Testing Extended Accounts in Scheduled Conservation of Open Woodlands with Permanent Livestock Grazing: Dehesa de la Luz Estate Case Study, Arroyo de la Luz, Spain

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SUPPLEMENTARY MATERIALS

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SM 1. Revisiting Agroforestry Accounting System Concepts of Total Income and Capital

This sub-section revisiting the concepts and evaluation methods employed to measure ecosystem total income and private capital published in previous versions of the Agroforestry Accounting System (AAS) [4, 16, 18, 19, 20, 21]. We conceptualize the revised AAS (hereafter extended accounts), in the context of the scientific debate, of the revision of national and ecosystem accounting within the statistical and scientific communities [17, 34, 37, 54, 55].

Total product

The production account in the extended accounts classifies the total product (TP) generated in an accounting period into intermediate product (IP) and final product (FP). The aggregated TP for all of the individual activities of the ecosystem together lacks economic significance as double accounting of the IP occurs. This is due to the fact that IP is also embedded in the FP of the accounting period. However, we need to know the TP of each individual activity as they constitute an essential record to estimate the net value added (NVA) and the net operating margin (NOM) of each of the activities or individual products of an ecosystem.

The intermediate products (IP) are classified into raw materials (IRM) and services (ISS). An agroforestry ecosystem produces a wide variety of IRM and ISS utilised as inputs to produce the final products (good and services) of the estate. An intermediate product is utilised as input, generally, in the production of the final product of an activity different from the activity from which it originated, although in certain activities an intermediate product may be consumed in the final production of the same individual activity in question. The IRM are generally characterized by the observable market prices of the products in which they are incorporated, so there is no conceptual difficulty associated with their valuation, although in practical terms the lack of information can make the valuation more difficult. Examples of intermediate raw materials of an agroforestry activity include grazing (grass and acorns) along with the stumpage values of harvested products such as timber, firewood, cork and game hunting. The intermediate services (ISS) are classified as commercial (ISSc) and non-commercial (ISSnc).

The ISSc are embedded in the final products of the private and public activities which consume them. An example of ISSc is the residential service provided by the dwelling occupied by the family owner in the agroforestry estate, which is a self-consumed service input of the private amenity activity. Another example of ISSc is the plantation service of the conservation forestry activity, which, depending on the type of owner, could be an input of private amenity activity or public activity of the landscape conservation service. Scarce difficulty is involved in the valuation of the commercial intermediate services (ISSc) as there are transaction prices for the same product in the local market and the manufactured investment is known, allowing the normal net operating margin to be estimated. The most practical difficult valuation of ISSc is that of the residential dwellings occupied by owners on account of self-consumption of amenities. These dwellings often present singularities which complicate direct comparison with the leasehold prices of rural dwellings in the local market.

These ISSnc can be separated into those which are compensated (ISSncc), normally by the government and those donated (ISSncd) by an institutional owner, both being consumed as inputs of the public activities and self-consumed (ISSnca) as inputs of the private amenity activity. The ISSnc pose a substantial conceptual challenge to the valuation of ecosystem products. Only some parts of the total ISSnc are observable; those which the government "purchases" through compensations (ISSncc) to the owner of the ecosystem. The ISSnca and ISSncd can be valued in accordance with the loss of monetary margin to the owner of the manufactured investment in the private activities which generates them. A family owner and an institutional owner (private or public industry) do not generate ISSncd and ISSnca, respectively.

The final product (FP) is classified as consumed (FPc) by people or other economic units and the own-account gross capital formation (GCF) of work in progress capital formation (GWPCF) and fixed capital formation (GFCF) which remain in the same ecosystem at the closing of the accounting period, contributing to the economic activities of future accounting periods. The FPc are classified as sales (FPS), self-consumption by the owner (FPa), public products (FPpu) and other final products not included in the previous classes (FPo):

$$TP = IP + FP \quad (SE.1)$$
$$IP = IRM + ISS \quad (SE.2)$$
$$ISS = ISSc + ISSnc \quad (SE.3)$$
$$ISSnc = ISSncc + ISSncd + ISSnca \quad (SE.4)$$
$$FP = FPc + GCF \quad (SE.5)$$
$$FPc = FPs + FPa + FPpu + FPo \quad (SE.6)$$
$$GCF = GWPCF + GFCF \quad (SE.7)$$

Total cost

The total cost (TC) is consistently classified in alignment with the ordinary TP in ordinary total cost (TCo) and the investment total cost (TCi) which are attributed to the TPc and the GCF, respectively. The TC comprises intermediate consumption (IC), labour (LC) and consumption of fixed capital (CFC). The IC is separated into raw materials (RM), services (SS) and work in progress used (WPu). The RM comprises bought (RMb), own (RMo) and environmental (RMe). The SS embrace bought (SSb), own (SSo) and environmental (SSe). The WPu are classified into environmental (WPeu) and manufactured (WPmu). Labour is differentiated into employee (LCe) and sel-employed (LCse). All the CFC is manufactured:

$$TC = TCo + TCi \quad \text{(SE.8)}$$
$$TC = IC + LC + CFC \quad \text{(SE.9)}$$
$$IC = RM + SS + WPu \quad \text{(SE.10)}$$
$$RM = RMb + RMo + RMe \quad \text{(SE.11)}$$
$$SS = SSb + SSo + SSe \quad \text{(SE.12)}$$
$$WPu = WPeu + WPmu \quad \text{(SE.13)}$$
$$LC = LCe + LCse \quad \text{(SE.14)}$$

Net operating margin

The production account presents the social net operating margin (NOM) at social prices (after adding the non-commercial intermediate services to producer’s price). The residual valuation of the NOM is obtained as the difference between the extended accounts total products (TP) at social price and the total cost (TC). The NOM comprises an environmental part (NOMe) which originates from the appropriation by the owner of the operating income from the land and another manufactured part (NOMm) which corresponds to the operating profit from manufactured capital invested by the landowners and from the livestock. In the case of activities in which the value of the NOMm is simulated, it is estimated by imputing a normal profitability rate (r) to the immobilized manufactured capital (IMCm) of the corresponding activity (SE.17):

$$NOM = NOMe + NOMm \quad \text{(SE.15)}$$
$$NOM = TP - TC \quad \text{(SE.16)}$$
$$NOMm = r \cdot IMCm \quad \text{(SE.17)}$$

Self-employed labour

The family activity which is carried out using self-employed labour (LCse) generates a family net value added (NVAfpp) at producer’s prices (before adding the non-commercial intermediate services) which is destined for the potential compensation of self-employed labour (LCse) and the residual net operating margin (NOMpp) at producer’s prices. The NVAfpp is estimated as the residual value of the total product (TPpp) at producer’s prices less the total family cost (TCf), excluding from the latter the service of self-employed family labour (LCse) (SE.19). The part of the NVAfpp destined to the remuneration of self-employed family labour (LCse) is estimated by subtracting the net operating margin (NOMpp), both environmental (NOMe) and manufactured (NOMmpp) at producer’s prices from the value of the NVAfpp (SE.20). Once the environmental net operating margin (NOMe) is known the family net value added manufactured (NVAfmpp) is obtained by subtracting the NOMe from the NVAfpp (SE.21). The NVAfmpp is equal to the sum of the NOMmpp and the LCse.

Attributing an hourly price to the self-employed family labour is accepted as consistent as long as the value of the NVAfpp is positive (NVAfpp > 0), and the NVAfmpp is also positive (NVAfmpp > 0). In this case the existence of compensation for self-employed labour (LCse > 0) is accepted, and it is assumed that the NVAfmpp preferentially remunerates the LCse, as long as the hourly remuneration for self-employed labour (rhse) does not exceed 80% of the respective hourly price of employee labour (rhe) (SE.23) [4, 16]:

$$NVAfpp = LCse + NOMpp \quad (SE.18)$$
$$NVAfpp = TPpp - RM - SS - WPu - LCe - CFC \quad (SE.19)$$
$$LCse = NVAfpp - NOMe - NOMmpp \quad (SE.20)$$
$$NVAfmpp = NVAfpp - NOMe \quad (SE.21)$$
$$NVAfmpp = NOMmpp + LCse \quad (SE.22)$$
$$0 \leq rhse \leq 0{,}8 \cdot rhe \quad (SE.23)$$

Ecosystem services consumed

The ecosystem services consumed (ES) represent the contribution of nature to the value of the ecosystem products consumed (TPc) in the accounting period. The ES contain values for utilized environmental work in progress (WPeu) and the ordinary environmental net operating margin (NOMeo). The latter excludes the own gross environmental investment of natural growth of firewood and cork yet to be extracted. The ES are generally not observable in the form of products as they are residual values embedded in the values of the individual agrosilvopastoral ecosystem products consumed in the accounting period. The individual values of all the components which contribute to the value of the products consumed are known except the ordinary environmental net operating margin (NOMeo). The latter is the residual value of the components which make up the value of the individual product of the agroforestry ecosystem consumed (SE.24):

$$NOMeo = TPc - ICmo - LCo - CFCo - WPeu - NOMmo \quad (SE.24)$$
$$ES = WPeu + NOMeo \quad (SE.25)$$
$$ES = TPc - ICmo - LCo - CFCo - NOMmo \quad (SE.26)$$
$$NOMmo = r \cdot IMCm, \text{ if } NOMo \geq r \cdot IMCm \quad (SE.27)$$
$$NOMmo = NOMo, \text{ if } r\ IMCm \geq NOMo \quad (SE.28)$$

Where ICmo is the ordinary manufactured intermediate consumption, LCo: ordinary labour, CFCo: ordinary consumption of manufactured fixed capital, NOMo: ordinary net operating margin, NOMmo: ordinary manufactured operating margin, IMCm: manufactured immobilized capital, and r: the normal private profitability rate.

Capital gains

Capital gains (CG) is a measure of income for the accounting period which takes into account, on the one hand, the revaluation of existing standing stock of work in progress given the reduction of one year (i.e. one year closer) to the future extraction of the utilised work in progress; and on the other hand, the revaluations, at the closing of the current and future accounting periods, of work in progress and fixed capital stocks not predicted at the opening of the accounting period. The plantations and infrastructures also show capital gains due to the variations in the market price of replacement cost of historical investments. Capital gains (CG) are estimated according to the revaluation of capital (Cr) less destruction of capital (Cd) and plus accounting adjustments (Cad) made to avoid double accounting of the total income due to instrumental accounting records of the accounting period. The revaluation of capital (Cr) is estimated as the residual value of the capital balance account according to the difference between the closing capital (Cc) and the capital withdrawals (Cw) less the opening capital (Co) and the capital entries (Ce),

$$CG = Cr - Cd + Cad \quad \text{(SE.29)}$$
$$Cr = Cc + Cw - Co - Ce \quad \text{(SE.30)}$$

Total income

Function F contains all the production factors necessary to estimate the total income and the capital of the agroforestry ecosystem. In the extended accounts applied to the ecosystem, function F of the total income (TI) employs the production factors of intermediate consumption (IC), labour services (LC) and fixed capital services (CF) [18, 19]. The total capital stock (C) is classified as existing stock of work in progress (WP) and fixed capital stock (FC). The latter comprises land, biological resources, tree plantations and infrastructures. In both components of total capital we distinguish between environmental asset (EA) and manufactured capital (MC).

Total income (TI) appears in terms of the balance equation for the extended accounts in the equation (SE.32). In this equation, the TI is separated into net value added (NVA) at social price and the capital gains (CG) [18]. The net value added (NVA) at social price, which is obtained from the production account, represents the labour cost (LC) and the net operating margin (NOM) at social price of the respective remunerations to workers and the immobilized capital of the land and livestock owners invested in the estate economic activities of the estate.

The total income (TI) of the ecosystem is distributed on the basis of the services provided according to the production factors of labour (LC) and capital income (CI). The latter embraces the sum of the net operating margin (NOM) and the capital gains (CG) (SE.35). The CI is also classified into manufactured capital gain (CGm) and environmental income (EI). TI is divided into the income from the production factors of labour (LC), manufactured capital income (CIm) and environmental income (EI) (SE.37):

$$TI \equiv F(IC, LC, FC) \quad \text{(SE.31)}$$
$$TI = NVA + CG \quad \text{(SE.32)}$$
$$NVA = LC + NOM \quad \text{(SE.33)}$$
$$TI = LC + CI \quad \text{(SE.34)}$$
$$CI = NOM + CG \quad \text{(SE.35)}$$
$$CI = CIm + EI \quad \text{(SE.36)}$$
$$TI = LC + CIm + EI \quad \text{(SE.37)}$$

Environmental asset

The valuation of the land includes the land itself and the above-ground cover as inseparable elements but excludes the installations and equipment, which are included in the manufactured fixed capital. The latter is valued at replacement cost adjusted according to obsolescence and state of conservation for production. The land valuation for private estates poses no conceptual difficulty as market prices are available for real transactions, and once the value of the manufactured fixed capital of the estate has been estimated the value of the land is obtained as the difference. The valuations of the individual environmental asset (EA) are derived from the discounted future values of their respective resource rents (RR). The standard system of environmental-economic accounting central framework (SEEA-CF) only estimates the environmental asset of commercial forestry products according to the discounted future flows of natural RR [34]. In the extended accounts the RR as defined by standard accounts (SEEA-CF) corresponds to the sum of the utilised environmental work in progress (WPeu) and the environmental income (EI) (SE.39). The environmental income is estimated from the sum of the net environmental operating margin (NOMe) and the environmental capital gains (CGe) (SE.40).

$$EA = \sum_{s=t}^{\infty} \frac{RR}{(1+r)^{(s-t)}} \quad \text{(SE.38)}$$

$$RR = WPeu + EI \quad \text{(SE.39)}$$

$$EI = NOMe + CGe \quad \text{(SE.40)}$$

Where s is the year of consumption of the natural resource and t is the current year.

Profitability

The profitability of the ecosystem originates both from the profitability of the operation, derived from the productive activities registered in the production account, and from the profitability of capital gains stemming from variations in prices and registered destructions of capital stocks in the capital balance account. Measuring profitability can be individualised in the case of products for which complete production and capital balance accounts can be elaborated. The profitability rates may be partial or total depending on whether the net operating margin and capital gain are taken into account. Another classification relates to whether it corresponds to the accounting period or is adjusted in accordance with past price variation trends. The current profitability rate corresponds to that derived from the prices during the accounting period, without taking into consideration inflation. The real profitability rate is the current profitability less the inflation rate.

A common practice is to estimate the real capital gains rate for the accounting period as the current capital gains potentially present greater volatility than the net operating margin. This is the case with variations in land prices. The current profitability considers the nominal profitability as it is with the prices of the accounting period in which the income is measured, whereas the real profitability substitutes the variation in the price of the land in the accounting period for the real cumulative annual variation in the price of the land (excluding inflation) over a period of several years prior to the current accounting period.

The total profitability rate (r) is estimated by the quotient between the capital gain and the immobilised capital (IMC) (SE.42). The latter is opening capital (Co) plus working capital (WC). The operating rate (o) (SE.43) and the capital gain rate (g) (SE.44) are distinguished, among many other possibilities:

$$IMC = Co + WC \quad \text{(SE.41)}$$

$$r = CI/IMC \quad \text{(SE.42)}$$

$$o = NOM/IMC \quad \text{(SE.43)}$$

g = GC/IMC (SE.44)

SM 2. Change of Net Worth

We define the total income (TI) in a given period as the maximum potential consumption of the total product of ecosystem services which allows the real opening and closing value of total ecosystem capital to remain constant [14]. In this case the representation of the total income and its factorial distribution is simplified by regrouping the extended accounts components which comprise the total private income into just two components, that is, as simulated revenue (R) and less expenditure (E):

TI = R – E (SE.45)

We define simulated private revenue for the year as the aggregated values for the intermediate raw materials (IRM), commercial intermediate services (ISSc), non-commercial intermediate services (ISSnc), sales (S), the gain of net worth (GNW) and autoconsumption (A):

R = IRM + ISSc + ISSnc + S + GNW+ A (SE.46)

We simulate private expenditure as the intermediate consumption of raw materials (RM), services (SS), work in progress used (WPu), and loss of net worth (LNW):

E = RM + SS + WPu + LNW (SE.47)

Positive change of net worth (CNW) is registered as gain of net worth (GNW) and a negative variation as loss of net worth (LNW). The components of the change of net worth are the own-account gross capital formation (GCF), the consumption of fixed capital (CFC), capital revaluation (Cr), extraordinary destruction of capital (Cd) *ad hoc* capital adjustments (Cad) in order to avoid double accounting of instrumental records [16, 22, 32]:

CNW = GCF ─ CFC + Cr ─ Cd + Cad (SE.48)

SM 3. Resource Rent

The value of the standard accounts resource rent (RR), which allows us to simulate the value of the land environmental asset (including wild biota) at market price, is ascribed to future individual resource rent from grazing, firewood and cork in Dehesa de la Luz. The concepts and criteria for the valuation of resource rent from individual forestry resources in Dehesa de la Luz in 2014 are described below. The forestry activity resource rent for the accounting period is estimated by the extended accounts as the sum of the values for environmental work in progress used (WPeu), net environmental natural growth (NGe), plus the environmental net operating margin (NOMe) embedded in the values of the forestry products (natural growth and total product consumption). The individual values of all the components of the resource rent are known, except the balancing item which is the NOMe. Taking into account that standard accounts do not include NGe in the supply side and WPeu in the use side of the production account, forestry activity RR is estimated as shown in the following accounting identities:

$RR = NOMe + WPeu – NGe$ (SE.51)
$NOMe = NOM – NOMm$ (SE.52)
$NOM = TP – TC$ (SE.53)
$NOMm = r\ IMCm, \text{ if } NOM \geq r \cdot IMCm$ (SE.54)
$NOMm = NOM, \text{ if } r\ IMCm \geq NOM$ (SE.55)
$RR = TP – ICm – LC – CFC – NOMm + WPeu – NGe$ (SE.56)

SM 4. Intermediate Services

In our case study, conservation forestry provides commercial intermediate services (ISSc) and donated non-commercial intermediate services (ISSncd) as inputs to the public landscape conservation activity. Livestock provides compensated non-commercial intermediate services (ISSncc), donated non-commercial intermediate services (ISSncd) and self-consumed amenity intermediate service (ISSnca) as inputs to public landscape, threatened livestock biodiversity and private amenity activities respectively. Commercial intermediate service provides SSIncd which are utilized in public recreational and landscape activities.

Conservation forestry

The gross capital compensations (GCC) for conservation forestry, perceived in one single payment by the landowner, are annualized to estimate the annual equivalent compensation (CAC) of the production flow of commercial intermediate services (ISSc). This is done through the following equation (SE.57):

$CAC = GCC\ (r/\{r – (1/(1 + r))\ T + 1\})$ (SE.57)
$ISSc = CAC$ (SE.58)

Where T is the amortization period of the own-manufactured fixed capital and r is the normal profitability rate expressed as a unitary value.

We consider the ISSc for conservation forestry as implicit "purchases" by the government from landowners and the gross compensation (subsidies) for livestock and fencing are also considered as ISSncc. The latter are re-employed as inputs to the public landscape conservation service at Dehesa de la Luz.

Conservation forestry contributes ISSc, which are valued according to their ordinary total cost of production (TCocp) or gross capital equivalent annuity compensation (CAC) paid by the government if the latter exceeds the former. If the CAC is below the cost of production, then a donation (ISSncd) of conservation forestry is assumed to exist, estimated as the difference between the cost and CAC.

Livestock

The ISSnc of the public landowner's livestock and infrastructure services are valued according to the difference between the manufactured net operating margin at normal social price (NOMm) and net operating margin at producer price (NOMmpp) (SE.61), except for the family livestock owners' activity which contributes ISSncc valued by the gross operating compensation (GOC), and ISSnca which are ascribed to the private amenity activity, since donations by family livestock owners for public activities are assumed absent. The NOMm (SE.62) of the investment in manufactured immobilized capital by the landowner in the individual activity which produces it is obtained by imputing the normal rate of profitability (r) to the manufactured immobilized capital (IMCm). The NOMmpp (SE.60) is estimated as the difference between the total net operating margin at producer's prices (NOMpp) and the environmental net operating margin (NOMe). The compensated non-commercial intermediate service (ISSncc) is estimated by the gross operating compensations (GOC) (SE.59). The landowner donated non-commercial services (ISSncd) and amenities (ISSnca) are valued according to the loss of monetary margin to the public landowner (SE.64) and the family livestock owners (SE.65) respectively:

$$ISSncc = GOC \quad (SE.59)$$
$$NOMmpp = NOMpp – NOMe \quad (SE.60)$$
$$ISSnc = NOMmsp – NOMmpp \quad (SE.61)$$
$$NOMm = r\ IMCm \quad (SE.62)$$
$$ISSnc = ISSncc + ISSncd + ISSnca \quad (SE.63)$$
$$\text{Public landowner: } ISSncd = ISSnc – ISSncc \quad (SE.64)$$
$$\text{Family livestock owner: } ISSnca = ISSnc – ISSncc \quad (SE.65)$$

Livestock owner generated non-commercial intermediate services (ISSncc) are compensated with public money to encourage the continuity of livestock grazing given the public benefits associated with the conservation of dehesa landscape and the preservation of threatened autochthonous livestock breeds, the numbers of which have reached critical thresholds. The family-owners receive gross operating compensation (GOC) and the landowner, gross capital equivalent annuity compensation (CAC) received over the last 12 years for repairs to the dry-stone wall [22]. No compensation (subsidy) was registered in 2014 corresponding to livestock of the public landowner:

$$ISSncc = GOC \quad \text{if family livestock owner} \quad (SE.66)$$
$$ISSncc = CAC = SSIncc = GCC\ (r/\ \{r – (1/(1 + r))\ T + 1\}) \quad \text{if landowner} \quad (SE.67)$$

The landowner donates non-commercial intermediate services (ISSncd) for his livestock, among which are threatened livestock species (White Cacereña cow, Black Merina sheep, and Cordobes donkey), incurring loss of operating margin. The ISSncd for the public landowner's livestock is estimated as the difference between the net operating margin at social price (NOM) and the net operating margin at producer's price (NOMpp), which is obtained directly from the extended accounts [18]. The NOM is obtained by multiplying the normal profitability rate by the manufactured immobilized capital (IMCm):

$$NOMpp = TPpp – TCpp \quad (SE.68)$$
$$NOMsp = r\ IMCm \quad (SE.69)$$
$$ISSncd = NOM – NOMmpp \quad (SE.70)$$

Where TPpp is the total product at producer's prices (market price) and TCpp is the total cost at purchase's price.

The family livestock owners contribute non-commercial intermediate services of self-consumed private amenities (ISSnca), since it has been assumed that these family livestock owners, motivated by their livestock breeding activity at Dehsesa de la Luz, cannot admit a negative net operating margin:

$$\text{If } NOMpp > 0 \text{ then } ISSnca = 0 \quad (SE.71)$$

If NOMpp < 0 then ISSnca = TCpp – TPpp (SE.72)

SM 5. Scheduled Conservation Forestry and Modeling Natural Growth and Extracted Products

Scheduled conservation forestry and modeling natural growth and extracted products are based on the current state of the stand, the different management activities which take place and information gathered from inventories, models and instrumental accounting calculations. The management alternatives proposed for the estate follow criteria compatible with the dehesa landscape conservation objectives. Furthermore, improvements to the stand over the coming decades are programmed, taking into consideration the nature and multifunctional supply of public and private products (goods and services).

Description of the inventories conducted at Dehesa de la Luz

Holm oaks are classified into three groups: (1) holm oaks originating from natural regeneration outside the area planted out in 1993, (2) young holm oaks from the 1993 plantation and densification of 2014, (3) holm oaks which originate from natural regeneration and which have been retained within the 1993 plantation plot. The cork oaks are classified into two groups: (1) adults dispersed across the area not planted in 1993 and (2) those within the area of the 1993 plantation. In accordance with this classification, a management division of the estate into six stands is established, based on the location as well as on the physical, environmental and dasometric characteristics (Figure S1). This division is used to situate and to develop the different conservation forestry activities scheduled.

Inventory of holm oaks originating from natural regeneration

Random sampling was carried out with a net of 540m in length, resulting in a total of 34 circular plots of 40m radius (Figure S2). In each of these plots, a tape measure was used to measure the circumference of all the holm oaks at breast height or normal circumference (CBH) along with two perpendicular crown diameter measurements. Other variables were also recorded, such as the coordinates, the aspect and slope of the plot.

The diameter distribution is estimated in trees/hectare (tree distribution by diameter class) and thickness (sum of the absolute frequency of all diameter classes). The basal area (*G*) of the stand is also calculated, along with the sum of normal cross-sections of all trees with breast diameters (Db) and their respective mean crown diameters (Dc) (arithmetic mean of the two perpendicular crown diameters measured), fitting a model Dc = f(Db), where the breast diameter is entered in cm and the crown diameter in metres.

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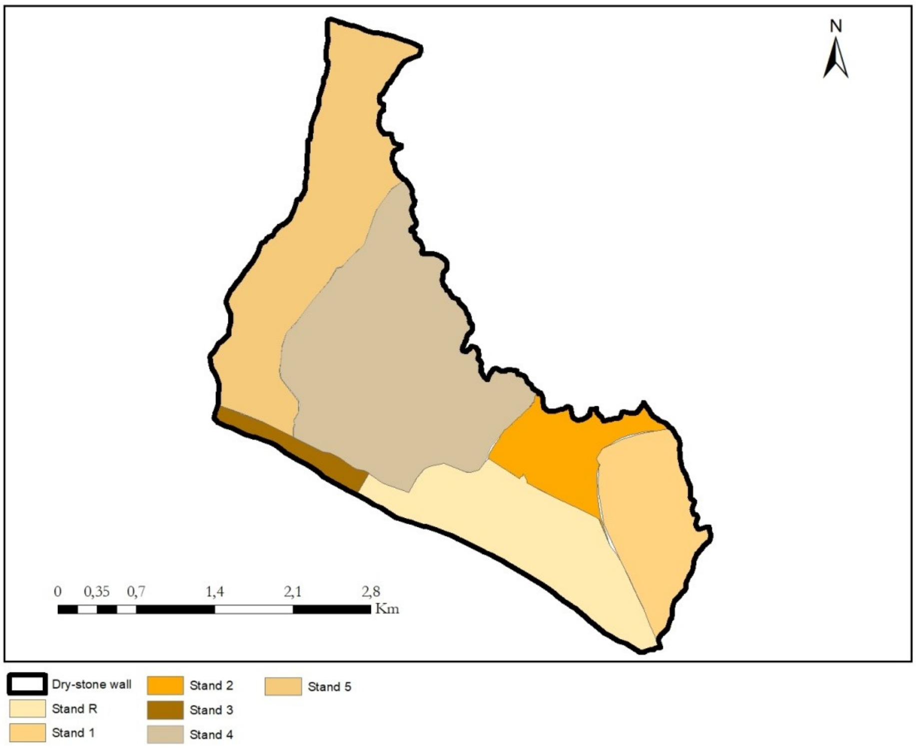

Figure S1. Division of Dehesa de la Luz into stands for scheduled future conservation forestry activities (2014).

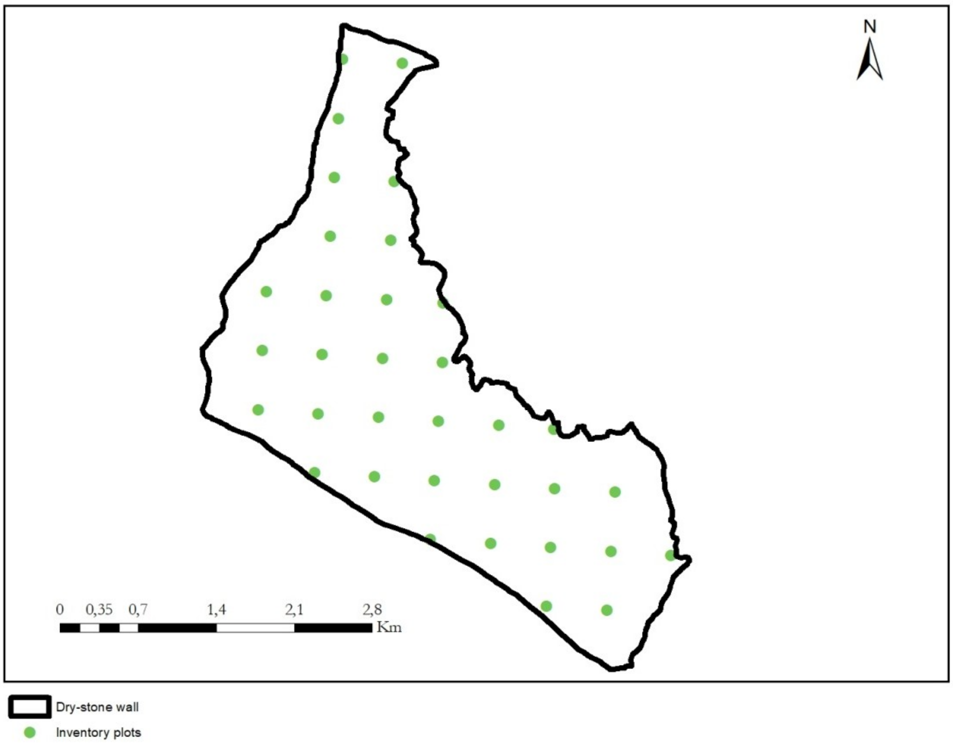

Figure S2. Distribution of the inventory plots for holm oaks originating from natural regeneration (2014).

Inventory of cork oaks from natural regeneration

The inventory of these trees involved carrying out a stem by stem count of all the adult cork oaks from natural regeneration dispersed throughout the estate (Figure S3). All the cork oaks were registered in the inventory, noting their location coordinates and recording various parameters such as circumference at breast height, crown diameter, height, phytosanitary condition, soil on which they are growing and the distance to the three nearest trees. For the purposes of the inventory analysis, of the 759 trees located, those which only consist of a trunk with no branches are discarded along with those on which the breast diameter cannot be measured due to inaccessibility and those with a diameter of less than 7.5 cm, leaving a total of 587 for the analysis.

Inventory of holm oaks and cork oaks originating from plantation

The existing plantation at the estate, established in 1993 over an area of 153 ha, included holm oaks and cork oaks in different proportions. No exact data are available regarding the proportions of trees initially planted although the initial density was 625 trees/ha. A total of twenty 400m transects (Figure S4) were established, distributed throughout the stand with 100 trees planted in each (planting design 4x4), not all of which are still there today.

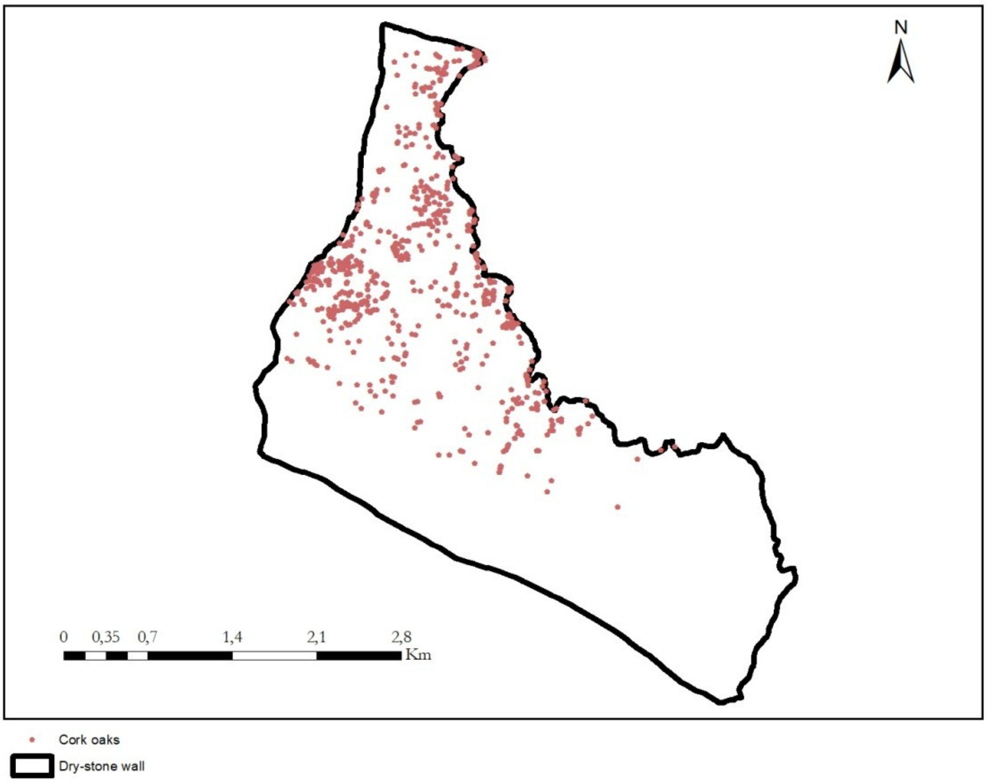

Figure S3. Location of the cork oaks from natural regeneration dispersed throughout the estate (2014).

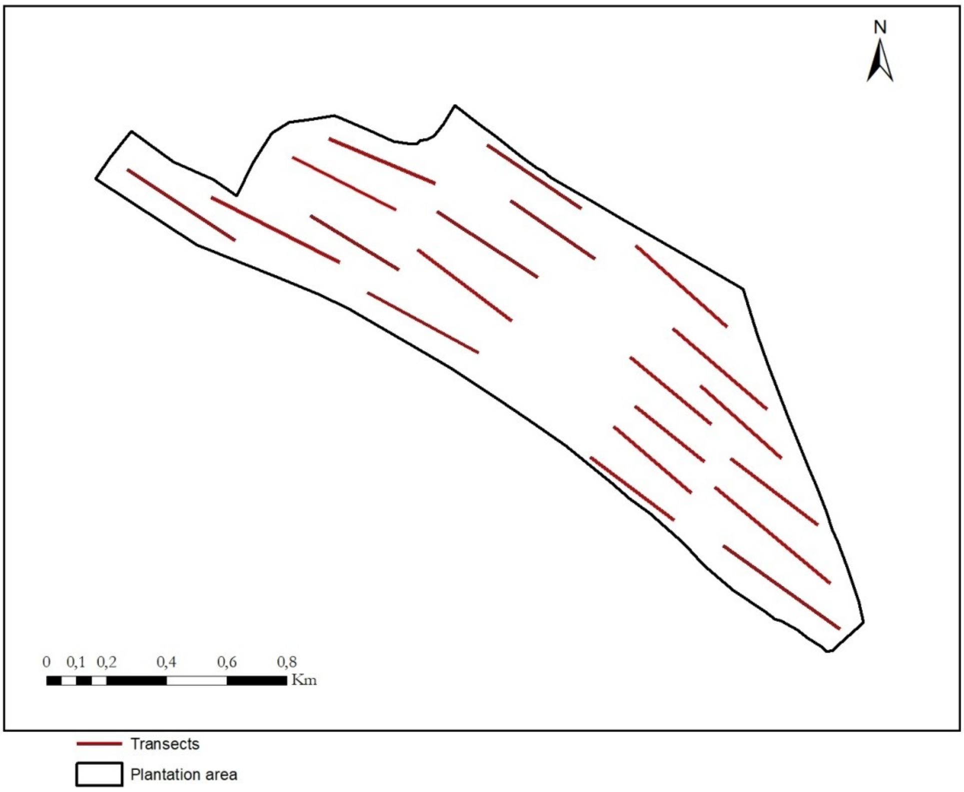

Figure S4. Distribution of the transects in the 1993 plantation area (2014).

Tree mortality calculation at Dehesa de la Luz

In order to model the future of the stand according to the silviculture applied to the different species and the stand in general, it is necessary to determine the evolution of the stand over recent years, in other words, to evaluate the mortality and the existence of natural regeneration. To determine mortality in Dehesa de la Luz, aerial photography is used to quantify the evolution of the woodland in the estate, comparing the years 1956, 1984 and 2010. Using PNOA orthophotos taken in the previously mentioned years, the trees are digitalized over the time period in 47 randomly distributed one hectare plots until the whole estate (approximately) is covered (Table S1). Subsequently, in the analysis of the silvicultural division into stands, the plots used for the mortality analysis are extracted from each stand and the mortality rates are taken for each zone respectively. In the plantation stand (Stand R) it was not possible to conduct a specific analysis due to the incorporation of young trees which complicate the analysis when GIS is used. Hence, the results from these specific stands were affected. In this case, the weighted mean of the adjacent stands was calculated.

Where the number of individuals in a stand were found to have increased, sampling was conducted *in-situ* to confirm the regeneration and where the situation was not clear, mortality was estimated as the weighted mean of the stand itself and the adjacent stands.

For the Dehesa de la Luz as a whole, it is estimated that 16.9% of the woodland has been lost over the last 54 years. This analysis complements the evaluation of density in each zone and the effect of past management

.

Table S1. Analysis of the mortality rate per stand at the estate between 1956 and 2010.

Plot number	Forest stand	Number of trees			Difference in number of trees		Increase or decrease	
		1956	1984	2010	Years 84-56	Years 2010-84	(%) 84-56	(%) 2010-84
1	1	30	28	27	-2	-1	-6.7	-3.6
2	1	24	21	23	-3	2	-12.5	9.5
3	1	32	32	31	0	-1	0.0	-3.1
4	1	15	19	16	4	-3	26.7	-15.8
5	1	23	18	14	-5	-4	-21.7	-22.2
6	1	30	27	28	-3	1	-10.0	3.7
7	2	26	20	17	-6	-3	-23.1	-15.0
8	2	19	14	12	-5	-2	-26.3	-14.3
9	2	22	17	11	-5	-6	-22.7	-35.3
10	2	9	8	8	-1	0	-11.1	0.0
11	2	23	21	15	-2	-6	-8.7	-28.6
12	2	31	20	17	-11	-3	-35.5	-15.0
13	2	15	13	10	-2	-3	-13.3	-23.1
14	R	14	10	33	-4	23	-28.6	230.0
15	R	18	16	62	-2	46	-11.1	287.5
16	R	30	20	69	-10	49	-33.3	245.0
17	R	25	24	64	-1	40	-4.0	166.7
18	R	31	19	26	-12	7	-38.7	36.8
19	R	17	14	51	-3	37	-17.6	264.3
20	5	22	17	18	-5	1	-22.7	5.9
21	3	31	36	27	5	-9	16.1	-25.0
22	5	26	20	28	-6	8	-23.1	40.0
23	3	21	19	22	-2	3	-9.5	15.8
24	5	50	45	50	-5	5	-10.0	11.1
25	3	49	31	36	-18	5	-36.7	16.1
26	3	29	27	28	-2	1	-6.9	3.7
27	5	44	25	33	-19	8	-43.2	32.0
28	4	64	50	50	-14	0	-21.9	0.0
29	4	44	29	35	-15	6	-34.1	20.7
30	5	20	16	17	-4	1	-20.0	6.3
31	5	43	36	31	-7	-5	-16.3	-13.9
32	5	31	38	33	7	-5	22.6	-13.2
33	5	34	43	30	9	-13	26.5	-30.2
34	5	40	29	28	-11	-1	-27.5	-3.4
35	5	36	36	36	0	0	0.0	0.0
36	5	42	30	39	-12	9	-28.6	30.0
37	4	31	38	36	7	-2	22.6	-5.3
38	4	28	29	37	1	8	3.6	27.6
39	5	38	47	60	9	13	23.7	27.7
40	4	39	34	40	-5	6	-12.8	17.6
41	4	48	45	46	-3	1	-6.3	2.2
42	4	52	46	48	-6	2	-11.5	4.3
43	5	21	22	19	1	-3	4.8	-13.6
44	5	20	29	20	9	-9	45.0	-31.0
45	5	37	39	31	2	-8	5.4	-20.5
46	4	63	55	54	-8	-1	-12.7	-1.8
47	4	34	50	35	16	-15	47.1	-30.0

The projected annual mortality in 10, 20 and 30 years' time is also shown, this information being necessary to calculate the dynamics of the trees under each of the proposed conservation forestry alternatives.

The results obtained for the plots in Stand 1 reveal a drop of 9% in the last 54 years, equivalent to 0.18% annually. The mortality rates over the coming years are estimated at 1.8%, 3.6% y 5.4% in 10, 20 and 30 years respectively.

In stand 2, mortality is higher than in the other stands. The results obtained point to a decrease of 38% in the last 54 years, equivalent to an annual fall of 0,76%. Estimated mortality rates in 10, 20 and 30 years are 7.6%, 14.6% and 22.8%, respectively.

The analysis of the plots located in Stand 3 reveals a decrease of 6% in the last 54 years, which is equivalent to an annual decline of 0.12%. The mortality rate in 10 years is estimated at 1.2%, in 20 years at 2.4 % and in 30 years at 3.6%:

The results for Stand 4 show a decrease of 6.5% in the last 54 years, which is an annual drop of 0.13%. The expected mortality rates in this stand in the next 10, 20 and 30 years are estimated at 1.3%, 2.6% and 3.9% respectively.

The first analysis obtained for the plots included in Stand 5 reveal an increase in the number of trees of 4.2%, which is due to this zone being the furthest from the town. However, *in-situ* checks through sampling in this zone confirm the absence of regeneration. Hence, the mortality rate was adjusted, giving a mortality of 2.16% in the last 54 years, which means an annual mortality of 0.04%. The specific mortality rates for the coming years in this stand are estimated at 0.4%, 0.9% and 1.3% in 10, 20 and 30 years respectively.

Mortality in Stand R, which corresponds to the 1993 plantation, is obtained as the weighted mean of the adjacent stands due to the difficulties described above. This gives a mortality rate of 12.2% in the last 54 years, which is an annual mortality rate of 0.24%. The estimated mortality rates for the next 10, 20 and 30 years are estimated at 2.4%, 4.8% and 7.8% respectively.

Holm oak growth models, pruning rotation and cycle

Holm oak growth model

Using the data gathered in the inventory conducted as a starting point, which allows us to determine the diameter distribution of the stand, along with the model by [23], which relates age to diameter, in order to calculate the volume (V) we first turn to the data from the second National Forest Inventory (NFI II) for the province of Cáceres [24]. The timber-yielding volume, with bark, (dm^3) of the mean tree per species, the volume measurement form[1] 4 and diameter class, conforms to the data gathered in the inventory carried out at Dehesa de la Luz. The model which relates volume with bark (V), in dm^3, to the breast diameter (Db), in cm, is given by the following formula:

$$V = 0.2571 \cdot (Db)^{1.8156} \qquad \text{(SE.73)}$$

To calculate the natural growth volume (ng) of the stand, the derivative of the volume function approach is used: ng = dv/dd·dd/dt, where dv/dd is the derivative of the volume with respect to the diameter and dd/dt is the derivative of the diameter with respect to

[1] Volume measurement form: Describes the form of the stem of the studied species, used to distinguish the volume models applied.

time. For this purpose, an individual tree volume equation is required like V = f(Db), previously estimated, as well as the age (Ae)-breast diameter (Db) curve, based on the model by [23]:

$$Db = \frac{(\ln(Ae+72.9875)-4.4433)}{0.0158} \qquad (SE.74)$$

Thus, applying the derivative of the volume function approach, natural growth volume can be estimated by the following expression:

$$ng = 29.5437 \cdot (Db)^{0.8156} \cdot \left(\frac{1}{Ae+72.9785}\right) \qquad (SE.75)$$

Holm oak cycle

From equation model (SE.75) it is possible to estimate the age of maturity or cycle of the species. In the case study, the holm oak is not a timber-yielding species, although it is necessary to determine tree volume and growth in order to estimate the cycle for the purposes of landscape conservation forestry. In this case study and for this species it is assumed that the end of the cycle is reached at the moment when the growth curve shows a tendency towards asymptotic curve. Thus, the natural growth curve in relation to volume is analysed. This analysis consists of estimating the point at which the line parallel to the linear trend is tangent to the curve which best fits the data obtained, in this case, power function. This operation allows us to determine the approximate age at which the growth variation shows a marginal tendency with respect to volume. From this age onwards, the overmature trees, which are no longer useful for firewood and which have uncertain stool or root sprouting capacity [56], are retained to promote biodiversity and cultural landscape.

Thus, the first step is to calculate the linear trend (SE.76) of the data series relating natural growth to volume. The equation is expressed as follows:

$$ng_{linear} = -0.0002 \cdot V + 1.930 \qquad (SE.76)$$

Next, the power equation is estimated. This equation allows us to obtain the natural growth according to the volume (with $R^2 = 0,99$):

$$ng_{power} = 2.905 \cdot V^{-0.084} \qquad (SE.77)$$

To identify the point of tangency between a line parallel to the linear trend and the natural growth curve according to volumes it is necessary to determine the slope of the former. This is done by finding the derivative of the equation (SE.76):

$$ng'_{linear} = -0.0002 \qquad (SE.78)$$

Once this has been done it is possible to estimate the point at which the aforementioned slope intersects the slope of the power equation which relates natural growth according to volume. This is done by deriving the power model (SE.77) and matching it to the slope obtained in the expression (SE.78):

$$ng'_{power}=\frac{-0.24402}{V^{1.084}} \quad (SE.79)$$

$$-0.0002=\frac{-0.24402}{V^{1.084}} \quad (SE.80)$$

Finding the variable V, the point of tangency between the line parallel to the linear trend of the data and the growth curve according to the volume is obtained and therefore it is possible to determine the maximum cycle, which will be the approximate age (Ae) at which this volume is reached. If the relationship between volume and age is applied, the holm oaks reach this volume when the cycle is around 225 years, thus establishing this age as the maximum cycle for the species.

Pruning rotation period for holm oak firewood

To estimate the rotation period for firewood extraction, the starting point is the model which relates the diameter to the weight of extracted firewood (based on extraction measurements from 30 holm oaks) (SE.81) and the function extracted from the NFI II data for the province of Caceres. To find the volume of firewood, a coefficient is estimated which relates wood volume from the NFI with the total holm oak firewood (V) calculated using expression (SE.73). Assuming that this relationship remains constant throughout the life of the tree, it is possible to estimate firewood natural growth by applying the coefficients obtained to the total firewood natural growth model (ng). The objective of this analysis is to determine the time needed to replace the quantity of firewood extracted. This time will be the rotation period between two consecutive extractions of firewood in the same area, assuming the quantities extracted and the current growth rates remain the same.

$$P_{firewood}=0.6661\cdot Db^{1.3314} \quad (SE.81)$$

In accordance with the annual firewood production estimated for trees originating from natural regeneration which are within the maximum cycle for the species (225 years) and bearing in mind the data for firewood growth obtained through the analysis, the pruning rotation is established at 41 years. To estimate the rotation period corresponding to the plantation trees, the evolution of the trees planted in Stand 2 in 2014 has been projected into the future in accordance with the mortality rate, and using the same procedure as before, the mean time period needed to replace the firewood between two consecutive extractions has been estimated, giving a pruning rotation length of 27 years. This 27 year rotation period will only be applied once the planted trees have completely replaced those originating from natural regeneration in order to assure that growth always exceeds extraction.

Development of full-cycle landscape conservation forestry

In each of the six stands (Figure S1), silvicultural management of different intensities and duration is applied which may involve only one type of silvicultural activity or several at the same time depending on the species or the origin (plantation or natural regeneration) of the trees in the stand.

The aim is to continue with the current management activities at the estate along with different soil and above-ground treatments spread over time and space. Plots with an area of approximately 20 ha comprise the silvicultural management units (Figure

S5), which are delimited using natural elements and infrastructures. The scheduling of the conservation silviculture is designed according to area, location, year of intervention and type of activity or treatment to be applied. A qualitative description is given below of the silvicultural techniques applied to the holm oaks and cork oaks in accordance with their physical and geographical characteristics as well as their production.

The general treatments applied to individual holm oaks in the estate from plantation to the end of their productive life are:

a) Preparation of the land: A backhoe is used to make a 60 x 60 cm hole for planting the trees.
b) Planting: Carried out manually using nursery plants. Suitable tools are used to cover the roots of the plant, which is supported with a guide post as well as protective elements.
c) Irrigation: Carried out using a water tanker with hose during the summer period.
d) Formative pruning: Performed on the youngest individuals to remove lower branches or shape the tree for adult development.
e) Replacing failed plants: Five years after initial planting, failed plants are replaced with new ones.
f) Production pruning: Elimination of productive branches for use as logs, in accordance with criteria aimed at assuring that the extraction is compatible with growth. A rotation period of 41 years is established for each of the areas with pruning interventions until the trees from natural regeneration have been completely replaced by the planted trees, at which point the rotation period will change to 27 years.

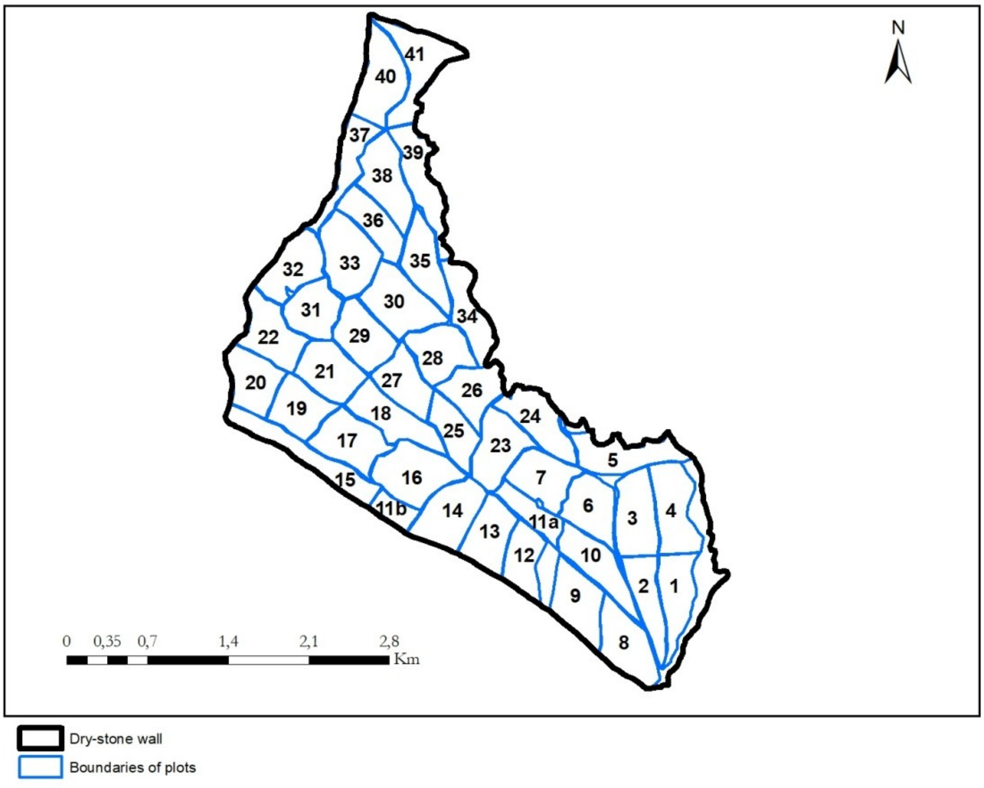

Figure S5. Plots established in the estate for future treatments and interventions.

The first three of these treatments correspond to tasks which form part of the densification plantation process, while the rest are performed subsequently over time. Once the stands and the general treatments have been defined (Figure S1), the specific characteristics of each of the stands dictate the scheduling of the landscape conservation silviculture to be applied. Thus, the silvicultural models are defined, differentiating the treatments in each stand according to the origin of the holm oaks present. In all cases, the mortality rate over the evolution of the each stand is considered. Common to all the stands is the employment of production pruning as the only intervention applied in the case of trees originating from natural regeneration. The first densifications are carried out with an interval of four years between stands in accordance with those undertaken in the estate in previous years and with the woodland in its present state. Intervention is considered to be more urgent in stands with higher mortality rates and poor phytosanitary state. It has also been established that the maximum area in which interventions are performed within the same year must not exceed that of the 2014 treatments in Stand 2 so as not to increase the annual cost in larger stands. The criterion adopted for future planting is that plantations will be performed when the overall density of the holm oaks falls below 34.5 stems/ha, which is considered the minimum acceptable, even in the case of young trees. Therefore, the time period between two densifications in the same plots will be linked to the specific mortality rate in each stand. Production pruning is scheduled according to the estimated rotation between two consecutive firewood extractions at the same point. A peculiarity of stand 1 is that there was a failed attempt at densification in 2010 and the replacement of these failed plants began in 2015. In Stand R, adult holm oaks from natural regeneration live alongside holm oaks planted in 1993. In the case of the latter, the assumed initial density is 165 stems/ha and modeling towards the future takes into account the specific mortality rate for this stand and the normal mortality rate for young growth during the first years established by [57].

The general treatments contemplated for the cork oaks in the estate are:

a) Regeneration felling: These are fellings carried out during the final years of cork production to promote the dispersion, protection and establishment of regeneration. This treatment is only applied to cork oaks in Stand R.
b) Selective felling (exceptional): Extraction using the single-tree selection system where trees are growing in clumps in order to improve the growth and productivity of planted trees. This treatment is only performed where it is deemed necessary.
c) Formative pruning: The first pruning treatment carried out on the youngest trees consists of eliminating the lower branches or shaping the tree for its adult development.
d) Debarking: This consists of cork removal by specialist workers. The cork is stripped in sheets by making specific incisions in the trunk of the cork oak.

In the case of this species, two silvicultural models are created according to the origin of the trees. One silvicultural schedule is used for the cork oaks from natural regeneration and another for those from the 1993 plantation. The adult cork oaks from natural regeneration are found distributed across different stands, with the exception of Stand R, and densifications with cork oaks are not contemplated. Stand R comprises the young cork oaks from the 1993 plantation. The silviculture proposed for the naturally regenerated cork oaks at Dehesa de la Luz consists of carrying out cork stripping (debarking) according to the set rotation period. As conservation pruning is not performed and there is no interest in the firewood from cork oaks in the estate, the scheduled silvicultural models do not contemplate pruning treatments, regeneration felling or any other treatments apart from debarking. The silviculture proposed for this species in Stand R is based on an initial stand density of 454 trees/ha. The normal mortality rate for young growth is taken into account during the first years [57] and from the current age onwards the actual mortality rate for the stand itself is applied. The treatments proposed from the current age onwards are debarking and regeneration felling at an age of 150 years, maintaining a density of 25 trees/ha, with delimitation of grazing zones and subsequent natural regeneration. Using this system a density of around 2.000 stems/ha is obtained, attaining full stand regeneration after 27 years [58].

SM 6. Forestry Valuation Modeling

Conservation forestry

Conservation forestry (CF) contributes commercial intermediate services (ISSc) which are valued according to the criteria given in the SM 5. At Dehesa de la Luz the CF net operating margin is null because the TCocf exceeds the CAC and the owner does not incur opportunity costs for manufactured investment in forestry.

The final product of actual investment in plantations, replacement of failed plants and densification (gross fixed capital formation: GFCFcf) is valued according to its production cost (TCicf). The total cost of investment in conservation forestry contracted to forestry service companies employing paid labour and intermediate consumption of services is registered. The amortization schedule is 25 years, starting from the year following the investment, incorporating the ordinary cost of consumption of fixed historical capital of the conservation forestry.

Firewood, cork and acorns

Firewood is separated into the production accounts of silviculture and pruning. In the case of silviculture, the residual standing value of the felled firewood is registered both as work in progress used up (WPuf) and as intermediate raw material (IRMf). The end products are the natural growth of the firewood (gross work in progress formation: GWPCFfcf) valued according to its residual standing price a year after the pruning, not counting the current accounting period, and the final sale price of the chopped firewood.

Cork is valued according to the same criteria as the firewood. The cork production account at Dehesa de la Luz for 2014 only registers natural growth (GWPCFc). The price applied to value the natural growth corresponds to the standing price of the raw reproduction cork and of the virgin cork, discounting that of this moment in time from that of the year in which the cork extraction is expected to take place. This price is obtained by updating stumpage price of the cork extracted in 2010. These prices are set according to the conditions established in the extraction records from 2010 and are updated in accordance with the consumer price index variation between 2010 and 2014.

The respective environmental capitals of firewood (ECf) and cork (ECc) are obtained from the discount of the expected infinite flow of resource income from firewood and cork. The environmental capital of the firewood and the cork includes ongoing production (WPf and WPc), that which is already produced (standing stock) and that which is expected to be produced over the course of the current rotation period. The fixed capital biological resources register the current net value of the firewood

(FCbrf) and the cork (FCbrc) which the inventoried holm oaks and cork oaks are expected to produce over the course of the current production cycle, after future extractions during the current rotation period, as well as in the remaining firewood and cork extraction rotations for standing holm oaks and cork oaks prior to reaching the maximum cycle for the species or loss through natural mortality. The land fixed capital for firewood (FClf) and cork (FClc) considers the current value of the expected firewood and cork productions respectively, in the infinite production cycles subsequent to the current one (Table S3).

The estimated production of intermediate acorn raw material (IRMa) is the only information registered in the production account as the manufactured costs of the holm oak and cork oak forestry are attributed to the intermediate production of conservation forestry services. The IRMA is also registered as a cost of intermediate self-consumption of livestock owner activity raw material (RMo).

The acorn price is estimated based on the price of the total forage units consumed by the livestock, and the quantity of acorns produced is calculated by applying the acorn production functions. It is assumed that all the estimated acorn production is consumed by the livestock since it was not possible to separate the acorns consumed by domestic livestock from those consumed by wild animals. It is assumed that the contribution of acorns to the diet of the different livestock species is proportional to the annual energy consumption per species from grazing. The price applied to the acorn forage units consumed is the same as that applied for the consumption by livestock of grass forage units.

The environmental capital of the acorns varies with the evolution of the naturally regenerated woodland and the plantation. The environmental capital of the acorns from the current production cycle (FCbra) is estimated by discounting the net environmental margin of acorns usable for livestock grazing annually in the current production cycle of the holm oak and cork oak, considering the acorn production models described above. Discounting the net environmental margin from successive cycles allows us to obtain the fixed capital (land) for acorns. (FCla) (Table S3).

In the case of Dehesa de la Luz it is considered that the main reason for the silvicultural treatments applied is to promote the conservation of the holm oaks and cork oaks. The development of the physical measurements and the valuations of the different products, costs and components of the income from firewood, cork and acorns is described in detail in [19].

Grazing

The grazing forage units (acorn and grass) consumed by the livestock are estimated as a residual value, based on the net leasehold fee paid by the family livestock owners, of the cost of infrastructure services used in livestock farming activities. The intermediate raw material of grazing is the product of the forage units grazed by the estimated unit price. The only cost attributed to grazing is the soil ploughing performed by family livestock owners as payment in kind (Figure S6).

Figure S6. Soil ploughing to mitigate soil compaction and favour runoff water filtration. Photograph: Daniel González.

The landowner does not incur grazing production capital use cost and therefore the net operating margin coincides with the net environmental margin.

The quantity of forage units consumed in livestock grazing is estimated according to the resulting balance of total forage units consumed less the forage units contained in the supplementary foodstuff provided to the livestock over the year [31]. The total forage units are calculated by modeling the total energy requirements of the livestock in Dehesa de la Luz in 2014 [18, 22, 31]. Forage unit price (which is equivalent in metabolisable energy content to a kilogram of barley) is estimated based on the cost of grazing leasehold paid by the family-scale livestock owners and the consumption of grazing forage units by their livestock in Dehesa de la Luz in 2014 [22]. The residual price of the grazing is estimated based on the leasehold fee, from which we subtract the part which corresponds to the commercial intermediate services of livestock management infrastructures and feeding troughs. Hence, to calculate the unit price of grazing forage, the adjusted leasehold fee is divided by the estimated consumption of forage units in 2014 per livestock species belonging to the family-scale leasehold owners. This forage unit price obtained for the livestock belonging to the leasehold owners is also applied to the livestock grazing consumption of livestock belonging to the landowner [22, 31]. The environmental price of the grazing (Pg_{FU}) is estimated residually based on the livestock leasehold fee (LFg) paid by the livestock owners to the landowner in return for the consumption of grazing (RMog), stored water (SSow) and livestock management infrastructures used (SSoi) along with the cost of intermediate consumption of soil ploughing service (SScp):

$$LFg = RMog + SSow + SSoi + SScp \quad \text{(SE.82)}$$

$$Pg_{FU} = (LFg - RMog - SSow - SSoi - SScp)/FU_g \quad (SE.83)$$

Where FU_g represents the quantity of forage units extracted through grazing in 2014 [22].

The fixed environmental capital of grazing (FClg) is estimated discounting the expected value of future income flows from this resource. In Dehesa de la Luz it is assumed that the environmental capital value of grazing remains constant.

SM 7. Dehesa De la Luz Forestry Economy

The intermediate products of the raw materials of cork, firewood and grazing (acorns, grass and browse) consumed represent their standing stumpage values. The first two come from the utilized ongoing productions since cork extraction did not take place in 2014. The firewood hardly contributes any standing value, although at Dehesa de la Luz there is a negligible value of the felled dead holm oaks (Table S2). The raw material from pruning is an instrumental record which represents the value of the felled, unchopped firewood on the ground which is bought by family-scale loggers who are the final purchasers of the firewood.

The intermediate product of conservation forestry services (CF) is 76% of the raw material of the grazing (Table S2). The firewood makes up less than 8% of the intermediate product (Table S2). Grazing does not provide end products since all the production is re-employed as intermediate self-consumed cost of livestock farming activity. The end product of CF represents 73% of the total end product of the forestry activity (Table S2). The most important single end product of CF in 2014 was the holm oak densification (recorded as manufactured gross fixed capital formation). The product which contributes least to the total value of the end products is the natural growth of cork as a consequence of the small number of adult cork oaks and the young age of the 1993 plantation trees.

Sixty eight percent of the total cost of forestry activity corresponds to intermediate consumption, 25% to labour and 7% to the consumption of fixed capital (Table S2). CF makes up more than two thirds of the total cost. The consumption of fixed capital of forestry activity corresponds to that recorded for plantations and historical forestry improvements.

Forty nine percent of the net value added of forestry activity is destined to pay labour services and the remaining 51% corresponds to the net forestry operating margin, which in Dehesa de la Luz is all environmental as the landowner incurs no investment in manufactured immobilised capital (Table S2).

The environmental net operating margins of cork and firewood are estimated according to natural growth. The environmental net operating margin of grazing is estimated as the total residual value of the product less the total cost, since there is no manufactured margin. The net margin of the conservation forestry is null as the products have not been valued at production cost. Grazing makes up 47% of the net value added and 91% of the net operating margin of the forestry activity. Firewood and conservation forestry contribute similar net value added and labour. Employee labour and self-employed labour also have similar values (Table S2).

Table S2. Forestry production account in Dehesa de la Luz (2014: €/ha).

Class	Cork	Firewood			Grazing			Conservation forestry	Forestry
		Selviculture	Prunning	Total	Grass and browse	Acorn	Total		
	1.1	1.2.1	1.2.2	1.2 = 1.2.1 + 1.2.2	1.3.1	1.3.2	1.3 = 1.3.1 + 1.3.2	1.4	1 = ∑1.1 a 1.4
1. Total product (TP)	2	1	21	22	25	4	29	75	128
1.1 Intermediate product (IP)		1	4	4	25	4	29	22	56
Intermediate raw materials (IRM)		1	4	4	25	4	29		34
Intermediate services (ISS)								22	22
Commercial (ISSc)								*22*	*22*
Non-commercial (ISSnc)								*1*	*1*
Compensated (ISSncc)									
Donated (ISSncd)								*1*	*1*
1.2 Final product (FP)	2	0	17	17				52	72
Sales (FPs)			17	17					17
Gross fixed capital formation (GFCF)								52	52
Gross work in progress formation (GWCPF)	2	0		0					2
2. Total cost (TC)		1	21	21	5		5	75	101
2.1. Intermediate consumption (IC)		1	8	9	5		5	55	69
Raw materials (RM)			7	7				28	35
Bought (RMb)			*3*	*3*				*28*	*31*
Own (RMo)			*4*	*4*					*4*
Services (SS)			1	1	5		5	27	33
Bought (SSb)			*1*	*1*	*5*		*5*	*26*	*33*
Own (SSo)								*0*	*0*
Work in progress used (WPu)		1		1					1
2.2 Labor cost (LC)			13	13				12	25
Employees (LCe)								12	12
Self-employed (LCse)			13	13					13
2.3 Consumption of fixed capital (CFC)								7	7
3. Net operating margin (NOM)	2	0		0	20	4	24	0	27
4. Gross valued added (GVA)	2	0	13	13	20	4	24	20	59
5. Net valued added (NVA)	2	0	13	13	20	4	24	12	52

The value of forest environmental assets at Dehesa de la Luz is an aggregated value including ongoing productions, land and biological forest resources, contributing 95% of the opening capital of the forestry activity (Table S3). Firewood and cork opening work in progress account for 2% of the opening capital. 46% of the value of ongoing productions corresponds to expected cork production over the current rotation period and the other 14% to firewood production (Table S3). The value of the opening land capital is estimated to be 46% of the opening capital. Grazing accounts for 97% of the land capital (Table S3). The remaining 3% corresponds to cork and firewood. The biological resource fixed capital represents 48% of the opening capital. Cork accounts for 74% of the biological resource fixed capital. The manufactured capital of plantations contributes 5% of the remaining opening capital.

The revaluation of the forestry activity capital during the study period was positive, accounting for less than 1% of the opening capital (Table S3). The main revaluation of biological resource fixed capital is due to future natural growth increments of cork beyond the current rotation period. The fixed manufactured capital of the plantations depreciates significantly (negative revaluation) as a consequence of the falling cost of replacement of the amortization of the plantations during 2014. The value of the outgoings for capital reclassifications corresponds to the natural growth of firewood and cork over the year, at prices of 1st January 2014. Other outgoings recorded in the capital balance account correspond to stored dead firewood in the biological resources, which is extracted during the study year. Hence, these outgoings account for 5% of the total for the year. Utilized ongoing productions of firewood, corresponding to the extractions which take place over the study year, account for 18% of the value of the capital outgoings.

The capital gain is due, on the one hand, to natural growth (effect of the discount in ongoing productions of firewood, cork and acorns) and on the other, to the adjustment in consumption of fixed capital of plantations in order to avoid double accounting and to record the variation in the cost price of replacing the amortization of the plantations. Conservation forestry contributes the least, while cork accounts for the highest contribution in Dehesa de la Luz in 2014 (Table S2). The input from ongoing productions corresponds to the growth of firewood and cork during the year. The input from cork growth accounts for 88% of the total input from ongoing productions. Dead firewood extraction from the biological resources also contributes 148€. Inputs from ongoing productions account for 5% of the value of the capital inputs while the remaining 95% come from the densification carried out in 2014. The total income of the landowner from forestry activity mainly comes from grazing, which contributes 43%. The next largest contributor is cork (27%), and then firewood (21%) (Table S4).

Conservation forestry accounts for around 9% of the total forestry activity income of the landowner. Almost all the forest environmental income comes from grazing (61%) and from cork (39%), with that from firewood being only a small quantity. Private conservation forestry of the landowner only produces manufactured capital income, which is negative (Table S4).

For each of the individual products and for the forestry activity overall, the estimates of current profitability for the accounting period reflect social price as intermediate non-commercial services have been included in this application of the extended accounts.

Table S3. Capital account of forestry activity in Dehesa de la Luz (2014: €/ha).

Class	1. Opening capital	2. Entries				3. Withdrawals						4. Revaluation	5. Closing capital
		2.1 Bought	2.2 Own	2.3 Other	2.4 Total	3.1 Used	3.2 Sales	3.3. Destructions	3.4 Reclassifications	3.5 Others	3.6 Total		
	(Co)	(Ceb)	(Ceo)	(Ceot)	(Ce)	(Cwu)	(Cws)	(Cwd)	(Cwrc)	(Cwo)	(Cs)	(Cr)	(Cc)
1. Capital (C=WP+FC)	1472		55		55	1			2	0	3	5	1528
2. Working in progress (WP)	30		3		3	1			2		3	1	30
Cork (WPc)	23		2		2				2		2	1	24
Firewood (WPf)	7		0		0	1			0		1	0	6
2.1 Produced (WPP)	14		3		3	1					1	0	16
Cork (WPPc)	10		2		2							0	12
Firewood (WPPf)	4		0		0	1					1	0	4
2.2 Expected (WPE)	16								2		2	0	14
Cork (WPEc)	14								2		2	0	12
Firewood (WPEf)	3								0		0	0	2
3. Fixed apital (FC)	1442		52		52					0	0	4	1498
3.1 Land (FCl)	663											1	664
Cork (FClc)	*22*											*1*	*23*
Firewood (FClf)	*1*											*0*	*1*
Grass (FClg)	*622*												*622*
Acorn (FCla)	*18*											*1*	*19*
3.2 Biological resources (FCbr)	703									0	0	17	719
Cork (FCbrc)	528											16	544
Firewood (FCbrf)	6									0	0	0	6
Acorn (FCbra)	168											1	169
3.3 Plantations (FCp)	76		52		52							-14	114

Table S4. Total income of forestry activity in Dehesa de la Luz (2014: €/ha).

Class	Cork	Firewood			Grazing			Conservation forestry	Forestry
		Selviculture	Prunning	Total	Grass and browse	Acorns	Total		
	1.1	1.2.1	1.2.2	1.2 =1.2.1 + 1.2.2	1.3.1	1.3.2	1.3 = 1.3.1 + 1.3.2	1.4	1 = ∑ 1.1 a 1.4
1. Total product consumption (TPc)		1	21	21	25	4	29	22	73
2. Intermediate consumption (IC)		1	8	9	5		5	55	69
3. Net consumption (NC) (1 – 2)		0	13	13	20	4	24	-33	4
4. Gross capital formation (GCF)	2	0		0				52	55
5. Total product (TP) (1 + 4)	2	1	21	22	25	4	29	75	128
6. Consumption of fixed capital (CFC)								7	7
7. Net capital formation (NCF) (4 – 6)	2	0		0				45	48
8. Labor cost (LC)			13	13				12	25
9. Total cost (TC) (2 + 6 + 8)		1	21	21	5		5	75	101
10. Gross value added (GVA) (5 – 2)	2	0	13	13	20	4	24	20	59
11. Net value added (NVA) (3 + 7)	2	0	13	13	20	4	24	12	52
12. Net operating margin (NOM) (5 – 9)	2	0		0	20	4	24		27
13. Capital gain (CG)	15	0		0		2	2	-7	10
14. Change of net worth (CNW) (7 + 13)	17	0		0		2	2	38	57
15. Capital income(CI)	17	0		0	20	5	26	-7	36
16. Environmental (EI)	17	0		0	20	5	26		43
17. Manufactured (CIm)								-7	-7
18. Total income (TI) (11 + 13 = 3 + 14 = 8 + 15)	17	0	13	13	20	5	26	5	62

At Dehesa de la Luz in 2014, grazing accounts for more than 50% of the immobilised capital of forestry activity (Table S5). Grass and browse make up 77% of this and acorns 23% of the immobilised capital. It should be noted that in accordance with the accounting conventions adopted in this study, conservation forestry is the only product of private forestry activity in which opening manufactured capital is employed, accounting for 5% of the total immobilised capital. Taken together, all the products of forestry activity presenting environmental capital make up 93% of the total immobilised capital, with grass (and browse with just a nominal contribution) along with cork comprising 99% of the total environmental capital and 92% of the immobilised capital of the forestry activity. In contrast, the combined value of circulating capital of all the activities is less than 3% of all the immobilised capital of the forestry activity.

The rates of profitability as a whole are estimated for grazing, firewood, cork and conservation forestry. The estimated current rate of profitability for the landowner's private forestry activity is 2.4%. Conservation forestry presents a rate of -6.4% based on the cost of replacement of the plantations at la Dehesa de la Luz. Similarly, firewood is affected by the pruning or chopping activity which, despite having a null net margin, does have associated circulating capital due to the fact that the unpaid labour employed does not reach the maximum hourly remuneration of 80% of that for paid labour.

Table S5. Immobilized capital of forestry activity in Dehesa de la Luz (2014: €/ha).

Class	Opening environmental asset			Opening manufactured capital	Working capital	Immobilized capital
	Work in progress	Fixed capital	Total			
	WP	FC	EC_O	MC_O	WC	IC
	1.1	1.2	1 = 1.1 + 1.2	2	3	4= 1 + 2 + 3
1. Cork	23	551	574			574
2. Firewood	7	7	13		0	13
Selviculture	7	7	13			13
Prunning					0	0
3. Grazing		809	809		3	811
Grass and browse		622	622		3	625
Acorns		187	187			187
4. Conservation forestry				76	34	109
Total forestry	30	1366	1396	76	36	1508

SM 8. Livestock Valuation

The livestock activity embraces the livestock belonging to the family leasehold owners as well as that belonging to the public landowner (Table S6). The total product of the livestock (TPl) is classified into the non-commercial intermediate services (ISSncl) and final product (FPl). Livestock farming generates non-commercial intermediate services which it is assumed are consumed by the public activities of conservation of dehesa landscape, threatened biodiversity and private amenity.

The price of livestock sales (FPsl), raw material purchase, services contracted and labour cost are obtained according to the quantity of the product by its declared price, contrasted with the market price (Table S7 and Figure S7).

Own gross fixed capital formation (GFCFl) is estimated taking into account the number of animals which become reproductive during the year and the market price of adult breeding livestock (Agriculture and livestock market of Extremadura, 2014) at the closing of the accounting period.

Table S6. Livestock inventory (2014).

Class	Quantity (LU[(1)])	Price (€/LU)	Value (€)
1. Family livestock owners	409	903	369,084
1.1 Bovine	400	903	360,807
1.2 Equine	9	890	8277
2. Landowner	113	573	64,749
2.1 Ovine	92	470	43,180
Merina precoz	*84*	*455*	*38,264*
Merina negra	*8*	*635*	*4916*
2.2 Bovine	10	1013	10,322
2.3 Equine	11	1026	11,248
3. Total	522	831	433,833
3.1 Ovine	92	470	43,180
Merina precoz	*84*	*455*	*38,264*
Merina negra	*8*	*635*	*4916*
3.2 Bovine	410	906	371,129
3.3 Equine	20	964	19,525

Note: [(1)]Livestock unit (LU) estimated as a coefficient on the annual energy requirements of an empty retinta cow in normal sanitary condition and with a live weight of 450 kg [55]. One LU equals an annual requirement of 5,171.32 Mcal of metabolizable energy.

Table S7. Livestock heads birth and sales in *Dehesa* de la Luz (2014).

Class	Unit (u)	Quantity (u)	Price (€/u)	Value (€)
Family livestock owners				
Bovine				
Calves birth	*breeding per RF [(1)]*	*0.7*	*413.1*	*291.9*
Calves sales	*breeding per RF*	*0.5*	*457.0*	*223.5*
Ageing (breeders)	*heads per RF*	*0.0*	*540.0*	*5.9*
Equine				
Foals births	*breeding per RF[)]*	0.8	633.4	475.0
Foals sales	*breeding per RF*			
Landowner				
Rambouillet Merina				
Lamb birth	*breeding per RF*	*0.7*	*62.1*	*44.9*
Lamb sales	*breeding per RF*	*0.3*	*62.1*	*18.7*
Black Merina				
Lamb birth	*breeding per RF*	*0.8*	*62.1*	*48.6*
Lamb sales	*breeding per RF*	*0.3*	*62.1*	*16.8*
Bovine				
Calves birth	*breeding per RF*	*0.9*	*618.8*	*530.4*
Calves sales	*breeding per RF*	*0.7*	*618.8*	*442.0*
Equine				
Foals birth	*breeding per RF*	*0.3*	*450.0*	*135.0*
Foals sales	*breeding per RF*	*0.1*	*450.0*	*45.0*

The gross work in progress formation (GWPCFl) is the value of non breeding animals, recording the value of offspring at the closing of the year, taking into consideration the number of heads and the price of livestock for slaughter as published in the price tables (Agriculture and livestock market of Extremadura, 2014). The utilised ongoing production (WPul) refers to non-breeding livestock utilized during the production process at the start of the accounting period, such as offspring. These animals are valued in a similar way to the non-breeding livestock, considering the existing sale price at the start of the year for each livestock [32].

Figure S7. Threatened Cordobés donkey rearing in Dehesa de la Luz. Photograph: Daniel González.

The livestock farming activity undertaken by the family-scale leasehold owners uses unpaid labour (LCse) which generates a mixed operating income (MOI) for these owners and is estimated as a residual value [18]. It is assumed that a family-scale livestock owner can accept a lower income per working hour than a paid worker since they have "free" time at their disposal which would not be used for another activity and they also benefit from payment in kind which we term self-consumption of private amenity [22, 31] (see detailed description of the residual estimate of unpaid labour in [4, 16, 32].

The total cost of the livestock activity is classified as intermediate consumption of raw materials (IRM), services (SSl), utilized ongoing production (WPul) and labour (LCl) (Table S8).

In this case, the consumption of infrastructure fixed capital is not specified as it is embedded in the cost of livestock farming services originating in the intermediate services produced by the infrastructures used in livestock farming and the cost of family-scale livestock farmer services purchased (Figure S8).

The consumption of water and livestock infrastructure services is valued according to the maintenance costs, amortization and imputed normal income of 3% from the manufactured investment. The consumption is distributed according to the ovine livestock units (OLU) of each livestock species. Grazing consumption is calculated as the difference between the leasehold fee and the consumption of water and infrastructure services.

Table S8. Livestock production account in Dehesa de la Luz (2014: €/ha).

Class	Family livestock owners			Landowner						Livestock
	Bovine	Equine	Total	Ovine			Bovine	Equine	Total	
				Merina precoz	Merina negra	Total				
	1.1.1	1.1.2	1.1 = 1.1.1 + 1.1.2	1.2.1.1	1.2.1.2	1.2.1 = 1.2.1.1 + 1.2.1.2	1.2.2	1.2.3	1.2 = ∑ 1.2.1 a 1.2.3	1 = 1.1 + 1.2
1. Total product (TP)	233	5	238	39	7	46	10	6	62	300
1.1 Intermediate product (IP)	32	0	32	14	3	17	6	2	25	57
Intermediate raw materials (IRM)										
Intermediate services (ISS)	32	0	32	14	3	17	6	2	25	57
Commercial (ISSc)										
Non-commercial (ISSnc)	*32*	*0*	*32*	*14*	*3*	*17*	*6*	*2*	*25*	*57*
Compensated (ISSncc)	*14*		*14*	*14*	*1*	*16*	*2*	*2*	*19*	*34*
Donated (ISSncd)					*1*	*1*	*4*		*5*	*5*
Amenity (ISSnca)	*17*	*0*	*18*							*18*
1.2 Final product (FP)	201	5	206	25	4	29	4	4	38	244
Sales (FPs)	63		63	7	1	7	3	0	11	74
Gross fixed capital formation (GFCF)	19		19	7	2	8			8	28
Gross work in progress formation (GWCPF)	118	5	123	12	2	13	1	4	18	142
2. Total cost (TC)	228	5	234	38	5	43	8	7	58	292
2.1. Intermediate consumption (IC)	215	5	220	27	4	31	4	6	41	260
Raw materials (RM)	83	3	86	9	1	10	2	2	14	100
Bought (RMb)	*45*	*1*	*46*	*4*	*0*	*4*	*2*	*0*	*6*	*52*
Own (RMo)	*38*	*2*	*40*	*5*	*1*	*6*	*1*	*2*	*8*	*48*
Grazing	*25*	*2*	*27*	*1*	*0*	*1*		*1*	*2*	*29*
Water	*13*	*0*	*13*	*4*	*0*	*5*	*1*	*1*	*6*	*19*
Services (SS)	17	1	18	8	1	9	1	1	11	30
Bought (SSb)	*5*	*1*	*5*	*3*	*0*	*3*	*1*	*0*	*4*	*10*
Own (SSo)	*13*	*0*	*13*	*6*	*1*	*6*	*0*	*0*	*7*	*20*
Work in progress used (WPu)	114	1	115	10	2	12	1	3	16	131
2.2 Labor cost (LC)	14	0	14	11	1	12	4	1	18	31
Employees (LCe)				11	1	12	4	1	18	18
Self-employed (LCse)	14	0	14							14
2.3 Consumption of fixed capital (CFC)										
3. Net operating margin (NOM)	4	0	4	1	2	3	2	0	4	8
4. Gross valued added (GVA)	18	0	18	12	3	15	6	1	22	40
5. Net valued added (NVA)	18	0	18	12	3	15	6	1	22	40

Figure S8. Stone shepherds' hut at Dehesa de la Luz. Photograph: Daniel Gónzalez.

In the case of the landowner, the price of the leasehold fee of grazing forage paid by the family livestock owners is assumed. Own intermediate consumption of these grazing forage units and water raw materials (RMo) and infrastructure services (SSo) are balanced by their intermediate products of grazing forage units and water raw materials and infrastructure services.

The capital stock of livestock (Cl) is classified into work in progress (WPl) and fixed capital of biological resources (Crl). The opening capital value of the non-breeding livestock inventory (WPnb) coincides with the value of the outgoings of utilised ongoing production (WPul) during the year. The inputs of the ongoing production coincide with the final value of the non-breeding livestock production; therefore no capital revaluations are registered. The opening fixed capital of biological resources (FCbrb) includes the breeding livestock and is valued according to the prices observed at the Agriculture and livestock market of Extremadura at the start of the period, since it is assumed that the main function is to obtain new offspring, and they are contrasted with the sales and purchase records from the estate itself. Deaths of breeding livestock are valued according to the same criteria. The equine livestock is valued by checking prices in internet (market prices are not available in this case), taking the average value from a minimum of three price searches per breed. The closing value is estimated based on the physical inventory, taking into account the market prices along with sales and purchase records, at the closing of the accounting period.

SM 9. Extended data tables and figures

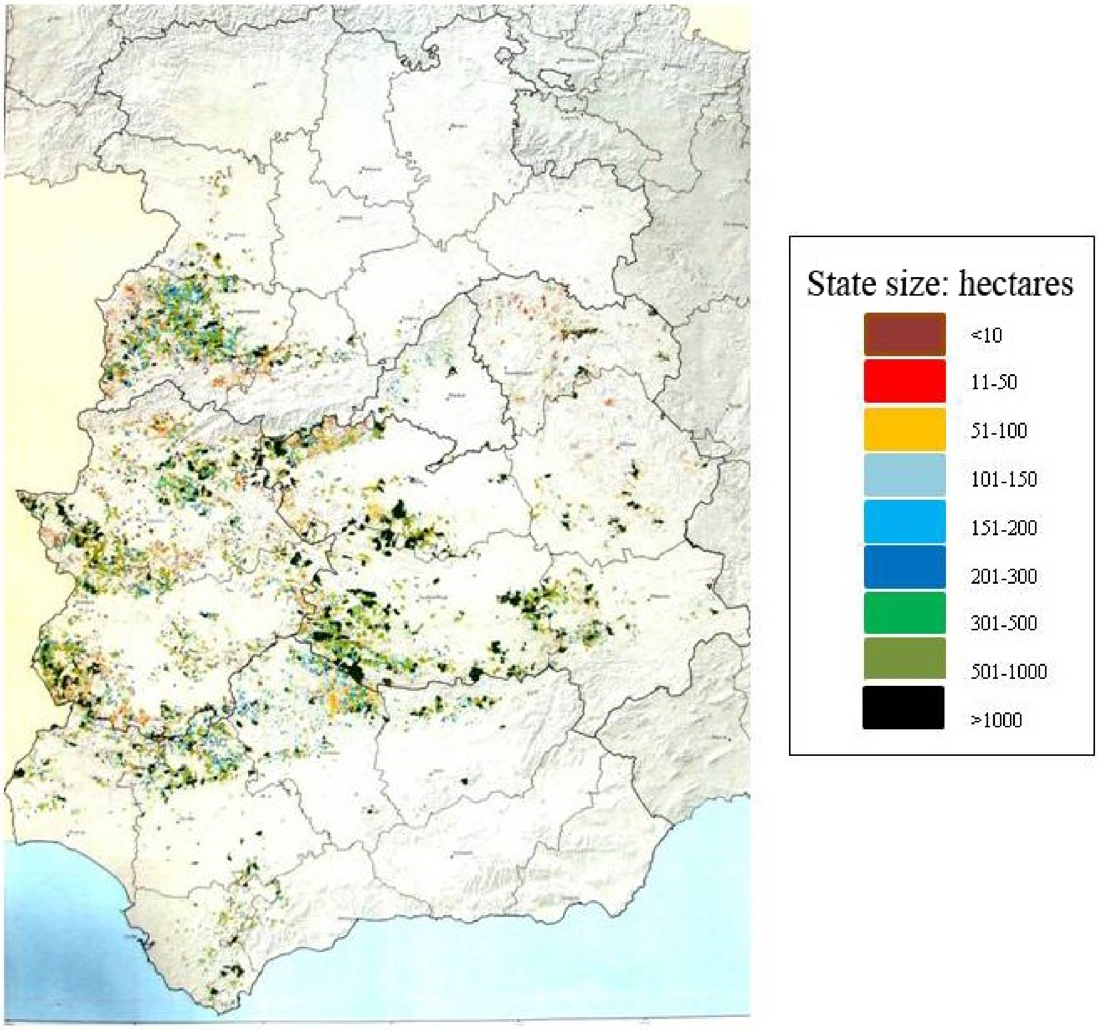

Figure S9. Dehesa estate classification map according to surface area in the five autonomous communities in West and Central Spain. Source: Adapted from Reference [8] (Map 4, p. 22).

Figure S10. Visigothic tombs at Dehesa de la Luz. Photograph: Daniel Gónzalez.

Figure S11. 'Pozo de las Matanzas' where people celebrate the late medieval Muslim and Cristian war legend. Photograph: Daniel Gónzalez.

Figure S12: Ermita de la Luz sanctuary at Dehesa de la Luz. Photography: Daniel Gónzalez.

Table S9. Holm oak and cork oak carbon uptake in Dehesa de la Luz (2014).

Class	Quantity ($t\ CO_2$)	Price (€/$t\ CO_2$)	Value (€)
Carbon fixation	426.0	6.0	2538.9
Holm oaks	*335.7*	*6.0*	*2000.5*
Cork oaks	*90.3*	*6.0*	*538.4*
Carbon emission	380.4	6.0	2267.2
Holm oaks	*353.4*	*6.0*	*2106.3*
Cork oaks	*27.0*	*6.0*	*160.9*
Carbon net fixation	45.6	6.0	271.7
Holm oaks	*-17.8*	*6.0*	*-105.8*
Cork oaks	*63.3*	*6.0*	*377.5*

Table S10. Services production account for Dehesa de la Luz (2014: €/ha).

Class	Fencing 1.1	Installations 1.2	Paths 1.3	Services 1 = ∑ 1.1 a 1.4
1. Total product (TP)	161	9	15	185
1.1 Intermediate product (IP)	75	9	15	99
Intermediate raw materials (IRM)				
Intermediate services (ISS)	75	9	15	99
Commercial (ISSc)	11	9		20
Non-commercial (ISSnc)	*64*		*15*	*79*
Compensated (ISSncc)				
Donated (ISSncd)	*64*		*15*	*79*
1.2 Final product (FP)	86			86
Sales (FPs)				
Gross fixed capital formation (GFCF)	86			86
Gross work in progress formation (GWPCF)				
2. Total cost (TC)	102	5		107
2.1. Intermediate consumption (IC)	86			86
Raw materials (RM)				
Bought (RMb)				
Own (RMo)				
Services (SS)	86			86
Bought (SSb)	*86*			*86*
Own (SSo)				
Work in progress used (WPu)				
2.2 Labor cost (LC)				
Employees (LCe)				
Self-employed (LCse)				
2.3 Consumption of fixed capital (CFC)	15	5		20
3. Net operating margin (NOM)	59	4	15	79
4. Gross valued added (GVA)	75	9	15	99
5. Net valued added (NVA)	59	4	15	79

Table S11. Fencing and construction infrastructures capital balance account for Dehesa de la Luz (2014: €/ha).

Class	1. Opening capital (Co)	2. Capital entries				3. Capital withdrawals						4. Revaluation (Cr)	5. Closing capital (Cc)
		2.1 Bought (Ceb)	2.2 Own (Ceo)	2.3 Other (Ceot)	2.4 Total (Ce)	3.1 Used (Cwu)	3.2 Sales (Cws)	3.3. Destructions (Cwd)	3.4 Reclassifications (Cwrc)	3.5 Other (Cwo)	3.6 Total (Cw)		
1. Capital (C=WP+FC)	2578		86		86	0	0	0	0	0	0	-26	2639
2. Work in progress (WP)													
3. Fixed capital (FC)	2578		86		86							-26	2639
3.1 Infraestructure (FCco)	2578		86		86							-26	2639
Sheds	102											-1	101
Fencing	215											-2	213
Bridges	160											-2	158
Footpaths	340											-3	337
Dry-stone wall	1721		86		86							-17	1790
Firewall	10											0	10
Tanks	8											0	8
Others	22											0	22

Table S12. Private capital income at producer's price, basic price and social price in Dehesa de la Luz (2014: €/ha).

Class	Forestry 1	Water 2	Livestock 3	Services 4	Amenity 5	Private 6 = Σ 1 a 5
Producer's prices						
Net operating margin	26	15	-48	0		-7
Environmental	27					27
Manufactured	-1	15	-48	0		-34
Capital gain	10	-1	7	-5	-20	-11
Environmental	17				-20	-4
Manufactured	-7	-1	7	-5		-7
Capital income	36	14	-42	-5	-20	-18
Environmental	43				-20	23
Manufactured	-7	14	-42	-5		-41
Basic prices						
Net operating margin	26	15	-15	0		26
Environmental	27					27
Manufactured	-1	15	-15	0		0
Capital gain	10	-1	7	-5	-20	-11
Environmental	17				-20	-4
Manufactured	-7	-1	7	-5		-7
Capital income	36	14	-8	-5	-20	16
Environmental	43				-20	23
Manufactured	-7	14	-8	-5		-7
Social price						
Net operating margin	27	15	8	79		129
Environmental	27					27
Manufactured		15	8	79		102
Capital gain	10	-1	7	-5	-20	-11
Environmental	17				-20	-4
Manufactured	-7	-1	7	-5		-7
Capital income	36	14	15	73	-20	118
Environmental	43				-20	23
Manufactured	-7	14	15	73		95

Table S13. Owners and government total income by activities in Dehesa de la Luz (2014: €/ha).

Class	Forestry	Water	Livestock	Services	Amenity	Private	Recreation	Landscape	Carbon	Biodiversity	Public	Total
	1	2	3	4	5	6 = ∑ 1 a 5	7	8	9	10	11 = ∑ 7 a 10	12 = 11 + 6
1. Revenue (R)	130	19	307	168	18	642	15	119	16	5	156	797
Intermediate raw material (IRM)	34	19				53						53
Intermediate services (ISS)	22		57	99		178						178
Commercial (ISSc)	22			20		42						42
No-commercial (ISSnc)	1		57	79		136						136
Compensated (ISSncc)			34			34						34
Donated (ISSncd)	1		5	79		85						85
Amenity (ISSnca)			18			18						18
Sales (S)	17		74			91						91
Gain of net worth (GNW)	57		176	69		303			13		13	316
Public goods and services (PGS)							15	119	3	5	142	142
Autoconsumption (A)					18	18						18
2. Expenditure (E)	69	5	260	95	38	467	15	119	2	5	142	609
Raw materials (RM)	35		100			135						135
Services (SS)	33		30	86	18	167	15	119	2	5	142	309
Work in progress used (PCu)	1		131			131						131
Loss of net worth (LNW)		5		9	20	34						34
3. Total income (TI) (1-2)	62	14	46	73	-20	175			14		14	188
Labor cost (LC)	25		31			57						57
Capital income (CI)	36	14	15	73	-20	118			14		14	132
Environmental (EI)	43				-20	23			14		14	36
Manufactured (CIm)	-7	14	15	73		95						95

Table S14. Comparison of the AAS and EAA/EAF economic indicators per activity at Dehesa de la Luz (2014: €/ha).

Class	Forestry 1	Water 2	Livestock 3	Services 4	Amenity 5	Private 6 = Σ 1 a 5
Extended accounts (AAS)						
1. Total product consumption (TPc)	73	19	131	99	18	339
2. Intermediate consumption (IC)	69		260	86	18	433
3. Net consumption (NC) (1 – 2)	4	19	-130	13		-94
4. Gross capital formation (GCF)	55		170	86		311
5. Total product (TP) (1 + 4)	128	19	300	185	18	650
6. Consumption of fixed capital (CFC)	7	4		20		32
7. Net capital formation(NCF) (4 – 6)	48	-4	170	66		279
8. Labor cost (LC)	25		31			57
9. Total cost (TC) (2 + 6 + 8)	101	4	292	107	18	521
10. Gross value added (GVA) (5 – 2)	59	19	40	99		217
11. Net value added (NVA) (3 + 7)	52	15	40	79		185
12. Net operating margin (NOM) (5 – 9)	27	15	8	79		129
13. Capital gain (CG)	10	-1	7	-5	-20	-11
14. Change of net worth (CNW) (7 + 13)	57	-5	176	61	-20	269
15. Capital income (CI)	36	14	15	73	-20	118
16. Environmental (EI)	43				-20	23
17. Manufactured (CIm)	-7	14	15	73		95
18. Total income (TI) (11 + 13 = 3 + 14 = 8 + 15)	62	14	46	73	-20	175
Standard accounts (EAA/EAF)						
1. Total product consumption (TPc)	39	19	74	35		167
2. Intermediate consumption (IC)	64		100			164
3. Net consumption (NC) (1 – 2)	-24	19	-27	35		3
4. Gross capital formation (GCF)	52		46			98
5. Total product (TP) (1 + 4)	92	19	119	35		265
6. Consumption of fixed capital (CFC)	7	4		10		21
7. Net capital formation(NCF) (4 – 6)	45	-4	46	-10		77
8. Labor cost (LC)	25		31			57
9. Total cost (TC) (2 + 6 + 8)	96	4	132	10		242
10. Gross value added (GVA) (5 – 2)	28	19	19	35		101
11. Net value added (NVA) (3 + 7)	21	15	19	26		81
12. Net operating margin (NOM) (5 – 9)	-4	15	-12	26		24
Accounting systems comparison						
$GVA_{AAS}/GVA_{EAA/EAF}$	2,1	1,0	2,1	2,8		2,1
$NVA_{AAS}/NVA_{EAA/EAF}$	2,5	1,0	2,1	3,1		2,3
$TI/NVA_{EEA/EAF}$	2,9	0,9	2,4	2,8		2,2

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