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Original Research

The Contribution of Amenities to Landowner Income: Cases in Spanish and Californian Hardwood Rangelands

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ABSTRACT

Rangeland economists have noted that people tend to pay far more for ranches and rangelands than can be justified by the potential income from livestock operations alone. This gap in price can be explained when the value of the amenity benefits from owning a ranch and the capital gains from the rangeland investment are integrated as part of the "income" accruing to the landowner. In this paper, we apply an accounting framework that takes such values into account, the Agroforestry Accounting System, to three hardwood rangeland case studies in Andalucía (southern Spain) and three in California. We estimate how commercial operations, private amenities consumed by the landowner, and capital gains contribute to landowner income and rangeland investment profitability in these case studies. Results show that private amenity consumption and capital gains make the greatest contribution to landowner income. When these income components are included in the estimations, total real profitability ranges from 2.7% to 4.5% in the Spanish cases and from 4.5% to 7.8% in the California cases, rates that are competitive with alternative investments. Our results suggest that conservation programs may be strengthened by enhancing or building on amenity benefits to landowners, motivating them to engage in and continue with these programs. In addition, landowner willingness to pay for amenities may increase the cost-efficiency of programs that would enhance the provision of these, or of closely related, amenities.

Introduction

Standard national and farm accounting for agriculture and forestry focus on the commercial operating income from land investments (AAEA, 2000; European Communities, 2000; European Commission, 2010, 2013; BEA, 2016). In extensive rangeland systems in western Spain and the United States, this kind of accounting shows negative profitability rates for livestock operations (Martin and Jefferies, 1966; Agee, 1972; Workman, 1986; Campos and Riera, 1996; McGrann, 2000; Torell et al., 2001; Forero et al., 2004; USDA, 2016). Yet ranch and rangeland market prices are much higher than can be justified by the income from commercial production (Torell et al., 2001). How can this be explained?

One explanation theorizes that standard accounting systems fail to consider all the benefits of owning a ranch—benefits that ranch purchasers are willing to pay for. It is well documented that private non-industrial rangeland owners in Spain and the United States consume amenities such as living in nature or a rural lifestyle from land ownership (Martin and Jefferies, 1966; Torell et al., 2001; Campos et al., 2009), that these amenities have a significant influence on the market price of ranchlands (Pope, 1985; Torell et al., 2005; Wasson et al., 2013), and that they are part of motivations for landownership (Young and Shumway, 1991; Liffmann et al., 2000; Rowe et al., 2001; Gentner and Tanaka, 2002; Campos et al., 2009; Huntsinger et al., 2010). Land revaluation is also often ignored in standard income accounting for agriculture and forestry, further reducing our ability to understand land prices and investment decisions in rangelands. Capital gains, particularly those due to land revaluation, are important in the long term for understanding landowner decisions and the income from rangeland investment (Martin and Jefferies, 1966; McElroy, 1976; Workman, 1981; Eisner, 1989; Torell et al., 2005).

In this study we propose an alternative to standard accounting methods for gaining a fuller understanding of what values motivate people to invest in ranches and rangelands, as well as to quantify these values. We apply the experimental Agroforestry Accounting System (AAS) (Campos et al., 2008) at the farm scale to integrate non-market private amenity consumption and capital gains into

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measurement of landowner income and profitability on hardwood rangelands. The AAS was developed to extend the criteria of standard national accounting in order to better estimate the total income from an ecosystem that incorporates both natural processes and human interventions in economic activities (Campos et al., 2008; European Commission, 2013; BEA, 2016; Ovando et al., 2016). Our accounting approach provides a complete set of income, capital, and profitability indicators for both commercial and private amenity activities. It also distinguishes between the income derived from rangeland operations and the capital gains generated by changes in net worth. This avoids the undervaluation of rangelands and their products by standard accounting used in policy making because in the AAS the amenities that are consumed by landowners are given a monetary value and integrated as part of rangeland income and production.

Here, the empirical application is carried out in a comparison of privately owned hardwood rangelands in Andalucía (southern Spain) and California. We gathered data on commercial activities from six case studies of private hardwood rangeland properties (three in each location), private amenity consumption and land prices from two contingent valuation surveys applied to a sample of properties from each location, and land revaluation rates from published statistics (also for each location). The two places share a Mediterranean climate and open oak and conifer woodlands that permit the development of an annual grassland forage base, where livestock grazing is the main traditional land use. In both countries such hardwood rangelands are considered international "biodiversity hot spots" (Myers et al., 2000), and environmental organizations are actively engaged in conserving the woodlands and traditional land uses in these working landscapes (Campos et al., 2013). Rangeland operations potentially increase public ecological and economic values in these systems (Bugalho et al., 2011; Huntsinger and Oviedo, 2014).

Background

The concept we refer to as "private amenities" has been noted in diverse ways in the literature. Pope (1985) and Smith and Martin (1972) talked about [non] "consumptive use"; Torell et al. (2005) used quality-of-life values; and Bastian et al. (2002) and Wasson et al. (2013) referred to rural and environmental amenities. Gentner and Tanaka (2002) classified ranchers in the United States according to different motivations for ranching, mainly differentiating between professional and hobbyist ranchers. No matter how ranchers were classified, they are described as having motivations that go beyond commercial profit and as typically obtaining services from the land that do not include direct market transactions or inputs into commercial activities. We use the term "private amenities" because they are a result of private ownership of land. Thus, private amenities include the nonmarket (environmental) services consumed by landowners (e.g., open space, recreation, and scenic benefits) and other intangible benefits associated with the rural lifestyle (e.g., legacy options, status derived from owning a ranch, and opportunity to engage in ranching or hunting).

From an economic point of view, the implication of landowners valuing their land amenities is that they are capitalized into land prices and become a market value when the land is sold (Pope, 1985). Buyers are willing to pay to acquire the right to enjoy these amenities, and sellers incorporate their value into land price offers. Once the land is acquired, the annual amenity consumption by the landowner is not subject to a market transaction, so it does not have a directly observable market flow value––it is a private nonmarket benefit on the production side and a commercial capital gain on the land revaluation (capital) side.

The common analytic approach for this phenomenon is hedonic pricing. When analyzing the on-site contribution of amenities to land values, this method relates land prices to land attributes and estimates the part of the land price explained by amenities. In this context, hedonics have been applied to ranchland and ranchettes in Arizona (Martin and Jefferies, 1966; Sengupta and Osgood, 2003), rural agricultural land in Texas (Pope, 1985), undeveloped private land in California (Standiford and Scott, 2001), agricultural land and rangeland in Wyoming (Bastian et al., 2002; Wasson et al., 2013), and ranches in New Mexico (Torell et al., 2005). Hedonic pricing proves useful for showing that private amenities are capitalized into land prices, and for determining how much of the land price is due to amenities. However, for calculating amenity income out of hedonic pricing we need to assume a discount rate that transforms the amenity capital stock value into an amenity flow income using the standard capitalization formula. With this procedure, both the estimated income and profitability rate figures depend on that discount rate.

In our approach we work with both a production account and a capital account, which allows estimating income values for each hardwood rangeland activity independently from the capital values associated with these activities (Campos et al., 2008). Thus, we estimate the income and profitability rates from different activities without relying on an assumed discount rate. The income from commercial activities is estimated from the case studies, the amenity income is estimated for each case study based on the contingent valuation results, and the capital values are estimated from the case studies and land price data.

We acknowledge that our estimations of private amenity consumption and land prices are based solely on the side of the market represented by current landowners. We are missing a part of the market represented by the potential buyers of rangeland properties, but they are difficult to identify and therefore analyze. We believe that it is better to have information on only one side of the market than it is to miss the economic values associated with private amenity consumption entirely.

Materials and Methods

Our analysis draws on six case studies of privately owned hardwood rangelands, three from Andalucía (southern Spain) and three from California. We offer detailed data on individual commercial activities and manufactured capital during an accounting period of 1 yr using these case studies. Then we obtain the private amenity product and land price values from two contingent valuation surveys of a larger sample of hardwood rangeland properties in each location. On the basis of the survey results, we estimate amenity consumption and land price values specific to each of the six case studies. Finally, we estimate an average land revaluation rate from published statistics in each study area and use it for the case studies. All these data are integrated into the Agroforestry Accounting System (AAS).

All AAS indicators are economic values and are presented in 2010 US dollars per hectare of useful agrarian land. The case study, private amenity consumption, and land price data from Spain were estimated in 2010 euros and converted to 2010 US dollars when integrated into the AAS using the euro-dollar currency rate for 2010 (€1 = $1.3257 in 2010; Eurostat, 2016). Commercial data from the California case studies were taken in 2007 US dollars and converted to 2010 US dollars when integrated in the AAS using the 2007 − 2010 inflation rate for California ($1 in 2007 = $1.0437 in 2010; California Department of Finance, 2014). California private amenity and land price functions correspond to a survey done in 2004 but analyzed in 2002 euros (Campos et al., 2009). For integrating the values from these functions into the AAS, we converted them to 2002 US dollars using the euro-dollar currency rate for 2002 (€1 = $0.9456 in 2002; Eurostat, 2016) and then to 2010 US dollars using the 2002 − 2010 inflation rate for California ($1 in 2002 = $1.2193 in 2010; California Department of Finance, 2014).

Products and intermediate consumptions are valued at producer and purchase prices, which exclude subsidies and taxes on production (European Commission, 2013; BEA, 2016). This is because our approach focuses on the income generated by the hardwood rangeland, while subsidies and taxes are considered money transfers from and to other sectors of the economy. In addition, subsidies are usually temporary and change often, so they rarely affect land prices. We also note that subsidies are different in each region. In Spain, rangeland owners mostly receive direct subsidies, while in California they benefit from tax breaks, emergency programs, cost-share funding and grants.

Hardwood Rangelands in California and Spain

Both California and west-central Spain have hardwood rangeland with a well-developed understory of grasses and herbs and a history of livestock grazing. In California, livestock-producing hardwood range properties are referred to as *ranches* and are found in coastal and Sierran foothills. They cover 2.1 million ha and are 81% privately owned (California Department of Forestry and Fire Protection, 2010). In Spain, hardwood rangelands managed for agricultural production are called *dehesa* and are largely found in the Andalucía and Extremadura regions. Dehesa properties cover 3.6 million ha, of which 2.2 million ha are oak wooded dehesa[1] and are 85% privately owned (MAPA, 2008). Valued for agricultural production, these rangelands are crucial reservoirs of biodiversity (Campos et al., 2013). Their extensive character, mild climate, and structurally and nutritionally rich mix of acorn-producing trees, grasslands, and shrubs make them prime wildlife habitat.

Dehesa is widespread in low-elevation foothills and valleys in the dry-summer, frost-free Mediterranean climate. The overstory is usually well-spaced evergreen Holm *(Quercus ilex)* and/or cork *(Quercus suber)* oak. The annual grassland understory commonly includes wild oats (*Avena* spp.), wild barley (*Hordeum* spp.), bromegrasses (*Bromus* spp.), and fescues (*Festuca* spp.). The average property size is 338 ha (MAPA, 2008), although private properties can reach up to 3 000 ha, and for publicly owned properties the size can go up to 10 000 ha (Ovando et al., 2016). Dehesa typically has 10 − 60 oaks ha^{-1}, depending on the management goals and environmental characteristics of the site (Joffre et al., 1999). The savanna-like appearance is maintained by thinning and pruning of trees and by grazing and tilling of the understory to prevent shrub invasion (Campos et al., 2013). If grazing is removed and no other control measures are used, dehesa changes into scrub in as few as 10 yr, with a loss of forage quality, increased fire risk, loss of biodiversity, and landscape homogenization (Bugalho et al., 2011). Abandonment is one of the main threats faced by the dehesa system.

Dehesa commercial products include livestock (cattle, pigs, sheep, and goats), often in concert with cork, charcoal and other oak products, mushrooms, hunting, and crops. Hunting can generate commercial income and/or be aimed at the enjoyment of the landowner and relatives (Herruzo et al., 2016). Wild boar *(Sus scrofa)* and red deer *(Cervus elaphus)* are typical big game species. In Andalucía, 83% of dehesa owners are involved full-time or part-time in land management while the remaining owners leave these tasks to a manager or lease the land (Oviedo et al., 2015). However, much of the on-site animal husbandry, grazing, and vegetation management is typically done by workers hired from nearby villages and professional caretakers. Complex work such as cork harvest may be done by specialist laborers who travel through the region during the harvest period. Although 71% of landowners have a residential house on the property for weekends and vacation, only 9% are resident owners (Oviedo et al., 2015). Dehesa is considered "high nature value" traditional agriculture in Europe, meaning that it is rich in biodiversity, and this biodiversity is to some degree dependent on agricultural activity (Campos et al., 2013).

Although the vegetation looks similar, there are differences in use and management between Spanish and Californian hardwood rangelands (Campos et al., 2013). In California, the average hardwood rangeland ranch size is between 600 and 1 000 ha, though there is great variation (Huntsinger et al., 2010). These rangelands require little human intervention to remain open, although they have often been thinned in the past through indigenous burning and ranch practice. Oak distribution is more variable than in Spain and is usually clumped.

Commercial uses and products are not as diverse as in the dehesa, and for these reasons, labor needs are lower. Grazing is most often by cattle, and hunting and fuelwood are the most common secondary products. Woodland ranches have four oaks that are considered particularly widespread and characteristic: the deciduous blue oak *(Quercus douglasii)*, the valley oak *(Quercus lobata)*, the evergreen coast live oak *(Quercus agrifolia)*, and the interior live oak *(Quercus wislizenii)*. The understory is dominated by grasses from the Mediterranean region as a result of transfer to California starting in the 18th century, and the same grasses found in dehesa are common, perhaps most notably wild oats. More than three-fourths of landowners live on their property at least part of the year, and most labor is provided by household members (Huntsinger et al., 2010). As in the dehesa, hunting can be oriented to commercial income or landowner enjoyment. Wild boar *(Sus scrofa)* (a result of intercontinental transfer to California) and mule deer *(Odocoileus hemionus californicus)* are typical big game species. Hardwood rangelands are the most biodiversity-rich extensive habitat type in California. Livestock grazing and agricultural infrastructure have been found important for maintaining the habitats of a number of rare or endangered plant and animal species, as well as for managing vernal pools rich in endemic biodiversity (Huntsinger and Oviedo, 2014). Grazing is also widely used to reduce biomass that contributes to fire hazard. The main threats to California hardwood rangelands are fragmentation, conversion (particularly to vineyards), and land development.

Case Studies

The three dehesa (Dehesas A, B, and C) and three ranch (Ranches A, B, and C) case studies that we analyze include up to five private activities: forestry, game, livestock, cropping, and services. The last includes both private amenity and housing subactivities. The property sizes of the dehesa cases fall in the lower (178.8 ha for Dehesa A) and in the upper limits (1 312.0 ha for Dehesa B and 1 256.7 ha for Dehesa C) of what it is frequently found in a dehesa. For the ranches, the case studies have property sizes above what is usually found in California (2 671.3 ha for Ranch A, 1 358.1 ha for Ranch B, and 2 656.8 ha for Ranch C). Vegetation in these case studies is dominated by the oak species common to each area. Treeless grassland and cropland are more common on the ranches. All case studies are primarily livestock-oriented operations except Ranch B, which is hunting oriented, although some hunting also takes place on the other properties. Some properties also harvest firewood and carry out silvopastoral practices. The ranch case studies fall outside the area designated by the State of California of "at risk of development by 2040" (Gaman and Firman, 2006). In Spain, severe land use restrictions preclude land use conversion in our case study area. This reduces the influence of land development expectations on the estimated amenity income and land prices. All our cases studies are also located 90 − 150 km from the major urban center in the area where the property is located, limiting development pressures.

The three dehesas have land uses and vegetation typical of dehesa properties in western Andalucía and Extremadura. Similarly, the California case studies have land uses and vegetation common to many hardwood rangeland ranches, except for Ranch B, which is primarily oriented to hunting. However, even if they share common land uses and vegetation types, each dehesa or ranch property is in fact unique in its ecological, environmental, management, and landowner characteristics (Huntsinger et al., 2010; Campos et al., 2013).

Accounting Method

According to Eisner (1989), if income is defined as "that which can be consumed while keeping real wealth intact, saving is the difference between this measure of income and actual consumption. Both income and saving will then include real capital gains. To preserve the saving-investment identity, investment would also have to include these capital gains. Failure to include them causes a disparity between income

[1] A dehesa with a canopy cover between 5% and 60% and grazed by livestock and wild animals (MAPA, 2008).

statements and balance sheets that reflects market values." BEA (2016), European Communities (2000), and McElroy (1976) use similar definitions for total income. Accordingly, the two components of total income *(TI)* are the net value added *(NVA)* and capital gains *(CG):*

$$TI = NVA + CG \quad (1)$$

The AAS uses both a production account, which offers the *NVA* estimate, and a capital balance account, which offers the *CG* estimate, to measure *TI*. The production account measures product value and costs. The net operating margin is the difference between total product value and costs. The *NVA* is estimated as net operating margin plus labor. The latter includes compensation to both employees (salaried compensation) and self-employed labor (nonsalaried compensation to landowners and their family members when they work in the rangeland operation). The capital account incorporates initial and final capital and entries, withdrawals, and revaluation (changes in the value) of fixed capital and stored work in progress (i.e., the growing stock of wood that is not harvested in the accounting period). The growth and storage of wood during the accounting period can be estimated from silvicultural models of the species for the case studies. Growth functions allow estimation of the ecological side of revaluation, which can be expressed in economic terms by using the corresponding prices, management costs, and discount rates.

CG are measured from capital revaluation less capital destruction plus fixed capital consumption during the accounting period. In the AAS, fixed capital consumption is considered an operating cost in the production account and it is also implicitly discounted in the capital revaluation figure in the capital account. Therefore, and to avoid double counting, it is added in the *CG* estimation.

Our analysis focuses on the income from rangeland to the landowner (given that there are no external investors), which derives from the capital income and paid self-employed labor. Capital income *(CI)* results from adding net operating margin *(NOM)* and *CG*:

$$CI = NOM + CG \quad (2)$$

We estimate the operating, capital gain, and total profitability rates (p_o, p_{cg}, and p_t) as the ratios of *NOM, CG,* and *CI* to the total immobilized capital *(IMC)* over the accounting period, respectively:

$$p_o = (NOM/IMC)^* \, 100 \quad (3)$$

$$p_{cg} = (CG/IMC)^* \, 100 \quad (4)$$

$$p_t = (CI/IMC)^* \, 100 \quad (5)$$

The *IMC* is the average annual investment in a rangeland operation including in land, infrastructure, equipment, and animals. It is calculated as the opening capital plus the working capital used during the accounting period.[2]

If all labor devoted to the ranch operation is hired, landowner operating income derives entirely from the *NOM*. However, when landowners and/or households work directly in rangeland operations, they obtain a mixed operating income *(MOI)* composed of *NOM* as return to capital and self-employed compensation *(SEL)* as return to their labor. In this case, it is relevant to differentiate between the net operating margin derived from manufactured capital *(MNOM)* and the net operating margin derived from the environmental asset *(ENOM):*

$$MOI = MNOM + ENOM + SEL \quad (6)$$

Knowing the value components of this *MOI* is relevant for profitability rates as labor remuneration should not be part of them. In our application, we propose a means of separating the capital and self-employed labor components of this *MOI*. For each activity, we calculate first the hours of self-employed labor for the year and estimate the value of its *MOI*. The latter can be estimated from the production account of the AAS as total product *(TP)* minus raw materials (*RM*), services (*SS*), work in progress used *(WPu),* fixed capital consumption *(FCC),* and employee compensation *(EL):*

$$MOI = TP–RM–SS–WPu–FCC–EL \quad (7)$$

From our case studies we obtain all the values in the right-hand side of Eq. (7) (which gives the value of the *MOI*), as well as the value of *ENOM* in Eq. (6). Thus, the only remaining unknown elements of Eq. (6) are *MNOM* and *SEL,* for which three situations could arise in order to estimate their value: 1) if *MNOM* plus *SEL* gives a negative value, all is attributed to *MNOM;* this assumes that *SEL* will never have a negative value—it is just unpaid; 2) if *MNOM* plus *SEL* gives a positive value that on a per-hour basis is ≤ 80% of the employee hourly wage in the area, then all is attributed to *SEL;* this assumes that landowners prioritize the remuneration of their labor; and 3) if *MNOM* plus *SEL* gives a positive value that on a per-hour basis is > 80% of the employee hourly wage in the area, *SEL* corresponds to that 80% and the rest is *MNOM;* this assumes that the marginal productivity of self-employed labor is lower than that from hired labor (Hamilton, 2000). This 80% limit is tentative based on preliminary observations during data collection.

These assumptions imply that when landowners (and/or households) devote working time to land operations, they can potentially incur an opportunity cost for this labor. This opportunity cost is recognized in the landowner willingness to pay for enjoying private amenities, such as working in ranching operations and enjoying the associated lifestyle.

Data and Extensions to Standard Accounts

We gathered market data on commercial operations and capital (including infrastructure, equipment, and animals) for different activities in the case studies using bookkeeping records, in-depth interviews, and field data. We focus in the next subsections on the data extensions relevant for our analysis: 1) the private amenity consumption of the landowner and 2) the measurement of capital gains as part of the total income, paying close attention to those associated with land price variation.

Other AAS extensions aim to consider natural resource growth and depletion. These refer to 1) the intermediate product value of forage grazed by livestock in the accounting period and of the annual natural growth of tree and shrub products that will be harvested in a future accounting period (e.g., firewood, timber or cork annual natural growth); and 2) the cost of tree and shrub products grown in previous years that are harvested, or contribute to products harvested, during the accounting period (e.g., shrubs browsed by game and wood products from trees). These extensions are considered in our AAS application, but they are not our main focus here.

Private Amenity Consumption

To obtain a monetary value for the nonmarket private amenity consumption, we designed and applied a contingent valuation (CV) survey in the two analyzed regions. The California survey is statewide. The Spanish survey focuses on Andalucía, where the case studies are located. The results of these surveys are published in Campos et al. (2009) and Oviedo et al. (2015). We present here the amenity valuation scenario,

[2] The information for the opening capital comes from the capital account. The information for the working capital comes from both the capital and the production accounts as it includes fixed capital and work in progress bought plus the total cost of the operation net of sales, work in progress used, fixed capital consumption, and raw materials used by other activities within the operation.

survey characteristics, and function used to obtain a specific value of the private amenity consumption for our case studies.

In both surveys, we designed a CV scenario that presented the landowners with two situations: 1) the current situation, where they own the land, obtain a commercial net operating margin from the land denoted by Y_0 (this can be positive or negative), and enjoy land amenities denoted by Z_0 (this is a positive value), with landowner utility represented by:

$$U_0 = U(Y_0, Z_0), \tag{8}$$

and 2) a situation where they sell the land, and therefore give up land amenities, in order to make an alternative investment that offers a net operating margin denoted by Y_1, which is equivalent to the value of their previous commercial net operating margin from the land (Y_0) plus an additional amount A, with landowner utility represented by:

$$U_1 = U(Y_1, Z_1) = U(Y_0 + A, Z_1), \tag{9}$$

where Z_1 is zero, because in this situation there is no amenity consumption; and Y_1 represents the net operating margin from the alternative investment, being equivalent to $Y_0 + A$. Thus, the amount A is the difference between the net operating margin from an alternative investment (Y_1) and the commercial net operating margin from the land (Y_0). Assuming that sociodemographic characteristics and other income sources remain similar in the two situations, the amount A that equates the utility in both situations (U_0 and U_1) is the landowner maximum willingness to pay (WTP) for enjoying land amenities; that is, the maximum opportunity cost that the landowner is willing to assume for keeping the land and the consumption of land amenities. This is the value of the landowner private amenity consumption. The CV questions used in the surveys (Appendix S1) estimate this value for a sample of landowners in Andalucía and in California. The resulting WTP functions from these samples were used to estimate the private amenity consumption value specific to each of the analyzed case studies. There are slight differences in the wording of the questions because we adjusted them to each study area and because the Andalucía study benefited from the results and feedback from the California study.

In the Andalucía case, we surveyed 765 private hardwood rangeland and forest owners in 2010 (458 valid observations for the CV question). We used a single-bounded CV question, where landowners were asked whether they would pay (give up) or would not pay a specific annual amount of money in order to keep their property and therefore their land amenities in the scenario described earlier. The amount offered varied among respondents according to a specific design (Oviedo et al., 2015). Using a logistic regression analysis of the answers to this question, we estimated a WTP function based on Cameron (1988). For California, we surveyed 115 private hardwood rangeland owners in 2004 (30 valid observations for the CV question). We used an open-ended CV question, where landowners were directly asked to state their maximum WTP in the scenario described earlier. Although this format is less used nowadays, it is useful when samples sizes are small, as we anticipated in this study (Campos et al., 2009). We estimated a function using a weighted least square regression on the maximum WTP stated by landowners. Table S1 shows the main characteristics of the sampled properties in each case.

For obtaining WTP values for our case studies we use the linear WTP function for California from Campos et al. (2009) and the log-linear WTP function for Andalucía from Oviedo et al. (2015). We estimate the landowner WTP for each of our case studies by inserting into the function the value of the explanatory variables corresponding to the case study. The resulting value is recorded as final product of the private amenity activity in the production account of each case study.

Land Prices and Land Revaluation

The capital account of the AAS requires an opening land price in the accounting period (initial land capital value). However, land prices specific to hardwood rangeland properties are limited in availability and cannot be directly observed unless the land is sold, which is not the situation for our case studies. To get estimations for land prices, we included in the surveys from Campos et al. (2009) and Oviedo et al. (2015) a question asking landowners what they thought the current sale price of their rangeland property was (Appendix S2). As with the CV questions, the difference in the wording of the questions is due to adaptation to the context of each area.

We use the land price function for hardwood rangelands and forests of Andalucía from Oviedo et al. (2015) and the survey data from Campos et al. (2009) to estimate a land price function for California ranches. These functions have a linear and semilog specification, respectively. We estimate the land price for each of our case studies by inserting into the corresponding function the value of the explanatory variables of the case study. The resulting value is recorded as the opening land capital value in the capital account of the AAS.

The capital account of the AAS also requires a closing land price in the accounting period (final land capital value). This is obtained by applying an annual land revaluation rate to the opening land price. Land revaluation is a highly variable figure, and estimates based on a single year would not represent a long-term trend. For this reason, we used an average annual revaluation rate based on data from the period 1994 − 2013 for the Spanish cases and from the period 1999 − 2013 for the Californian cases. As we offer our income and profitability results separately for commercial and private amenity activities, we also have to distinguish the share of land revaluation corresponding to these activities. Based on recent literature, hardwood rangeland real commercial net operating margin shows a decreasing trend in both areas (Torell et al., 2001; Ovando et al., 2016) while landowner amenities have an increasing influence (Huntsinger et al., 2010; Oviedo et al., 2015). We assume then that all land revaluation (appreciation or devaluation) is explained by an expected increase (or decrease) in private amenity consumption and is entirely attributed to the capital gains of this activity.

Results

Willingness to Pay for Private Amenities

The WTP functions and WTP estimates for the case studies are presented in Table 1 in 2010 euros for Andalucía and in 2002 euros for California, as the dependent variables of these functions were originally analyzed in these monetary units (Campos et al., 2009; Oviedo et al., 2015). The WTP estimates for the case studies are converted to 2010 US dollars when integrated in the AAS (see “Materials and Methods” earlier for conversion rates).

Following Cameron (1988), the Andalucía WTP function (see Table 1) derives from a reparametrization of a logit regression that uses the yes/no answers to the contingent valuation question as the dependent variable. As there is no R^2 or test for the overall significance of the model directly linked to the Andalucía WTP function in Table 1, we report here those from the logit regression used to obtain this WTP function. This regression showed a 0.0629 McFadden’s pseudo R^2, which represents a modest improvement over an intercept-only model, and a chi-square statistic (with 5 degrees of freedom) of 38.6314 for the likelihood ratio test comparing this model with an intercept-only model. The latter statistic is significant at the 1% level, indicating that our model significantly improves over an intercept-only model.

The predicted WTP values from this function range from €32.06 ha^{-1} to €728.39 ha^{-1}. The function shows that the WTP per hectare drops as property size increases, indicating that a large land area is not needed for the consumption of private amenities. We also find that when

Table 1
Willingness to pay (WTP) functions for private amenity consumption in Andalucía hardwood rangelands and forests and in Californian hardwood rangelands. Resulting WTP values for the case studies.

Variables	Andalucía hardwood rangelands and forests	Californian hardwood rangelands
	Dependent variable = Log (unobserved WTP per hectare); € 2010	Dependent variable = stated WTP per hectare; € 2002[1]
	Coefficients	Coefficients
Intercept	3.8629***	1 077.4400
	(1.1884)	(1 997.4110)
Property size (ha)	−0.0004	
	(0.0002)	
Oak woodland (ha) under canopy cover		−5.8192
		(12.1531)
Square of oak woodland (ha) under canopy cover		0.0012
		(0.0027)
Eucalyptus (=1 if > 30% of the property is covered by eucalyptus)	−1.6468*	
	(0.9517)	
Aleppo pine (=1 if > 40% of the property is covered by aleppo pine)	−1.3387***	
	(0.5132)	
Log of distance (km) from the property to the province capital	0.5292*	
	(0.2821)	
Land price		0.0692**
		(0.0333)
Square of land price		−2.1581E-07**
		(8.7200E-08)
n[5]	455	25
R^2	n.a.[3]	0.3838
F-test statistic for model significance[4]	n.a.[3]	3.1000**
Resulting WTP values[5] for:		
- Case study A	510.9	79.1
- Case study B	371.9	185.7
- Case study C	304.9	66.8

Note: Standard errors are shown in parentheses. n.a., not available. Asterisks (e.g., *,**,***) denote significance at the 10, 5, and 1% level, respectively.
Source: Oviedo et al. (2015) and Campos et al. (2009).
[1] To avoid heteroscedasticity problems, this is a weighted regression using "Land price" as the weighting variable.
[2] Three observations in the Andalucía function and five observations in the California function are not included in the regression because of missing values in the explanatory variables.
[3] There is no R^2 or test for the overall significance of the model directly linked to the Andalucía WTP function reported in this table.
[4] For the California function, the *F*-test statistic follows an *F*-distribution with (4, 20) degrees of freedom.
[5] These WTP values are shown in 2010 euros for the Andalucía cases and in 2002 euros for the California cases in this table, as the dependent variable of these functions were originally analyzed in these monetary units (Campos et al., 2009; Oviedo et al., 2015). These values are converted to 2010 US dollars when integrated in the AAS.

eucalyptus (*Eucalyptus* spp.) and Aleppo pine (*Pinus halepensis*) cover more than 30% and 40% of the property, respectively, the landowner WTP per hectare significantly drops. This is likely linked to the low scenic value of these exotic species, which were introduced through reforestation in Spain. The log of the distance from the property to the provincial capital (the major urban center in the area) significantly increases the landowner WTP per hectare, indicating that additional amenity consumption is attained when the hardwood rangeland is farther from urban centers. According to this function, Dehesa A offers the highest WTP per hectare because it has by far the smallest area. Dehesas B and C are similar in size, but Dehesa B is the farthest from the provincial capital and shows the second highest landowner WTP per hectare. Eucalyptus and Aleppo pine are marginal in the three dehesas, so this characteristic does not affect the WTP per hectare in these case studies.

For the California WTP function (see Table 1), the R^2 indicates that only 38% of the variation in the WTP is explained by the model. This may derive from the high variability in the WTP, which ranges from a negative value to €6 045.48 ha^{-1}. However, the *F*-test statistic shows that we can reject the null hypothesis that all regression coefficients of the function are equal to zero (see Table 1). The function shows that hectares of oak woodland under canopy cover in the property have a negative effect on the WTP per hectare. In addition, the stated land price in the survey has a positive, significant effect on the WTP. Both variables include quadratic terms. In our case studies, Ranch B presents the highest WTP according this function (see Table 1), as this is the ranch case with the lowest hectares of oak woodland under canopy cover (i.e., the ranch with more open woodland).

Land Prices and Revaluation

As with the WTP estimates, land price functions and land prices estimated for the case studies are shown in Table 2 in the original monetary units used in Campos et al. (2009) and in Oviedo et al. (2015), which were 2010 euros for Andalucía and 2002 euros for California. The land prices estimated for the case studies are then converted to 2010 US dollars when integrated in the AAS (see "Materials and Methods" earlier for conversion rates).

Table 2
Land price functions in Andalucía hardwood rangelands and forests and in Californian hardwood rangelands. Resulting land prices for the case studies.

Variables	Andalucía hardwood rangelands and forests	Californian hardwood rangelands
	Dependent variable = stated land price per hectare; € 2010	Dependent variable = log of stated land price per hectare; € 2002
	Coefficients	Coefficients
Intercept	9 279.7762***	9.1271***
	(1 123.7660)	(0.1834)
Property size (ha)	0.4424*	
	(0.2550)	
Oak woodland (ha) in the property		−0.0016***
		(0.0005)
Square of oak woodland (ha) in the property		2.8824E-07**
		(1.3570E-06)
Cork oak (=1 if there is cork oak in the property)	1 855.4456***	
	(497.6243)	
Gall oak (=1 if there is gall oak in the property)	2 215.4970*	
	(1 139.9781)	
Wild olive tree (=1 if there is wild olive tree on the property)	2 160.1402***	
	(684.1187)	
Eucalyptus (=1 if there is eucalyptus in the property)	−3 353.2150[1]	
	(1 094.2029)	
Pine (=1 if there is pine in the property)	−944.9363*	
	(520.0866)	
Shrubland (=1 if there is treeless shrubland in the property)	−823.9877**	
	(367.7118)	
Protected (=1 if the property is located in a protected area)	894.7348**	
	(365.2345)	
Western (= 1 if the property is located in western Andalucía)[1]	1 344.8185***	
	(425.8735)	
Log of distance (km) to the closer coastal town	−746.3142[1]	
	(227.9836)	
n	588	64
R^2	0.1833	0.1652
F-test statistic for model significance[2]	12.9495***	6.0381***
Resulting land prices[3] for:		
- Case study A	6 643.6	3 348.6
- Case study B	7 493.7	3 380.2
- Case study C	5 207.4	2 978.3

Note: standard errors are shown in parentheses. Asterisks (e.g., *,**,***) denote significance at the 10, 5, and 1% level, respectively.
Source: Oviedo et al. (2015) and data from Campos et al. (2009).
[1] Western Andalucía provinces are *Cádiz*, *Córdoba*, *Huelva*, and *Sevilla*.
[2] The *F* test statistic follows an *F* distribution with (10, 577) degrees of freedom for the Andalucía function and an *F* distribution with (2, 61) degrees of freedom for the California function.
[3] These land prices are shown in 2010 euros for the Andalucía cases and in 2002 euros for the California cases in this table, as the dependent variables of these functions were originally analyzed in these monetary units (Campos et al., 2009; Oviedo et al., 2015). These values are converted to 2010 US dollars when integrated in the AAS.

The Andalucía land price function (see Table 2) offers an R^2 that explains only 18% of the variation in the model, with land price predictions ranging from €3 123.09 ha^{-1} to €13 814.04 ha^{-1}. The *F*-test statistic shows that we can reject the null hypothesis that all regression coefficients of the function are equal to zero (see Table 2). The function shows that larger property size significantly increases the land price per hectare and that up to six vegetation types have a significant effect on the land price per hectare, including cork oak, gall oak *(Quercus faginea)*, wild olive *(Olea europaea)*, eucalyptus, any kind of pine *(Pinus* spp.) species, and treeless shrubland. On one hand, the presence of cork oak, gall oak, and wild olive increases land price per hectare, probably because of their commercial (from grazing, hunting, and forestry products) and amenity (they are native species providing more natural landscapes) benefits. On the other hand, the presence of eucalyptus, pine stands of any species, and treeless shrubland decreases land price per hectare, suggesting that any commercial benefits from forestry, hunting, or grazing do not compensate for the low scenic values of these vegetation types. We also find a higher land price per hectare when the property is located in a protected area and in western Andalucía, as well as when the property is closer to a coastal town. In our case studies, and according to this function, the highest land price per hectare is found for Dehesa B, which is located in a protected area, is largest in size, and is the closest to a coastal town. Dehesa C has the lowest price per hectare because it has eucalyptus, pine stands, and treeless shrubland.

The California land price function (see Table 2) also offers a low R^2 that explains only 17% of the variation in the model, with land price predictions ranging from €1 170.26 ha^{-1} to €9 200.93 ha^{-1}. However, we also find here that the *F*-test statistic shows that we can reject the null hypothesis that all regression coefficients of the function are equal to zero (see Table 2). This function shows that having more hectares of oak woodland on the property leads to a lower land price per hectare. The quadratic terms indicate that this reduction is not linear––that is, at a certain point the land price per hectare stops decreasing with the hectares covered by oak woodland. An explanation for the effect of this variable is that a property dominated by trees, compared with a property with a mixture of trees and grasslands, has less capacity to produce forage and therefore to support livestock and wild grazers. Thus, when oaks are denser, the land price is lower. A mixture of trees and grassland is also likely to enhance scenic values for landowners, increasing land prices. In the case studies, Ranch B has the highest land price per hectare as it has fewer hectares of dense oak woodland.

Concerning land revaluation, we estimate for the dehesa cases an annual average 5.0% rate based on the average cumulative land revaluation rate for dry natural grassland in Spain between 1994 and 2013 (MAGRAMA, 2016). For the ranch cases we estimate an annual average 6.2% rate based on the average cumulative land revaluation rate for rangelands in California between 1999 and 2013 (CASFMRA, 2016). Both are the longest periods for which we found data.

Income and Profitability

The production accounts show the product values, costs, and net operating margin for each activity in each case study (Tables S2 and S3). The dehesa cases show mostly negative, or very low, net operating margins for livestock, game, and forestry activities. Crop activities are marginal in these case studies. Service activities provide the highest net operating margin mainly because of the private amenity product (row "1.2.4 Owner consumed" in Tables S2 and S3). In the ranch cases, the net operating margin is positive for forestry, although with low value, and it goes from negative to positive in livestock, game, and crop activities. Service activities offer the highest net operating margin, also due to the private amenity product, although the value of this product is lower in the ranch cases than in the dehesa cases.

We now compare results for commercial and private amenity activities. Private amenities contribute more to the net operating margin, capital gains, and capital income than do commercial activities in both the dehesa (Table 3) and ranch cases, except for the net operating margin of Ranch A (Table 4). The difference in the contribution of commercial and private amenity activities is less in the ranch cases. Capital gains contribute to capital income more than net operating margin in most cases, with this contribution ranging from 27% to 70%.

Income from labor corresponds solely to commercial activities and is completely derived from hired employment in the dehesa cases and from both hired and self-employed labor in the ranch cases. Self-employed labor contributes 19% to total labor in Ranch B and 79% in Ranch C. According to the hours of self-employed labor observed in these ranches, we estimate a self-employed labor income of \$0.9 and \$5.8 h^{-1}, respectively, representing 4% and 24% of the average wage for related work in the area in 2010. Net value added and total income figures go beyond landowner income as they incorporate salaried compensation to employees, which makes the lowest contribution to these indicators in all cases.

Profitability rates (Table 5) also show higher values for private amenity activities except for the operating profitability of Ranch A. Considering all case studies, total profitability ranges from 5.4% to 10.5%. If capital gains were not considered, the total profitability would be reduced between 3% and 5% (except for Dehesa A, which suffered a significant loss in manufactured capital during 2010). If private amenity income was also omitted, total profitability would additionally be reduced between 2% and 4.5%, becoming negative or near zero in most cases. If we adjust the land revaluation rates by the average cumulative inflation rate from the same periods for which these revaluation

Table 3
Income and capital indicators for three dehesa case studies (unit: US dollars per hectare of useful agrarian land; yr. 2010).

Class	Dehesa A			Dehesa B			Dehesa C		
	Commercial	Private amenity	Total	Commercial	Private amenity	Total	Commercial	Private amenity	Total
Labor *(L)*	179.3	–	179.3	212.5	–	212.5	64.6	–	64.6
Employee compensation *(EL)*	179.3	–	179.3	212.5	–	212.5	64.6	–	64.6
Self-employed compensation *(SEL)*[1]	0.0	–	0.0	-	–	–	0.0	–	0.0
Net operating margin *(NOM)*	−117.8	642.1	524.3	−208.0	465.9	257.9	−13.0	389.3	376.3
Capital gain *(CG)*	−91.1	281.4	190.3	73.3	525.7	599.0	−4.6	349.5	344.9
Capital income *(CI = NOM + CG)*	−208.9	923.5	714.6	−134.7	991.6	856.9	−17.6	738.8	721.2
Net value added *(NVA = NOM + L)*	61.5	642.1	703.6	4.5	465.9	470.4	51.6	389.3	440.9
Total income *(TI = NVA + CG)*	−29.6	923.5	893.9	77.8	991.6	1 069.4	47.0	738.8	785.8
Land price[2]			8 807.4			9 934.4			6 903.5
Immobilized capital *(IMC)*			13 156.9			11 931.6			10 513.1

[1] Self-employed compensation shows a zero value to denote unpaid labor in the activity (hours of self-employed labor that gets no remuneration) and shows a dash when there is no self-employed labor time devoted to the activity.
[2] Land price at the beginning of the year.

Table 4
Income and capital indicators for three ranch case studies (unit: US dollars per hectare of useful agrarian land; yr 2010).

Class	Ranch A			Ranch B			Ranch C		
	Commercial	Private amenity	Total	Commercial	Private amenity	Total	Commercial	Private amenity	Total
Labor *(L)*	35.3	–	35.3	19.6	–	19.6	6.6	–	6.6
Employee compensation *(EL)*	35.3	–	35.3	15.8	–	15.8	1.4	–	1.4
Self-employed compensation *(SEL)*[1]	–	–	–	3.8	–	3.8	5.2	–	5.2
Net operating margin *(NOM)*	104.1	90.9	195.0	5.0	201.1	206.1	18.9	63.0	81.9
Capital gain *(CG)*	4.1	218.6	222.7	31.4	219.6	251.0	−10.7	192.7	182.0
Capital income *(CI = NOM + CG)*	108.2	309.5	417.7	36.4	420.7	457.1	8.2	255.7	263.9
Net value added *(NVA = NOM + L)*	139.4	90.9	230.3	24.6	201.1	225.7	25.5	63.0	88.5
Total income *(TI = NVA + CG)*	143.5	309.5	453.0	56.0	420.7	476.7	14.8	255.7	270.5
Land price[2]			3 495.1			3 527.9			3 108.6
Immobilized capital *(IMC)*			3 976.8			4 447.4			3 630.1

[1] Self-employed compensation shows a zero value to denote unpaid labor in the activity (hours of self-employed labor that gets no remuneration) and shows a dash when there is no self-employed labor time devoted to the activity.
[2] Land price at the beginning of the year.

rates were estimated (2.7% in both locations), real total profitability is 2.7%, 4.5%, and 4.1% for Dehesa A, B, and C, respectively, and 7.8%, 7.5%, and 4.5% for Ranches A, B, and C, respectively.

Discussion

We have presented a 1-yr pilot study of the application of an accounting method that includes private amenity consumption and capital gains to six case studies of private hardwood rangeland properties in California and Spain. This is a first approximation assessment for a complex economic and investment process. It will require more than a year and six case studies to fully measure and understand the different components of total income in these rangelands. While our case studies may represent a share of hardwood rangeland properties in each country, the limited scope of our analysis leaves out ranch types and landowner profiles that would show different income results. Nevertheless, we have acquired the empirical data needed to test the proposed accounting system and to compare similar agroforestry systems in two different countries using the same analytic approach.

Methodological Challenges

Nonmarket valuation has undergone important developments in recent decades, and the current methods are generally accepted in the scientific literature. The main challenge for our approach is the integration of WTP values in an accounting system that uses exchange values. This requires a single price that would be paid in a simulated competitive market (Caparrós et al., 2003), implying that only part of the landowner's WTP is being capitalized into the land price. In our application, however, we include the mean WTP for a specific landowner and property type as the amenity product price, which implicitly assumes that all landowners within the same type would pay their maximum WTP and that this WTP is fully capitalized into the land price. We consider this monopolistic scenario to be realistic in our application because each property represents a unique environmental asset that is differentiated from other properties. Under this assumption, the mean WTP for each landowner type is a (simulated) exchange value. Further research may explore relaxing this assumption and estimating how it would affect income and profitability estimations.

Moreover, for future applications we should consider that a part of the WTP for amenities actually corresponds to some commercial activities, as the landowner's desire to enjoy the rural lifestyle may be associated with working in traditional ranch operations. For example, livestock management can be part of the rancher lifestyle, and an amenity, and owner WTP for private amenities might not exist without the presence of livestock and related activities. It is also known that hunting activities exist at least partly because landowners enjoy hunting themselves instead of maximizing commercial profits. Attributing part of the WTP for amenities to some of these commercial activities would not change the total income and profitability figures, although it would increase those from commercial activities and decrease those from private amenity activities. In accounting terms, this implies that commercial activities are producing intermediate amenity services (a product) that are used up as an input (an intermediate consumption cost) by the private amenity activity.

The integration of capital gains is not free of shortcomings, either, particularly for land revaluation. In our application, we use an annual average land revaluation rate estimated over a period of time. This is more appropriate for analyzing a long-term trend. Had we used the land revaluation rate of the year for which the case study data were taken, we would have obtained very particular results: negative rates in Spain (−3.4% in 2010) and exceptionally high rates in California

Table 5
Profitability indicators for three dehesa and three ranch case studies (unit: %; yr 2010).

Class	Dehesa A			Dehesa B			Dehesa C		
	Commercial	Private amenity	Total	Commercial	Private amenity	Total	Commercial	Private amenity	Total
Operating profitability (p_o)	−0.9	4.9	4.0	−1.7	3.9	2.2	−0.1	3.7	3.6
Capital gain profitability (p_{cg})	−0.7	2.1	1.4	0.6	4.4	5.0	−0.1	3.3	3.2
Total profitability (p_t)	−1.6	7.0	5.4	−1.1	8.3	7.2	−0.2	7.0	6.8
Class	**Ranch A**			**Ranch B**			**Ranch C**		
	Commercial	Private amenity	Total	Commercial	Private amenity	Total	Commercial	Private amenity	Total
Operating profitability (p_o)	2.6	2.3	4.9	0.1	4.5	4.6	0.5	1.7	2.2
Capital gain profitability (p_{cg})	0.1	5.5	5.6	0.7	4.9	5.6	−0.3	5.3	5.0
Total profitability (p_t)	2.7	7.8	10.5	0.8	9.4	10.2	0.2	7.0	7.2

Operating profitability is calculated as (*NOM*/*IMC*) * 100; Capital gain profitability is calculated as (*CG*/*IMC*) * 100; and Total profitability is calculated as (*CI*/*IMC*) * 100.
NOM, net operating margin; *CG*, capital gains; *CI*, capital income; *IMC*, immobilized capital.

(19.6% in 2007). These year-specific rates respond to two very different economic situations in each country in each year. In 2010, Spain was in the middle of an economic recession that caused dramatic declines in land prices. In 2007, the housing bubble reached a peak in the United States with high increases in land values.

The open question is whether having a longer period of land revaluation data would better reflect the long-term trend, and specifically whether this would have lowered the estimated profitability rates. This could be the case for California, for which we are missing data from the mid-1990s, a period in which prices increased more slowly. In addition, we must note that we are using average rates in each region and it is likely that this rate increases for those properties closer to urban centers. However, as pointed out previously, our case studies are located in areas with low development pressure so that land revaluation figures are not expected to be much influenced by potential land conversion.

Conservation and Management in Hardwood Rangelands

In our study areas, the negative or low commercial net operating margins would be expected to increase the likelihood of the cessation of livestock grazing activities and, following from that, increase the likelihood of abandonment or land use change. In Spain and most of Europe, lack of management is a widely recognized problem and a concern for conservationists because of the importance of agricultural activities in maintaining many habitats (Bugalho et al., 2011). In dehesa, while land use conversion is strongly limited by zoning, a lack of grazing leads to the natural expansion of shrubs into grasslands and woodlands, with a potential loss of natural capital due to vegetation changing away from hardwood rangeland (Ramírez and Díaz, 2008). In California, where zoning is relatively flexible, low commercial net operating margin and high land revaluation can contribute to the likelihood of property subdivision and subsequent habitat fragmentation as cash-poor ranchers sell parcels or the entire ranch. The State of California projects that more than 1 million acres of California hardwood rangelands will be developed, and approximately 750 000 are at risk of urban development in the near future (Gaman and Firman, 2006).

In this context, the values of private land amenities to landowners have two important policy implications. First, they can motivate landowners to continue in livestock production or forestry operations, assuming that amenity values are linked to these activities. Yet they ultimately cannot make up for the lack of cash income resulting from a negative or low net operating margin. Thus, programs supporting declining commercial activities may be strengthened by linking them to the amenities already consumed by landowners as this will encourage landowners to maintain the commercial operations targeted by these programs. For example, providing carbon credits to landowners to plant trees that sequester carbon but that also offer scenic values may encourage them to maintain the trees in the long term. Similarly, public funding for rangeland management that promotes biodiversity, and at the same time allows the rancher to continue the lifestyle associated with livestock production, may improve the success of these programs because they do not impinge on the lifestyle motivations of some ranchers. An example in California is the federal Environmental Quality Improvement Program (EQIP), which provides funds to ranchers who make improvements that enhance wildlife habitat or protect soils. If these funds target projects that are linked to landowner amenities, they are more likely to be successful. In Spain, the agrienvironmental measures of the Common Agricultural Policy (CAP) could also benefit from targeting actions that promote land management and uses aligned with landowner amenity preferences (e.g., retiring exotic tree species or promoting native endangered cattle breeds). The availability of disaggregated estimates of commercial and amenity incomes at the ranch, ecosystem, or regional scale could help to allocate conservation funds by targeting areas where there are synergies between landowner amenities and desirable management actions.

Second, the existence of amenity values may increase the cost-efficiency of some conservation programs (i.e., landowners motivated by amenity values may carry out specific actions or engage in conservation schemes on their properties even if funding is relatively low). For example, conservation easements, where a conservation organization purchases the development rights to a property from a willing seller, might be less costly when the landowner knows that she will continue to consume amenities associated with ranching after the easement is established. In other words, for similar ranches in terms of commercial production, a landowner who obtains more amenity values from the land might be willing to accept a lower price for their development rights. This also may apply to the agri-environmental measures of the CAP that seek to compensate landowners for the lost profits derived from a specific action. The program could target more landowners if compensations are reduced according to the landowner-expected private amenity benefits. Off-ranch income could play an important role here, as amenity values do not provide the cash income that may be needed to sustain traditional agricultural operations. Thus, for example, the purchase of easement-protected properties may in the future be possible only for purchasers with substantial outside income, and ultimately the amenities associated with the ranching lifestyle may have to in some part be funded by this off-ranch income.

Finally, although private amenity consumption takes place on properties where landowners have the right to exclude access, some ecosystem services associated with private amenity enjoyment, such as open-space, wildlife, or scenic values, are also available to the general public. These services might be reduced in the absence of private amenity motivations, given that limited public conservation budgets cannot sustain all the habitats and species provided by private hardwood rangelands. Supporting private amenity consumption could be justified from the public perspective because it can help reduce the cost of conservation programs and contribute to the provision of some public ecosystem services.

Implications

Our results show that private amenity consumption and capital gains are the main contributors to landowner total income and that the analyzed hardwood rangeland case studies are competitive with alternative investments when these income components are considered. If we only consider commercial activities, however, profitability is negative or near zero and falls short of explaining market land prices. Both private amenity consumption and capital gains contribute to the continuation of working landscapes in both countries and should be considered in the design of conservation policies for these hardwood rangelands.

In the Spanish cases, low commercial profitability in the absence of private amenity consumption might lead to the cessation of grazing and active management, changing an ecosystem recognized for its high levels of biodiversity. In California the same phenomena could lead to grazing cessation and land use change, fragmenting extensive habitat of high biodiversity and reducing options for management of wildlife habitat and fire. The disaggregated estimation of private amenity consumption, commercial, and capital gain values allows for a better understanding of the economic forces present in these rangelands and can improve the design of conservation policies. Policy action supporting traditional rangeland operations may be strengthened by building on landowner amenities as these contribute to desirable environmental outcomes and reduce the risks associated with low or negative net operating margins. In addition, the existence of amenity values may increase the cost-efficiency of conservation approaches or programs due to landowner willingness to pay to consume amenities that may be enhanced by these programs.

Our research contributes to progress in integrating market and nonmarket values into decision making. The income accounting extensions we have applied at the individual property level could serve as the basis for the development of larger-scale applications. A representative sample of dehesas/ranches could be used to obtain results that are inferred to the larger population. A sampling process based on key characteristics of hardwood rangeland properties would be needed to obtain representative information about commercial operations, private amenity consumption, and capital valuation as required by the AAS. It would also be optimal to collect these data for several years (we have done this only for the land revaluation rate). For commercial data and capital valuation, we would need to carry out a field data collection procedure with the sample of properties. For the contingent valuation survey, it is likely that amenity preferences hold relatively stable for several years and it would be necessary to determine the optimal frequency of this type of survey. Due to the different type of data to be collected, the sample of properties used for the contingent valuation survey should be larger than that used for commercial and capital data collection.

This type of large-scale application would allow for a more comprehensive analysis of the evolution of the economic factors shaping these rangelands and would benefit policy making by incorporating temporal trends for the different landowner income components. These trends will help to understand the strength or weakness over the years of the different income components that could threaten or conserve these rangelands. While declining private amenity values could indicate that the management of these rangelands are evolving toward more of a commercial profit orientation, it could also be pointing to a high probability of abandonment or conversion, increasing the conservation risks faced by these rangelands.

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Supplementary data (Appendix S1, Appendix S2, Table S1, Table S2,Table S3)

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.rama.2017.02.002.

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