Marginality and restoration of olive plantations in Andalusia

Manuel ARRIAZA[1], José R. GUZMÁN[2], Olexandr NEKHAY[1] and José A. GÓMEZ-LIMÓN[3]

[1] IFAPA, Department of Agricultural Economics, Cordoba, Spain
Corresponding author: manuel.arriaza.ext@juntadeandalucia.es

[2] University of Cordoba, Department of Forestry, Cordoba, Spain
[3] University of Valladolid, Palencia, Spain

Paper prepared for presentation at the XIth Congress of the EAAE (European Association of Agricultural Economists), Copenhagen, Denmark, August 24-27, 2005

MARGINALITY AND RESTORATION OF OLIVE PLANTATIONS IN ANDALUSIA

Abstract

This paper presents the first results of the initial stages of a three years research project on optimization of the use of agricultural lands subject to risk of abandonment. After devising a physical marginality index for olive cultivation based on soil quality and slope, we estimate an approximate area of 200,000 hectares of marginal olive plantations in Andalusia. The risk of abandonment of these farmlands increases with the decoupling of the CAP subsidies and with the socio-economic characteristics of the production. The probable abandonment of these areas implies the negative consequences of wild forestation. We present some actions to minimize the negative effects of this process, being the use of grass cover and hedgerows, on an initial qualitative analysis, the most positive measures.

Keywords: land abandonment, marginal olive groves, biodiversity, soil erosion and visual quality.
JEL Classification: H41, Q21, Q26.

1. Introduction

This study is part of a three years research project financed by the National Agricultural Research Institute (INIA RTA04-086) beginning in January 2005. The aim of the project is to optimize the provision of externalities from olive groves that suffer from a process of marginalization due to the decoupling of the subsidies. The achievement of this objective involves the following phases:

- Definition of marginalization criteria in olive groves
- Study of alternatives aimed to reverse the process of abandonment and to maximize the provision of positive externalities.
- Assessment of the impact of the alternatives upon selected non-market environmental benefits: provision of traditional landscapes, assurance of biodiversity and prevention of erosive processes.
- Integration of externalities into a utility function that weigh them according to the stated preferences of the Society.
- Estimation of the social utility optimum for a given level of public expenditure.
- Selection of sets of alternatives to achieve the optimum.

This paper focuses on the first phase of the project and explores some alternatives and their impact upon biodiversity, erosion avoidance and visual quality of the landscape as the main categories affected by farmland abandonment (Euromontana, 1998).

2. Progressive marginalization of Mediterranean mountain areas

The process of olive grove marginalization in mountain areas can be framed into one of the driven forces that have characterized the changes of the European landscape in the past decades (Wolters, 1999), namely:

- Intensification: in the new EU member States.
- Extensification: in areas under increasing environmental regulations.
- Abandonment: particularly important in Mediterranean areas.

The last one could represent a problem in the Mediterranean mountains covered with olive groves following the reform of the olive oil OCM since most of these plantations, without the subsidy, do not cover the variable costs of production. The abandonment of olive groves, which grow mostly on

inclined, shallow and low fertility soils, would transform the territory into natural Mediterranean type forests. This change, without human control, generally has an undesirable effect on both the environment (Vacher-Richard, 1987; Brown, 1991; MacDonald et al. 2000; Loumou and Giourga, 2003) and the rural identity of these areas (Hochtl et al., 2004). Therefore, the abandonment of these cultivated lands will have an effect on:

- ✓ *Biodiversity*. It varies depending on the scale of observation (Holl and Crone, 2004; Conti and Fagarazzi, 2004). In general, the abandonment of cultivated fields the non-human controlled expansion of forest leads to a reduction of biodiversity.
- ✓ *Soil erosion*. There are mixed arguments on the effects of land abandonment, some authors claim a better control of erosion after the invasion of a dense shrub that reduces water runoff (Cernusca et al., 1996; Tasser et al., 2003). On the contrary, García-Ruiz et al. (1996) find negative effects like the invasion of riparian vegetation that block rivers and the degradation of man-made structures that reduce erosion (e.g. terraces in olive groves), or even desertification as a consequence of repeated fires (González Bernáldez, 1992).
- ✓ *Cultural landscapes*. Although people tend to assume that natural landscapes are synonymous of ecological quality, the former may not imply the latter (Nassauer, 1992). Moreover, from an aesthetic point of view, this natural reafforestation could have a negative impact on the visual quality of these traditional landscapes, especially for locals (Hunziker, 1995).

Assuming that, to certain extent, the process of abandonment is expected in many Mediterranean mountain areas, the negative effects associated with this change could be reduced with the introduction of some correction measures. As we will see later, these measures could have a positive effect on the optimization of externalities provided by these agricultural systems.

3. Definition of marginality

3.1. Physical approach

In order to determine the agricultural land under risk of abandonment we must first define the concept of marginality. Although this concept encompasses both a socio-economic and physical dimension, this paper focuses on the physical side assuming that, in many cases, the former is consequence of the latter. In the case of the olive groves of Andalusia (Southern Spain), these areas coincide to a large extent with mountain areas highly fragile from an environmental point of view.

Marginality definition varies among countries, e.g. in arid countries the hydrological balance and the risk of erosion are fundamental aspects of marginal areas, whereas in more temperate climates acidity and soil fertility are the key variables (The Macalulay Institute, 1997). The physical criteria considered in Guzmán (2004) are:

A.- *Soil characteristics*. They limit the development of the crop, among others we selected:

- ✓ Lixiviation capacity
- ✓ Fertility (pH, carbonates, etc)
- ✓ Deepness
- ✓ Texture
- ✓ Shape (flat, wavy, etc)

We classify the olive soil into five qualitative categories ranging from 1, none of the limitation is present, to 5, extreme negative conditions for the plant.

B.- *Average slope*. Divided into four categories of suitability for olive cultivation: between 30-50%, the crop is non viable, between 20-30%, 10-20% and less than 10%. The potential viability of the plant increases as the slope decreases but the index is modified depending on the previous one.

Merging both indexes we get an index of marginality for olive cultivation, from A to E, being A the most suitable land for olive cultivation and E the worst. The following table shows the interaction of both indexes.

Table 1. Qualitative index of marginality for olive cultivation

		Soil limitation index for olive cultivation				
		1	2	3	4	5
Slope	<10%	A	A	B	C	E
	10-20%	B	B	C	D	E
	20-30%	C	C	C	D	E
	30-50%	E	E	E	E	E

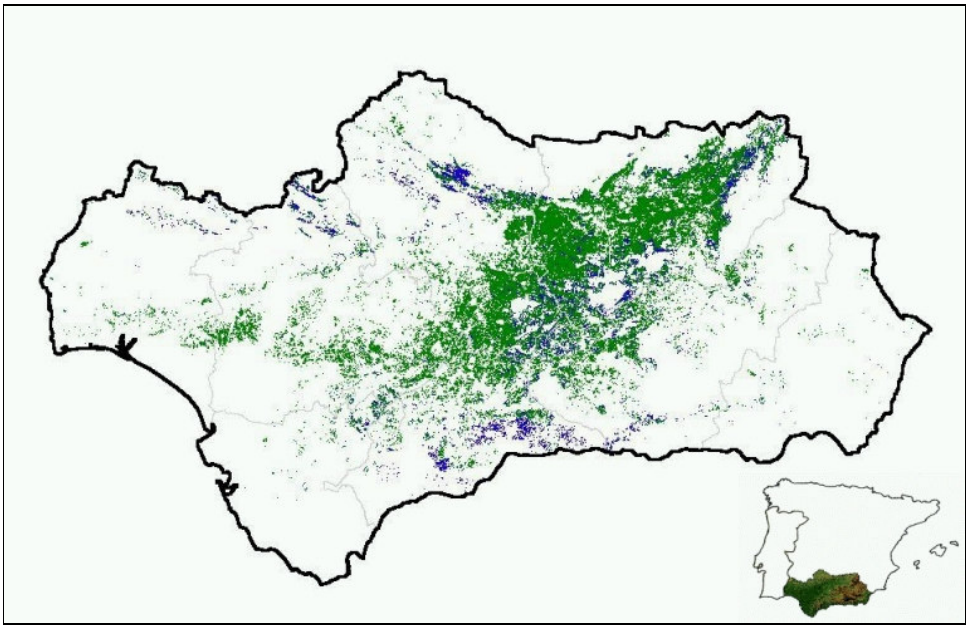
Guzmán (2004) obtains the qualitative index of marginality for the olive cultivation in Andalusia using the following source of data:

- Digital geographic information of the land use (Consejería de Agricultura y Pesca, 2001). The digital map was obtained from aerial photographs (1:60,000).
- Soil map of Andalusia (1:400,000).
- Vector map of slopes. Cell of 20x20 m over topographic map (1:50,000).

Table 2. Marginality index of olive plantations in Andalusia

Marginality index	**Olive area (ha)**	**Percentage**
A	328,004	24.6%
B	390,898	29.3%
C	394,955	29.6%
D	84,008	6.3%
E	134,772	10.1%
Total	*1,332,636*	*100.0%*

According the previous data, more than 16% of Andalusian olive plantations can be considered as marginal, from a physical point of view, and have a clear risk of abandonment after the decoupling of the subsidies. Geographically, the following map shows the location of the marginal olive plantation of Andalusia (marginality index D and E):

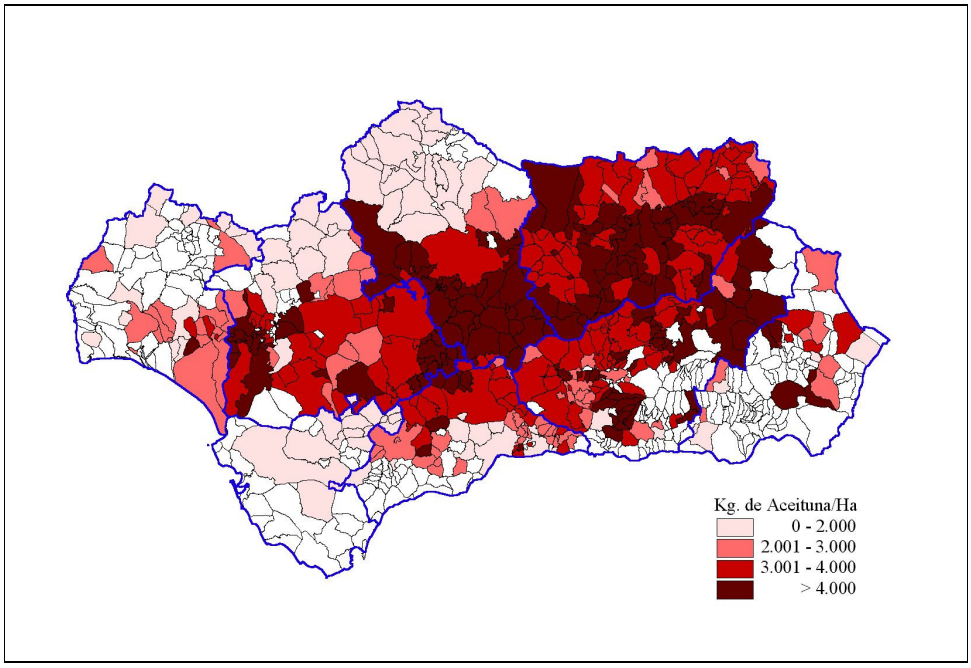


Map 1. Marginal olive plantations in Andalusia (blue) and non-marginal (green). Physical analysis.

From the map, it can be deducted that most marginal olive plantations are mainly located in South and North of the region, both areas crossed by mountains.

3.2. Economic approach

The physical characteristics of the olive plantation will not determine by themselves the probability of abandonment. There are social and economic considerations to be taken into account, among them, the olive yields, as the following map depicts:



Map 2. Average olive yields by municipalities
Source: DG-VI, European Commission (2000-2005)

From the above map, the marginal olive plantations according to physical characteristics can be divided into two groups:

- ✓ Marginal olive plantations in the North and South of the region, with low yields. These olive plantations present high risk of abandonment after the decoupling of the subsidies.
- ✓ Marginal olive plantation in the central area of the region. The continuity of these plantations will depend upon the particular slope of the field (implying the level of variable costs) and the yield, since within a municipality can be found some differences in this variable.

4. Analysis of some corrective measures

The abandonment of theses agricultural lands could have a negative impact on the sustainability of the ecosystem. In this section we explore five measures aim to maximize the provision of positive externalities by olive plantations in marginal areas, namely:

- ✓ *Restoration of riversides*. Including two alternatives:
  - Gallery forests, they include species different from the adjacent plants (Malanson, 1993). Only viable in areas where water is not a limiting resource, this type of vegetation increases landscape diversity (Burel, 1992; Brown and Daniel, 1991).
  - Reforestation with riparian species. The choice of local species increases the probability of success of the action (Schultz et al., 2004).

- ✓ *Use of grassland in olive plantations*. The benefits of the cultural practice of vegetal cover in olive groves include the control of soil erosion (Castro, 1993; Ariza-Seguin et al, 2003). They also add a positive effect on landscape visual quality (Calatrava and Sayadi, 2001; Arriaza et al., 2004).

- ✓ *Restoration of terraces*. These structures prevent from soil erosion and runoff (Dunjo, 2003). Moreover, they enrich the cultural landscape of the area.

- ✓ *Integration of man-made elements*. Rural building and roads may have a negative impact on landscape visual quality. The integration of these antropic elements using local materials and/or green fences leads to an improvement of the scenic role of human intervention on landscape (Arriaza et al., 2004).

- ✓ *Use of hedgerows.* They have a positive effect on biodiversity, increase water infiltration and reduce soil erosion as windbreaks (Hess and Fisher, 2001; Burel, 1992; Laurance, 2004; Falloon et al., 2004).

In order to illustrate their impact on the region, we built a Leopold Matrix for the three externalities under analysis: biodiversity, soil erosion and landscape visual quality. This matrix marks with numbers from 1 (minimum) to 10 (maximum) both the magnitude of the interaction between the action and the externality (in the upper left hand corner) and the extension of the change (e.g. local vs. regional). The sign before the number indicates if the action is beneficial (+) or damaging (-). Although the use of the matrix, developed United States Geological Survey in 1971, is subject to some criticism (the scale itself is subjective and the method fails to identify uncertainty and environmental variability), it is useful for initial stages of the research.

Table 2. Leopold matrix of olive plantation restoration

	Restoration of riversides	Use of grass cover	Restoration of terraces	Integration of man-made elements	Use of hedgerows	*Total*
Biodi-versity	8 6	4 9	1 2	2 4	8 7	*23* *28*
Soil erosion	3 2	9 9	7 7	1 3	7 6	*27* *27*
Visual quality	9 5	8 9	6 6	8 6	8 8	*39* *34*
Total	*20* *13*	*21* *27*	*14* *15*	*11* *13*	*23* *21*	

From the previous exploratory matrix of impacts it is clear that all the actions proposed in the study have a major impact in the visual quality of the landscape. At regional level, the practice of grass cover in the olive cultivation produces the highest impact, followed by the use of hedgerows.

Conclusions

At this stage of the research project we have spotted the dimension of the problem: more than 200,000 hectares of olive plantation in mountain areas of Andalusia are in risk of abandonment after the decoupling of the subsidies. Whereas the natural forestation, this is, no human driven process, is one alternative, most authors warn of its negative effect on the environment and cultural landscapes. We have presented some possible actions aim to reduce the negative impact on the territory, among them, the use of grassland cover as olive cultivation practice and the presence of hedgerows seem, in this initial stage of the research, the two alternatives with higher corrective properties in terms of biodiversity, soil erosion and visual quality of landscape.

References

Ariza-Seguin, M., Díez-Patier, E. and Martínez-Arroyo F. (2003). La lucha contra la erosión en el cultivo del olivar en pendiente. Agricultura Revista agropecuaria 853: 512-516.

Arriaza, M., Cañas-Ortega, J.F., Cañas-Madueño, J.A. y Ruiz-Avilés, P. (2004). Assessing the visual quality of rural landscapes. Landscape and Urban Planning 69: 115-125.

Brown, V.K. (1991). Early successional changes after land abandonment: the need for research. In Land abandonment and its role in conservation. Proceedings of the Zaragoza-Spain seminar. Seminar series A, No. 15, 97-101.

Brown, T.C. and Daniel, T.C. (1991). Landscape aesthetics of riparian environments: relationship of flow quantity to scenic quality along a Wild and Scenic River. Water Resources Research 27: 1787-1895.

Burel, F. (1992). Effect of landscape structure and dynamics on species diversity in hedgerow networks. Landscape Ecology 6: 161-74.

Calatrava, J. and Sayadi, S. (2001). Análisis funcionales de los sistemas agrarios para el desarrollo rural sostenible. Madrid: Serie estudios, Ministerio de Agricultura y Pesca y Alimentación.

Castro, J. (1993). Control de la erosión en cultivos leñosos con cubiertas vegetales vivas. PhD Thesis. University of Córdoba.

Cernusca, A., Tappeiner, U., Bahn, M., Bayfield, N., Chemeni, C., Filat, F., Graber, W., Rosset, M., Siegwolf. R. and Tenhunen, J. (1996). ECOMONT: ecological effects of land use changes on European terrestrial mountain ecosystems. Pirineos 147-148: 145-171.

Consejería de Agricultura y Pesca (2001). Mapa digital de cultivos y aprovechamientos. Sevilla: Consejería de Agricultura y Pesca, Junta de Andalucía.

Conti, G. and Fagarazzi, L. (2004). Sustainable mountain development and the key –issue of abandonment of marginal rural areas. The European Journal of Planning. http://www.planum.net.

Dunjo, G., Pardini, G. and Gispert, M. (2003). Land use change effects on abandoned terraced soils in a Mediterranean catchment, NE Spain. Catena 52: 23-27.

Euromontana (1998). L'integration des preoccupations environnementales dans l'agriculture de montagne. Brussels: Report for European Comisión, DGXI.

Falloon, P., Powlson, D. and Smith, P. (2004). Managing field margins for biodiversity and carbon sequestration: a Great Britain case study. Soil Use and Management 20: 240-247.

García-Ruiz, J.M., Lasanta, T., Ruiz-Flaño, P., Ortigosa, L., White, S., González, C. and Marti, C. (1996). Land use changes and sustainable development in mountain areas: a case study in the Spanish Pyrenees. Landscape Ecology 11: 267-277.

González Bernáldez, F. (1992). Ecological consequences of the abandonment of traditional land use systems in central Spain. Options Mediterraneennes 15: 23-29.

Guzmán, J.R. (2004). The palimpsesto cultivado. Historia de los paisajes del olivar andaluz. Sevilla: Consejería de Agricultura y Pesca, Junta de Andalucía.

Hess, G.R. and Fischer, R.A. (2001). Communicating clearly about conservation corridors. Landscape and Urban Planning 55: 195-208.

Hochtl, F., Lehringer, S. and Konold,W. (2005). "Wilderness": what it means when it becomes a reality –a case study from the southwestern Alps. Landscape and Urban Planning 70, 85-95.

Holl, K.D. and Crone, E.E. (2004). Applicability of landscape and island biogeography theory to restoration of riparian understorey plants. Journal of Applied Ecology 41: 922-933.

Hunziker, M. (1995). The spontaneous reafforestation in abandoned agricultural lands: perception and aesthetic assessment by locals and tourists. Landscape and Urban Planning 31: 399-410.

Laurance, S.G.W. (2004). Landscape connectivity and biological corridors. Agroforestry and biodiversity conservation in tropical landscapes. Washington: Island Press, 50-63.

Loumou, A. and Giourga, C. (2003). Olive groves: "the life and identity of the Mediterranean". Agriculture and Human Values 20: 87-95.

MacDonald, D., Crabtree, J.R., Wiesinger, G., Dax, T., Stamou, N., Fleury, P., Gutierrez Lazpita, J. and Gibon, A. (2000). Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. Journal of Environmental Management 59: 47-69.

Malanson, G.P. (1993). Riparian landscape. Cambridge: Cambridge University Press.

Nassauer, J.I. (1992). The appearance of ecological systems as a matter of policy. Landscape Ecology 6: 239-250.

Schultz, R.C., Isenhart, T.M., Simpkins, W.W. and Colletti, J.P. (2004). Riparian forest buffers in agroecosystems - lessons learned from the Bear Creek Watershed, Central Iowa, USA. Dordrecht: Kluwer Academic Publishers, 61/62: 35-50.

Tasser, E., Mader, M. and Tappeiner, U. (2003). Effects of land use in alpine grasslands on the probability of landslides. Basic and Applied Ecology 4: 271-280.

The Macalulay Institute (1997). Land use options for plants. http://www.mluri.sari.ac.uk/annualreport /1997/index.html.

Vacher-Richard, J. (1987). Una matorralización acelerada: mapa de evolución de las principales unidades del paisaje. In F. Fourneau, J. Garrido and J. Lleo (eds.), Supervivencia de la Sierra Norte de Sevilla. Evolución de los paisajes y ordenación del territorio en Andalucía Occidental. Madrid: MAPA - Junta de Andalucía - Casa de Velázquez.

Wolters, R. (1999). Strategic actions for European landscapes. In D.M. Wascher (ed.), Landscape and sustainability. Proceedings of the European workshop on landscape assessment as a policy tool. Strasbourg, 25-26 March, 12-19.