to the management of the natural environment with the enhancement of threatened biodiversity, the mitigation of global warming and the growth of income of environmental services. The government could implement a short-term functional classification of public expenditure linked to the commercial and environmental production of the montes taking into account the criteria of common *International Classification of the Ecosystems Services* (CICES) (Haines-Young and Potschin, 2010).

In relation to the improvements of official statistics in the short-term in Spain an extension of the methodology of the National Forest Inventory (NFI) is required in relation to woodland and shrubland to incorporate the functions of growth, and to facilitate the estimation of models of forestry production to complete cycles of forest species. In the field of hunting activities, hunting catch information for estimating models of hunting production could be improved, in order to know complete cycles of species in large homogenous areas and types of hunting management.

Finally, the RECAMAN project will provide preliminary results of Hicksian total income and whole capital of the montes of Andalucía in June 2012 and the final results will be presented in June 2013. In the later years the *Department of Natural Environment* of the of Andalucía government has the aim of continuing with the annual updates of the measurements of the total income and capital of the montes of Andalucía.

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[69] It should be mentioned that in this paper the terms monte and forest ecosystem are equivalent.

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APPENDIX: RECAMAN PROJECT

The *Income and Capital of the Montes of Andalucia* (RECAMAN) project is being developing by the *Department of the Natural Environment/General Directorate of Management of the Natural Environment* of the *Andalucía Government* that awarded the contract for this research to the Institute of of the Spanish National Research Council (IPP/CSIC). In the development of the RECAMAN project management and GIS works, the public Andalusian Agency of Natural Environment and Water (AMAyA)*/Division of Actions in the Natural Environment*. The project has duration of five years (2008-2013).

The Group of Environmental Economics (GEA) of the Institute of Public Goods and Policies (IPP) of the Spanish National Research Council (CSIC) is the scientific coordinator of the RECAMAN project. The RECAMAN project main researcher is the economist Pablo Campos del IPP-CSIC. IN RECAMAN collaborates with GEA nine other research groups from universities and research centers specializing in habitat conservation and wildlife, water resources, Mediterranean forestry, hunting and livestock production, valuation of environmental goods and services, forestry economics and green national accounting.

In the RECAMAN project participate researches and other assistant staff from 12 scientific and governmental institutions:

1. *Instituto de Políticas y Bienes Públicos* (IPP-CCHS-CSIC): Begoña Álvarez-Farizo, Pablo Campos, Alejandro Álvarez, Alejandro Caparrós, Bruno Mesa, Paola Ovando, José Luis Oviedo, Nuria Ruiz and Soledad Letón.

2. *Museo Nacional de Ciencias Naturales* (MNCN-CSIC): Cesar Luis Alonso, Mario Díaz and Elena Daniela Concepción.

3. *Estación Experimental de Aula Dei* (EEAD-CSIC): Santiago Beguería and Roberto Serrano.

4. *Instituto de Estudios Sociales Avanzados de Andalucía* (IESA-CSIC): Eduardo Moyano, Sara Pasadas and Carlos Priego.

5. *Centro de Investigación Forestal* (CIFOR-INIA): Andrés Bravo, María Martínez, Gregorio Montero, María Pasalodos, Ricardo Ruíz-Peinado and Mario Soliño.

6. *Escuela Técnica Superior de Ingenieros de Montes de Madrid* (ETSIM-UPM): Luis Díaz-Balteiro, Casimiro Herruzo, Carlos Romero, Ana Torres, Roberto Voces and Eloy Almazán Riballo.

7. *Facultad de veterinaria de la Universidad de Extremadura* (FV-UEX): Juan Carranza, Pedro Fernández, José Manuel Seoane and Jerónimo Torres.

8. *Centro de Servicios Forestales de Castilla y León* (CESEFOR): Fernando Martínez and Jorge Aldea.

9. *Escuela Universitaria de Estudios Empresariales de Soria de la Universidad de Valladolid* (EA-Emp-Soria-UVA): Pablo de Frutos.

10. *Université Montesquieu-Bordeaux IV*: Marc Leandri.

11. Agencia *Andaluza de Medio Ambiente y Agua* de la *Junta de Andalucíal División de Actuaciones en el Medio Natural*: María García, Luis Guzmán, Samuel Gómez and Isabel Martín.

12. *Consejería de Medio Ambiente* de la *Junta de Andalucía/Dirección General de Gestión del Medio Natural*: Francisca de la Hoz and José Ramón Guzmán.