Silvopastoralism and Sustainable Land Management

Edited by
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CABI *Publishing*

Proceedings of an International Congress on Silvopastoralism and Sustainable Management held in Lugo, Spain, in April 2004

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CABI Publishing

This book has been funded by the European Union as Accompanying Measure QLAM-2001-00512

CABI Publishing is a division of CAB International

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Oxfordshire OX10 8DE
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A catalogue record for this book is available from the British Library, London, UK.

Library of Congress Cataloging-in-Publication Data

International Congress on Silvopastoralism and Sustainable Management (2004 : Lugo, Spain)
Silvopastoralism and sustainable land management : proceedings of an International Congress on Silvopastoralism and Sustainable Management held in Lugo, Spain, in April 2004 / Edited by M.R. Mosquera-Losada, A. Rigueiro-Rodríguez and J. McAdam.
p. cm.
Includes bibliographical references and index.
ISBN 1-84593-001-0 (alk. paper)
1. Agroforestry-Congresses. I Mosquera-Losada, M.R. II. Rigueiro-Rodríguez, A. III. McAdam, J. (Jim) IV. Title.

A464.5.A45I574 2006
634.9'9--dc22

ISBN-10: 1 84593 001 0
ISBN-13: 978 1 84593 001 1

Printed and bound in the UK, from copy supplied by the editors, by Cromwell Press, Trowbridge.

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Economic considerations of silvopastoralism in California oak woodlands

R. B. Standiford [1], L. Huntsinger [1], P. Campos-Palacín [2] and A. Caparrós [2]
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Abstract
Oak woodlands in California cover 4 million hectares and are over 80% privately owned. Silvopastoralism is the dominant land use, providing a working landscape with the highest biodiversity levels in the state. However, high opportunity costs from alternative land uses threaten to fragment these areas. Despite these economic pressures, landowners make management decisions reflecting their utility for environmental services. Positive mathematical programming, an optimization technique that constrains solutions with actual producer behaviour, is used to determine these values. These derived environmental service values are incorporated into a dynamic optimal control model illustrating the interaction of livestock grazing, hunt clubs and firewood harvest for different risk and land productivity scenarios. The value of silvopastoral management of oak woodlands is further demonstrated with contingent valuation and hedonic pricing. Individual parcels with oak cover have higher value than bare land. Oak woodland open space adds value to individual parcel owners and the entire community. These results are discussed in the context of conservation policies for oak woodlands.

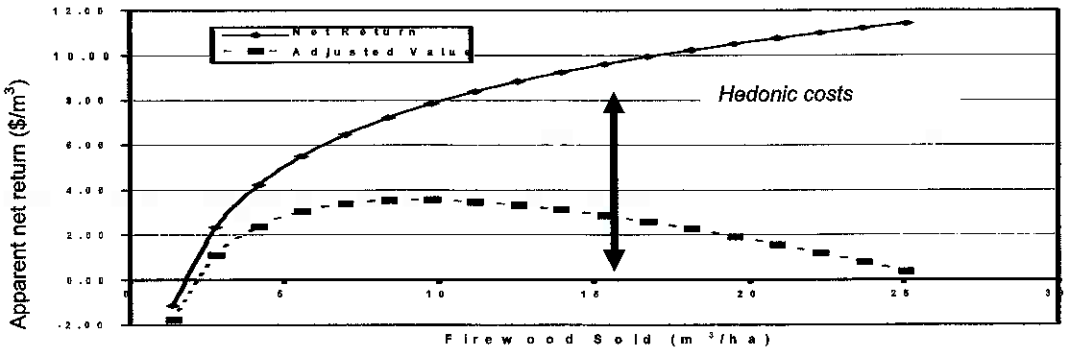
Key words: optimal control, working landscapes, resource economics

Introduction
California has approximately 4 million hectares of oak woodlands, which are the most biologically diverse broad habitat in the state (Standiford and Tinnin, 1996). Most of the state's water flows through these lands and they supply both aesthetics and recreational values. These public values are mainly supplied by private landowners, who own over 80% of the state's oak woodlands (Standiford and Tinnin, 1996). Over two-thirds of all oak woodlands are grazed by domestic livestock and managed as silvopastoral enterprises (Huntsinger *et al.*, 1997).

The continued supply of public values from these private lands depends on the value of silvopastoral enterprises and the opportunity costs of competing land uses, such as urban developments, intensive agricultural enterprises and rural subdivisions. Economic institutions such as conservation easements and property tax policies provide incentives to private owners to supply public values. Broadened markets for oak woodlands products, including fee hunting, recreational leasing and mitigation banking, increase returns and help maintain extensively managed silvopastoral working landscapes. Economic quantification of the ecological services from oak woodlands demonstrates the importance of conservation policies.

Landowner investment in environmental value
Models of likely silvopastoral management decisions must incorporate landowners' utility for environmental services produced on their lands. Poorly specified production models understate a manager's self-consumption of amenity and environmental services, and lead to erroneous conclusions about likely management strategies and appropriate public polices.

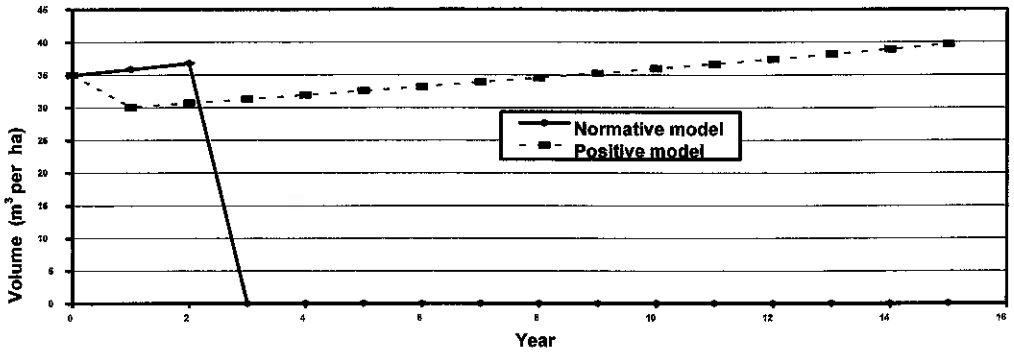
Figure 1. Net firewood return per cubic metre as function of amount of wood harvested (Standiford and Howitt, 1992).



A normative dynamic oak woodland optimization model including cattle, firewood and hunting concluded that markets at that time would lead to oak clearing to increase forage yield for livestock production (Standiford and Howitt, 1992). Although common in the 1940s to 1970s, this behaviour was rare in recent years (Standiford *et al.*, 1996). The model shortcomings were due to failure to accurately account for a landowner's utility from retaining oaks for their amenity value. A positive mathematical programming (PMP) approach (Howitt, 1995) was used to derive missing elements of the true costs and returns of oak harvest omitted from the normative model. The dynamic optimization model was constrained by actual landowner behaviour to derive these missing values. The shadow prices from the behaviour constraint represent the marginal benefit of retaining trees from what might otherwise be predicted from an engineering approach to harvest values.

Figure 1 shows the firewood revenue model developed from market information, and the hedonic pricing model calibrated from the actual behaviour of oak woodland owners. The difference between the two curves represents the environmental self-consumption value of retaining trees. Figure 2 shows how this specification, which incorporates actual landowner behaviour, gives a more realistic assessment of actual landowner behaviour than a model which omits the value a landowner places on tree retention (Standiford and Howitt, 1992).

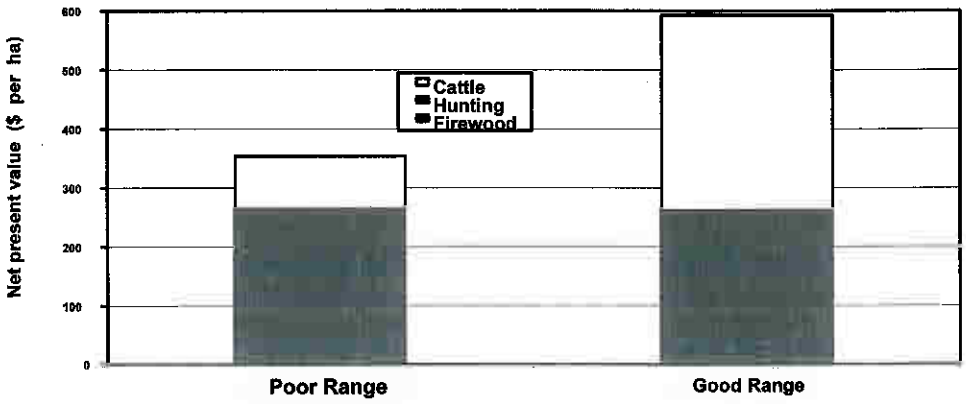
Figure 2. Oak volume levels in California oak woodlands under normative and positive modelling approaches (Standiford and Howitt, 1993).



Commercial values of silvopastoral systems

This optimization model, incorporating landowner utility, is used to evaluate oak cover, firewood harvest and cattle grazing under different risk and land productivity conditions (Standiford and Howitt, 1992). Figure 3 shows the contribution of the three major commercial enterprises to total net present value of California oak woodlands with an initial oak volume of 50 m^3/ha (Standiford and Howitt, 1993). Cow-calf enterprises on average have a positive economic value. Fee hunting can be an important enterprise, contributing from 40% (on good range sites) to 70% (on poor range sites) of the total silvopastoral value. The economic contribution of wood harvest is low.

Figure 3. Net present value of California oak woodlands from various commercial enterprises (Standiford and Howitt, 1993).



The model showed that diversification of silvopastoral enterprises reduced tree harvesting and cattle grazing. The marginal value of retaining oaks for wildlife habitat for hunt clubs exceeded the marginal value of the extra forage or

firewood harvest (Standiford and Howitt, 1992). Wood harvest is used in years with poor forage production or low livestock prices. The capital value of the trees is a hedge against years with low livestock profitability. Inclusion of a risk term shows that firewood harvest and livestock grazing intensity both increase. Policies reducing landowners' risk, such as a subsidized loan programme during poor forage production or low livestock price years, might reduce the need to liquidate oak tree capital assets.

Opportunity costs of oak woodlands

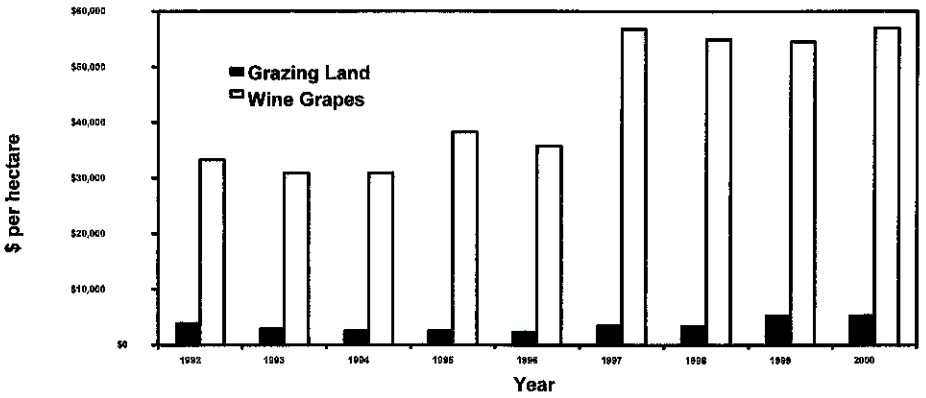
In many areas of California, the commercial values from silvopastoral management represent only a small fraction of the actual land value. Alternative land uses such as intensively managed agricultural products or subdivision for residential housing usually have much higher market values than extensively managed oak woodlands. Many of these higher value land uses, unless carefully planned, convert and fragment oak woodland habitats, diminishing their capacity to supply public amenity values (Merenlender *et al.*, 1998).

These alternative land uses create an opportunity cost for owners. For example, in the central coast of California, grazing land value may be worth less than 10% of the value of the land for intensive agricultural use for wine grapes (Figure 4), or less than 1% of its value for residential uses (CALASFMRA, 2001), creating tremendous pressure to move to land uses that may cause higher environmental costs.

The California Land Conservation Act (CLCA), also known as the Williamson Act, is one attempt to reduce the conversion pressure by basing annual property tax on current land use, rather than its "highest and best use" (Carman, 1977). This policy requires landowners to maintain their extensive agricultural use for 10 years.

Estate taxes of oak woodland parcels are determined by their "highest and best use" derived through the land market. High estate taxes, driven by these opportunity costs, have been identified as one of the largest constraints to inter-generational transfers of large, extensively managed oak woodland parcels (Johnson, 1997). USA estate tax reform is being considered to reduce conversion pressures on agricultural lands, including oak woodlands.

Figure 4. Typical value of central coast California oak woodlands for different land uses (CALASFMRA, 2001).



Environmental service values from oak woodlands

One of the reasons for the migration of Californians from urban areas to oak woodlands is because of their amenity values. Land markets for oak woodlands include amenity values. The oaks on the property, the presence of oaks in a surrounding neighbourhood and the presence of oak woodland in open space adjacent to a property all affect property values.

Contingent valuation was done on different spatial arrangements of oak stands to evaluate how oak cover affects property value (Diamond *et al.*, 1987). On 2 hectare lots, rangeland with at least 100 oaks per hectare was worth 27% more than open land. There was a similar value for open to heavy tree stocking (100 to 1140 trees/ha) on these 2 hectare lots. Similar trends were also observed on 0.8 hectare lots, with 100 trees/ha being worth 22% more than bare land. Denser areas (over 100 trees/ha) were not worth as much as the more open stands, but still had higher value than bare land.

The effect of a 3400 hectare oak woodland open space in southern California on overall community land and home value was evaluated using hedonic pricing. A decrease of 10% in the distance to the nearest oak stands and to the edge of the permanent open space land resulted in an increase of $4 million in the total home value and an increase of $16 million in total land value in the community (Standiford and Scott, 2001). Evaluation of over 3000 individual home and land parcel values showed the effect of adjacent oak stands and open space land. The average home immediately adjacent to a native oak stand was 12% more valuable than a home located 0.25 km from an oak stand. Land prices for lots immediately adjacent to the oak woodland open space is valued 17% higher than the same land characteristics set

0.25 km from the edge of the open space area. Private owners receive a premium by being located adjacent to land that will remain as dedicated open space.

Conservation of oak woodland open space increases overall land and home value of an entire community. The overall assessed property value of a community is higher because of the value added by these environmental assets. The resulting increases in annual property tax accruing to local government can be used to justify public financing of local oak restoration efforts, or the purchase of development rights for permanent open space or extensively managed working landscapes.

Conservation easements and land trusts

With the large private ownership of California's oak woodlands, and high opportunity costs of maintaining silvopastoral working landscapes, new approaches are needed to conserve these lands. Currently, one of the largest sources of funding for oak woodland conservation comes through a diverse set of institutions known as "the Land Trust Movement". Land trusts are organizations that act directly to conserve land. These vary in scale from localized groups, operating with volunteer staffs and little to no direct budget, to regional groups with staffs and some funding, to large international groups, such as the Nature Conservancy. In California, there are 132 land trusts, conserving over 400,000 ha of land (LTA, 2002).

Land trusts purchase directly or accept donations of conservation easements. Conservation easements are contracts that divide the bundle of rights involved in land ownership (development rights, grazing rights, mineral rights, water rights, etc.) between the landowner and the holder of the easement, in this case a land trust. The conservation easement creates a permanently deeded restriction on the limits and kinds of development for a property. For example, the urban development rights for an oak woodland property may be sold or donated to a land trust. The development rights are held in perpetuity by the land trust. The landowner receives benefits from the capital value of the rights donated or sold, and society benefits by the maintenance of the ecological value of the land. The area can continue to be used for silvopastoralism.

Funding for conservation easement purchases comes from private sources, such as foundations, as well as from public sources. Considerable oak woodland area has been placed into conservation easements in Sonoma County in California, funded by a local sales tax surcharge for the county (Mackenzie and Merenlender, 2000). In the Northern Sierra, the Nature Conservancy, working with a state organization called the Rangeland Trust, has acquired conservation easements on blue oak woodlands using private foundation funding sources (Reiner *et al.*, 2002). An oak woodland conservation easement to preserve unique habitat for several threatened and endangered species was acquired in the San Francisco Bay Area, funded by fees provided by a private developer as mitigation for habitat being lost elsewhere as part of a development project. Landowners were compensated for having their oak woodland serve as a mitigation bank for unique habitats.

Another type of conservation easement transaction involves donations of the easement to a land trust. The market value of the portion of the property rights donated represents a reduction in the land's basis. This can be considered a charitable donation, reducing the landowner's taxable income. Lowering the land basis also reduces the inheritance tax as the land passes from generation to generation. This reduces the need to liquidate some of the opportunity costs of the land in order to pay inheritance taxes.

Conclusions

Silvopastoral management of California's oak woodlands provides a diverse array of products. These economic enterprises serve as working, privately managed landscapes, supplying high environmental service values to Californians. Much of the production of these environmental values comes from landowners' utility for these values. These amenity and environmental values of oak woodlands create incentives for landowners to maintain the health and vigour of trees.

Owners have motivation to maintain oak stands in areas that may be developed, because of the higher value for these lots. Also, since forested neighbourhoods have higher value, it may be wise for homeowner associations to utilize covenants, codes and restrictions (CCRs) to maintain overall oak stands in a neighbourhood. The effect of extensively managed open space on enhancing adjacent property values points to the role of compensation of large ownerships through land trusts, because of the economic as well as the conservation value of these types of lands. Silvopastoral management strategies can offer cost-effective means to provide environmental services to the adjacent community.

Many oak woodland ecological values can be correlated with economic value as these resources become increasingly scarce. Outright compensation of landowners through the purchase of development rights or tax and estate planning benefits through donation of the land value differences provide additional economic incentives for landowners to maintain the conservation value of their lands. However, the opportunity cost of conversion to higher value land use is driving a decrease in large expanses of oak woodland open space.

Silvopastoral management strategies for oak woodlands in California provide important conservation values to the public. However, these values have been undervalued by traditional agricultural production models. New approaches to evaluating the self-consumption of environmental services and the quantification of the real utility of

amenity values observed in the market offer promising approaches to better represent their value to landowners and society. These tools can be used to evaluate new conservation policies for California's oak woodland resources.

References

CALASFMRA (American Society of Farm Managers and Rural Appraisers: California Chapter) (2001) Trends in agricultural land and lease values-California land prices: Central Coast. www.calasfmra.com/landvalues/2002 (accessed April 2004).

Carman, H.F. (1977) California landowner's adoption of a use-value assessment program. *Land Economics* 53, 275-287.

Diamond, N.K., Standiford, R.B., Passof, P.C. and LeBlanc, J. (1987) Oak trees have varied effect on land values. *California Agriculture* 41 (9-10), 4-6.

Howitt, R. (1995) Positive mathematical programming. *American Journal of Agricultural Economics* 77, 329-342.

Huntsinger, L., Buttoloph, L. and Hopkinson, P. (1997) Ownership and management changes on California hardwood rangelands: 1985 to 1992. *Journal of Range Management* 50 (4), 423-430.

Johnson, S.G. (1997) Factors contributing to land-use change in the hardwood rangelands of two central Sierra Nevadan counties. In: Pillsbury, N.H., Vecner, J. and Tietje, W.D. (eds) *Proceedings of a Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues*. USDA Forest Service General Technical Report PSW-GTR-160, San Luis Obispo, USA, pp. 593-602.

LTA (Land Trust Alliance) (2002) *The Land Trust Census*. LTA, Washington, DC, USA.

Mackenzie, A. and Merenlender, A. (2000) Sonoma County Acquisition Plan 2000: a tool for conserving oak woodlands. *UC-IHRMP Oaks 'n Folks* 16, 2.

Merenlender, A.M., Heise, K.L. and Brooks, C. (1998) Effects of sub-dividing private property on biodiversity in California's north coast oak woodlands. *Transactions of the Wildlife Society* 34, 9-20.

Reiner, R., Underwood, E. and Niles, J.O. (2002) Monitoring conservation success in a large oak woodland landscape. In: Standiford, R.B., McCreary, D. and Purcell, K.L. (eds) *Proceedings of the Fifth Symposium on Oak Woodland: Oaks in California's Changing Landscape*. USDA Forest Service General Technical Report PSW-GTR-184, San Diego, USA, pp. 639-650.

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

Standiford, R.B. and Howitt, R.E. (1993) Multiple use management of California's hardwood rangelands. *Journal of Range Management* 46, 176-181.

Standiford, R.B. and Scott, T.A. (2001) Value of oak woodlands and open space on private property values in Southern California. *Investigación Agraria: Sistemas y Recursos Forestales* 1, 137-152.

Standiford, R.B. and Tinnin, P. (1996) *Guidelines for Managing California's Hardwood Rangelands*. Leaflet no. 3368, University of California, Berkeley, USA.

Standiford, R.B., McCreary, D., Gaertner, S. and Forero, L. (1996) Impact of firewood harvesting on hardwood rangelands varies with region. *California Agriculture* 50 (2), 7-12.