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Evolution of the landscape as a response of a demographic change. A case study in the Duero riverside, Spain

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The Arribes del Duero area, in western Spain, at the border with Portugal, is suffering a drastic change in the landscape, as a response of the diminution of population. Traditional tasks related to agriculture have been abandoned, and heavy sheep farming on the area is provoking the impoverishment of soils. The effect derived from these actions is the disintegration of the terraces, which are one of the major attractions for tourists visiting the region. We propose that incentives for local people could help to develop those traditional labours to recover the landscape, together with the promotion of immigration of families with school-age children, could bring back the economy to the area.

Keywords: landscape degradation; demographic changes; Arribes del Duero; Spain

Introduction

Changes in demography affect different aspects of both urban and rural areas. Sudden increases in the population may lead to a complete disorganisation of a city or even of a village. They may also have direct impacts on human health and the environment, at both the local and the global level (Abolina and Zilans 2002).

In contrast, if the established population leaves an area massively, the structure, sociology, and cultural heritage of that area tend to fade, with social and environmental implications (Fisher 2005). The same happens with the landscape when a given population has lived from a specific type of product and leaves the area in search of a more comfortable way of life, mainly in large neighbouring towns and cities or even in distant areas. This is a common feature in many areas of Spain (and Europe, Keller 2004), where young people are moving to the main cities, abandoning traditional rural activities. Some areas, such as the Spanish Mediterranean mountains, have become marginal territories, with very few inhabitants and significant changes in land use, both resulting in the degradation of the landscape (Lasanta *et al.* 2001, 2005).

Structural changes in the economy of a region also have many repercussions, one of them being the abandonment of labour-intensive tasks such as farming in deep valleys (Rodewald 2004) and the change to other less intense land use, such as grazing (Ries 2010). The abandonment is more evident in places where traditional farming had originally endowed the landscape with very characteristic features. This is what has been occurring

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along the shores of the Duero river, where for many years the inhabitants lived off the produce they obtained from the typical terraces (these terraces are called "bancales" in Spanish and "terraços" in Portuguese) built across the vast mountainous landscape, taking advantage of the geological substrate of granite, gneisses, and schist. The main crop from these terraces used to be olives (for olive oil), almonds, vines (mainly for wine), and oranges. Now, however, all these agricultural activities are being abandoned, and this abandonment is taking to land degradation. Land degradation is recognised as a global problem associated with desertification, and it can be related to climate change and biodiversity changes (Gisladottir and Stocking 2005). Here we discuss the current state of the landscape of the Duero riverside, together with a survey of the population aimed at estimating the possibilities of recovering traditional farming practices. We also propose some recommendations concerning the possibility of sustainable development of the area by introducing new socio-economic perspectives for the population.

Study area

The study area is located along the Duero river, in the central-western part of Iberia, naturally dividing the peninsula into two countries: Spain and Portugal (Figure 1). The area is known as "Las Arribes del Duero" and has very recently been awarded the status of "Natural Park" (Boletín Oficial de Castilla y León 2002). The Duero river and its tributaries have cut deep into the granitic and metamorphic basement to generate very narrow and deep valleys, encased within steep-sloping hillsides where terrace farming ("bancales¤ or "terraços") has been practised (Figure 2). The Duero river is the natural limit between Spain and Portugal. Although most of our work was carried on the Spanish side, there will be frequent references to the Portuguese side, since this is the ideal image we believe both sides should look like: as a mirror, with the river as the symmetric axis. The Portuguese side has the status name of the *Douro International Natural Park*. The main Spanish villages mentioned here are Vilvestre, Saucelle, Hinojosa, and La Fregeneda.

Study methods

The main technique used in the present work to study the evolution of the landscape was based on aerial photographs from three different episodes (American flight from 1956,

Figure 1. Location of the study area, in the limit between Spain and Portugal.

Figure 2. Very well-preserved terrace farming in the study area.

scale 1:33.000; Spanish Geographical Institute flight from 1977, scale 1:18.000; and Castile and Leon Regional Government flight (orthophoto) from 2000, scale 1:10.000). We also used the national topographical maps from 1999, scale 1:25.000: sheet 449-I (Vilvestre), sheet 449-III (Saucelle) and 448 bis-IV (San Martin); the geology and geomorphology maps from the Spanish Geological Survey (sheet 448/9, Vilvestre), from 2000, scale 1:50.000, and the corresponding farming maps. The episodes we chose for the analyses are only related to the availability of the aerial photographs. However, major changes in the population had taken place during that period. We made a very detailed interpretation of all the bibliographic references we could find to traditional farming practices and demographic changes in the area (Table 1). We also studied the attempts (successful or not) to recover terrace farming in other areas in Spain.

Another very important aspect involved our field trips along the area, noting down the differences between the Portuguese side and the Spanish side. It is clear that Portugal has maintained the landscape for many years, taking advantage of European subsidies (de Graaff *et al.* 2010) and funding to produce *appellation* produce, which is marketed at a higher price but which has the guarantee of a high quality. The differences can be observed very well when sailing along the Duero river, between Spain (Vilvestre) and Portugal (Freixo da Espada a Cinta). There are river ports on both sides. Boat trips are very popular during the summer time, and this is a good way to study the evolution of the landscape, and, as mentioned below, they are certainly a possible tourist attraction.

Finally, we carried out a survey among the inhabitants of the main villages covered in this study. We sent copies of the questionnaires to the majors of the villages, and they in turn sent them to the group of people they believed would be representative for the study. Note should be taken here of the lack of cooperation on behalf of some of the majors, who were convinced that the whole village was in agreement about things remaining as they were, because the abandoned land was then being used for sheep farming and, indeed, sheep cheese is now the major produce elaborated by the villagers.

Table 1. Population evolution between 1534 and 2003.

Year	La Fregeneda	Hinojosa de Duero	Saucelle	Vilvestre
1534	904	1360	**2216**	1192
1587	1400	**2200**	1120	800
1594	1244	1928	–	–
1752	848	1664	932	1352
1787	807	1878	937	1366
1860	1207	1667	1216	1736
1877	1342	1831	1321	1881
1887	1596	2014	1336	**1927**
1900	1499	**2059**	1151	1672
1910	**1651**	1994	1101	1532
1920	1527	1835	1005	1379
1930	1532	1745	921	1449
1940	1508	1878	971	1479
1950	1418	1900	903	1448
1960	1294	1880	**1630**	1397
1970	947	1279	815	906
1981	711	958	620	695
1991	622	813	437	711
2001	543	827	411	605
2003	496	796	385	561

Note: Bold numbers reflect the maximum figures. Some of them are related to events that called up population to the villages, like the construction of dams in Saucelle.

Evolution of the landscape

Landscapes change because they are the expression of the dynamic interaction between natural and cultural forces in the environment (Antrop 2005). For many centuries, the main crop in the studied region was cereal, which was for family consumption. Cereal was not appropriate as an economic resource, mainly because of local market policies at that time, stipulating that products could not be sold out of the region. Accordingly, the inhabitants started farming, taking advantage of the walls along the river, where the climate is very mild and benefits the cultivation of vines, almonds, olives, and oranges. All these products generate a better income, more so when the law allowed these products to be sold to other regions, such as the north of Spain. In order to farm along the river, the previous terraces, which had mainly been devoted to stock rising, were adjusted for the new crops and, although very tedious and time-consuming, this activity eventually promoted the economy of the region. Nevertheless, in the nineteenth century, vineyards were affected by phylloxera (Schmid *et al.* 2003). This disease had already begun to affect the French vineyards, and Spanish grapes were sent to France as substitutes. However, in 1888, phylloxera was introduced from Portugal (Andresen *et al.* 2004) and vine farming had to stop; because most such farming practices were related to the terraces, these were abandoned.

Terrace farming started in ancient times, when farmers built terraces to shore up a hillside, creating several arable lands on several levels. Terracing was a common farming strategy used by the people of the Arribes de Duero. Taking advantage of the natural landscape, they trapped rich topsoil before it could be washed away, which is what would have happened if terraces had not been constructed. The rich topsoil would have been washed down into the Duero canyon. Soil erosion can generate severe risks; after being abandoned for several years, soil develops surface crusts that decrease the infiltration capacity of the soils and lead to flooding, losing the soil into the valley (Cerdá 2002). It is true that

accelerated rainfall runoff and soil erosion are always linked to farming practices on steep hillsides, but it has also been demonstrated that if, additionally, the areas have been abandoned the risk of rapid runoffs and soil erosion is even higher (Harden 1996). Areas with high humidity conditions, as in the north of Spain, do not have an extreme problem, but the Arribes del Duero is very dry, and the recovery of abandoned soil is much more problematic. It has been demonstrated (Cerdà 2002) that the soil structure improves after 10 years of abandonment and that aggregates are more stable owing to the increase in the organic matter and the lack of farming. However, it is also possible to find soils that even after decades of abandonment maintain a high depletion index. This is due to other activities that have taken place on the terrain, such as animal farming, which does not allow soil recovery. This would be an important aspect to point out when trying to convince the population to return to traditional farming practices.

Another dangerous disadvantage is that areas that have been abandoned may be invaded by plant cover in some form, which is fodder for fires during dry periods. Fires will in turn lead to increases in erosion (Cerdà and Lasanta 2005). A good fire policy could be the promotion of farming in the fields of the bottom valley, since this would act as a "fire break" in the event of fire and would prevent the accumulation of bush, which accelerates ignition.

The landscape has developed in different ways, depending on the degree of development of the villages on which our study was focused. Areas interested in maintaining tourism have implemented major landscape conservation policies. In contrast, areas that have seen more profitable interest in other fields (i.e. animal products) have almost completely neglected terrace farming, and the current state of such terraces is witness to their abandonment. The evolution of the landscape can be observed by comparing the aerial photographs from the three different periods chosen with the evolution of the population in the areas (Figures 3–6; Table 1). Figure 3 shows the evolution of the terraces at Vilvestre; it may be seen that the population of terraces has been more or less maintained over the years. These are the best-preserved terraces in the area. Figure 4 shows the evolution of the terraces at Saucelle, where it may be seen that terrace farming was popular in the mid-1950s; it remained more or less constant during the 1970s, but was mostly abandoned at the beginning of the twenty-first century, the terraces being localised in very few areas, closer to the village (Figure 4(c)). In Figure 5, the continuing presence of the terraces in Hinojosa is shown; there are no important changes between 1956 (first photograph) and 2000 (last photograph). Figure 6(a) shows how, close to La Fregeneda, terrace farming was very important along the Duero river during the 1950s. In the 1970s, no terrace farming was maintained along the river, although terraces were present along the tributaries. Since 2000, terrace farming has been very scarce.

The abandonment of terrace farming was basically due to the socio-economic changes that took place in the middle of the twentieth century in Mediterranean Europe, together with the difficulties in mechanising farming along the skirts of deep valleys. Farming policies in the EU have promoted the abandonment of the low-production terrains in favour of intensive sheep farming. Sheep milk cheese is currently the basis of the local economy. Despite this, several years ago, the economy was mainly based on agriculture: almonds, olives, oranges, and wine. The Portuguese side, however, has found a way to preserve the landscape. At some points where farming in terraces was difficult, the farmers have changed them into "patamares". These are wider and shallower terraces than the *terraços*, without supportive stonewalls, and they are mainly dedicated to vine growing. Although this is not an ideal solution, it is not as bad as the complete abandonment that has occurred in Spain. The increase in erosion after the abandonment of farming is related to a reduction in soil porosity. The soil then degrades, affecting its both physical and chemical characteristics.

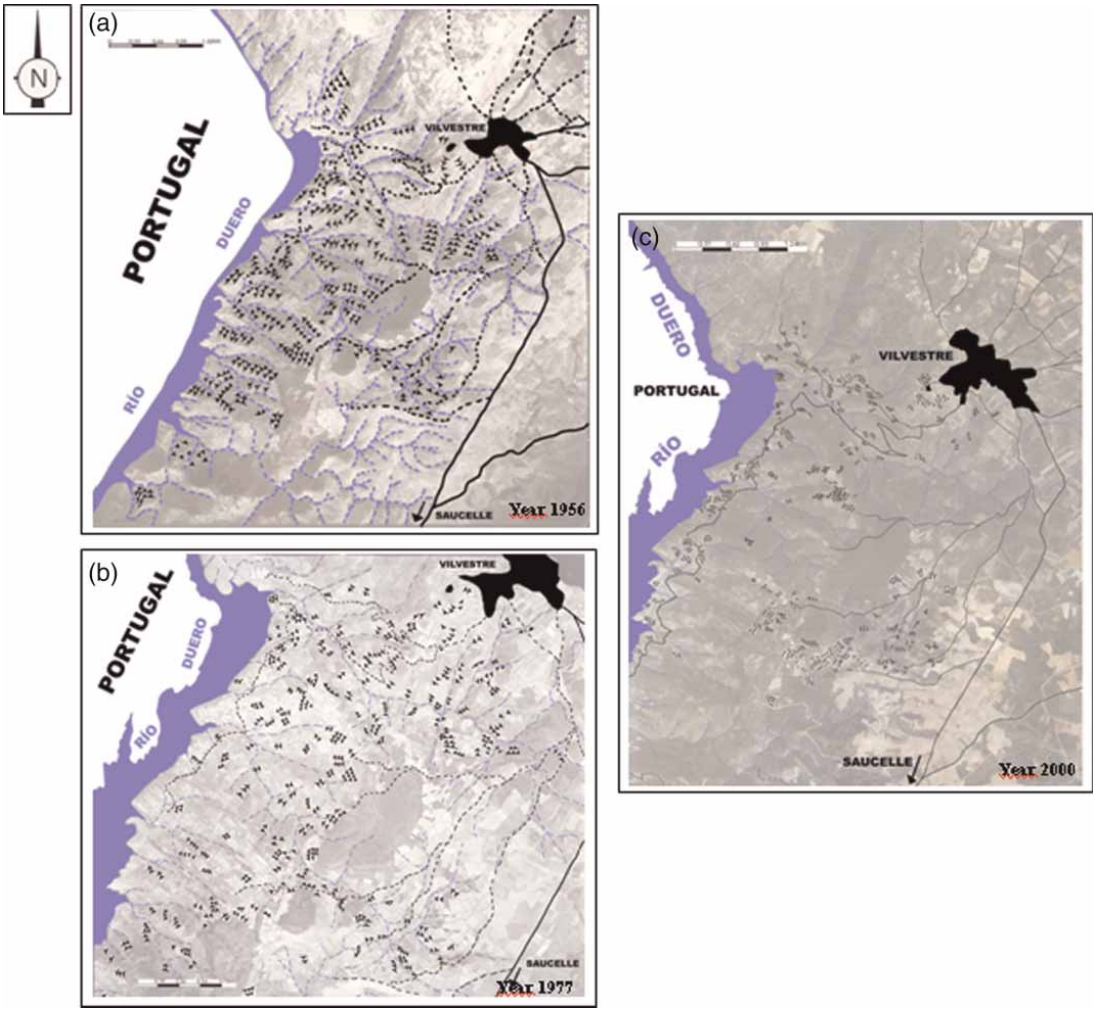

Figure 3. Evolution of terraces with time in Vilvestre. Notice that terraces have been added manually for better comparison.

Results of the survey

In 2006, after visiting the villages involved in this work, we sent 50 applications to each one, addressed to the major of the villages to be distributed among the native population as he/she thought convenient. Participation was very high (up to 68%, total), which can be seen as a high interest on the part of the inhabitants. However, it is surprising that one of the interviewed villages returned a participation of 100%, even though the major had told us that the people would not be interested in any changes. We did not go further into this matter. However, it should be noted that the villages in which the major was most interested in our project were those that maintained a better aspect from the tourism point of view. We conclude from this that if the population is interested in developing the area, it is probably easier to obtain valid results.

The complete results of the survey can be seen in the appendix. Following is a briefing of the 16 questions of the questionnaire. A high proportion of the population questioned believed that their district was very important in the whole of the province of Salamanca. Only 4% said that it was not important. A very high percentage believed that tourism is important as an attraction to the area, and over 70% thought that the villages were working in the right direction to enhance tourism. Again, a high proportion of the respondents were in agreement that a well-designed tourism programme would attract more visitors.

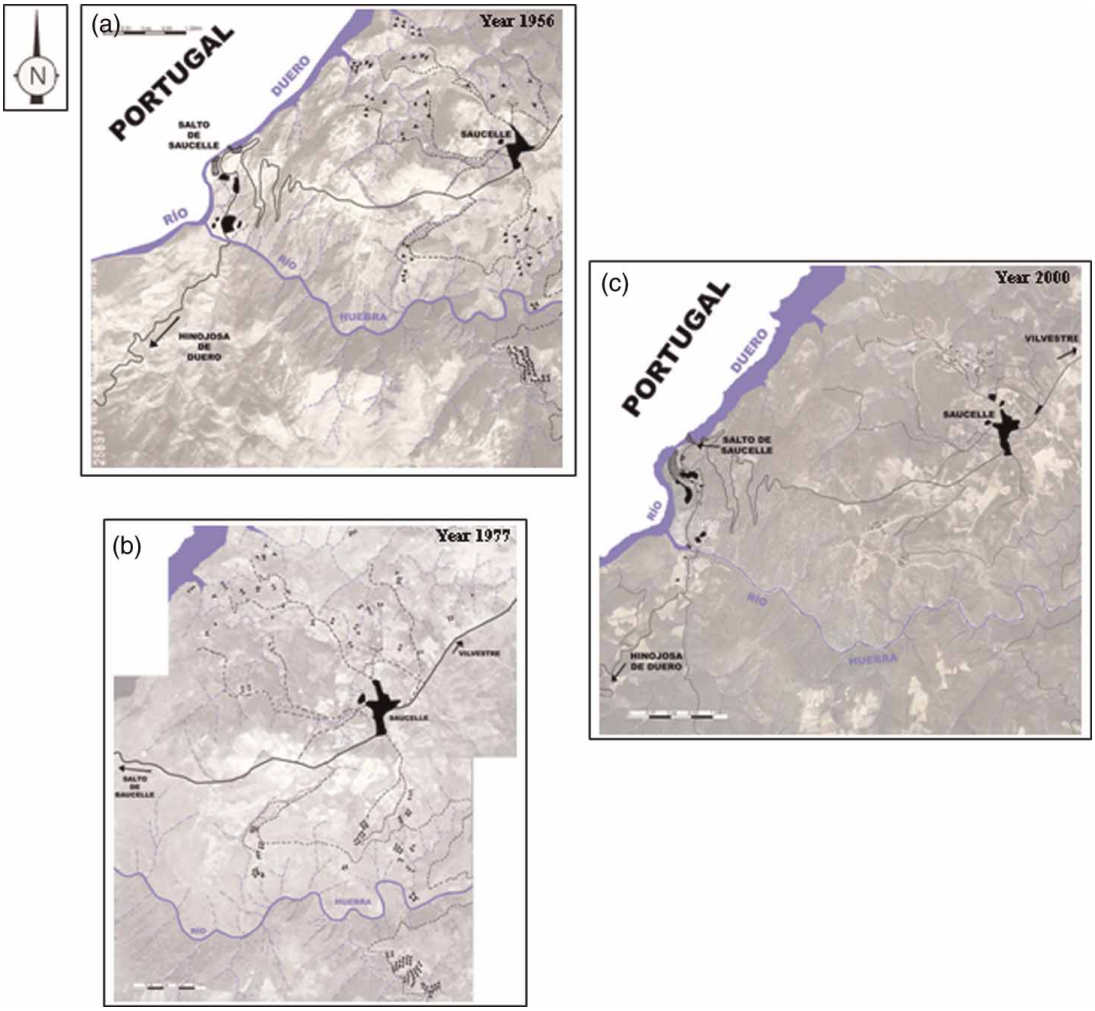

Figure 4. Evolution of terraces with time in Saucelle. Notice that terraces have been added manually for better comparison.

Sixty per cent of the respondents were in agreement with the idea that recovering old traditions could bring more tourists, and none of them stated that it was a very bad idea. Fifty per cent of the people interviewed thought that the recovery of old local traditions could create more employment, and none thought that this would be a very bad solution.

Regarding the landscape, more than 93% of the interviewees thought that it serves as a tourist attraction, and more than 50% had a good opinion about the recovery of terrace farming. None of them was totally against the idea. We asked about the possibility of establishing a tourist route, visiting the Arribes area on both Spanish and Portuguese sides of the border. Of those asked, 68% thought it was a good idea, and nobody thought it was a very bad one. Concerning the possibility of a tourist itinerary explaining the evolution of the landscape on both sides, 87% believed that this would be positive.

When asked about how involved they would be prepared to get in the landscape recovery, only 44% stated that they would be prepared to invest considerable efforts; 40% stated to some extent and 10% said only a little. Six per cent of the respondents answered that they would not be prepared to get involved at all. Regarding involvement in the recovery of the population of the villages, the same percentages as before were obtained. When asked about the compatibility between increases in tourism and the recovery of traditional activities, 87% thought that there was a correlation, while 10% did not know.

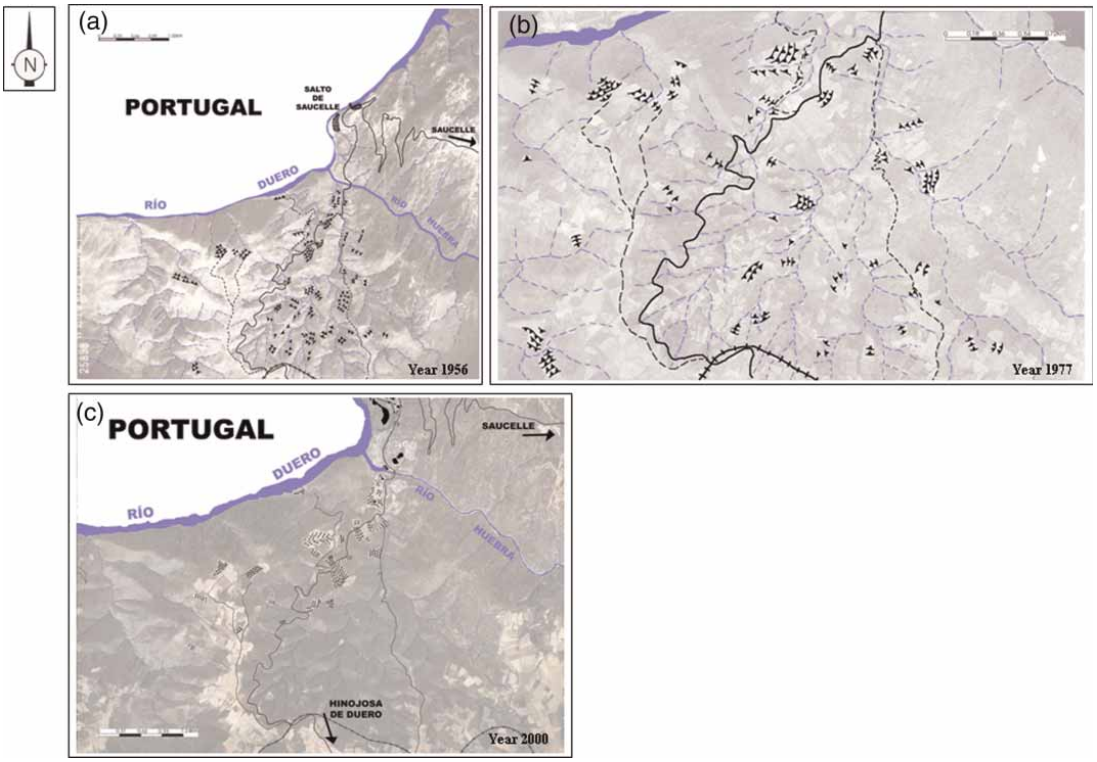

Figure 5. Evolution of terraces with time in Hinojosa de Duero. Notice that terraces have been added manually for better comparison.

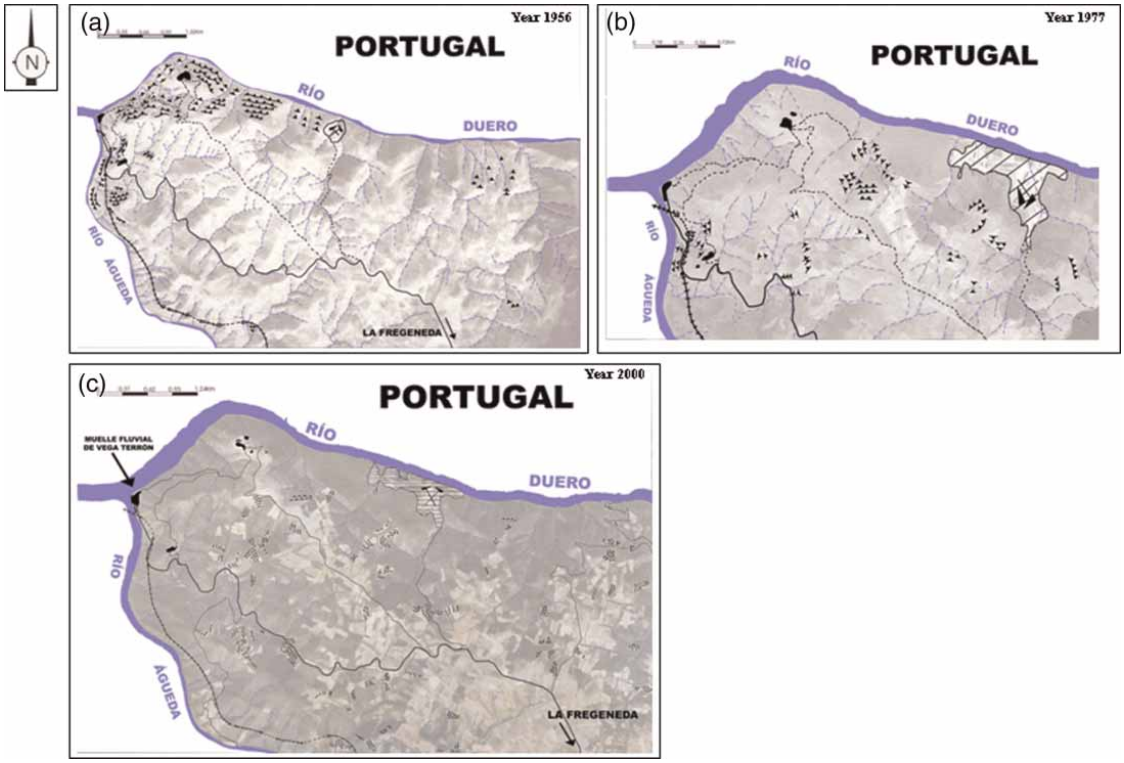

Figure 6. Evolution of terraces with time in La Fregeneda. Notice that terraces have been added manually for a better comparison.

With respect to the possibility of designing common projects between Spain and Portugal to promote tourism, 88% were in agreement and 9% did not know.

Most people were in agreement about the positive aspects of the area having been declared a National Park to promote the social–economic development of the village.

Finally, we asked about the difficulties the respondents had found in answering the survey: 61% thought it was very easy; 35% easy; 2% difficult, and 2% very difficult.

Discussion and recommendations

Some agricultural areas of Europe have gone through important changes related to major events such as mechanisation and the establishment of the EU Common Agricultural Policy (Antrop 2005, Martínez-Casasnovas *et al.* 2010, and references therein). The increase in population following very concrete processes affected as well the maintenance of the outcrops during a certain time, where some activities run parallel to farming; mining for tungsten and wolfram during the First and Second World War (Losada and Rodríguez 2004) and the dam construction in Saucelle and afterwards in Aldeadavila (from 1949 to 1963; Bueno 2002) attracted a lot of population (Table 1), granting a job for almost everyone. After these peaks (Table 1), a reduction in the population derived in a continuous abandonment of the traditional farming.

Traditional cultural and natural resources are now very scarce in developed countries. However, the higher the standard of living, the greater the need to find intact nature and original landscapes (Keller 2004). The demand for landscapes and nature is proportional to the income of population, because the production factor is of economic value. The preservation of nature is costly, but benefits must be found because some people do not wish to live in the middle of a protected area if no other economic advantages are available. Rural tourism is a source of benefits in many other countries (i.e. Switzerland, Keller 2004) and it has been shown that the same tourists would be willing to contribute economically to the preservation of natural landscape values (Lee and Han 2002, Raymond and Brown 2006). Additionally, to preserve protected regions, they must by definition be visited, and promoting tourism and landscape values is a way of preserving the cultural identity of an area.

Swiss farming practices are an example of the preservation of nature and landscapes (Mann 2005). The farmers still take care of the cultural landscape, and this is a call for tourists. The same happens in Portugal and should be promoted in the Spanish part of the Duero river.

The abandonment of traditional farming is leading to the loss of landscape and cultural diversity in Spain. Terrace farming took advantage of the specific geography and microclimatic conditions along the Duero river and for decades was the main activity in the area. However, the difficulties involved in farming the terrain, the ageing of the population, and the more attractive lifestyle offered by large cities led to a general abandonment of the long-established agricultural husbandry.

Despite this, from the results of the present survey, we conclude that the population is willing to find a way to recover traditional activities. In fact, some of the villages are now pushing towards the recognition of the area for inland tourism. Several features in the area could be promoted to bring visitors to the area, such as outdoor sports, geology, and the geographical peculiarities of the area, prehistoric monuments, etc. Nevertheless, the most important issue in recovering the area is to attract stable populations to the villages. We have found that it is difficult to promote traditional activities among young populations that only return to the villages for sporadic visits (holidays, vacations). Such activities are very tedious and time-consuming and intensive public relations will be needed to bring them back into the spectrum of opportunities that can be offered to outside visitors.

We thus suggest the following alternatives, based on the comments and requests of the survey participants.

- To make the area available for all immigrants currently coming to Spain. Many people come from farming cultures and would be willing to start a life in the abandoned terrain. In fact, there was the suggestion in the survey that the influx of immigrants with children of schooling age should be promoted.
- Local people asked about the possibilities of tourism courses for them.
- Money should be invested in good road and rail connections; also, more tourist facilities would help in attracting visitors. Currently, connections are very poor.
- Support should be given to farming associations and cooperatives, as they are now present in Portugal (*Quintas*), which increase the production efficacy and promotion of quality local products. Cross-compliance obligations could be followed as in the neighbour country (de Graaff *et al.* 2010).
- It is crucial that all decisions should be taken following common lines of agreement with Portugal. Public discussions about the Natural Park Management Plan in Portugal among different institutions and private sectors (including representatives on the Spanish side) have led to the conclusion that there are several contradictions between the Portuguese and the Spanish laws regarding the Natural Park.
- Tourist routes should be drafted to show the evolution of the landscape, from the *terraços* to the *patamares* in Portugal (Andresen *et al.* 2004) and from the *bancales* to the abandoned terrains in Spain. On comparing these, it is easy to see how traditional farming has promoted a richer landscape with farming diversity. Terrace farming supports an ecological agriculture, which is related to other rural values. This should encourage activities such as tourism, which helps to maintain the vitality of rural areas and decreases abandonment by young people owing to job unavailability.
- Tourism can be enhanced by the offer of local products, such as fruit, cheese, and wine. The increase in tourists will help to cover all excess produce that, in its day, was obtained only for local consumption.

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References

Abolina, K. and Zilans, A., 2002. Evaluation of urban sustainability in specific sectors in Latvia. *Environment, Development and Sustainability*, 4 (4), 299–314.

Andresen, T., Bianchi de Aguiar, F., and Curado, M.J., 2004. The Alto Douro wine region greenway. *Landscape and Urban Planning*, 68 (4), 289–303.

Antrop, M., 2005. Why landscapes of the past are important for the future. *Landscape and Urban Planning*, 70 (1–2), 21–34.

Boletín Oficial de Castilla y León Ley 5/2002, de 11 de Abril, de Declaración de Parque Natural de Arribes del Duero (Salamanca-Zamora). B.O.C.y.L, Nº 79 (in Spanish).

Bueno, F., 2002. *Historia de las Obras Públicas en la provincia de Salamanca: el complejo hidroeléctrico "Saltos del Duero"*. Ediciones Diputación de Salamanca. Publicaciones Generales 39, 97–128 (in Spanish).

Cerdà, A., 2002. Tierras marginales, abandono del campo y erosión. Available from: http://www.uv.es/metode/anuario2002/176-2002.html [Accessed April 2009].
Cerdà, A. and Lasanta, T., 2005. Long-term erosional responses after fire in the Central Spanish Pyrenees. 1. Water and sediment yield. *Catena*, 60 (1), 59–80.
de Graaff, J., *et al.*, 2010. The future of olive groves on sloping land and ex-ante assessment of cross compliance for erosion control. *Land Use Policy*, 27 (1), 33–41.
Fisher, C.T., 2005. Demographic and landscape change in the Lake Pátzcuaro basin, Mexico: abandoning the garden. *American Anthropologist*, 107 (1), 87–95.
Gisladottir, G. and Stocking, M., 2005. Land degradation control and its global environmental benefits. *Land Degradation and Development*, 16 (2), 99–112.
Harden, C.P., 1996. Interrelationships between land abandonment and land degradation: a case from the Ecuadorian Andes. *Mountain Research and Development*, 16 (3), 274–280.
Keller, P., 2004. La compatibilidad del turismo y el desarrollo sostenible en los espacios naturales protegidos. Ministerio Suizo de Economía. I Simposio Hispano-Suizo: La integración Social de los Espacios Naturales Protegidos. MiraSuiza-JCyL. 67–76 (in Spanish).
Lasanta, T., *et al.*, 2001. Marginal lands and erosion in terraced fields in the Mediterranean mountains. *Mountain Research and Development*, 21 (1), 69–76.
Lasanta, T., Vicente, S., and Cuadrat, J.M., 2005. Mountain Mediterranean landscape evolution caused by the abandonment of traditional primary activities: a study of the Spanish Central Pyrenees. *Applied Geography*, 25 (1), 47–65.
Lee, C. and Han, S., 2002. Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method. *Tourism Management*, 23 (5), 531–540.
Losada, A. and Rodríguez, M.X., 2004. Producción española de volframio y "guerra económica", 1936–1945. in: J. Fontana, ed. *Historia i projecte social*. Barcelona: Ed. Crítica, 1556–1572 (in Spanish).
Mann, S., 2005. Different perspectives on cross compliance. *Environmental Values*, 14 (4), 471–482.
Martínez-Casasnovas, J.A., Ramos, M.C., and Cots-Folch, R., 2010. Influence of the EU CAP on terrain morphology and vineyard cultivation in the Priorar region of NE Spain. *Land Use Policy*, 27 (1), 11–21.
Raymond, C. and Brown, G., 2006. A method for assessing protected area allocations using a typology of landscape values. *Journal of Environmental Planning and Management*, 49 (6), 797–812.
Ries, J.B., 2010. Methodologies for soil erosion and land degradation assessment in Mediterranean-type ecosystems. *Land Degradation and Development*, 21 (2), 171–187.
Rodewald, R., 2004. La explotación agrícola en función de la protección del Medioambiente. Fundación Suiza para la tutela del paisaje. I Simposio Hispano-Suizo: La integración Social de los Espacios Naturales Protegidos. MiraSuiza-JCyL 191–193 (in Spanish).
Schmid, J., Manty, F., and Rühl, E.H., 2003. Experience with phylloxera tolerant and resistant rootstocks at different vineyards sites. *Acta Horticulturae*, 617, 85–93.

Appendix

This survey was handed out to the majors of the four localities involved in the study, to give to the inhabitants to the village. The aim was to know the feelings of the main population about the recovery of old traditions that would allow recovering the landscape.

The questions were addressed in Spanish, and the people were asked to mark a cross on the preferred answer. Following each question, we include the results in the form of a pie diagram (Figure A1).

Comments added by the interviewed people

Hinojosa de Duero

- It should be promoted the immigration of families with young children.
- Politics should deal with recovery of landscape and railway in an active way, instead of visiting the area only during elections.
- The area needs European money to help development.

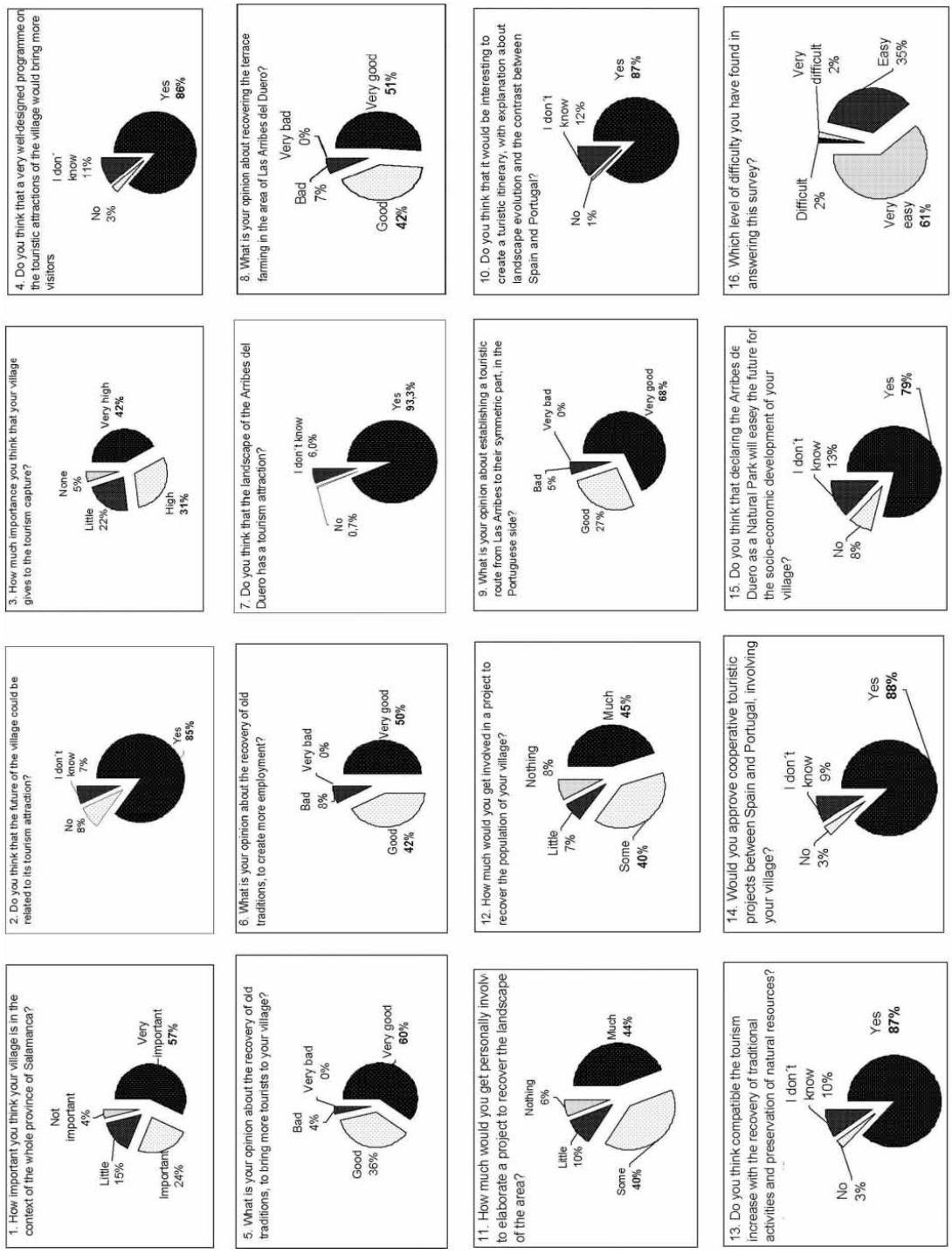

Figure A1. Pie charts showing the villagers' responses to the 16 questions in the survey.

Saucelle

- Politics should be more involved in feasible projects.
- Environment should be respected, as our ancestors used to do.

Vilvestre

- There is a need for special courses for the local people to promote the area.
- There are very bad road connections. Improving these, restaurants and hotels could call up tourists.
- Generating jobs would help to keep the local people.
- There is a need of real projects, not only words.