Can we use non-market valuation techniques in forests applied green national accounting?[1]
(Preliminary version)

Pablo Campos-Palacín and Alejandro Caparrós-Gass
Spanish Council for Scientific Research (CSIC), Spain

Abstract
Theory on green national accounting has been an important research topic in recent years. Nevertheless, little effort has been put into the practical measurement of exchange values for environmental goods and services to be integrated with commercial ones in applied green national accounting. While market values are measured in national accounts using market exchange prices time quantity, environmental valuation techniques yield consumer surplus and other non-exchange market values, so a homogeneous aggregation of those values is required. This paper proposes to simulate markets, demand and cost functions, for forest environmental goods and services, at the micro-level, to obtain imputed exchange values that can be aggregated to commercial values in a homogeneous manner. The methodology is illustrated by applications to Mediterranean forests using contingent valuation data for the public free access and owner's self-consumption of environmental services. In addition, open access grazing resource exchange value is estimated as a joint accounting residual value from market livestock self-employed net value added.

Key words: exchange value, environmental services, forest green total income.

[1] This paper has benefited from MEDMONT (QLRT-1999-31031), CREOAK (QLRT-2001-01594) and COAS (6P/02) projects funded by the European Union and the Spanish Agency for International Cooperation. It has also benefited from funding from the regional government *Junta de Andalucía* and the private firm *Belga de los Pinares de El Paular*. We thank Paola Ovando and José Luis Oviedo for their helpful comments. The usual disclaimer applies.

1 Introduction

There is an ideological perspective amongst many forest owners, experts, conservationists and policy makers that aims government compensation for forest conservation and production improvements on the basis of a "general list of presumable environmental benefits provided by forests, without any rigorous of exact identification of these services" (Baptista and Santos, 2005: 52). In addition of the exact services and property rights identifications, to receive government compensations it is necessary "to verify that it is an intentional production of the output associated to a cost non null" (Baptista and Santos, 2005: 52). In this paper we develop a scientific perspective to measure the monetary exchange value of keys forest non market outputs, both private and public environmental outputs.

Forest is most times a multiple economic property rights, where people' uses generate on site and off site income effects, both private and public incomes effects. This paper will focus on some on site keys well identified forest environmental goods and services: visitors environmental recreation services, visitors environmental conservation services, owners self-consumption of private environmental services and conditioned open access grazing resources. Our interest is to incorporate these environmental outputs in the context of an extended framework of the conventional system of national accounts (SNA). To do it, two conceptual problems have to be resolved with sound economic theory. The first one is to expand the SNA narrow commercial concept of production process to include the environment (Bartelmus, 1998: 269; FAO, 1998: 2-3; Nordhaus and Kokkelenberg, 1999: 5). The second one is to simulate proxy exchange values for environmental services (Campos et al., 2001; Caparrós et al., 2003; Eurostat, 2002: 45; FAO, 1998: 4).

There is a general consensus between national accountants and economists that Hicksian income is the true concept of the economic return from the wealth given by nature, man-made capital, intermediate consumption and labour (Nordhaus and Kokkelenberg, 1999: 35). This is the case too in the European Union when the current system of economic accounts for agriculture and forestry states that "income can be defined as the maximum amount which the beneficiary can consume over a given period without reducing the volume of his/her assets" (Eurostat, 2000: 87).

The Hicksian income recognition by SNA system is not enough and the satellite system of integrated environmental and economic accounts (SEEA) remains unchanged in respect with production function boundaries (United Nations et al., 2003): "The SEEA is a satellite system that is built upon the principles of SNA. The upshot of this is that we cannot expect to find that the propose measures of income are consistent with theoretical measures like FLH[Fisher-Lindahl-Hicks]-income" (Heal and Kriström, 2001: 68). Spite of the recent advances on environmental valuation "there is a gap between some of the empirical theory and practice: empirical studies are not always backed up by sound theory" (Heal and Kriström, 2001: 4).

The national accounts data are mainly based on market prices, while studies of the value of for example forest recreation functions usually include the consumer surplus (Eurostat, 2002: 45). Then, a homogenous aggregation requires finding out marketable or exchange values of identified on site environmental benefits.

Extending the SNA to include the forest environmental incomes has "substantial risks of overlapping and double counting with values already included in the national accounts" (Eurostat, 2002: 45; Vincent, 1999). Measuring total Hicksian income requires to estimate simultaneously, in the land unit (forest uses) or for a singular economic activity (e.g.: livestock), the operating income (the so called net value added) and the capital gains. In practice, conventional system of national accounts operates as if real capital gains were cero or implicitly assuming a steady state, in the latter case the conventional system of national accounts (SNA) applies a simplified production account to generate a correct measurement of the total commercial income, despite of these latter are called inappropriately too net value added. For simplifying our arguments we assume forest and livestock economic steady stay situations (see the **Appendix** for a formal development of the extended national system of accounts).

The challenger for greening de SNA is well illustrated in the case of owner's self-consumption of private environmental services. There were many scientific studies that point out their importance in the forest sector, one of the early ones said: "we argue that it is unrealistic to compute cattle ranch costs and returns simply on the basis of one output –beef. In addition to beef, there are the relatively non quantifiable outputs of farm fundamentalism and conspicuous consumption, as well as possibilities for the monetary outputs of tax shelters and ranch appreciation. These outputs are not competitive but additive. Receiving more of one does not imply receiving less of another. If these additional outputs were included in our evaluation of the costs and returns of cattle ranching, perhaps the prices paid for cattle ranches would appear perfectly rational. Investors are purchasing both a resource to be use for production purposes as well as a resource for personal consumption" (Martin and Jefferies, 1966: 235).

The main objective of this paper is to discuss the gap between theory and real forest incomes measurement in the context of an ideal forest sector and national economy steady state. But extending SNA production boundaries to scarce environment faces with current household total income restriction. This could lead to change the present national general equilibrium relative price structure. Here we assume that simulated markets for forest environmental services will create new forest market equilibrium without changing the present national price structure. This is founded in the idea that the changes are "small enough" (Varian, 1992: 408).

We proceed as follows. In section 2 we present the theoretical foundations for exchange value measurement of a group of key private and public environmental forest benefits. In section 3 we show and discuss strengths and weaknesses of a selected forest green accounting results. Section 4 concludes with a summary of the main findings in recent forest green accounting applications.

2 The exchange value theory of environmental benefits in applied green national accounting

It is clear the theoretical and institutional recognition that extending and measuring environmental benefits will show a more accurate picture of real forests contribution to human wellbeing and national income: "The challenge is to utilize non-market values in the forest sector, witch are estimated in the macroeconomic or general equilibrium context of analysis. The value must be consistent and comparable with market values in

the large system. Often non market values are estimates of consumer surplus for non market goods and services. It must be kept in mind those prices for market goods are treated as parameters in the policy analysis. If this were not the case, consumer surplus would also be included in the value of market goods and services as well. Thus, one important issue to resolve is how to estimate values" (FAO, 1998: 4).

2.1 Shared forest economic property rights

It said that capital and income are the two faces of the same coin, what means that forest is considered at the same time a private and a public economic property rights: "property is often called a 'bundle of sticks' because it actually is made up of multiple rights. In its most complete form, ownership of property gives its owner the right to derive value from the asset, to exclude others from the using it, and to transfer the asset to others [..], however, property rights may be less complete, allowing an owner to derive only some value from an asset, exclude only some people from using it, or transfer only certain uses for a specified time period" (Anderson and McChesney, 2003: 1).

Land ownership from a legal perspective needs to be extended to real uses rights when economic activities are considered, thus "for economic analysis, only true economic rights, not nominal legal rights, are relevant" (Eggertsson, 2003: 73). Then, forest environmental services generate incomes to the legal forest' owner as well to the open access final users when they pick up the forest environmental goods and services.

2.2 The open access public recreation exchange value

In the AAS methodology followed here, the social income measurement is extended to include the open access public environmental services consumption. In principle, nothing distinguishes, from a non-timber product, services like the open access public recreation. Nevertheless, where no real market for the recreational services of forests exists, it is necessary to simulate the market to determine what the price would be if the services were marketable (Caparrós et al., 2003; Campos and Caparrós, 2005; Campos et al., 2005a and Campos et al., 2005b)[1]. The SNA does not includes consumer surplus measurements (or any other welfare measure) provided by contingent valuation studies (see United Nations et al., 2003: 407). Here we assume that the forest owner can choose one price for the recreational access and that his/her revenues will be given according to demand. Further we assume that the forest-owner will set the price for access to his/her property in order to maximise his/her revenues[2]. This shows an upper bound for the market revenue of the recreational services provided by the forests (costs still need to be deducted). A lower bound will be given by the costs of the services, assuming that the owner sets the price in order to cover the costs[3] with no margin (or with a given 'standard' margin). The former option implies a monopolistic solution assuming that no variable costs exist[4] and the latter option is a perfect market solution. The real market price would be in between and probably close to the monopoly solution when the simulated market for the forest affected is assumed to be relatively unique in the local are. Thus, we recommend use the value of the monopoly solution for aggregation the recreation value as quasi an exchange value.

The issue of the number of units (visits) consumed remains (Hultkrantz 1992). The normal procedure consists in multiplying the simulated market price by all the units

consumed outside the market; thus, assuming that the setting of a price would not reduce consumption. This assumption is not theoretically acceptable. Nevertheless, establishing a price taking into account the visitors willingness to pay (WTP) would obviously reduce the number of units consumed. Concretely, if the price for the recreational service were set equal to the median of the WTP, then the monopolist solution gives that only 50% of current visitors would be ready to pay it (Caparrós et al., 2003; and Campos and Caparrós, 2005).

A similar criterion is supported by the Eurostat Task Force on Forest Environmental and Economic Accounting: "For a service with a cero price, the consumer surplus represents the area under a stated demand curve, and often the valuation studies allow deriving the shape of this demand curve. This can then be used to determine a 'quasi-market' value of the service. If the demand curves are linear, it can be shown that the maximum hypothetical 'quasi-market value' [price] of output would be 50 % of the consumer surplus. Analyses of the forms of demand curves derived from contingent valuation method (CVM) studies show that they tend to be convex rather than linear, which implies that the 'quasi-market' value will be less than 50 % of consumer surplus" (Eurostat, 2002: 48).

2.3 The visitors forest conservation exchange value

An income effect value measurement for natural habitat conservation has been recognised by experts: "It should be noted that conservation value, while a social-political choice, require and ecological accounting metric such an ecological price, properly to value an environment-economy (exchange) transaction" (Friend, 2000: 42). We have included in forest national accounting visitors' conservation value, although the integration of this value in national accounting is probably arguable, since it is a joint current environmental functions values, option values and passive-use (existence) value. We have included the total value that visitors declared to be ready to pay for this concept to a fund his/her maximum willingness to pay, since under this assumption each agent could pay a different amount (Caparrós et al., 2003: 188; Campos et al., 2005a: 327)[5]. Habitat conservation is a concept that could be estimated, theoretically, for society as a whole, but due to data limitations, in this paper we have focused solely on visitors.

2.4 The owners' self-consumption of private environmental services

Nowadays in western industrialised economies "land is not only an input into agricultural production but is also an important argument in many individuals' utility functions. There is a consumptive value associated with ownership of rural land, reflecting innate desires to own land, live in a rural environment, obtain or maintain the lifestyle of a farmer or rancher, engage in outdoor recreation, get back to nature, and partake of any other real or perceived benefits of rural land ownership. Many investors seek an investment they can touch, feel, experience, and enjoy. They may also expect to be able to sell the land to other investors who have similar feelings for the land" (Pope and Goodwin, 1984: 750). This owner consumptive woodland investment has a long tradition in ranches economics literature. Nevertheless, there have been published a few theoretical studies, after the seminal paper from Martin and Jefferies (1966), on

qualitative description and economic theory relative to owner' self-consumption of private environmental services. We quote next some of them:

(a) "A ranch owner is directly or implicitly equating the value of money foregone to him in not selling the ranch to the amount of satisfaction that he obtains through ranch ownership. If the marginal valuation for the ranch in production and consumption is greater than the market price for ranches, the ranch owner would indicate that his ranch is presently not for sale; if the contrary is true, then the present ranch owner would indicate that his ranch is for sale at current market prices [..]. In discarding the pure theory of the firm approach to explain the economic behaviour of Arizona cattle ranchers, the 'satisficing' concept is found to be a highly useful analytical tool in explaining their socioeconomic behaviour" (Smith and Martin, 1972: 218).

(b) "Consumptive factors and QOL [quality of life] values have influenced the ranch real estate market for years. There were, and continue to be, major policy implications when ranch values exceed the income potential from livestock production. Ranch investment and policy analysis require a great deal more thought than is offered by traditional cost and returns [CAR] studies about the economic value of livestock production. Answers to important policy questions are elusive when it is recognized that ranchers maximize utility not [commercial] profit. We can measure cost, livestock prices, and net returns, and estimate how these economic variables might change under alternative policy scenarios. But we can only guess about what motivate a person to pay a premium price for a western ranch and to continue in business when alternative investment would yield higher [commercial] economic returns" (Torell et al., 2001: 55).

(c) "The emphasis in this study was therefore to view costs and benefits very much from the perspective of the private woodland owner. In this context, the term 'non-market benefits' is inappropiated. Private landowners have the potential to realise financial benefit passively in the form of capitalised asset" (Samuel and Thomas, 1999: 204).

(d) "Hedonic analysis of actual transactions is useful to estimate the value attached to other uses such as private recreational uses, including those related with the existence of wild biota, game, etc." (Eurostat, 2002: 75).

(e) "Hedonic pricing is based on the idea that the purchase of a forest estate represents the purchase of a bundle of attributes that can no be sold separately: land itself, volume of standing timber of particular species and age composition, and other forest goods and services such as hunting rights and recreational services. Statistical regression analysis of forest estate sales on the attributes of the forest reveals the amount that bare land, timber volume and characteristics and NTFP contribute of the forest value of land. The same method may be applied to wooded land no available for wood supply. It will have a positive value that includes the value of land plus the value of NTFP" (Lange, 2004: 79, Box 7.2).

It is not doubt that, in addition to the open access public environmental services described above, forest private income should also integrate the private environmental services (in a large sense) that the owner of the forest could consume himself, as it was referred in the above literature cited. For these owners' self-consumption of private environmental services (SC_{ES}), unfortunately, market prices are not available. The exchange value of these SC_{ES} should be capitalised in the market price of the land, since owners are willing to pay for these private uses when they decide the price to pay for a

forest estate. Thus, a hedonic price approach could give us the part of the land price that corresponds to this owners' self-consumption, as recognise the above cited authors and the Eurostat Forest Task Force (Eurostat, 2002). Nevertheless, this hedonic approach has two main drawbacks, one that applies generally and one that is more particular to forest case study. The general problem is that income measurement is actually a flow value and applying a specific self-consumption discounting rate (or interest rate) to the hedonic measurement of self-consumption capital is nearly an uncertainty subjective election. The particular drawback for applying the hedonic technique to the forest "is the small number of annual transactions" (Lange, 2004: 79, Box 7.2). Therefore, other alternatives valuation techniques could be applied to obtain the owner' self-consumption capital income, as they are: (i) the additional commercial capital income gained investing the forest immobilised capital value in an alternative asset (lower bound) and (ii) the forest owners' contingent valuation for estimating the WTP marginal exchange value (upper bound).

It was shows above that there is a general consensus that, in purely financial terms, owners may be able to accept to loosing money by keeping their properties, since they might obtain higher potential capital income in alternative investments. The difference between the capital income generates in an alternative investment and their present forest commercial capital income is what they are actually "paying" for the environmental services that they enjoy (Campos and Riera, 1996: 89). Nevertheless, this market alternative investment opportunity cost is only a lower bound for the price that the market of landowners is ready to pay for this environmental service (SC_{ES}). To find the upper bound we could question to the landowners about their maximum willingness to pay (WTP) for the private environmental services that they enjoy (we have framed the question in terms of the maximum amount that they were ready to loose before selling their property)[6]. This is the upper bound for the marginal market price of these SC_{ES}, because if they had found somebody ready to pay more than this amount they would have sold their property[7]. The real market self-consumption price will be somewhere in between these two bounds. Nevertheless, if the interviewed landowners (a representative sample of the current landowners) are representative of all the landowners-market-agents, the price would be close to the value expressed by them as the maximum WTP level before they are ready to sell theirs forests. Thus, we use the upper limit for aggregation purposes.

2.5 The government consumption expenditures cost criterion

Exhange value criterion is not applied in national accounts for valuing public administration services: "government administration is a non-market service with no identificable product sold in markets, so it is valued in national accounts at its cost of production" (Lange, 2004: 83). The latter criterion could be theoretically acceptable if there were competitive market for the supply of the public services, that is far to be the case in the government supply of the forest open access public environmental services.
Simulated exchange value and not production cost national accounting criterion could be preferable when the demand of the public service is known. The open access public recreation and conservation services have government own fixed conservation investment output and consumption expenditures cost. The former output does not matter witch will be the valuation criteria, but the latter cost has a stated visitors

exchange value output. It is the reason to incorporate these commercial output and cost into the open access public on site environmental services account to be able to estimate the visitors' environmental services net value added (Campos et al., 2005b).

2.6 The self-employed and open access grazing resource conditioned values

Followings the Anderson and McChesney definition of economic property rights, open access grazing resource could be treated as private good, one it is picked up by private animals. It has been point out that current "forest accounts have most often measured the physical quantities and output value of NTFP [non timber forest products], but have not always calculated the value-added component of these products and have rarely considered the rent or on site value. For the harvest of NTFP, household labour is often the main input and the distinction between total value added and on site value is highly sensitive to the assumptions made about the opportunity cost of labour" (Lange, 2004: 82).

For most of non market NTFP most authors suggest "to value forest products at the cost of replacing them with close substitutes. For example, grazing of livestock may be valued at the market cost of purchasing an equivalent amount of fodder" (Lange, 2004: 83). By contrast, Campos et al. (2005c) reject independent subjective valuation of grazing resource rent and self-employed values and these authors propose a conditioned exchange price approach for joint grazing resource rent and household self-employed labour for avoiding misled income theory application. Thus, given an objective market measurement of forest household total income, we could adopt subjective values for non-market grazing resource rent and self-employed cost, but taken into account the trade off between them, and conditioned to forest household total income value remains constant in the accounting year.

The livestock household self-employed net value added ($NVA_{L,SE}$) from open access livestock activity can be measured objectively considering the follow steady state identity as residual market value[8]: $NVA_{L,SE} = R_{L,SE} + SC_{L,SE} - CE_{L,SE} - LC_{LE,SE} - RM_{OSC} - T_{LG,SE}$.

Being, $R_{L,SE}$: livestock self-employed revenues, $SC_{L,SE}$: livestock household self-employed self-consumption, $CE_{L,SE}$: livestock household self-employed equivalent consumption expenditures, $LC_{LE,SE}$: livestock employee compensations pay by household self-employed livestock keeper, RM_{OSC}: livestock household self-employed own forage unit supplementary consumption and $T_{LG,SE}$: government taxes on products[9].

The above livestock accounting identities steady state permit to say that joint livestock[10] household net value added at market prices ($NVA_{L,SE}$) is shared by production factors household self-employed cost ($LC_{L,SE}$) and current consumption of forest open grazing resource rent (GR_{CC}). Given an imputed value for livestock household self-employed wage rate ($W_{L,se}$) –e.g. euros (€)/working hour (H)–, then the residual exchange value of current grazing resources consumption could be estimated as: $GR_{CC} = NVA_{L,SE} - LC_{L,SE}$.

The open access grazing resources (GR_{CC}) could have a conditioned positive or negative exchange value pending on imputed livestock household self-employed cost ($LC_{L,SE}$), but this subjective $LC_{L,SE}$ does not affect the livestock household self-employed total commercial income ($NVA_{L,SE}$).

3 Selected forests applied green accounting results and discussion

3.1 The open access visitor's environmental services in forests applied green national accounting

3.1.1 The open access visitor's recreation

Neither the open access public recreation services output nor government expenditures are consider in conventional national forest accounts: "The only tourism services that are directly recorded as such in national accounts are payments such as entrance fees from national parks, licensing fees for hunting, etc. However, entrance and license fees are often no related to the cost of providing the recreation service and cannot be taken as the value of recreation. Moreover, some forest recreation opportunities are provide free to the consumer" (Lange, 2004: 84). Here, we show the results of a contingent valuation in the Cork Oak Natural Park (CONP), where demand curve and steady state government production cost were estimated in 2002 (Campos et al., 2005b).

Current CONP visitors state a median value for a recreation visit of 22 €, that is equivalent to a final output of 5.12 €/ha, when half of current visits (½V = 0.24 visits/ha) are taken into account. This quasi exchange value for recreation final output is confronted with government consumption expenditures (CE_G) and government employee labour cost (LC_{GE}) as the only production cost considered for the supply of the free recreation services. In the CONP the recreation CE_G accounts 2.60 €/ha and the LC_{GE} 3.64 €/ha. The public free recreation service generate a net value added of 2.52 €/ha and, as residual value, a negative net operating margin of –1.12 €/ha.

3.1.2 The visitor conservation value

The conservation value was measured in CONP by a contingent valuation question. The numbers of visitors that state they have willingness to pay (WTP) one specific amount of money per year basis time their WTP give a mean exchange value of 30 €/visitor and year, and this amount is equivalent of 5.8 €/ha exchange value of conservation final output. In the CONP the conservation CE_G accounts 0.17 €/ha and the LC_{GE} 1.22 €/ha. The CONP visitors conservation service generate a net value added of 5.63 €/ha and, as residual value, a positive net operating margin of 4.41 €/ha.

3.1.3 The visitor's environmental services in applied green national accounting

Campos et al. (2005b) measures the open access public consumption of recreation and conservation environmental services from forest applied green national accounting. There are two final outputs. The commercial one reflects the government forest internal investment (FO_{II}) that, what is expected in the steady state, it matches the value of internal fixed capital consumption (FCC_I), that is 2.03 €/ha. The CONP current visitors environmental output (FO_{ES}) offers the aggregated recreation and conservation quasi total services final output of 11 €/ha. The Cork Oak Natural Park (Cádiz, Spain) visitors FO_{ES} incur in a government consumption equivalent expenditures ($CE_{G,ES}$) of in 2.8 €/ha. Thus, the open access public environmental services generate a net value added (NVA_{ES}) of 8.2 €/ha. This total income from visitor's environmental services is nowadays appropriated by government employee compensation (60 %) and the visitors as net operating margin (40 %). In addition, the visitors obtain a consumer surplus given

by the difference between their WTP and the final output for the half of the current visitors with higher WTP.

The national accounting government *production cost* ($CE_{G,ES}$) criterion rule for valuing the visitors environmental output, beyond its lack of theoretical fundaments, in the CONP case underestimates 67 % the total income measured by de AAS *proxy* exchange value criterion.

3.2 The owners' self-consumption of private environmental services

In contrast with the early recognition of private environmental services on the market price of land, few and recent studies have measure their contribution to the owner' utility function (Kallio, 1999)[11], the quasi exchange value output (Campos and Mariscal, 2003; and Campos and Martínez, 2004) and the forestland price (Campos and Martínez, 2004; and Samuel and Thomas, 1999; Standiford and Howitt, 1992).

The Spanish dehesa and Portuguese montado owner's self-consumption of private environmental services were measured, as the lower limit, by Campos and Riera (1996). It was assumed a real private total profitability rate (p_p) of alternative investment of 3.6 %. For a sample of 15 dehesa and montado estates was estimated a real private commercial profitability rate (p_c) of 3.0 %, given a residual minimum value of private environmental profitability rate (p_e) of 0.6 % (Campos and Riera, 1996: 56, Table 2): $p_e = p_p - p_c$ = 3.6 % – 3.0 % = 0.6 %. Government livestock subsidies explain 44 % and owner's self-consumption 17 % of p_p, respectively. In other words, these subsidies and self-consumption private environmental services contribute with a minimum of 61 % of total dehesa and montado real private total profitability rate.

The upper bound of Scotch pine forest (Spanish high mountain of Central System) owner's self-consumption of private environmental services was measured in 2002 by a forest owner contingent valuation survey (Campos and Martínez, 2004). Private landowners of forest properties in the Central System are willing to waive annual commercial earnings of up 141 €/ha rather than selling their properties. This waiver of commercial earnings is justified by mushroom harvesting, recreational enjoyment and welfare through conservation of the habitat that landowners would relinquish if they sold their property. The sample of 21 forests properties has an average asset value of environmental services (L_E) of 2,580 €/ha, as stated by landowners. The estimated forestland capital value of the owners' self-consumption environmental services (L_E) represents 43.2% of the total estimated forestland market price (L_T) of average sample property, which is 5,975 €/ha (Campos and Martínez, 2004: 81).

3.3 The grazing resource rent in applied green national accounting

The value of grazing resource rent is currently incorporated implicitly in national accounts in the agricultural sector, although it would be more appropriate to include it as an intermediate production in the forestry sector (Vincent, 1999). Grazing resources rent has been valued using market prices for renting pastures (Rodríguez et al., 2004: 89, Table 1; Campos et al., 2005a:) or using market prices for what it is supposed to be a close substitute, as it has been assumed for commercial hay or barley surrogate goods (Skånberg, 2001: 51; Daly-Hassen and Ben-Mansoura, 2005: 114; Ellatifi, 2005: 77; Mendes, 2005: 343). Because these authors do not follow the central national

accounting exchange value criterion, they offer forests aggregated output value that misled income theory.

3.3.1 The grazing resource commercial rent in Spanish dehesa

Livestock activity is an important subsidised business in the European Union. In fact, the grazing resource market price captures partially this government subsidy. For example in Monfragüe's dehesa there is a positive grazing resource rent, while livestock income with employee labour cost leads to generate a negative capital income at market prices. When livestock government subsidies are considered, and this is the real case for dehesa's owner, livestock capital income at factor cost become positive (Campos et al., 2001; and Rodríguez et al., 2004).

In Spanish *dehesa* we have founded a real market price for a grazing rented forage unit (FU) that it is about 50% cheaper than the same FU obtained from commercial barley at farm gate (Rodríguez *et. al*., 2004: 89).

3.3.2 The open access grazing resource conditioned rent

In Sweden, "the Sami people have a historical [open access] right to feed reindeer with lichen. That means that no market price on lichen, i.e. of the forage right, exists. The alternative to lichen forage [GR_{CC}] is to feed the reindeer with hay, [..]. A reindeer consumes 1,25 kg of lichen a day, [..]. To feed the [..] reindeer [with] hay cost approximately Euro 1½ a day per reindeer in 1999, which give the annual lichen [grazed] production a value of Euro Mill. 84" (Skånberg, 2001: 51). Skånberg assumption to equals de FUs of commercial hay and grazing resource in Sweden has high risk to overvalue the former FU

It is preferible the local real and objective measurement of reindeer household self-employed net value added ($NVA_{R,SE}$) that could generate a conditioned subjective lichen unitary price. Skånberg substitute hay price criterion represents subjective lichen price of 1.20 €/kg. At this lichen price, how much will the self-employed reindeer keeper wage rate ($W_{L,SE}$) be? Because $NVA_{R,SE}$ is an objective market value, and being $NVA_{R,SE} = LC_{R,SE} + GR_{CC}$, the latter lichen grazed value can not be higher than $NVA_{R,SE}$, but this upper limit could be reached only if the $LC_{R,SE}$ imputed value is cero. Given a steady state objective value for $NVA_{R,SE}$, the open access simulated GR_{CC} exchange value will be from cero value to a lower value than $NVA_{R,SE}$.

In Tunisia cork oak agroforesty system in Iteimia area, we have found that Daly-Hassen and Ben-Mansoura (2005: 112, Table 7.4) equals values criterion for commercial barley and open grazing resource FUs overvalue the former FU a 115 % against the conditioned grazing resource value estimated, when a self-employed wage rate ($W_{L,SE}$) of 50 % of forestry employee wage rate ($W_{F,E}$) is assumed (Campos et al., 2005c). Thus, Campos et al. (2005c) estimate a self-employed livestock net value added ($NVA_{L,SE}$) of 119.6 €/ha of utilized agroforestry land (UAL). We found a negative value for Iteimia GR_{CC}[12] when $W_{L,SE}$ is 70 % higher than Iteimia $W_{F,E}$[13]. Considering that Iteimia livestock breeding employs usually women and children, Campos et al. (2005c) assume a $W_{L,SE}$ equals to 0.19 €/H for these self-employed livestock keepers. This assumption gives a Iteimia local current grazing resource consumption (GR_{CC}) simulated forage unit exchange value of 0.06 €/FU. This value corresponds to a $W_{L,SE}$ of 50 % of $W_{F,E}$. If we operate opposite, and we assume the forage unit market price substitute –e.g. a market barley price of

0.15 €/FU (Daly_Hassen and Ben-Mansoura, 2005: 114)– for valuing subjectively the Iteimia grazing resource, then the residual wage rate obtained for $W_{L,SE}$ will be 0.07 €/H. The latter value represents only the 20 % of $W_{F,E}$. Even adopted a cero value for Iteimia open GR_{CC} – that is, assuming $LC_{L,SE} = NVA_{L,SE}$– the $W_{L,SE}$ remains 70 % of $W_{F,E}$.

In Portugal most forestland is private ownership and there is a private market for grazing resource[14]. Mendes (2005: 343) does not use the Portuguese market price for grazing resource rent, and, without a theoretical justification, he applies the price of barley as a "surrogate price" (Mendes, 2005: 343). What is here difficult to justify is why the author rejects the market price for the grazing resource forage unit (FU) and he prefers to impute the commercial price of barley as a "surrogate price" for GR_{CC} measurement. The latter we have demonstrate in Mediterranean forests is far to be a close substitute of grazing resources in terms of exchange value (Rodríguez et al., 2004; Campos et al., 2005a; Campos et al., 2005b).

We have show that most forest accounts grazing resource valuation literature fails from a sound economic theory perspective, when it is applied the forage unit market substitute (e.g barley or hay unit price) for open or private grazing resource consumption. It is misleading too to adopt forestry employee compensation local wage rate as marginal opportunity cost of self-employed labour. AAS methodology gives a complete and extended framework to avoid double counting and unrestricted subjective valuation criteria on related self-employed livestock total income and open or private own grazing resource consumption.

4 Conclusions

First of all, it appears not to be enough reason to argue that scientific controversies avoid to implements new regulation and application of forest applied green national accounting. Of course, to measure forest total economic value will be perhaps an impossible task, but there are nowadays developed agroforestry accounts systems and non market valuation techniques with higher sound theory than the present non exchange value government services production cost criterion applied by the SNA.

Our AAS methodology has been developed to improve the SNA applications and to adding on site environmental incomes. The central commercial production boundary must to continue offering a commercial net value added and the extension of income measurement to non market good and services could supply environmental income indicator, but integrated in an unique national accounting system, otherwise the risk is very high of missing outputs and cost, making double counting and adopting arbitrary valuation criteria.

This paper proposes and develops new green accounting approach to estimate exchange values for on site forest private owners' and visitors' environmental consumptions. The open access visitors' recreation and habitat conservation have been measure by several contingent questionnaires in Spanish dehesa and Scotch pine timber forest in mountain Central System. We argue that accepting the visitors stated median time half of real current annual visits gives a proxy exchange value recreation of free access visitors to the forest.

Our most innovative and theoretically robust measurement is the forest owners' self-consumption of private environmental services. If private capital income and asset values are the two faces of the same coin, here being the forestland asset a capitalised

market value of owner future capital income, there is not cause to miss it from the central frame of the SNA. We believe that our contingent questionnaire approach gives an accurate theoretical and operative result to understand why forests are valued so much in the market if commercial profitability rate is so low. Mediterranean forests and other forests in industrialised countries (U.S.A, Spain, Portugal, U.K., Finland, etc.) become a joint low commercial profitability investment and a luxury private environmental services self-consumption investment, pending on owners' and potential buyers' preferences.

From a forest applied green national accounting perspective the challenger is to estimate exchange value for well identified forest environmental goods and services. Some environmental values are intermediate outputs incorporated in other forest final goods, e.g.: potential open access or private grazing resource rent is included in livestock net value added. This permit to estimate the grazing resource rent conditioned to a given self-employed cost and the rest of factor of production. This joint grazing resource and household self-employed objective measurement avoid subjective –some times arbitrary– grazing resource imputed value. Iteimia cork oak agroforestry case study shows that when it is assumed surrogate barley price for valuing grazing resource, this latter value overvalue 115 % the presumable value of grazing resource, conditioned to a self-employed wage rate equals 50 % of the forestry employee wage rate.

A last issue reaming that could weak our recommendations for incorporating inpute exchange values from contingent valuation techniques to built green national accounting with sound theory. We have assumed changes 'small enough', if simulated market were implemented, to retain the present national economy price structure. Here we have not a total accurate solution. To off set this weak, it must take account that the SNA has different but of great significant weak, e.g. income from government services equals the civil servant employee compensations, and that is not enough motive to reject, at all, the SNA.

Madrid, August 3, 2005
Institute of Economics and Geography of
Spanish Council for Scientific Research
Pinar 25, Madrid 28006, Spain
Phone: 34 91 4111098
Fax: 34 91 5625567
E-mail: *pcampos@ieg.csic.es* and *acaparros@ieg.csic.es*

Literature cited

Anderson, T. L. and McChesney, F. S. (2003) Introduction: Economic approach to property rigths. In: Anderson, T. L. and F. S. McChesney (eds.), Property rights. Cooperation, conflict and law. Princeton University Press, Princeton, pp. 1-11.

Bank of Spain (2005), available on line: http://www.bde.es/infoest/a0116.pdf.

Baptista, F.O. and Santos, R.T. (2005) Forests owners. Celta, Lisboa, 93 pp.

Bartelmus, P. (1998) The value of nature: valuation and evaluation in environmental accounting. In: K. Uno and P. Bartelmus (edis.), Environmental accounting in theory and practice. Kluwer Academic Publishers, London, pp. 263-307.

Campos, P. (2000) An agroforestry account system. In: H. Joebstl, M. Merlo and L. Venzi (eds.), Institutional aspects of managerial and accounting in forestry. IUFRO and University of Viterbo, Viterbo, pp. 9-19.

Campos, P. and Martínez, M. (2004) Multiple use of *pinus sylvestris* and *quercus pyrenaica* forests in the Spanish Central System. In: S. Schnabel and A. Ferreira (eds.), Sustainability of Agro-silvo-pastoral Systems - Dehesas, Montados -. Advances in GeoEcology 37. Catena Verlag, Reiskirchen (Germany), pp. 71-84.

Campos, P. and Caparrós, A. (2005) Social and private total Hicksian incomes of multiple use forests in Spain. Ecological Economics. Forthcoming.

Campos, P. and Riera, P. (1996) Rentabilidad social de los bosques. Análisis aplicado a las dehesas y los montados ibéricos. Información Comercial Española 751: 47-62.

Campos, P., Rodríguez, Y. and Caparrós, A. (2001) Towards the Dehesa total income accounting: theory and operative Monfragüe study cases. Investigación Agraria: Sistemas y Recursos Forestales (special issue on New Forestlands Economic Accounting: Theories and Applications) 1: 45-69.

Campos, P. and Mariscal, P. (2003) Preferencias de los propietarios e intervención pública: el caso de las dehesas de la comarca de Monfragüe. Investigación Agraria: Sistemas y Recursos Forestales 12(3): 407-422.

Campos, P., Caparrós, A. and Sanjurjo, E. (2005a) Spain. In: M. Merlo y L. Croitoru (eds.), Valuing Mediterranean Forests: Towards Total Economic Value. CAB Internacional, Wallingford (UK), pp. 319-330.

Campos, P., Caparrós, A. and Oviedo, J.L. (2005b). The open access visitors environmental services economies in the Cork Oak Natural Park (Cádiz, Spain). In: VIII Applied Economy Meeting Proceedings. Spanish Journal of Applied Economy – Murcia University.

Campos, P., Daly-Hassen, H., Chebil, A., Ovando, P., Montero, G., Stiti, B., Rodríguez, Y., Caparrós, A., Sánchez, M.O., López, E., Sánchez, M., Ruiz-Peinado, R., Bachiller, A., Chaar, H., Khaldi, A., Sebei, H. (2005c) Designing sustainable management models for Mediterranean silvopastoral forests: Application to cork oak forests in Cádiz (Spain) and Aïn Draham (Tunisia). Final report prepared for the Project 6P/02 of the Spain-Tunisian Inter-Universities Cooperation Programme founded by the Spanish International Cooperation Agency (AECI). Institute of Economics and Geography of Spanish Council for Scientific Research (CSIC) – National Institute of Rural Engineering, Water and Forests (INRGREF) – Center for Forestry Research of National Institute for Agrarian and Food Research and Technology (INIA) – National Institute for Tunisian Agronomy (INAT) – Tunisian Mograne School of Agriculture (ESAM), Madrid (Spain) – Ariana (Tunisia). In progress.

Campos, P., Ovando, P. and Rodríguez, Y. (2005d) Comparative analysis of the EAA/EAF and AAS agroforestry accounting systems: theoretical aspects. In: M.R. Mosquera, A. Rigueiro and J. McAdam (eds.), Silvopastoralism and Sustainable Land Management. CAB International, Wallingford (UK). Forthcoming.

Caparrós, A., Campos, P. and Montero, G., 2003. An operative framework for total hicksian income measurement: application to a multiple use forest. Environmental and Resource Economics 26, pp. 173-198.

Daly-Hassen, H. and Ben-Mansoura, A. (2005) Tunisia. In: M. Merlo y L. Croitoru (eds.), Valuing Mediterranean Forests: Towards Total Economic Value. CAB Internacional, Wallingford (UK), pp. 105-122.

Eggertsson, T. (2003) Open access versus common property. In: T. L. Anderson and F. S. McChesney (eds.), Property rights. Cooperation, conflict and law. Princeton University Press, Princeton, pp. 73-89.

Ellatifi, M.(2005) Marocco. In: M. Merlo y L. Croitoru (eds.), Valuing Mediterranean Forests: Towards Total Economic Value. CAB Internacional, Wallingford (UK), pp. 69-87.

Eurostat (1996) European System of Accounts - ESA-95. ECSC-EC-EAEC, Luxembourg, 383 pp.

Eurostat (2000) Manual on Economic Accounts for Agriculture and Forestry EAA/EAF 97 (Rev.1.1). European Communities, Luxembourg, 181 pp.

Eurostat (2002) The European framework for integrated environmental and economic accounting for forests-IEEAF. European Communities, Luxembourg, 106 pp.

Food and Agriculture Organitation (FAO) (1998) Economic and environmental accounting fro forestry: Status and current efforts. Planning and Statistics Branch/Policy and Planning Division/Forestry Department. Rome. www.fao.org (03/16/2005).

Friend, A. M. (2000) Roots of green accounting in the classical and neoclassical schools. In: S. Simon and J. Proops (eds.), Greening the accounts. Edward Elgar, Cheltenham (UK), pp. 32-51.

Heal, G. and Kriström, B. (2001) National income and the environment. http: //papers ssm.com/sol3/delivery.cfm/ SSRN-ID279112-CODE011118600.pdf (01/10/2003).

Hultkrantz, L. (1992) National Account of Timber and Forest Environmental Services in Sweden. Environmental and Resource Economics 2: 283-305.

Kallio, T. (1999) Non-market benefits and forest owners' total utility in profitability calculations. In: C. S. Roper and A. Park (eds.), The living forest. Non-market benefits of forestry. Forestry Commission, London, pp. 196-202.

Lange, G.M. (2004) Manual for environmental and economic accounts for forestry: a tool for cross-sectoral policy analysis. FAO Working Paper. Rome, 120 pp.

Martin, W.E. and Jefferies, G.L. (1966) Relating ranch prices and grazing permit values to ranch productivity. Journal of farm economics, 48 (2): 233-242.

Mendes, A. (2005). Portugal. In: M. Merlo y L. Croitoru (eds.), Valuing Mediterranean Forests: Towards Total Economic Value. CAB Internacional, Wallingford (UK), pp. 331-352.

Nordhaus, W. and Kokkelenberg, E.C. (eds.) (1999) Nature's numbers: expanding the national economic accounts to include the environment. National Academic Press, Washington, 250 pp.

Pope, III, C.A. and Goodwind, H.L., Jr. (1984) Impacts of consumptive demand on rural land values. American Journal of Agricultural Economics 66 (5): 750-754.

Rodríguez, Y., Campos, P. and Ovando, P. (2004) Commercial economy in a public Dehesa in Monfragüe Shire. In: S. Schnabel and A. Gonçalves (eds.), Sustainability of Agro-silvo-pastoral Systems. Dehesas & Montados. Advances in GeoEcology 37. Catena Verlag, Reiskirchen (Germany), pp. 85-96.

Rodríguez, Y., Ovando, P. and Campos, P. (2005) Comparative analysis of the EAA/EAF and AAS agroforestry accounting systems: application to a dehesa estate. In: M.R. Mosquera, A. Rigueiro and J. McAdam (eds.), Silvopastoralism and Sustainable Land Management. CAB International, Wallingford (UK), forthcoming September 2005.

Samuel, J. and Thomas, T. (1999) The valuation of unpriced forest products by private woodland owners in Wales. In: C. S. Roper and A. Park (eds.), The living forest. Non-market benefits of forestry. Forestry Commission, London, pp. 203-212.

Skånberg, K. (2001) Monetary forest accounts for timber and other forest related goods and services for Sweden 1987-99. In: Environmental accounts for forest. Test of a proposal framework for non-ESA/SNA functions. Statistics Sweden/National Institute of Economic Research: 46-76. epp.eurostat.cec.eu.int (03/16/2005).

Smith, A. H. and Martin, W. E. (1972) Socieconomic behaviour of cattle ranchers, with implications for rural community development in the West. American Journal of Agricultural Economics 54 (2): 217-225.

Standiford, R.B. and Howitt, R.E. (1992) Solving empirical bioeconomic models: a rangeland management application. American Journal of Agricultural Economics 74, 421-433.

Torell L.A., Rimbe N.N., Tanaka J.A. and Bailey S.A. (2001) The lack of a profit motive for ranching: implications for policy analysis. In: L. A. Torell., T. Barlett and R. Larrañaga (eds) Current issues in rangeland resource economics. Annual meeting of the Society for Range Management. February 17-23. Kailua-Kona, Hawaii, pp 47-58.

Tunisian Central Bank (2005), available on line: http://www.bct.gov.tn/

United Nations, Commission of the European Communities, International Monetary Fund, Organisation for Economic Cooperation and Development and World Bank (2003) Handbook of National Accounting. Integrated Environmental and Economic Accounting 2003.
http://unstats.un.org/unsd/envAccounting/seea2003.pdf (24/08/2004).

Varian, H. (1992) Microeconomic analysis, 3rd ed. Norton, New York.

Vincent, J.R. (1999) A framework for forest accounting. Forest Science 45(4): 552-561.

Appendix: AAS and ESA total incomes steady state comparison

In this appendix we shows a complete measurement theory of the forest total Hicksian income on the basis of an agroforestry accounting system (AAS) that were developed by the Environmental Economic Group (EEG) at Institute of Economics and Geography (IEG) of Spanish Council for Scientific Research (CSIC). For a detailed analysis of the differences and coincidences of the AAS and EAA/EAF see Campos (2000), Caparrós et al. (2003), Campos and Caparrós (2005), Campos et al. (2005d) and Rodríguez et al. (2005). The AAS generates the net value added from the production account and the capital gains from the capital balance accounts. The AAS will be compared with the European Union Economic System of Accounts (ESA) applied to agriculture and forestry (EAA/EAF) (Eurostat, 1996 and 2000).

A.1 AAS and ESA incomes comparison

A.1.1 Total output and cost

Total output (TO) at market prices (quantities time market price) include: intermediate output (IO), internal final investment (FO_{II}), sales from final outputs (FO_S), self-consumption of final outputs (FO_{SC}), and stock of final outputs of production in progress (FO_{PP}): $TO = IO + FO_{II} + FO_S + FO_{SC} + FO_{PP}$. It is assumed there is not final stock of finished goods in the accounting period or employee compensation in final forest products.

Total cost (TC) include: intermediate consumption (IC), labour cost (LC) and fixed capital consumption (FCC): $TC = IC + LC + FCC$. IC is classified as raw materials (RM) and services (SS). These have been classified in internal (intermediate output and production in progress used) and external intermediate consumption: $IC = RM + SS = IO + PP_U + RM_E + SS_E$. LC is composed by employees labour cost (LC_E) and self-employed labour cost (LC_{SE}): $LC = LC_E + LC_{SE}$. FCC is classified too in internal and external: $FCC = FCC_I + FCC_E$.

A.1.2 AAS and ESA private incomes comparison

The objective of this section is to exemplify the usefulness of AAS versus ESA –the European System of Accounts (ESA) is the national accounts applied in the European Union and the Economic Accounts for Agriculture and Forestry (EAA/EAF) is the satellite accounting system applied by Eurostat on the basis of ESA (Eurostat, 1996 and 2000)– in comparing, on uniform basis, the forest private incomes measurement at market prices. The identities presented here show that the AAS versus ESA forest private total income comparison are the same –however, this is only true for the aggregated NVA_{ESA}, since current applications at national level are incomplete for different reasons. The conventional EAF private net value added at market prices actually measured (NVA_{EAF}) undervalues the real commercial income generate in the forests, shrublands and grasslands by the aggregated values of grazing (GR_{FSG}) and hunting (H_{FSG}) rents that they are implicitly included in the agriculture and livestock net value added (NVA_{EAA}), except that the AAS system incorporates the value of self-consumption of private environmental services ($FO_{SC,E}$):

$TI_{AAS,P} = TCI_{AAS,P} + FO_{SC,E} = NVA_{ESA} + FO_{SC,E}$.

The AAS private total commercial income ($TCI_{AAS,P}$) and the ESA commercial net value added at market prices (NVA_{ESA}) we show they have the same values.

We said in the introduction section we have assumed hypothetical forest and livestock steady state. As we shall show below, this entails that there are not capital gains other than those arising from the effect of discounting production in progress, and then the AAS versus ESA incomes comparison can be made using complete system of accounts or only the ESA simplified production account. Under steady state assumptions, the simplified production account avoids to consider natural growth (GNG), production in progress used (PP_U) and capital balances (Caparrós et. al., 2003). It has been proved that in the steady state production in progress revaluation (PP_R) equals the values of production in progress used (PP_U) minus gross natural growth (GNG): $PP_R = PP_U - GNG$.

This steady state makes possible to estimate private total Hicksian commercial income ($TCI_{AAS,P}$) as the sum of AAS commercial net value added at market prices (NVA_{AAS}) plus production in progress revaluation (PP_R):

$TCI_{AAS,P} = NVA_{AAS,P} + PP_R$,

$TCI_{AAS,P} = TO_{ESA} + GNG - IC_{ESA} - PP_U - FCC + PP_U - GNG$,

$TCI_{AAS,P} = TO_{ESA} - IC_{ESA} - FCC = NVA_{ESA}$.

Being NVA_{ESA}: ESA commercial net value added at market prices, TO_{ESA}: ESA total output, IC_{ESA}: ESA intermediate consumption, and FCC: fixed capital consumption.

A.1.3 AAS and ESA social incomes comparison

Here in site forest AAS social total income ($TI_{AAS,S}$) extends private total income at market prices ($TI_{AAS,P}$) to the open access environmental goods and services consumed by visitors –e.g.: recreation and conservation values– and governmental expenditures. That is, social total income aggregates the different incomes generated by individual uses irrespective of the in site recipient, who may be the forest landowner, workers, recreational visitors and others. Thus:

$TI_{AAS,S} = NVA_{ESA} + FO_{SC,E} + FO_{OA,E} + LC_G - CE_G = NVA_{AAS,S}$.

Where, $FO_{OA,E}$: open access to pick up forest environmental (non market) goods and services (e.g.: free mushrooms collected, the public visitors recreation output, the visitors conservation value, etc.), LC_G: government forest employees compensations, CE_G): forest government consumption expenditures and $NVA_{AAS,S}$: AAS social net value added at market prices.

It has been showed that when forest steady state is considered, then the environmental extended simplified production account give a net value added that it matches the forest total sustainable income (Caparrós et al., 2003).

The main AAS social income differences with the ESA system is that neither owner's self-consumption nor open access visitor's environmental services, government employee compensation and intermediate government expenditures are taken into account in the presently applied ESA framework for forest account.

A.2 Self-employed net value added measurement

The net value added from total self-employed activities ($NVA_{T,SE}$) can be measured objectively considering the follow assumptions: physical and economic steady states –it can be proved that the following identities will match: $FC_{GI} = FCC + FC_S + FC_{SC}$, and

$FCC_E = FC_{EGI}$– and non opportunity costs for own tools and fixed capital. In addition, there is not residual value or self-consumption for external fixed capital investment and self-employed do not have property rights on final stocks of woody vegetation growth outputs:

$NVA_{T,SE} = TO_{T,SE} – IC_{T,SE} – FCC_{T,SE}$,

$TO_{T,SE} = IO_{T,SE} + FO_{II,SE} + FO_{S,SE} + FO_{SC,SE} + FO_{TPP,SE}$,

$IC_{T,SE} = IC_{I,SE} + IC_{E,SE} + PP_{TU,SE}$,

$FCC_{SE} = FCC_{I,SE} + FCC_{E,SE}$,

$FO_{II,SE} = FCC_{I,SE} + FC_{IIS,SE} + FC_{SC,SE}$,

$FCC_{E,SE} = FC_{EI,SE}$,

$FO_{TPP,SE} = PP_{TU,SE}$,

$NVA_{T,SE} = LC_{SE} + LC_{E,SE} + NOM_{T,SE}$,

$NOM_{T,SE} = GR_{CC} + RR_{F,SE} + T_{G,SE}$,

$LC_{SE} = FO_{S,SE} + FC_{S,SE} + FO_{SC,SE} + FC_{SC,SE} – CE_{SE} – LC_{E,SE} – GR_{CC} – RR_{F,SE} – T_{G,SE}$.

Self-employed revenues (R_{SE}) at market prices (quantities time market price) include sales from final outputs ($FO_{S,SE}$) and residual fixed capital ($FC_{S,SE}$): $R_{SE} = FO_{S,SE} + FC_{S,SE}$.

Self-consumption by self-employed family (SC_{SE}) from final outputs ($FO_{SC,SE}$) and fixed capital ($FC_{SC,SE}$) are valued at theirs correspondent imputed market prices: $SC_{SE} = FO_{SC,SE} + FC_{SC,SE}$.

Self-employed equivalent consumption expenditures (CE_{SE}), when steady state is assumed, include external intermediate consumption ($IC_{E,SE}$) and external fixed capital consumption ($FCC_{E,SE}$) in the accounting period. The latter equals the external fixed capital investment ($FC_{EI,SE}$) at replacement cost. This is the reason to include the $FC_{EI,SE}$ in the cost of the consumption expenditures: $CE_{SE} = IC_{E,SE} + FCC_{E,SE} = IC_{E,SE} + FC_{EI,SE}$.

The GR_{CC} are the resources rents appropriated by self-employed families for using the open access land. The $RR_{F,SE}$ value represents the resource rents paid to the forest owner by self-employed family. The $T_{G,SE}$ value will be the taxes on products –it is assumed that there is not net of operating subsidies– paid by the self-employed family to the government.

Thus, taking into account all the above assumptions, the $NVA_{T,SE}$ is estimated objectively as residual exchange value of the items self-employed revenues (R_{SE}), self-consumption (SC_{SE}) and consumer expenditures (CE_{SE}):

$NVA_{T,SE} = R_{SE} + SC_{SE} – CE_{SE}$,

$NVA_{T,SE} = LC_{SE} + LC_{E,SE} + GR_{CC} + RR_{F,SE} + T_{G,SE}$,

$NVA_{T,SE} = LC_{SE} + LC_{E,SE} + GR_{CC} + RR_{F,SE} + T_{G,SE}$,

The net value added that can be appropriated by self-employed from all forest activities (NVA_{SE}) is the $NVA_{T,SE}$ minus the self-employed payments to the employee ($LC_{E,SE}$), forest owner ($RR_{F,SE}$) and taxes on products ($T_{G,SE}$):

$NVA_{SE} = NVA_{T,SE} – LC_{E,SE} – RR_{F,SE} – T_{G,SE}$,

$NVA_{SE} = LC_{SE} + GR_{CC}$.

All the items required to estimate the net value added appropriated by self-employed (NVA_{SE}) are real or imputed market value. When some forest uses are free for self-employed, the total income appropriated by self-employed could include the current

grazing resource consumption exchange vale (GR_{CC}), if this exists, in addition of the self-employed compensation (LC_{SE}).

Notes

[1] Trip-expenditures increase question in contingent survey for Cork Oak Natural Park (CONP) (Cádiz, Spain):

[As you know *trip-costs* have changed in the last decades (i.e. gas prices have gone up and down relatively independently of generalized increases in prices and live costs). Now we are going to ask you to imagine that *total expenditures* of your visit increase for this reason, even though you realize exactly the same activity you have done (same transport, same food ...)]

If the per person total expenditures of your visit would have been ..... euros *(*…..pesetas) more than the quantity you have just calculated, would you still have come today? Please take into account that we are asking you to imagine a real payment and that you could not spend the money in alternative uses.

□ yes □ no □ don´t know

[2] Assuming a linear demand function, this maximisation will occur for the median, for the price half of the population is ready to pay.

[3] Since costs are assumed to be constant, marginal and average costs are equal

[4] The monopolist would maximise his/her benefit and with no variable costs this implies maximisation of the revenues.

[5] Visitors conservation question in CONP:

[For the following questions we request you do not to take into account the previous hypothetical cases stated].

[As you may know, besides recreational use, the CONP has other environmental functions such as the protection of endangered wildlife and flora].

Q. Would you be willing to contribute economically to create a fund utilised exclusively to preserve this natural area (CONP)?

□ yes □ no

Q. Which would be your maximum annual contribution every year? (Please, remember that the CONP is just one of the natural parks you may be interested in preserving).

[6] Contingent valuation question for forests owners' self-consumption of environmental services: "Consider a situation in which you could earn more by investing in other assets of comparable risk and time frame, such as public debt, houses, etc. (already taking into account capital gains from the land, e.g. land price increase). What is the maximum quantity of money you would be willing to give up from your earnings *each year per hectare* before selling your estate in order to invest in a *non-agrarian* business? (in Euros or Pesetas).

Keep in mind that by selling your estate your family and friends give up the exclusive right to enjoy the natural surroundings of your land, and you can no longer pass down this property to future beneficiaries.

_____ per year per hectare

[7] What implies that the forest potential buyer equals the forest owner self-consumption discount rate, other wise, given the same WTP for self-consumption supply and demand, the owner will sell the forest, if his/her discount rate is higher.

[8] The livestock household self-employed income identity is measured by the follow exchange value components: $NVA_{L,SE} = FO_{LS,SE} + FC_{LS,SE} + FO_{LSC,SE} + FC_{LSC,SE} - IC_{LE,SE} + FC_{LEI,SE} - LC_{LE,SE} - T_{L,SE}$. Being, $NVA_{L,SE}$: livestock household self-employed net value added at market prices, $FO_{LS,SE}$: livestock self-employed final output sales; $FC_{LS,SE}$: livestock self-employed fixed capital sales, $FO_{LSC,SE}$: livestock self-employed final output self-consumption,

$FC_{LSC,SE}$: livestock self-employed fixed capital self-consumption, $IC_{LE,SE}$: livestock self-employed external raw materials and services expenditures, $FC_{LEI,SE}$: livestock self-employed external fixed capital investment expenditures, $LC_{LE,SE}$: livestock employees compensation and $T_{L,SE}$: livestock taxes to the government paid by livestock owner.

[9] It is assumed there is not operating and capital subsidies.

[10] Current consumption of forest open grazing resource rent (GR_{CC}) it is not included in the livestock intermediate consumption cost.

[11] Kallio (1999) estimates owners' WTP for self-consumption of private environmental goods and services as a flow, although in terms of utility

[12] Given the 2002 our Iteimia livestock total fodder consumption estimation and the commercial fodder supplemented in the stable, we calculate a residual amount of current livestock grazing resources consumption (GR_{CC}) of 650.4 FU/ha of grazed land (GL) or 566.2 FU/ha of utilized agroforestry land (UAL).

[13] *Iteimia* (2002 data) forestry activity employee wage rate ($W_{F,E}$) equals: 0.50 DT/H_E (i.e. 4 DT per working day –8 working hours per day– or 3 €/day) or 0.37 €/H_E. Currency exchange value (2002 data): 1 € equals 1.34 DT (Tunisian Central Bank, 2005 and Bank of Spain, 2005).

[14] In Portugal livestock keeper receive government subsidies that could be higher value than the market price of grazing resources. This is the case too for Spain.