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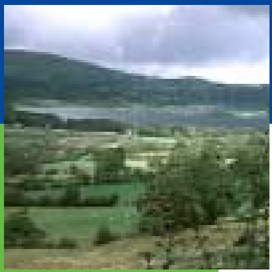
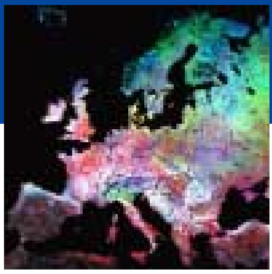
Examples of European agri-environment schemes and livestock systems and their influence on Spanish cultural landscapes

Edited by R.G.H. Bunce, M. Pérez-Soba, B.S. Elbersen, M.J. Prados, E. Andersen, M. Bell & P.J.A.M. Smeets





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WAGENINGENUR

Examples of European agri-environment schemes and livestock systems and their influence on Spanish cultural landscapes

Examples of European agri-environment schemes and livestock systems and their influence on Spanish cultural landscapes

In English, with the Introduction and Conclusions in Spanish

Proceedings of a European workshop
Soto del Real, 13-15 July 2000

Edited by R.G.H. Bunce[1, 2], M. Pérez-Soba[2], B.S. Elbersen[2], M.J. Prados[3], E. Andersen[4], M. Bell[5] & P.J.A.M. Smeets[2]

Description of cover photographs
The main photograph was taken in the Picos de Europa mountains in north-western Spain. Spanish landscapes vary from extensive open field systems to dense forests in the mountains, with many complex intergradations between them. This photograph shows a complex mosiac landscape (polyculture), including a mixture of woodlands, open forest grazed by stock and cultivated land. As such is is representative of the roll of livestock systems in maintaining traditional landscapes.

The lefthand lower photograph is representative of the Lake District in north-western England. It forms part of an Environmentally Sensitive Area (ESA), an agri-environment scheme discussed in the text. In the foreground is some semi-natural grassland and in the centre small fields with intensively managed grass currently grazed by sheep, but also by dairy cattle. The hills at the back of the picture are covered by moorland and heath and are extensively grazed by sheep. Support is provided by the scheme for maintaining farming practices, such as hedge laying and traditional hay meadows.

The lower central photograph is a satelite image of Europe. Colour composition of three NDVI maximum value composites (Red channel: May 1997,
Green Channel: July 1997, Blue channel: September 1997). Source: DLR, Germany.

The lower right photograph is representative of a livestock system which is linked to the maintenance of biodiversity. It was taken in the Sierra de Gredos mountains, in Avila province in central Spain. It shows a pedigree herd of Avileña cattle, a traditional breed used throughout Spain, but now rarely in pure herds, and mainly to cross-breed for the improvement of meat quality. The vegetation is a mixture of grassland and scrub, mainly of *Cistus* spp. species and is extensively grazed, and contains a high degree of faunal and botanical diversity.

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ABSTRACT

R.G.H. Bunce, M. Pérez-Soba, B.S. Elbersen, M.J. Prados, E. Andersen, M. Bell &
P.J.A.M. Smeets, 2001. *Examples of European agri-environment schemes and livestock systems and their influence on Spanish cultural landscapes, In English, with the Introduction and Conclusions in Spanish, Proceedings of a European workshop, Soto del Real, 13-15 July 2000,* Wageningen, Alterra, Green World Research. Alterra-rapport 309. 248 pp. 32 figs.; 58 tables.

The role of traditional agriculture in maintaining cultural landscapes is especially relevant at the present time, because of the widely reported decline in biodiversity on farmland and the current crisis in agriculture. The conference held in Spain, reported in this volume, is therefore significant, in that it provides guidelines to the way the Common Agricultural Policy could be redirected to maintain and enhance biodiversity. European agri-environment schemes and their links to livestock systems are summarised , with especial relevance to Spanish landscapes. Two keynote papers are of particular importance, because they present knowledge that has previously only been mainly available in Spanish. Although the agri-environment schemes are diverse and are primarily related to national priorities, the presentations nevertheless stimulated conclusions that provide a valuable starting point for the development of appropriate policy instruments. The many different initiatives need to be integrated and monitored so that their effectiveness can be assessed.

Keywords: agri-environment schemes, livestock systems, Common Agricultural Policy, cultural landscapes, Spain, biodiversity, policy, dehesas, dairy classification.

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Introduction

English

The original objective for convening the meeting was to review agri-environment schemes, identify their relationships with livestock systems and how they might be applied in Spain. This idea originated from discussions between the editors of this volume who are working on interrelated multidisciplinary projects. Experts on agri-environment schemes and agricultural systems in Europe were therefore invited to the workshop as specialists from representative countries. However, some countries could not be included because of insufficient resources of time and money. Examples of the implementation of the European Union (EU) regulation 2078/92 were presented. The role of the different types of agricultural systems, central to the maintenance of European cultural landscapes, was also extensively discussed.

Spain has many protected areas. However, the central role of agriculture, especially livestock systems, is not widely recognised. This is a logical result of agricultural policy measurements directed towards intensification of productivity rather than to support rural sustainability. Throughout history, agricultural practices have shaped cultural landscapes and are currently essential for the maintenance of biodiversity in many protected areas. However, in the last three decades the process of agricultural intensification has often been negative, involving loss of landscape features and biodiversity.

Some examples to illustrate this process in Europe are given below. In the Picos de Europa National Park in north western Spain, there is no policy for agricultural support, yet the hay meadows for which the region is famous depend entirely upon farmers. Wood pastures in southern England provide a contrasting example where the grazing animal is necessary to maintain the open conditions for the rich lichen floras on the trunks of the ancient trees. Many other landscapes in Europe are determined by diverse agricultural systems. For example, in south western Britain and Brittany, in western France, the *bocage* landscapes are the result of small-scale dairy farms, whereas the *dehesa* landscapes of central Spain are the product of extensive livestock systems.

The function of some of these features may have disappeared but they remain as landscape structures and still effect the distribution of biodiversity. For example, the terraces of the Mediterranean region often still remain in the landscape but may no longer be used for agriculture. Similarly, in western Britain and Scandinavia the medieval systems of agricultural holdings, the in-fields and out-fields, can still be seen in the landscape, although their original purpose has now disappeared. The Enclosure Acts of the late XVIII and early XIX centuries in Britain removed the system of strip fields, which can however still be seen in their virtually original form in the crofting townships of north-west Scotland. Many other examples were discussed at the workshop in relation to transhumance systems in Spain, which have a medieval origin but still persist in many mountain areas. There is a link between such systems and those in the French Pyrenees, the Massif Central and the Alps, showing convergence of farming practices in response to environmental pressures.

The evolution of these systems was determined by ecological and sustainable agricultural practices linked to social objectives. Their success can be measured by their maintenance over many centuries. By contrast, many habitats are now threatened because of rapid changes due to rationalisation and disappearance of traditional agricultural systems.

Throughout Europe the policy relevance of agri-environment schemes is widely recognised. However, there is no coherent overview available of their success or even of the differences in practical measures between countries, hence the agenda of the present meeting. There is a dynamic policy situation in Europe due to the recognition of the impact of the Common Agricultural Policy (CAP) on the environment and the saturation of agricultural markets. The extent of agricultural support is increasingly questioned by the public because of its dominance in the central budget of the EU. Other farming crises, such as Bovine Spongiform Encephalitis (BSE) and, since the meeting, foot and mouth disease, have also focused public attention on the way the CAP is distributed. In addition, external forces, e.g. free trade negotiations, are increasing the pressure on the EU to change the present market intervention policy, because of the negative influence on the world food market. Furthermore, the CAP is now widely perceived to have indirectly caused many environmental problems, such as hedgerow removal in Britain, and the destruction of *dehesas* in Spain. The fundamental reason for these problems is that the annual budget for agricultural market support and price intervention, is at least two orders of magnitude higher than for agri-environment schemes.

The reorientation of the CAP towards direct income support, such as environmentally friendly measures, would reduce these pressures and would help to conserve the quality of the European landscape. Examples of CAP reorientation are the measures to combine agricultural production with environmental protection and conservation of the countryside. This new legal and financial framework promotes the reorientation of the former agricultural policy as it has been applied in the past within the member states. This volume includes a series of relevant case studies.
Currently, in Spain discussions are taking place between the Ministry of Agriculture and relevant agencies concerning these regulations. In addition, some regions such as Andalucia are also discussing how they might be applied at the local level. It is hoped that the papers presented in the volume will assist such a debate by showing what various agri-environment schemes have achieved and how they could be used to promote the maintenance of biodiversity and conservation of wildlife and cultural landscapes. In reality, the conclusions given in the final chapter were rather different than was foreseen at the outset, in that the values of the schemes across the whole of the EU is by no means clear.

Livestock activities have a very important impact on the landscape and have often been a key historical factor for the evolution of specific cultural landscapes. The relationships between livestock farming practices and landscape characteristics are complex and vary widely between countries. Moreover, quantitative relationships are difficult and expensive to determine. In the short term, expert judgement provides a description of the systems involved, but further detail is required if modeling exercises are to be successful. The acquisition of detailed data, relevant to the way farming practices influence landscape, is further complicated by the wide variations in farming practices and landscapes across Europe. It is therefore difficult, to develop appropriate agri-environment schemes to enhance the key quality parameters in cultural landscapes across the whole of Europe. The purpose of the present volume is to stimulate discussion of agri-environment measures, and especially how they might be applied in Spain. For example, in the Lake District of northern England, walls are a key element in the landscape, whereas in the Picos de Europa, in northwestern Spain, Candelabra trees are a distinctive feature. Both examples of landscape features require different types of support to maintain them, although local farmers still have the expertise to maintain them.

Table 1. Rationale behind the various agri-environment schemes within the countries represented at the workshop, ordered according to geographical relationships. NI, Northern Ireland; GB, Great Britain; NL, The Netherlands; DK, Denmark; AU, Austria; ES, Spain; GR, Greece.

	NI	GB	NL	DK	AU	ES	GR
Landscape features	X	X	X			X	
Protected areas						X	
Extensification				X		X	X
Habitat maintenance	X	X		X			
Species protection / biodiversity			X			X	
Traditional farming practices			X			X	
Local breeds						X	
Organic / biological farming				X	X		X
Nitrogen pollution				X			X
Pesticide use				X			
Water management						X	
Archaeology	X	X					
Public access		X					

Table 2. Principal agricultural enterprises (>5 % farms or >10 % of land surface) within the countries represented at the workshop, ordered according to geographical relationships. NI, Northern Ireland; GB, Great Britain; BE, Belgium; NL, The Netherlands; DK, Denmark; FI, Finland; AU, Austria; ES, Spain; GR, Greece.

	NI	GB	BE	NL	DK	FI	AU	ES	GR
Horticulture				X				X	
Granivors		X	X	X	X	X		X	
Dairy	X	X	X	X	X	X	X	X	X
Intensive beef	X	X	X	X	X		X		
Cereals		X			X		X	X	
Intensive sheep / goats		X							X
Perennial crops							X	X	X
Extensive pigs								X	
Extensive sheep / goats	X	X						X	X
Extensive beef								X	
Sylvopastoral								X	X
Mountain							X	X	X

During the workshop the rationale behind the agri-environment schemes formed the basis of the discussions. A summary of these is given in Table 1 and it will be seen that there is very little agreement between the policies identified by the different countries. This is partly related with the strong variation in dominant farming systems in the different countries, as shown in Table 2 and hence their link to biodiversity and landscape character. Thus in the Netherlands, priority is given to certain threatened features associated with intensive farming practices, whereas in Austria it is more related to farming practice, because of the higher environmental capital. Political, cultural and socio-economic considerations are also a major factor behind the setting up of agri-environment schemes and will certainly play a major part in their future development in Spain. Following the workshop a provisional list of issues discussed during the meeting was produced, as shown in Table 3. Many of these problems are discussed in several of the papers in this volume, eg. Oñate and Gómez Sal. Other agricultural practices, which could form the basis of agri-environment schemes, are also discussed, eg. Ruiz.

Table 3. Summary of some principal problems identified during the workshop, which could be addressed by agri-environment schemes in Spain

1. Water

- 1.1. Expansion of intensive agriculture, involving increases in fertiliser and pesticide use, as well as stocking level, which result in ground water contamination.
- 1.2. Increase in land under irrigation and urbanisation resulting in water deficit.

2. Soil

- 2.1. Non-sustainable agricultural practices leading to loss of fertility and erosion and eventually to desertification.
- 2.2. Increase in intensive agricultural systems leading to soil contamination.

3. Biodiversity

- 3.1. Intensive pesticide and fertiliser use.
- 3.2. Decline of landscape features.
- 3.3. Decline in meadow management.
- 3.4. Increase in intensive agricultural systems leading to biodiversity loss.
- 3.5. Subtle changes in patterns of use.
- 3.6. Disappearance of extensive pastoral practices in high mountains.
- 3.7. Loss of fallow.
- 3.8. Loss of stubble.

4. Landscape

- 4.1. Conversion of *dehesas* into arable land.
- 4.2. Loss of distinctive landscape features.

5. Cultural heritage

- 5.1. Disappearance of latitudinal transhumance.
- 5.2. Decline and change in altitudinal transhumance patterns.
- 5.3. Decline in sylvopastoral systems.
- 5.4. Disappearance of local breeds and shift to highly productive types.
- 5.5. Loss of distinctiveness because of increasing homogeneity of the landscape.
- 5.6. Loss of archaeological features.

Spanish

El objetivo inicial del congreso fue el revisar esquemas agro-ambientales, identificar sus relaciones con sistemas ganaderos, y el estudiar cómo se podrían aplicar los esquemas en España. Esta idea se fraguó en discusiones previas entre los editores de este volumen, que trabajan en proyectos multidisciplinares interrelacionados. Por ello, se invitó al congreso a expertos en esquemas agro-ambientales y sistemas agrícolas en Europa. Los participantes fueron escogidos por ser especialistas de países representativos; sin embargo, algunos países no se pudieron incluir debido a falta de recursos financieros y de tiempo. Se presentaron ejemplos de la aplicación de la regulación 2078/92 de la Unión Europea (UE), así como ejemplos de esquemas agro-ambientales nacionales en países que tienen una larga tradición en la aplicación de este tipo de política. Se discutió extensamente sobre el papel de los diferentes tipos de sistemas agrícolas, esenciales para el mantenimiento de los paisajes culturales europeos.

España tiene muchas áreas protegidas. Sin embargo, el papel central que juega la agricultura, y sobre todo los sistemas ganaderos, no está ampliamente reconocido. Este es un resultado lógico de medidas políticas agrícolas dirigidas hacia la intensificación de la productividad, más que hacia el apoyo de la sustenibilidad rural. A través de la historia, las prácticas agrícolas han conformado los paisajes culturales y son en la actualidad, esenciales para el mantenimiento de la biodiversidad en muchas áreas protegidas. Sin embargo, en las tres últimas décadas, el proceso de intensificación agrícola ha sido a menudo negativo, pues conlleva la pérdida de características del paisaje y de biodiversidad. Hay varios ejemplos que ilustran esta situación en toda Europa. Por ejemplo, en el Parque Nacional de los Picos de Europa, no existe una política de apoyo agrícola, a pesar de que las praderas para heno, por las que la región es famosa, dependen totalmente de los agricultores. Los prados arbolados en el sur de Inglaterra, proveen un ejemplo que contrasta con el anterior, ya que el animal de pastoreo es necesario para mantener las condiciones abiertas para la flora rica en líquenes que se encuentra sobre los troncos de los árboles ancestrales. Otros muchos paisajes en Europa están determinados por diversos sistemas agrícolas. Por ejemplo, al sudoeste de Gran Bretaña y de Bretaña (Francia), los paisajes de bocage son el resultado de las granjas lecheras pequeñas, mientras que los paisajes de dehesa en el centro de España, son el producto de sistemas de ganadería extensiva. La función de alguna de éstas características del paisaje puede haber desaparecido, pero sin embargo se mantienen como estructuras del paisaje y todavía afectan la distribución de la biodiversidad. Por ejemplo, las terrazas de la región Mediterránea a menudo se mantienen en el paisaje, aunque ya no se utilicen más para la agricultura. De igual forma, al oeste de Gran Bretaña y Escandinavia, los sistemas medievales de las empresas agrícolas (los in-fields y out-fields) se pueden observar todavía en el paisaje, aunque su función original ya ha desaparecido. Las actas de setos de finales del siglo XVIII y principios del XIX en Gran Bretaña, eliminaron el sistema de strip fields (campos en franjas), que sin embargo pueden ser vistos todavía en su forma original en las crofting townships (ciudades agrícolas) del noroeste de Escocia. En el congreso se discutieron otros ejemplos relacionados con el sistema de transhumancia en España, que tiene un origen medieval pero que todavía persiste en muchas áreas de montaña. Hay una conexión entre estos sistemas españoles y aquellos en los Pirineos franceses, el Macizo Central francés y los Alpes, que muestran la confluencia de las prácticas agrícolas en respuesta a la presión ambiental. La evolución de estos sistemas ha sido determinada por prácticas agrícolas sostenibles y ecológicas, asociadas a objetivos sociales. Su éxito queda patente a través de su permanencia a lo largo de los siglos. Por el contrario, en la actualidad, muchos hábitats están amenazados por los cambios rápidos causados por la racionalización y desaparición de los sistemas agrícolas tradicionales.

La importancia política de los esquemas agro-ambientales está ampliamente reconocida en toda Europa. Sin embargo, no existe una visión de conjunto coherente sobre sus logros, y ni siquiera sobre las diferencias en medidas prácticas aplicadas en los distintos países. Estas carencias son las que dieron pié a la agenda del congreso. En la actualidad, hay un dinamismo en la situación política europea, debida al reconocimiento del impacto de la Política Agraria Comunitaria (PAC) sobre el medio ambiente y a la saturación de los mercados agrícolas. La opinión pública cuestiona cada vez más el nivel al que ha llegado el apoyo agrícola, debido al predominio de éste en los presupuestos centrales de la UE. Otras crisis agrícolas, como la Encefalopatía Espongiforme Bovina (EEB), también han centrado la atención del público sobre la forma en la que se distribuye la PAC. Además, fuerzas externas, como las negociaciones de mercado libre, están aumentando su presión sobre la UE para que cambie la existente política de intervención del mercado, que tiene una influencia tan negativa en el mercado de alimentos mundial. Asimismo, ahora se considera de forma generalizada a la PAC, como una fuente indirecta de muchos problemas ambientales, tales como el arrancamiento de hileras de setos en Gran Bretaña y la destrucción de las dehesas en España. La razón fundamental de estos problemas es que el presupuesto anual para apoyar al mercado agrícola e intervenir los precios es, por lo menos, dos órdenes de magnitud superior al presupuesto para el apoyo a esquemas agro-ambientales.

El reorientar la PAC hacia el apoyo de ingresos directo, tal como medidas amigables para el medio ambiente, reduciría la presión sobre el medio ambiente, y ayudaría a conservar la calidad del paisaje Europeo. Ejemplos de la reorientación de la PAC son las medidas para combinar la producción agrícola con la protección ambiental y conservación del paisaje rural. Este nuevo marco legal y financiero estimula la reorientación de la anterior política agrícola que se había aplicado dentro de los estados miembros. El presente tomo, incluye una serie de casos-estudio significativos. Actualmente, en España, están teniendo lugar discusiones sobre estas nuevas normativas entre el Ministerio de Agricultura y las entidades pertinentes. Además, algunas autonomías, como la andaluza, también discuten el cómo se podría aplicar en el ámbito local.

Esperamos que los artículos presentados en este libro ayuden a estimular este debate, mediante la presentación de lo que varios esquemas agro-ambientales han conseguido, y la discusión sobre el cómo podrían usarse para estimular el mantenimiento de la biodiversidad y la conservación de la naturaleza y los paisajes culturales. En realidad, las conclusiones del capítulo final, son bastante diferentes de las previstas al comienzo del congreso, en el sentido de que los valores de los esquemas a través de toda Europa no están claros en absoluto. Las actividades ganaderas tienen un impacto muy importante en el paisaje y a menudo han sido un factor histórico esencial para la evolución de paisajes culturales específicos. Las relaciones entre las prácticas agrícolas ganaderas y las características del paisaje son complejas y varían ampliamente entre los países. Además, el determinar estas relaciones de una forma cuantitativa es difícil y costoso. A corto plazo, la opinión de los expertos proporciona una descripción de los sistemas tratados, pero se requiere un detalle mayor si se quiere modelar con éxito. La adquisición de datos pormenorizados, significativos para determinar la forma en la que las prácticas agrícolas influyen en el paisaje, se complica aún más debido a la gran variedad en prácticas y paisajes a través de toda Europa. Por lo tanto, es difícil el desarrollar esquemas agro-ambientales adecuados para mejorar los parámetros cualitativos clave en los paisajes culturales Europeos. La intención de éste volumen es el estimular la discusión sobre las medidas agro-ambientales y especialmente sobre el cómo deberían aplicarse en España. Por ejemplo, en el distrito de los lagos en Inglaterra, los muros son un elemento clave en el paisaje, mientras que en los Picos de Europa en Asturias, son los árboles Candelabra los que constituyen un rasgo distintivo del paisaje. Ambos ejemplos de rasgos del paisaje, requieren diferentes tipos de apoyo para mantenerlos, si bien los campesinos locales todavía saben cómo mantenerlos.

Table 1. Razones existentes tras los varios esquemas agro-ambientales de los países participantes en el congreso, ordenados según sus relaciones geográficas. NI, Irlanda del Norte; GB, Gran Bretaña; NL, Países Bajos; DK, Dinamarca; AU, Austria; ES, España; GR, Grecia.

	NI	GB	NL	DK	AU	ES	GR
Rasgos del paisaje	X	X	X			X	
Áreas protegidas						X	
Extensificación				X		X	X
Conservación del hábitat	X	X		X			
Protección/biodiversidad de especies			X			X	
Prácticas agrícolas tradicionales			X			X	
Razas locales						X	
Agricultura orgánica/biológica				X	X		X
Contaminación nitrogenada				X			X
Uso de pesticidas				X			
Gestión del agua						X	
Arqueología	X	X					
Acceso público		X					

Table 2. Principales empresas agrícolas (>5% del número de granjas, ó >10% de la superficie territorial) en los países participantes en el congreso, ordenados según sus relaciones geográficas. NI, Irlanda del Norte; GB, Gran Bretaña; BE, Bélgica; NL, Países Bajos; DK, Dinamarca; FI, Finlandia; AU, Austria; ES, España; GR, Grecia.

	NI	GB	BE	NL	DK	FI	AU	ES	GR
Hortícolas				X				X	
Granívoros		X	X	X	X	X		X	
Sector lechero	X	X	X	X	X	X	X	X	X
Vacuno intensivo	X	X	X	X	X		X		
Cereales		X			X		X	X	
Ovino y caprino intensivo		X							X
Cultivos perennes							X	X	X
Porcino extensivo								X	
Ovino y caprino extensivo	X	X						X	X
Vacuno extensivo								X	
Silvopastoral								X	X
Montaña							X	X	X

Durante el congreso, las razones existentes tras los esquemas agro-ambientales formaron la base de las discusiones. Un resumen de estas razones se da en la Tabla 1, y cómo se puede observar existe muy poca homogeneidad entre las políticas identificadas por los diferentes países. Esto se debe en parte a la gran variación que existe entre los países en el sistema agrícola predominante, como se observa en la Tabla 2, y en consecuencia su conexión con biodiversidad y carácter del paisaje. Así, en los Países Bajos se da prioridad a ciertos rasgos del paisaje amenazados por prácticas agrícolas intensivas, mientras que en Austria se da más importancia a la agricultura orgánica/biológica, debido al alto patrimonio medioambiental. Por otro lado, las medidas agro-ambientales en España tienen por objeto el contener los efectos negativos del abandono del campo. Las consideraciones políticas, culturales y socio-económicas constituyen también un factor esencial en la creación de los esquemas agro-ambientales y, de seguro, jugaran un papel esencial en el futuro desarrollo de los esquemas en España.

Tras el congreso, se hizo una lista provisional de las cuestiones discutidas, indicadas en la Tabla 3. Muchos de estos problemas se tratan en varios artículos de este tomo, por ej. Oñate y Gómez Sal. También se tratan otras prácticas agrícolas que podrían formar la base de los esquemas agro-ambientales, por ej. Ruiz Pérez, y que pueden requerir consideración en un futuro.

Table 3. Resumen de algunos de los principales problemas identificados durante el congreso, que podrían ser considerados en los esquemas agro-ambientales en España.

1. **Agua**
   - 1.1. Expansión de la agricultura intensiva, que implica el aumento en el uso de fertilizantes y pesticidas, y del número de cabezas de ganado por unidad de superficie, lo que resulta en contaminación de las aguas subterráneas.
   - 1.2. Aumento de la superficie de regadío y urbanizada, que resulta en escasez de agua.

2. **Suelo**
   - 2.1. Prácticas agrícolas no-sostenibles, que dan lugar a pérdida de la fertilidad y erosión, y finalmente a desertización.
   - 2.2. Aumento en los sistemas de agricultura intensiva que originan contaminación del suelo.

3. **Biodiversidad**
   - 3.1. Uso intensivo de pesticidas y fertilizantes.
   - 3.2. Disminución de los rasgos del paisaje.
   - 3.3. Disminución en la gestión de las praderas.
   - 3.4. Aumento en los sistemas de agricultura intensiva, que da lugar a la pérdida de biodiversidad.
   - 3.5. Cambios sutiles en los esquemas de utilización del suelo.
   - 3.6. Desaparición del pastoreo extensivo en las zonas de alta montaña.
   - 3.7. Disminución de la superficie de barbecho.
   - 3.8. Reducción de la superficie ocupada con los restos de cosecha.

4. **Paisaje**
   - 4.1. Conversión de las dehesas en tierras de cultivo.
   - 4.2. Pérdida de los rasgos distintivos del paisaje.

5. **Patrimonio cultural**
   - 5.1. Desaparición de la transhumancia latitudinal.
   - 5.2. Descenso y cambio en los patrones de transhumancia altitudinal (transterminante).
   - 5.3. Descenso de los sistemas silvopastorales.
   - 5.4. Desaparición de las razas autóctonas y el cambio a razas más productivas.
   - 5.5. Pérdida de rasgos distintivos debido al aumento de la homogeneidad del paisaje.
   - 5.6. Pérdida de rasgos arqueológicos.

Examples of northern European landscapes with significant livestock systems.

Plate 1. Bialeiwieja, eastern Poland. This picture was taken on the edge of the ancient forest. There is some neglected grassland in the foreground and an old hay rack but with some cut grass in the centre. The forest in the background was originally an integral part of the livestock system but has now been isolated from the surrounding farms for over one hundred years. This photograph therefore shows historical change but also a currently changing landscape.

Plate 2. Sognfjord, western Norway. The valley bottom is managed for intensive grass production, used mainly by dairy cattle. Above these fields is the original inbuit (inbye in English), originally quite intensively used but now becoming overgrown with scrub. The outbuit (outbye in English) is comparable to common grazings in England, and is now largely abandoned. In Norway therefore the original structure of the landscape has now largely disappeared, although it can still be seen in the landscape.

Plate 3. Carmarthen, western Wales. The fields are almost entirely intensively managed grass used mainly by dairy cattle and are now of low biodiversity. The landscape is representative of the network of small fields and hedgerows typical of western England and Wales and is often called bocage, after a comparable region in Brittany, western France.

Agri-environment schemes

Intensification, rural abandonment and nature conservation in Spain

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Introduction

Human development has been closely related to agriculture since its origin around 10,000 years ago. The paleontologic, biogeographic, prehistoric and archaeological data highlight the agricultural expansion through the Mediterranean basin, from southwestern Asia and the eastern part of the Mediterranean Sea. From this initial starting point, the agricultural systems created and developed in the eastern centres of dispersion were successful because they were capable of developing integrated semi-natural systems, which maintained or imitated ecological processes. They also probably involved a profitable economy that was not based only on mere subsistence. Maintenance of the agrarian culture, very often ancestral, that was generated in those systems has been based on the importance placed upon the knowledge acquired with regard to the environment and respect of traditions. There was transfer between generations of what was learned from earlier successes and failures in the types of management practices.

The cultural landscape is the product of these interactions. This landscape is not usually uniform or monotonous, even in many regions with extensive cultivation (González-Bernáldez, 1991a; Rescia et al., 1994), but rather is generally made up of mosaics. Such systems contain mixtures of productive units with others, which accumulate much, little or almost no biomass. They are comprised of a mesh of thickets, hedges, embankments, different types of fences, sheepfolds and extensive boundaries with different functions. Such functions vary from bee-keeping to soil renovation with contributions from forest litter and manure, to the protection of crops, the maintenance of the fauna and the production of timber .The latter may be used by the farmers and hunters may also use various landscape elements.

The Mediterranean basin constitutes a paradigm for the historic persistence of cultures that have created cultural landscapes (Baldock et al., 1988; González-Bernáldez, 1995). It is usual to encounter mixed land uses involving agriculture, forestry and pastoralism, maintained as different types of production systems that are ecologically and economically complementary. The forest systems occupy the shallower soils with hillocks and slopes in the landscape, and the livestock farmers tend to use the medium-level slopes, whereas the crop farmers are found in fertile valleys. Connectivity between the systems is based on the imitation of natural processes, such as the flow of nutrients and fertility from the upper to lower zones, retention of erosion and deceleration of the water cycle. It may also involve the use of the pastures for seasonal (latitudinal transhumance) and local (altitudinal transhumance) migration, according to phenological and topographical changes.

This was the case in many parts of the world up to the industrial revolution, which in due course led to agricultural intensification, with an increase in gross production, because of increases in energy use, pesticides and fertilisers. This intensification was based on scientific and technological development and replaced traditional systems. These new agricultural practices were controlled by trade, transport, price agreements and economic factors at various scales (Pineda, 1996). In recent years, globalisation of agricultural products has become ever more important, and forms the background to the problems of maintaining cultural landscapes, as outlined below.

The shift to industrial agriculture has been, is now well accepted and established. However, it has been progressively criticised by conservationists who wish to maintain environmentally friendly agricultural practices.

Although man will always depend on agriculture, the current or traditional agricultural models, whether closely linked to the land or not, will largely disappear together with many of the familiar cultural landscapes that are present today. If the world population continues to grow at the present rate, one can imagine that a great deal of the food production could even be based on the development of large facilities that could use mirrors to manipulate sunlight and crops sustained by structures similar to modern greenhouses and experimental cultivation chambers.

The intensification and abandonment extremes of the Spanish rural landscape

Industrial agriculture largely ignores the structure of traditional systems and is less concerned with the maintenance of ecological capital, in the broadest sense, that sustained the original systems. The most unfortunate aspect of this scenario is the substitution of ancient cultural knowledge, accumulated around the world, by the application of modern techniques, rather than utilising the gained experience.

At the other extreme, rural abandonment is also a consequence of modern agriculture. Furthermore, because of industrial development in Spain, agriculture now accounts for only 3% of the Gross National Product (GNP), compared with 8% under two decades ago. This abandonment is the result of the cessation of agricultural activity from some landscape patches, allowing ecological succession to take place. Living or dead biomass is left, and accumulates naturally as a result of this process, permitting the re-appearance of wild plants and animals that had previously disappeared from the landscape. The production of these ecosystems, which may increase at the beginning of abandonment, then decreases. Removing livestock from pastures disturbs the equilibrium maintained by agriculture and leads to a decrease of production and an increase in biomass.

In Spain, intensification has generally taken place on highly productive land, but as elsewhere in the Mediterranean, it has not been confined to such situations. For example, some sylvopastoral areas, *dehesas*, with optimum production have been converted into crops, eg. cereals, sunflowers, cellulose and fast-growing timber, much of which is irrigated. The environmental, ecological and socio-economic costs of this process have been high. Different indicators highlight substantial losses, such as the disappearance of traditional cultures, the deterioration of valued landscapes and decreases in biodiversity (Campos Palacín, 1993; Sumpsi, 1996; Varela Ortega, 1997; Varela Ortega et al., 1996). Conversely, financial profitability has increased, and the price support mechanisms of the European Union (EU) have favoured the shift from extensive cereal crops to intensive systems.

Over the last three decades, 2 Mha of the Spanish *dehesas* have been seriously altered or destroyed (Beaufoy, 1996; Valladares, 1993), leaving now between 6 and 8 Mha. They are a unique example of nature conservation combined with optimal use (Casado et al., 1985; Ruíz & Groome, 1986). *Dehesas* are exceptional ancient landscapes, with a savannah-like appearance, with dispersed trees and dense, short pastures, formed by herbaceous plants, dominated by therophytes. The high diversity of the plant communities present is not found elsewhere in the world in managed systems (Pineda et al., 1981). The trees of the *dehesa* are centuries old, and mainly consist of holm oak (*Quercus rotundifolia*), cork oak (*Q. suber*), Lusitanian oak (*Q. faginea*) and Pyrenean oak (*Q. pyrenaica*). The acorns ripen in winter and constitute an important supplementary food for the livestock and wild fauna (Herrera, 1984; Ruíz, 1986); they also provide shelter in the cold Mediterranean winter mornings, important shade in summer, and in autumn valuable contributions of organic material and nutrients (Gómez Gutierrez, 1991; González-Bernáldez et al., 1989). Among the registered taxa of exceptional conservation interest are emblematic wild species eg. lynx (*Linx pardina*) and imperial eagle (*Aquila heliaca adalberti*), as well as other species of European migrating avifauna. The EU has only recently recognised the importance of maintaining the Iberian *dehesas*, in spite of the large amount of information on these systems produced and published in different forums (MaB, 1989).

Intensification has led to the loss of much of the character of the rural landscape and its distinctiveness. Such a process of homogenisation is also taking place in many other European landscapes. Soil erosion has also accelerated (Díaz Alvarez & Almorox Alonso, 1994; ICONA, 1995; Schmitz et al., 1998). A United Nations report has classified Spain as the European country subjected to the highest risk of desertification, involving a loss of soil productivity due to erosion. Salinization of soils, pollution of rivers and underground waters, extraction of water from aquifers and the destruction of rare natural Mediterranean wetlands (Pineda et al., 1999), are further consequences of intensification. Furthermore, the plantations of fast-growing trees and the resulting decrease in extensive livestock farming has led to an increase in the frequency and extent of fires (ADENA-WWF, 1994; Montalvo et al., 1988; Velez Muñoz, 1991). Other land, even on quite steep slopes, is now irrigated (Valladares, 1993).

The extensive systems described above, account for well over half of the agricultural land in the Iberian Peninsula, as shown in Table 1. Some of these areas have been subjected to intensification, and many of the rest are threatened by neglect, as shown in Table 2.

In Spain, abandonment is also accompanied by a series of environmental effects that generally have negative impacts on nature conservation (González-Bernáldez et al., 1969; Llorens & Gallart, 1992). If human activity were to cease completely, ecological succession would eventually lead to the return of the original forest, but this would involve unknown consequences.

The extent of the current conversion to scrub by the colonisation of bushes (*matorralización*), undoubtedly constitutes a new situation in the Mediterranean region because much of the land has been grazed for many centuries. Uncontrolled fire is the most immediate associated effect, although traditionally fire has been used to control the growth of shrubs. Today, together with the loss of traditional fire management skills, there has been an increase in the frequency and seriousness of fires caused by factors such as, inappropriate use of fire and lack of control.

Table 1. Distribution of land and crops in Spain according to the 1997 Anuario Español de Estadística Agraria. M ha.

Total land area		50.6	
Land for cultivation		18.7	
	Dry farming	Irrigated	Total
Herbaceous	8.3	2.3	10.6
Tree plantation	3.9	0.8	4.7
Fallow	3.2	0.2	3.4
Total cultivated	15.3	3.3	18.7
Meadows and pastures (natural)		7.0	
Forest land		16.4	
Total		42.0	
Other land		8.8	

Table 2. Distribution of land, intensification and abandonment (Anuario Español de Estadística Agraria, 1997). M ha.

Development process	Distribution	Surface	
	Highly productive land	Irrigation	3.5
		Fertile dry farming	1.5
		Total	5.0
Intensification	Extensive plowing of not marginal areas	Cereals	3.0
		Vineyards. Olive trees	1.0
		Dehesas	1.0
		Pastures	1.0
		Total	6.0
Abandonment	Extensive plowing of marginal areas	Cereals	6.0
		Marginal pastures	4.0
		Multi-annual dry farming (Vineyards, olive trees, fruit trees)	2.0
		Total	12.0

Fire due to natural causes has also increased because of the build up of dead biomass. Fires are also deliberately started by shepherds and livestock farmers, in response to losses of communal *dehesas* by State afforestation programmes. This reforestation has also contributed to rural abandonment (González-Bernáldez, 1991). Soil erosion in the burnt areas also constitutes a serious loss of natural capital and also affects wildlife.

González-Bernáldez (1991b) used the term *frutalización* to define the selection that has taken place in some Mediterranean wild trees, which have then been grown for their fruit, eg. olive, carob or in the Eastern Mediterranean, the pistachio, but also acorns from trees such as holm and cork oaks. Together with the domesticated animals, many wild species also survive the winter in the Mediterranean region with the help of the fruits from these trees and from semi-wild woody plants (Herrera, 1984). Many extensive woody crops are grown in orchards in dry areas and include many local varieties, which are no longer grown because of low profitability. This decline in traditional local produce is more a question of modern marketing and distribution rather than quality, because they are no longer appreciated by a population which has become more and more urban, and which now purchases mass produced food of lower quality. Soil erosion in the orchards has also increased following abandonment. It also leads to a loss of biodiversity comparable to intensification (Montalvo, 1992; Pineda & Montalvo, 1995). The spatial mesh of the landscape is lost with rural emigration, as well as the local knowledge of country people. The landscape tends to become more homogeneous and in the short term results in a loss of biodiversity (Rescia et al., 1995), which can be seen in the abandonment of pasture systems (Casado et al., 2000; Montalvo, 1992). Such pastures historically extended throughout the Mediterranean region, but following abandonment, plant and ecosystem diversity decline, as well as their associated nutritional value (Montalvo et al., 1988). Imported types that are less suited to the local environment and have higher maintenance costs also replace local traditional breeds of plants and animals that were well adapted to the local environment. These more intensive and productive systems do not belong to the traditional sylvopastoral landscape, which as a result becomes less heterogeneous and well managed. It would be interesting to follow the recent development of interest in traditional extensive systems, in view of the serious problems experienced by modern agriculture in Europe, eg. Bovine Spongiform Encephalopathy (BSE).

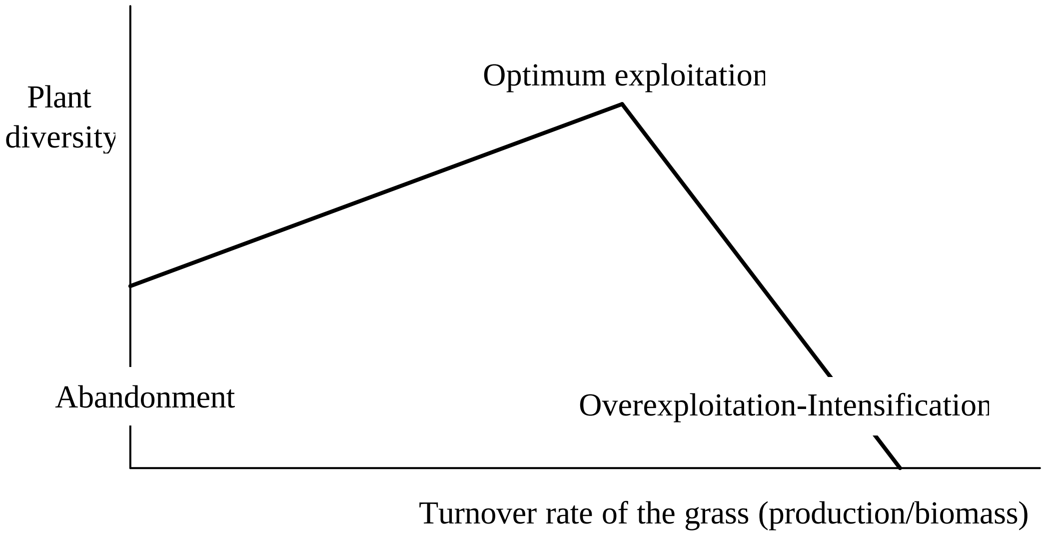

Figure 1. Experimental model of biological diversity in Mediterranean pastures according to the variation in their exploitation from high livestock loads to absence of grazing. Exploitation increases production and decreases the biomass present. Abandonment causes an increase in the unconsumed biomass of the pasture.

With the recent reform of the Common Agricultural Policy (CAP), the EU has finally recognised the importance of traditional agricultural practice in environmental conservation. The reform provides for subsidies for the more environmentally friendly extensive agricultural practices. For example, the agri-environment schemes act as income support programs, and offer compensation for a reduction in the use of irrigation, in Spain (Viladomiu & Rosell, 1997), also described by Oñate later in this volume. With the application of such measures, there has been a tendency back towards extensification, as shown in Table 3. Voluntary withdrawal is based mainly on productivity and the possibility to diversify crops, so that the farmers tend to intensify on farms that have a high potential for production (Astoquiza et al., 1996; Briz et al., 1994; Sumpsi & Varela-Ortega, in press).

Some authors believe that the tendencies towards reform of the CAP may lead to extensification and reduction in environmental damage, eg. the reduction of pollution by nitrates in response to a lower use of fertilisers (Sumpsi, 1996). There may also be possible other environmental benefits, eg. where the direct subsidies provided in 1992 for the maintenance of traditional winter pasture areas for sheep, subjected to seasonal migration in Extremadura, have halted the abandonment of cultivated land (CEAS, 1997 a, b,).

Table 3. Removal of crops and annual distribution of the subsidised areas from 1993 to 1997 (hectares). Data from Anuario Español de Estadística Agraria (1997).

		Withdrawal			Total
	Year	Obligatory	Voluntary	Total	Crops subsidised
a) Areas of dry farming land	1993			736,104	7,167,410
	1994	977,345	248,313	1,225,658	7,579,154
	1995	999,291	261,954	1,261,245	7,791,412
	1996	763,031	463,004	1,226,035	7,869,103
	1997	440,499	594,518	1,035,017	7,795,046
b) Area of irrigation land	1993			122,560	1,052,175
	1994	148,122	32,547	180,669	1,279,277
	1995	142,804	61,170	203,974	1,372,265
	1996	113,457	43,635	157,092	1,404,634
	1997	67,745	39,522	107,267	1,354,818

Socio-economic change and consequences for the landscape

Industrial agriculture greatly modifies the traditional character of rural land. Machinery, greenhouses, fertilisers, pesticides and crops of hybrid plants are now found almost throughout the Iberian Peninsula. In Spain, the associated socio-economic change is a reduction in the number of farmers working the land and an increase in the employment of these in the secondary and tertiary sectors of the economy. The incorporation of the two Iberian countries into the EU has accentuated this trend. It has been the object of much support by the government, given the relationship between modern agriculture and industrial development, leading to the construction of large dams and irrigation systems (Llamas, 2000; Sumpsi et al., 1994).

The Spanish government has also shown a clear tendency to ignore abandonment or even to aggravate it through forest policy (Groome, 1990), leading to the destruction of traditional activities that maintained cultural landscapes. Paradoxically, these landscapes are vital for tourism, an important economic sector in Spain, with an estimated income in excess of 30,000 MEUROS for the year 2000. The major development of the Spanish tourist industry since the 1960s has been linked almost exclusively to coastal and mountain areas. However, there is now a trend towards extending tourism into cultural, rural and natural landscapes, as expressed by the Green Spain advertisements in the European press. Tourism has led to the selection of certain environmental locations and often conflicts with nature conservation. The development strategies of local administrations often favour tourism and the construction of holiday homes, because they are considered beneficial to the local economy. This involves a shift away from the primary sector to service industries such as tourism. Marked changes in the socio-economic structure of these regions also follow and greatly influence the maintenance cultural landscape (Schmitz et al., 2001). Although this process has led to recognised economic benefits, there have been environmental costs, eg. the declining quality of the natural environment and the loss of local identity.

In view of the demands of expanding cultural tourism, and given the situation described, control of tourism should involve the correct use of the natural resources of the regions concerned and should be based on scientifically sound strategies, involving links between the appreciation of nature and conservation priorities. Both total or partial abandonment of some regions, together with agricultural intensification and eco-tourism provides a series of important challenges to conservationists. Integrated planning that involves government and society as a whole, is therefore required to resolve all these conflicts and must contain an important environmental component (Liang et al., 2001).

Conclusions

It can be concluded that, within the past few years, different sectors of society have come to recognise the real need to maintain traditional agrarian practices because of their links to nature conservation. The agri-environment programmes of the EU are an example of the recognition by European administrators of the fact that many regions with secular agro-systems need to conserve landscapes and biodiversity, which are considered as being of significant value.

There is a certain contradiction, however, between these programmes and the current economic development model applied by agricultural agencies. On one hand, both intensification and abandonment reflect circumstances that are stimulated by the administrators, in contrast with an alternative policy that could be more consistent with the maintenance of traditional systems. On the other, uncontrolled urban growth, , is doing serious damage to the landscape and the traditional agrarian systems in much of rural Spain. Local authorities do not consider this to be a serious problem, but rather as a positive indicator of development.

Although the ecological value of these systems is accepted, it is still not sufficiently recognised how they contribute to the maintenance of essential ecological processes and to the natural regulation mechanisms of biological diversity. As further emphasised by Gómez Sal later in this volume, an urgent initiative is therefore required to rectify this situation

References

ADENA-WWF. 1994. Incendios forestales. ADENA, Madrid.

Astorquiza, I., Bardají, I., Ramos, E., Ramos, F. & Murua, J.R. 1996. Economic responses facing the CAP reform in the Spanish Cereal Sector. 8th Congress of the EAAE. Edinburgh, UK.

Baldock , D. & Long, A. 1988. The Mediterranean environment under pressure: the influence of the CAP on Spain and Portugal and the IMPs in France, Greece and Italy. Report to WWF, Gland.

Beaufoy, G. 1996. Extensive Sheep farming in the steppes of La Serena, Spain. In: Mittchell. K. (Ed.). The Common agricultural Policy and Environmental Practices. Proc. Sem. Nature Conservation and Pastoralism European Forum WWF. COPA, Brussels:34-48.

Briz, J., de Felipe, O. & Merino, M. 1994. Set-aside programme in Spain. Aspects of Applied Biology 40: 575-578.

Campos Palacín, P. 1993. Sistemas agrarios. In: Naredo, J.M. & Parra, F. (Eds.): Una ciencia de los recursos naturales. Siglo XXI, Madrid: 281-304.

Casado, M.A., Castro, I., Ramirez-Sanz, L., Costa, M., De Miguel, J.M. & Pineda, F.D. 2000. Herbaceous plant richness and space occupation in Mediterranean grasslands and shrublands. Ecology, in press.

Casado, M.A.,de Miguel, J.M., Sterling, A., Peco, B., Galiano, E.F. & Pineda, F.D. 1985. Production and spatial structure of Mediterranean pastures in different stages of ecological succession, Vegetatio 64: 75-86.

CEAS Consultants-EFNCP. 1997a. Possible Options for the Better Integration of Environmental Concerns into the Various Systems of Support for Animal Products. Volume I. Centre for European Agricultural Studies, Wye and European Forum on Nature Conservation and Pastoralism. Final Report for EU Commission, D.G. XI. CEAS, London.

CEAS Consultants-EFNCP. 1997b. Possible Options for the Better Integration of Environmental Concerns into the Various Systems of Support for Animal Products. Volume II: Case Studies. Centre for European Agricultural Studies, Wye and European Forum on Nature Conservation and Pastoralism. Final Report for EU Commission, D.G. XI. CEAS, London.

Díaz Alvarez, M.C. & Almorox Alonso, J. 1994. La erosión del suelo. El Campo 131: 81-93.

Gómez Gutierrez, J.M. (Coord.). 1991. El Libro de las Dehesas Salmantinas. Junta de Castilla y León, Salamanca.

González-Bernáldez, F. 1991a. Diversidad biológica, gestión de ecosistemas y nuevas políticas agrarias. En: Pineda, F.D., Casado, M., de Miguel, J.M. & Montalvo, J. (Eds.): Diversidad Biológica/Biological Diversity. F.Areces, SCOPE, WWF, Madrid: 23-32.

González-Bernáldez, F. 1991b. Ecological consequences of the abandonment of traditional land use system in central Spain. Options Mediterraneennes 15: 23-30.

González-Bernáldez, F. 1995. Western Mediterranean Land-use Systems as antecedents for Semiarid America. In: Turner, B.L., Gómez-Sal, A. González-Bernáldez, F. & di Castri, F. (Eds.): Global Land Use Change. SCOPE-CSIC, Madrid: 131-149.

González-Bernáldez, F., Morey, M. & Velasco, F. 1969. Influence of *Quercus ilex rotundifolia* on the herb layer of El Pardo, Spain. Bol. Real Soc. Española Hist. Natural 67:265-284.

González-Bernáldez, F., Rey, J.M., Levassor, C. & Peco, B. 1989. The landscape ecology of uncultivated lowlands in Central Spain. Landscape Ecology 3: 3-19.

Groome, H.J. 1990. Historia de la política forestal en el Estado español. Agencia de Medio Ambiente, Madrid.

Herrera, C. 1984. A study of avian frugivores, bird-dispersed plants, and their interaction in Mediterranean scrublands. Ecological Monographs 54: 1-23.

ICONA. 1995. Estrategia Nacional para la Conservación de la Naturaleza. Instituto Nacional para la Conservación de la Naturaleza, Madrid.

Liang, L., Stocking, M., Brookfield, H. & Jansky, L. 2001. Biodiversity conservation through agrodiversity. Global Environmental Change 11: 97-101.

Llamas, M.R. 2000. Dictamen sobre el Anteproyecto de Plan Hidrológico Nacional. Consejo Nacional del Agua, Madrid.

Llorens, P. & Gallart, F. 1992. Small basin response in a Mediterranean mountainous abandoned farming area. Catena 19: 309-320.

MaB. 1989. Seminario sobre Dehesas y Sistemas Agrosilvopastorales similares. MaB, UNESCO. AURINSA, Madrid.

Montalvo, J. 1992. Estructura y función de pastizales mediterráneos. Tesis Doctoral. Univ. Complutense, Madrid.

Montalvo, J., De Miguel, J.M.,Schmitz, M.F., García-Criado, B., Pineda, F.D. 1988. Calidad de la hierba y sucesión secundaria en un pastizal mediterráneo. Monogr. Inst. Pirenaico de Ecología 4: 837-846.

Moreno, J.M. (Ed.) 1998. Large Forest Fires. Backhuys, Leiden.

Pineda, F.D. & Montalvo,J. 1995. Dehesa systems in the western mediterranean. In: Halladay, P. & Gilmour, D. (Eds.): Biological Diversity outside Protected Areas; Overview of Traditional Agroecosystems. IUCN, Forest Conservation Programme. Gland:107-122.

Pineda, F.D. (Ed.). 1996. Ecología y Desarrollo. Editorial Complutense, Madrid.

Pineda, F.D., Nicolás, J.P., Ruiz, M., Peco, B. & González-Bernáldez, F. 1981. Succession, diversité et amplitude de niche. Vegetatio 47: 267-277. Advances in Vegetation Science 4: 267-277.

Pineda, F.D., Fernández Rubio, R., López Sanz, G., Rosell, J. & Tarjuelo, J.M. (Comisión de Expertos del Alto Guadiana). 1999. Prospección, Diagnóstico y Propuesta de actuaciones para un Plan de Ordenación de los Recursos Naturales y Desarrollo Sostenible del Alto Guadiana. Informe para el Ministerio de Medio Ambiente y la Consejería de Agricultura y Medio Ambiente de Castilla La Mancha, Toledo, Madrid.

Rescia, A., Schmitz, M.F., Martin de Agar, P., De Pablo, C.L. & Pineda, F.D. 1994. Influence of landscape complexity and land management on woody plant diversity in northern Spain. Journal of Vegetation Science 5:505-516.

Rescia, A., Schmitz, M.F., Martin de Agar, P., De Pablo, C.L. & Pineda, F.D. 1995. Ascribing plant diversity values to historical changes in landscape: a methodological approach. Landscape and Urban Planning 31:181-194.

Ruíz, M. & Groome, H. 1986. Spanish agriculture in the EEC: A process of marginalization and ecological disaster?. FFSPN Rencontres Internationales Agriculture-Environment. Toulouse: 456-461.

Ruíz, M. 1986. Sustainable food and energy production in the Spanish Dehesa. The food Energy Nexus Programme, UNU. The United Nations University. FEN Res. Reports, París.

Schmitz M.F., Atauri, J.A., De Pablo, C.L., Martín, P., Rescia, A. & Pineda, F.D. 1998. Changes in land use in Northern Spain: effects of forestry management on soil conservation. Forest Ecology and Management 31:137-150.

Schmitz, M.F., De Aranzabal, I., Rescia, A. & Pineda, F.D. 2001. Implications of socioeconomic changes in Mediterranean cultural landscapes. IALE Congress: Development of European Landscapes. Tartu, Stockholm, in press.

Sumpsi, J.M. & Varela-Ortega, C. (in press) Política agraria y medio ambiente en la Comunidad Europea. El caso de España. In: Pineda, F.D., De Miguel, J.M. & Casado, M.A. (Eds.). La diversidad biológica de Iberoamérica. España. CYTED. Vol. IV. Multimedia, Madrid, México.

Sumpsi, J.M. 1996. La agricultura española ante los nuevos escenarios de la PAC. Rev. Española de Economía Agraria 176-177: 265-301.

Sumpsi, J.M., Pineda, F.D., Gómez Orea, D., Hernández, J.M., Montes, C., Tió, C. y Arranz, A. 1994. Dictamen sobre el Plan Hidrológico Nacional. I. Dictamen; II. Análisis metodológico; III. Evaluación ex-ante; IV. Propuestas de Mejora del Anteproyecto de Ley de Plan Hidrológico Nacional; V. Síntesis de Alegaciones. Dirección General de Política Ambiental. Ministerio de Obras Públicas, Transportes y medio Ambiente. QUASAR, S.A., Madrid.

Valladares, M.A. 1993. Effects of the EC policy implementation on natural Spanish habitats. The Science of the total environment 129: 71-82.

Varela-Ortega, C. 1997. Situation and possibilities in Spain for the assessment of additional policy instruments for plant protection products. In : Oskam, A. et al. (Eds.). Additional EU policy instruments for plant protection products, 2nd phase PES-A programme. DG XI. EU Commission, Brussels.

Varela-Ortega, C., Sumpsi, J.M. & Iglesias, E. 1996. The CAP and the Environment in Spain. In: Brouwer, F. & Van Berkun, S. (Eds.): CAP and the environment in the European Union. LEI-DLO. Wageningen Pers, Wageningen.
Velez Muñoz, R. 1991. Los incendios forestales y la política forestal. Revista de Estudios Agrosociales 158: 83-107.

Viladomiu, L. & Rosell, J. 1997. Gestión del agua y política agroambiental: el Programa de Compensación de Rentas por reducción de regadíos en Mancha Occidental y Campo de Montiel. Revista Española de Economía Agraria 179.

Three landscapes from northern Spain, showing regional differences in grasslands within a single region.

Plate 1. Cordillera Pirenaica, Comunidad Foral de Navarra, northern Spain. Some extensive grasslands on the gentle summit ridges, small hay fields in the valleys, often overgrown with bushes and returning to forest. The grass is used mainly by cattle, but also by some sheep. Some of the hillsides are covered with bracken (Pteridium aquilinum), still sometimes cut for cattle bedding. Otherwise the steeper slopes are still covered with forest.

*Plate 2. Cordillera Pirenaica, Comunidad Foral de Navarra, northern Spain. Intensively grazed limestone grassland set in karstic scenery, with dolines and limestone pavement, with altitudinal transhumance. Mainly mountain dairy cattle but with some sheep, an exceptionally high bidiversity resulting from traditional management practices. Some pine (*Pinus nigra*) forest and scattered trees on shallow soils.*

Plate 3. Sierra de la Demanda, La Rioja, northern Spain. Intensively grazed dry but not steppic, grasslands mainly acidic, but with some calcareous soils locally. Grazed by sheep, cattle and goats in a traditional way with a high biodiversity.Some invasion by scrub on steeper slopes and with forest on the lower valley sides.

Examples of pastoral landscapes in a small region, Picos de Europa in northwestern Spain.

*Plate 4. Picos de Europa, Cantabria, northwestern Spain. In the foreground, are trees of poplar (*Populus *spp) and ash (*Fraxinus excelsior*). The latter are pruned to form the Candelabra trees, of which the branhes and leaves are then used as fodder. In the central of the picture, are traditional managed meadows, which are surrounding a small village. At the back of the picture, are heavily grassy heathlands.*

*Plate 5. Picos de Europa, León, northwestern Spain. This landscape is on the eastern fringe of the main mountain massifs. In the foreground is a wet species rich meadow, with some willow bushes (*Salix *spp) along a small river. In the centre of the picture, there are heavily grazed acid grasslands, with groups of broom (*Cytisus *spp) and tree heathers (*Erica *spp). The sandstone hills at the back of the picture are also covered by acidic grassland.*

Plate 6. Picos de Europa, Cantabria, northwestern Spain. Polyculture, as described by Gómez Sal, this volume, in a valley below the eastern massif. Small vineyards, apple orchards, small fields on terraces, together with larger meadows. There are also large areas of forest and small patches of woodland and scrub.

Examples of Mediterranean landscapes in central and southern Spain.

Plate 7. Sierra de Gredos, Ávila, central Spain. The fields in the valley are used by pedigree Ávila cattle, and are sometimes cut for hay earlier in the year. There is a typical dehesa in the middle of the picture, with holm oak (Quercus ilex). The mountains behind are used for summer grazing by sheep, goats but especially cattle and have puertos as described by Gómez Sal, this volume.

Plate 8. Comunidad de Madrid, central Spain. Dry grasslands, called steppic (estepas) with extensive grazing, mainly by sheep. Some scattered trees and dehesa in the background.

Plate 9. Sierra de Grazalema, Andulacia province, southern Spain. Relatively moist grassland in the foreground, cut for hay in good years. In the centre of the picture are extensively grazed dry grasslands used by sheep and goats. In the background there are open woodlands and scrub that are also grazed extensively.

The experience of agri-environment schemes in Denmark

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Introduction

Denmark is not one of the member-states where agri-environment schemes implemented under Regulation 2078/92 have had a significant uptake by farmers. By 1999 less than 10% of the agricultural area was under agreement. The main reason for the limited uptake and success is the fact that agricultural production in Denmark is very intensive. For example, Denmark, compared with other member-states, has the highest share of Utilised Agricultural Area (UAA) as arable land. Furthermore, 10% of the pigs in the European Union (EU) are produced in Denmark, despite its small size. However, this paper will show that the implementation of the agri-environment schemes in Denmark has also had its successes, but has some problems and obstacles to overcome.

The data presented in this paper mainly comes from an evaluation of the Danish agri-environment programme financed by the Danish Ministry of Food, Agriculture and Fisheries and carried out in the period from 1996-98. More detailed information can be found in Andersen et al. (1998).

The Danish agri-environment programme

This paper focus on the agri-environment schemes implemented in the period from 1993-1999, that is the measures under Regulation 2078/92. It should however be noted that Denmark was one of the member-states that previously used the voluntary option and also implemented measures under Regulation 797/85. Also, a national organic farming scheme was in place before 2078/92 dating back to 1987 (Andersen et al., 2000).

The Danish programme of agri-environment schemes can roughly be divided into three parts based on their main objectives: environment, nature conservation and organic farming, although there is some degree of overlap. A short description of these measures is provided in Table 1.

Table 1. The agri-environment measures implemented in Denmark and the uptake by 1999. Data from the Ministry of Food, Agriculture and Fisheries, 2000.

Reduced use of nitrates. Agreements on all land within ESAs belonging to the participant reducing the N-input to 60% of official standards. Uptake 1994-1999: 5,400 ha.
Spray-free management. Agreements on single fields without use of sprayers. Uptake 1994-1999: 1,000 ha.
Spray-free margins. Agreements on 12-meter zones along specified landscape features banning the use of sprayers. Uptake 1994-1999: 100 ha.
Rye grass as groundcover. Agreements on single fields for under-sowing rye grass in arable crops to reduce leaching. Uptake 1994-1999: 4,500 ha.
20-year set-aside (arable land). Agreements on single fields of arable land. Uptake 1994-1999: 5,900 ha.
20-year set-aside (grassland). Agreements on single plots of grassland. Uptake 1994-1999: 300 ha.
Maintenance of extensive grassland. Agreements on single fields of permanent grassland putting restrictions on fertilisers, sprayers, grazing density etc. at different tiers. Uptake 1994-1999: 48,700 ha.
Management of grassland. Agreements on single plots of grassland specifying detailed management requirements in grazing, mowing and/or clearance of scrubs. Uptake 1994-1999: 6,100 ha.
Reduced drainage. Agreements on single fields where the farmers accept a raised water table due to modified drainage. Uptake 1994-1999: 700 ha.
Organic farming. Uptake 1994-1999: 127,000 ha.

The uptake of measures with environmental objectives has been limited and below expectations. By 1999 only about 18,000 ha was under agreement in the measures aiming to improve the environment by targeting a reduction in the use of fertilisers and pesticides. Although an environmental improvement was the primary stated aim of the programme, the measures with nature conservation goals actually have had a greater success. By 1999 the farmers had entered nature conservation orientated agreements on about 55,000 ha of land, mainly valuable extensively used grassland. Finally, organic farming, implemented as a separate measure, covers the largest area under agreement. By 1999 about 127,000 ha had been placed under organic agreements. In total, 9,500 agreements had been signed on environmental and nature conservation measures and 2,900 farms were included in the organic scheme by the end of 1999. The agreements covered 200,000 hectares corresponding to 7.5% of the agricultural area.

The agri-environment measures in Denmark have been targeted to areas designated solely for these purposes. Environmentally Sensitive Areas (ESAs) have been designated in relatively small, dispersed areas, as shown in Figure 1. More than 2,500 areas have been designated covering about 460,000 ha of land. The average size of 180 ha ranges from 0.22 ha to 7,643 ha. These areas have been designated by the counties based on a quota corresponding to their share of the agricultural land. The counties have to some degree based their designations on existing designations, such as those covered by conservation orders, by the Nature Protection Act, and by the Birds and Habitats Directives. The areas are therefore widely dispersed and 30% of farmers in Denmark has farmland within ESAs. There have been some changes in the targeting of the different measures since the implementation started in 1993, but today only the organic farming measure is available for the farmers outside the ESAs.

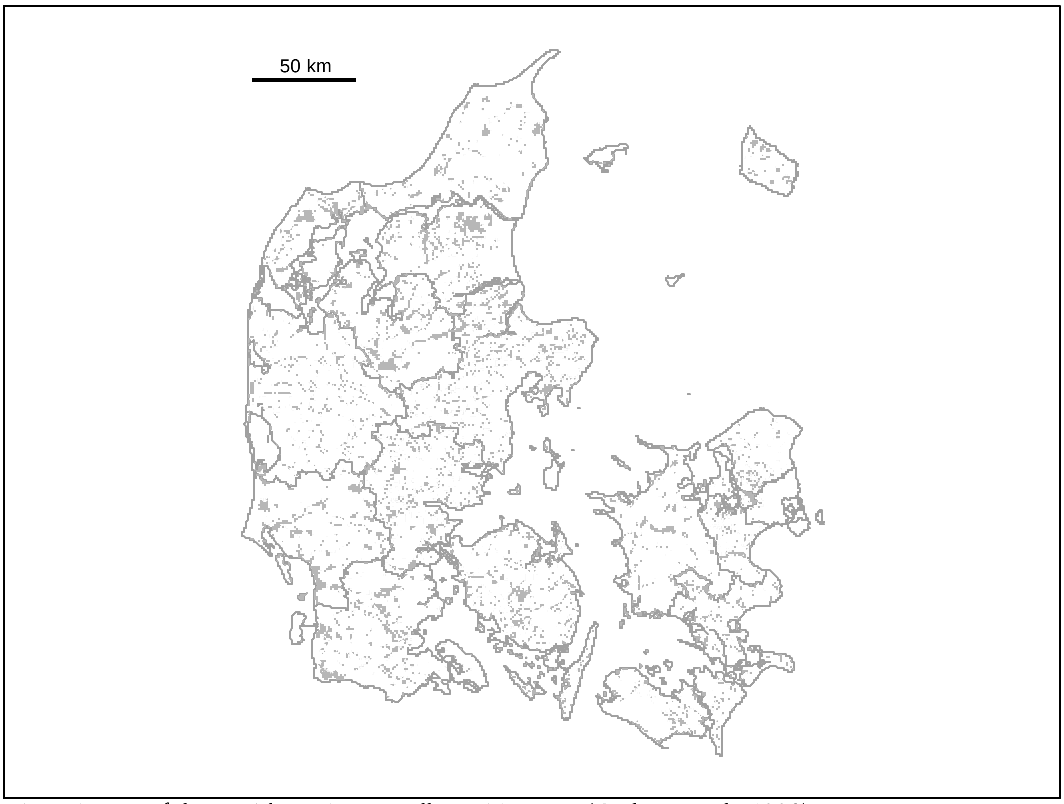

Figure 1. Map of the Danish Environmentally sensitive areas (Andersen et al., 1998)

Successes

The first success has been the measures targeting grassland, despite the low priority given to nature conservation and to the value of grassland for biodiversity. As mentioned above, the measures targeting nature conservation, mainly grassland, accounts for 75% of the agreement area, when organic farming is excluded. The success of these measures can be explained by several factors, eg. the existence of the same type of measures under the first generation of agri-environment measures (Regulation 797/85), acceptance of the relevance of the measures by the farmers and the targeting of the ESAs as sites with a high proportion of grassland. Within the EU, the high proportion of agri-environment agreements on grassland is sometimes attributed to the fact that farmers are accepting money for carrying out already existing practices, European Parliament (1998). The evaluation of the Danish implementation of agri-environment measures has however shown that this is not a complete picture of the effects of the measures (Andersen et al., 1998). Figure 2 shows the changes in management on grassland with agri-environment agreements and as it can be seen, more than half of the agreements have resulted in changes in the management of the areas.

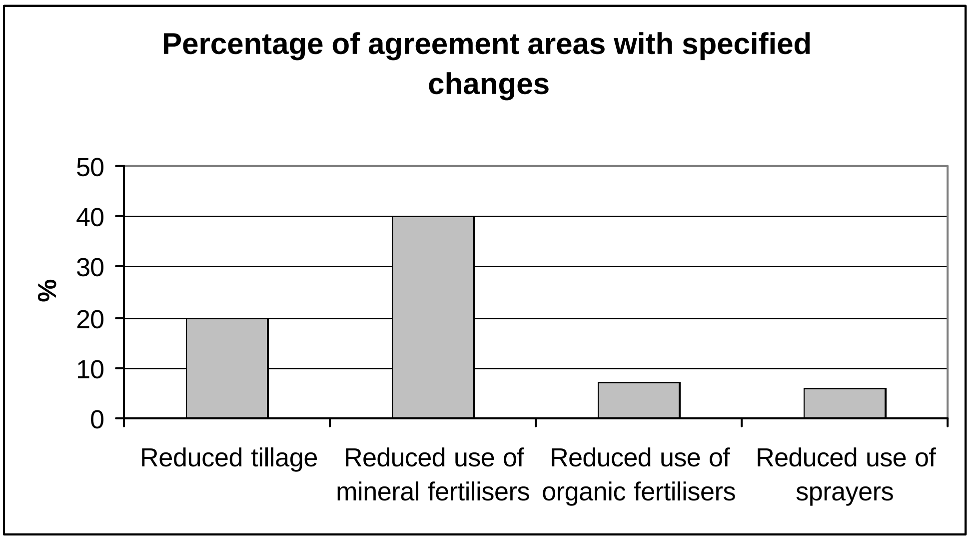

Figure 2. Management changes on grassland induced by agri-environmental agreements. Data from Andersen et al., 1998.

In most cases the farmers have reduced the input of fertilisers to the land, thus improving the quality of the habitats. The evaluation of the Danish measures has also shown the effects of protection. Through the period 1990 to 1997, grassland sites without agreement adjacent to those with agreement were analysed. The result was that almost 25% of the sites without agreement had either been taken into rotation, or were abandoned. In both cases there was a consequent reduction in the nature conservation value. Furthermore, 44% of the farmers with agreements, planned to change their management of the sites when the agreement period ended, indicating that the measures have had some protection effects. The overall conclusion is that the agri-environment scheme helped to protect and improve important grassland habitats in Denmark.

The organic farming measure has also had some success in Denmark, increasing the area managed organically six times since the implementation of Regulation 2078/92 to a total of 136,000 ha in 1999. Also, measures supporting organic farming have a history in Denmark going back to an initial national programme set up in 1987. However, it is also interesting to note that the success actually has taken place despite the fact that the premiums are relatively low compared with some of the other member-states (Buller, 2000). The success can be explained by a series of initiatives taken by the authorities and the dairy industry, to promote organic farming. Besides the area payments, accounting for less than 50% of the money spent to support organic farming, the following policies are involved:

(a) support for investments at farms
(b) support for marketing
(c) support for a specific organic research programme
(d) control and labelling, dating back to a national initiative in 1987
(e) economic support from the dairy industry to convert to organic farming
(f) a focus on organic products in the supermarkets with a special premium on 5% of the money spend to consumers, for buying organic products in the biggest chain
(g) distribution of milk quotas favouring organic farmers.

Together all these initiatives form an earth to table approach that has send a clear message to farmers and to consumers, that organic farming is good. The initiatives have thus promoted the success of the organic support under the agri-environment programme.

Problems

The agri-environment measures deal with issues such as biodiversity and water quality, which are influenced by long term processes. A problem is whether agreements covering typically only five years, are appropriate to address such issues. In the Danish evaluation, almost 45% of the participants stated that they would change management of their agreement area, if the agreement was not renewed at the end of the agreement period. Furthermore, 10% of the participants after one to three years participation already stated that they did not wish to continue with an agreement when the current one expired. These figures clearly show that it is difficult to ensure long-term effects by the present agri-environment agreements. The implementation and administration of the measures should take this into account by ensuring continuity. The Danish example is to some degree a perfect example of inappropriate implementation and administration. The administration of the measures has shifted more than one time from the national to the regional level and the goals and targets at the different levels have not always been synchronised. The content and targeting of the measures have been changed several times, leaving the farmers in confusion. Some initiatives have been positive, eg. higher premiums to farmers committing themselves for 20 years instead of five years. An interesting attempt in relation to continuity is to give the management achieved by the agreement signing a permanent status. This is done by making it a part of the agreement that the agreement area is placed under protection by the Nature Protection Act. If this form of agreement was used more widely, it might not be approved by the Commission as long term or indefinite agreements are considered to go beyond the scope of the agri-environment schemes. It could be argued that this is the most important limitation of the schemes, with the exemption of the organic measure, namely that they merely provide compensation for income foregone in a period of transition, instead of giving investment support for real changes in agricultural practices.

Apart from continuity in time, proximity in space is also important when seeking solutions for environmental and nature conservation problems. The designation of eligible land can be used to ensure this continuity in space, as the information strategy and other efforts to persuade the farmers to participate can be much more targeted. However, the evaluation of

Danish ESAs and designations, showed a low degree of coherence. Figure 3 shows that the agreement area covered more than 50% of the designated area in only 5% of the ESAs. In almost 1,500 of the 2,500 designated areas, no agreements at all were signed. Apart from questioning the whole concept of the Danish designation of ESAs, the question was also raised of how the farmers could be involved at the local level.

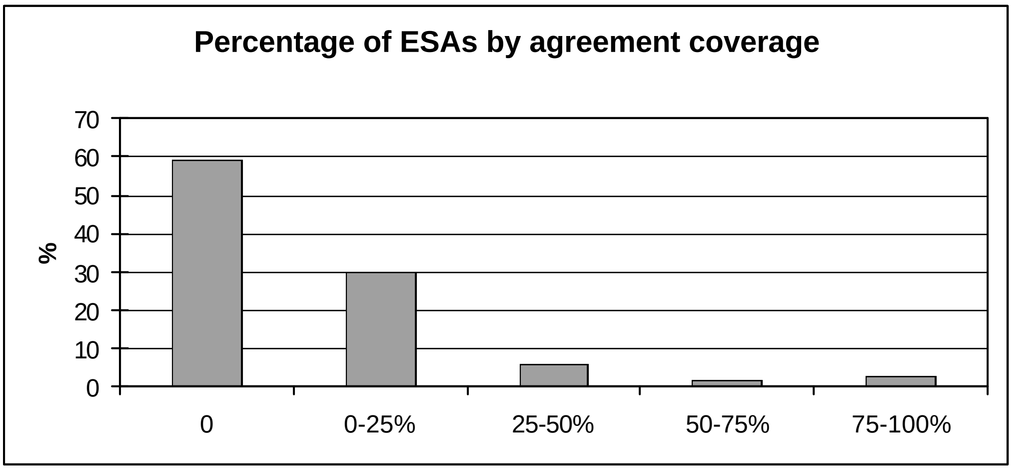

Figure 3. Agreement coverage in the Environmentally Sensitive Areas (ESAs). Percentage of ESAs distributed by agreement coverage in percent. Data from Andersen et al., 1998.

One of the attempts to raise local participation was to offer a bonus payment in ESAs, where the agreement coverage exceeded a threshold defined by the responsible county. Typically a high coverage was defined as 50% which would lead to a bonus payment of an extra 10%. By giving these bonus payments it was hoped that the most adaptive farmers would try to convince their neighbours to join the measures. A more enthusiastic local engagement was also created in some of the demonstration projects financed under Article 6 of Regulation 2078. Here the agricultural advisory system and the counties have worked together on the basis of initiatives originating from local farmers. The counties still promoted the so-called kitchen-table model, in which conversations between administrators and the farmers take place informally within the farmhouse to encourage farmers to participate. It is likely that the participation is increased, but taking into account recent discussions on the transaction cost of the measures, it might not be the way forward. An interesting alternative could be to promote the measures to groups of farmers encouraging local organisation. Traditionally reclamation of land in Denmark has been organised in this way and it could ensure local participation at a low cost.

Conclusions

Agri-environment measures are going to be reintroduced in a new package from 2001 in the new Rural Development Programme. Two new measures will be introduced in addition to the existing schemes, one relating to reduction in nitrates using tenders and the other for

green accounting at farm level. Both of the new measures will be available throughout Denmark and not limited to ESAs.
So far the amalgamation between the agri-environment schemes and the other rural development measures is limited to the fact that they are described in the same paper, the Danish rural development programme. There has only been a limited co-ordination of the goals for the different type of measures and at the more detailed level the content of the different measures are without co-ordination. Regarding the investment support for development of agricultural structures, the eligibility requires no more than normal agricultural practices and not enhancement, for example at the level of agri-environment schemes. It is however not really valid to judge the amalgamation already as synergy effects and possibilities for co-ordination might appear in the further implementation of the measures. As mentioned above, most agri-environment schemes have been limited by the lack of investment support being only available for the organic scheme, the new rural development framework could remedy this situation.

It is however also necessary to point out that, even if there were good intentions to co-ordinate agri-environment and rural development measures, the scope in Denmark and in other regions of intensive agriculture, might be limited. The structural and rural development funds have in these regions had a relatively low importance compared to the general agricultural support. This can be illustrated by the fact that in Denmark the Guidance section for structural policies, in 1998 accounted for about 2% of the payments from the European Agricultural Guidance and Guarantee Fund, whereas the EU-15 average was more than 10% (European Communities, 2000). In the long-term, co-ordination between general agricultural support and agri-environment schemes might be the only way that environmental objectives can be successfully achieved.

References

Andersen, E., Primdahl, J. & Solvang, V., 1998. Miljøvenlige jordbrugsforanstaltninger og de Særligt Følsomme Landbrugsområder 1994-96. DSR forlag, Frederiksberg.

Andersen, E., Henningsen, A. & Primdahl, J., 2000: Denmark: Implementation of a new agri-environmental policy based on Regulation 2078. In: Buller, H., Wilson, G.A. & Höll, A.: agri-environmental policy in the European Union. Ashgate, Aldershot.

Buller, H., 2000: Regulation 2078: Patterns of implementation. In: Buller, H., Wilson, G.A. & Höll, A.: agri-environmental policy in the European Union. Ashgate, Aldershot.

European Communities, 2000: The Common Agricultural Policy - 1999 Review. http://europa.eu.int/comm/dg06/publi/review99/full_en.pdf (23.10.2000).

European Parliament, 1998: Report on the report from the Commission to the Council and the European Parliament on the application of Council Regulation (EEC) No. 2078/92 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside - Committee on

Agriculture and Rural Development. A4-0345/98. http://www2.europarl.eu.int/omk/OM-europarl?prog=report&l=en&pubref=-//ep//nonsgml+report+a4-1998-0345+0+doc+pdf+v0//en&level=3 (23.10.2000)

Ministry of Food, Agriculture and Fisheries, 2000: Årsberetning 1999. The Directorate for Food, Fisheries and Agro Business. http://www.dffe.dk/publikationer/aars99/aars99.htm (23.10.2000)

Remonitoring of agri-environment schemes in Northern Ireland

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Introduction
The main agri-environment mechanism in Northern Ireland is the Environmentally Sensitive Areas (ESA) scheme. This was introduced by the Department of Agriculture and Rural Development (DARD) to help safeguard areas of the countryside where the landscape, wildlife or historic interest is of particular importance and where that interest would benefit through farmers continuing with or engaging in environmentally sensitive farming practices. This voluntary scheme was introduced in 1988 and has continuously expanded to five ESAs covering 20% of the land area of Northern Ireland. A ten year agreement plan has been set up with various tiers of management prescriptions. Restrictions are placed on fertiliser usage, stocking densities and cultivation. Payments are area based and paid annually in arrears. Payments vary according to the level of participation (tier level).

Monitoring of agri-environment schemes (Regulation 2078/92) is an EU requirement. In Northern Ireland monitoring is carried out independently by The Queen’s University of Belfast under contract to the Department of Agriculture and Rural Development. A long term monitoring programme was established in 1992 to determine the effectiveness of the scheme in meeting its stated objectives of maintaining or enhancing biodiversity and the rural landscape.

Baseline biological and landscape surveys were carried out on ESA-participant and non-participant farms between 1993 and 1995. Each area was re-surveyed after three and six year intervals. Data were compared to the baseline for both participant and non-participant farms.

Biological monitoring
The main emphasis of monitoring is on biodiversity. Plant and invertebrate communities were monitored as indicators of change in biodiversity. Permanent quadrats and pitfall traps were used to sample plant and invertebrate communities (Hegarty et al., 1994). Habitats monitored, included wet grasslands limestone grasslands unimproved grasslands, hay meadows, heathland and woodland. Habitat diversity was measured using a combination of species richness, plant species groups, vegetation types, the relative proportions of species in each of the plant strategy theory CSR (Competitors Stress-tolerant and Ruderals) groups (Grime et al., 1988) and the frequency and distribution of ground beetle and spider species. Ground beetles have been used extensively as indicators

of biodiversity and habitat quality (Luff 1996). Spiders are sensitive to changes in vegetation structure (Coulson & Butterfield 1986). The combination of plant and invertebrate monitoring provides a comprehensive measure of habitat biodiversity.

Total numbers of plant species and numbers of stress-tolerant species increased significantly in hay meadows on participant farms and decreased on heather moorland on non-participant farms. There were also increases in the number of stress-tolerant species on wet grassland and heathland on participant farms and decreases on hay meadows and limestone grassland on non-participant farms although these were not significant. Numbers of ground beetle species increased significantly on heathland on ESA participant farms and decreased on non-participant farms. Occurrences of ground beetle indicator species increased on ESA participant farms and decreased on wet grassland, hay meadows and heathland on non-participant farms (Cameron et al., 1997). An statistical analytical tool ordination has been used to relate ground beetle species composition to soil conditions and habitat and will prove valuable in future monitoring exercises (Cameron et al., 2000).

It was concluded from biological monitoring that plant and invertebrate species diversity is at present being maintained on all habitats on ESA participant farms and there are some indications of enhancement, with an increase in numbers of plant species in hay meadows, wet grassland and heathland. Further biological monitoring will show if enhancement is sustained and determine whether there are any effects of annual fluctuations in plant and invertebrate communities.

Landscape monitoring

Landscape monitoring characterises the landscape of each ESA by quantifying land cover elements such as, vegetation, buildings, field boundaries and historical features. This provides the basis for environmental management as the presence, type and distribution of landscape elements reflects the broad ecological and cultural patterns of the ESA. Monitoring change in the presence, type and distribution of land cover elements over time with respect to participation in the ESA scheme will enable broad changes in the character of the ESA to be recorded. This, in conjunction with biological, historical and management monitoring will allow an assessment of the effectiveness of the ESA scheme and permit refinement of management prescriptions, where necessary.

A baseline landscape monitoring programme was completed in all of Northern Ireland's ESAs in 1995 to provide an overview of the landscape character of each ESA and to act as a benchmark for assessment of change (Millsopp et al., 1997). This was repeated after three years and changes in land cover elements determined.

The Northern Ireland land classification (Cooper, 1986) provided a basis for stratified random sampling as it categorises Northern Ireland into twenty-three environmental classes. This permitted a greater dispersion and representation of samples and potentially greater accuracy and precision of estimates than simple random sampling. A total of one hundred and eighty three, twenty five hectare squares (a sampling intensity of 1.5%-2.0%

by ESA area) were recorded to give a reasonable estimate of common land cover types. The main emphasis was on estimates for the entire ESA, as sample sizes in some ESAs are small when lowland and upland land class groups are divided.

The landscape monitoring programme recorded similar information to the Northern Ireland landscape ecological surveys (Cooper et al., 1993), with some modifications to relate to the ESA scheme. Field code definitions for landscape monitoring were derived from guidelines issued by DARD in relation to habitat management plans and are used by their staff to classify ESA farms. The main landscape features were divided into seven groups (1) grassland and crops, (2) woodland (3) field boundaries (4) heather moorland (5) buildings and amenities (6) other vegetation types and (7) historical monuments with separate maps and specific recording codes for each group. Further descriptive codes were given in relation to the presence of common and indicator species characteristic of a common type of habitat, as derived from previous biological monitoring results (Hegarty et al., 1994, 1995). This enabled the landscape monitoring programme to be fully integrated with biological monitoring. Details of management practices, grazing and types of animals observed were also coded. Farm ownership boundaries have since been added to each sample square in the ESAs, to enable comparison between ESA participants and non-participants. Initially every 0.25 km survey square was digitised using the geographic information system PC ARC/INFO and all field codes for each land cover type were stored as database files (Dbase V). PC ARC/INFO in conjunction with ArcView was used to store and process all map information.

The comparison between 1995 & 1998 has indicated that, even in this short time, stock-proof boundaries have increased in three of the five ESAs and boundary management has increased in four ESAs. The West Fermanagh & Erne Lakeland ESA had the highest proportion of unmanaged boundaries. There were no significant changes in heathland or woodland in any of the ESAs over this time. Some increase in the numbers of traditional buildings classified as derelict was noted, however, there was also an increase in newly restored traditional buildings on ESA participant farms in four ESAs. Comparison between ESA participants & non-participants indicated that there was no re-seeding, hedge removal or scrub woodland removal on ESA participant farms whilst these operations continued on non-participant farms. Hedges had been planted on ESA participant farms under grant aid from the ESA scheme. Some poaching damage was noted on historic features on non-participant farms in the Sperrins and West Fermanagh and Erne Lakeland ESAs (Cameron et al., 1999).

Conclusion

The monitoring programme in Northern Ireland meets EU requirements and sets benchmarks in some cases. There is evidence of maintenance and, in some instances, enhancement of species diversity as a result of the ESA scheme. Land cover elements are being maintained on ESA participant farms whilst there are indications of degradation and removal on non-participant farms.

The monitoring programme has been instrumental in the revision of ESA scheme and the development of the new Countryside Management Scheme. Monitoring will continue to play an integral role in the implementation of agri-environment schemes in Northern Ireland.

References

Cameron, A., Anderson, R., &, McFerran, D.M., 2000, Edaphic conditions and ground beetle community structure. In: The Ground Beetles of Northern Ireland (Coleoptera-Carabidae). Ed: Anderson, R., McFerran, D.M. & Cameron, A. Atlases of the Northern Ireland flora and fauna, Vol. 1. Ulster Museum. National Museums and Galleries of Northern Ireland.

Cameron, A., Millsopp, C.A. & McAdam, J.H., 1997. Biological monitoring of grasslands in the West Fermanagh and Erne Lakeland Environmentally Sensitive Area. Grassland Management in the Environmentally Sensitive Areas. Ed. R. Sheldrick. British Grassland Society. Lancaster University. 23rd-25th September 1997.pp 55-60.

Cameron, A., Campbell, J. Johnston, R.J. & McAdam, J.H., 1999. Environmentally Sensitive Areas in Northern Ireland. Landscape Monitoring – a comparison between 1995 & 1998. Report to Dept. of Agriculture and Rural Development. The Queen's University of Belfast, Belfast.

Cooper, A., 1986 The Northern Ireland Land Classification, University of Ulster, Coleraine.

Cooper, A. McCann, T. & Smith, D., 1993 Land cover monitoring in the Mournes Environmentally Sensitive Area. Report to the Department of Agriculture (NI), University of Ulster, Coleraine.

Coulson, J.C. and Butterfield, J.E.L., 1986 The spider communities on peat and upland grasslands in northern England. – Holarct. Ecol. 9: 229-239.

Grime, J.P., Hodgson, J.G. & Hunt R., 1988 Comparative Plant Ecology: a functional approach to common British species. Unwin Hyman, London.

Hegarty, C.A., McFerran, D.M., Cameron, A. & McAdam, J.H., 1994. Environmentally Sensitive Areas in Northern Ireland. Biological Monitoring Report.-The West Fermanagh & Erne Lakeland. Year One - 1993. Report to Dept. of Agriculture and Rural Development. The Queen's University of Belfast, Belfast.

Hegarty, C.A., McFerran, D.M., Cameron, A., McAdam, J.H., 1995. Environmentally Sensitive Areas in Northern Ireland, Biological Monitoring Report.The Mournes and Slieve Croob, The Antrim Coast Glens & Rathlin, The Sperrins and Slieve Gullion. Year Two - 1994. Report to Dept. of Agriculture and Rural Development. The Queen's University of Belfast.

Luff, M. L., 1996 Environmental assessments using ground beetles (Carabidae) and pitfall traps. In: Environmental monitoring, surveillance and conservation using invertebrates. Ed. Eyre, M. D., EMS Publications, Newcastle upon Tyne.

Millsopp, C.A., Cameron, A. & McAdam, J.H., 1997. Landscape Monitoring of Environmentally Sensitive Areas in Northern Ireland. 1995. Report to Dept. of Agriculture and Rural Development. The Queen's University of Belfast, Belfast.

Agri-environment schemes in England: past; present and future

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Introduction

This short paper is designed to act as a pointer to the electronic literature published by the Ministry of Agriculture Fisheries and Food (MAFF) on the agri-environment schemes operated in England from 1987-2000. The paper highlights and describes the future of English agri-environment schemes, as published in the England Rural Development Programme (ERDP) in the autumn of 2000. It is recognised in England that monitoring of agri-environment schemes is vital if their effectiveness is to be judged; adequate financial resources are required for high quality monitoring.

The Environmentally Sensitive Area scheme

Agri-environment schemes in England began in earnest in 1987, with the introduction of the Environmentally Sensitive Areas (ESA) scheme. The Scheme was introduced to protect the landscape, wildlife and historic interest of specific areas of England which are of national environmental significance. In these areas changes in farming methods posed a threat to the environment and conservation depended on adopting, maintaining or extending particular farming methods. The scheme has been, and in 2000 still is, voluntary and farmers receive an annual payment based on income forgone for entering into ten year management agreements which require them to manage their land according to a set of management prescriptions. Each ESA has one or more tiers of entry, and prescribes specific practices to be followed. Tier 1 generally requires maintenance of the current environmental value of the land with higher tiers being for enhancement or restoration. These higher tiers consequently have more rigorous management prescriptions attached to them. Although a high proportion of land has been entered into Tier 1, Agreement Holders are encouraged to enter land into higher tiers that are more costly both to the Ministry and to the landowners.

Each of the ESAs, as shown in Figure 1 have their own environmental objectives tailored to the specific area. The individual ESA's have been monitored since they were set-up and the reports of the monitoring were available at www.maff.gov.uk/erdp at the time when this paper was written. The monitoring included botanical, landscape, and historical aspects of each ESA. Figures on the uptake of the scheme are also available on the web pages.

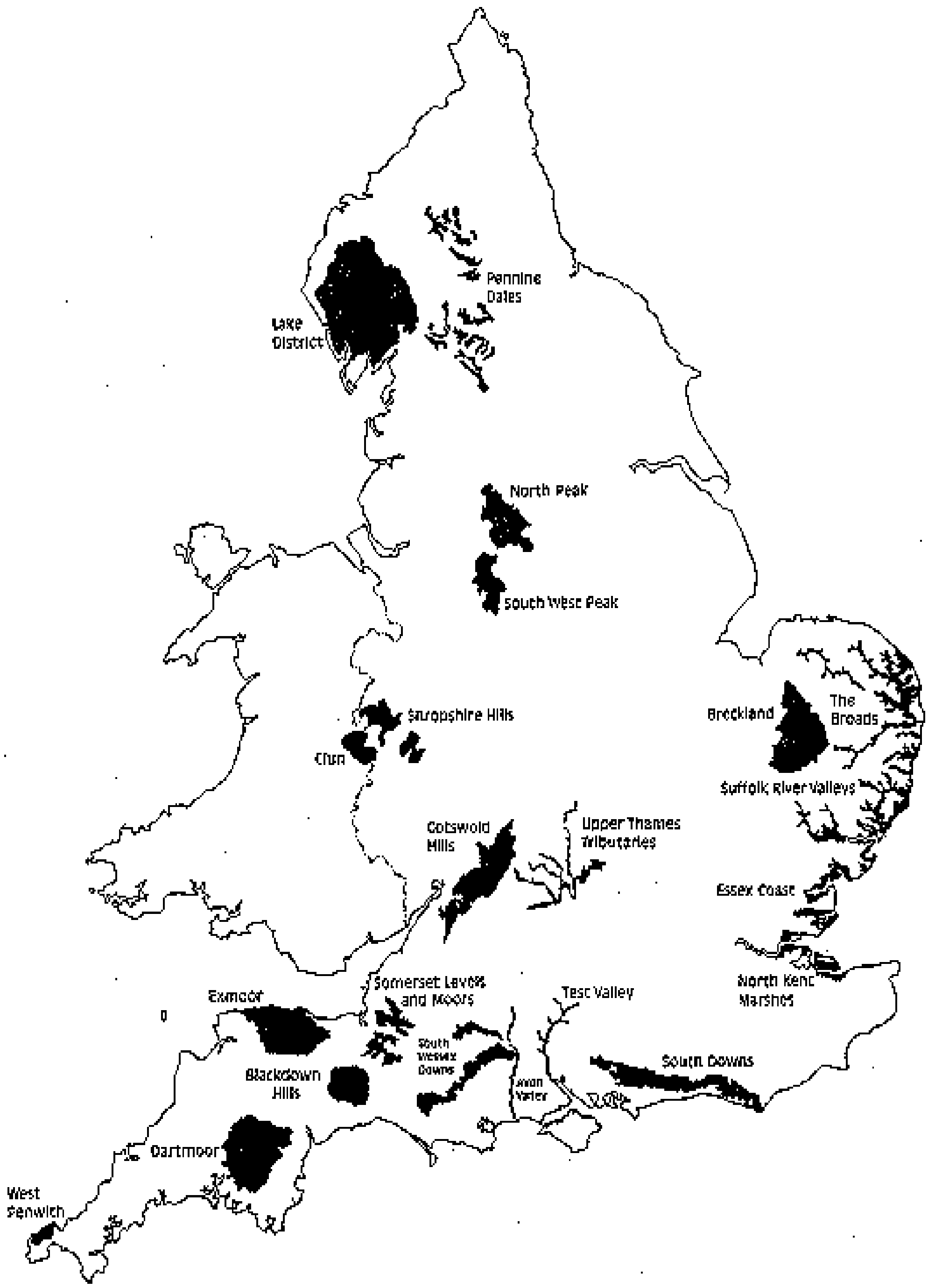

Figure1. The Environmentally Sensitive Areas of England (© MAFF)

The Countryside Stewardship Scheme

In 1991 a further scheme was introduced to cover the wider countryside outside of the ESAs. This scheme was the Countryside Stewardship Scheme (CSS) and was originally run as a pilot and administered by the Countryside Commission. In 1996 the Ministry of Agriculture, Fisheries and Food (MAFF) took over control of the scheme and its scope was widened.

The CSS had initially multiple objectives:
(a) to sustain landscape beauty and diversity
(b) to protect and extend wildlife habitats
(c) to conserve archaeological sites and historic features
(d) to restore neglected land or features
(e) to create new wildlife habitats and landscape features
(f) improve opportunities for people to enjoy the countryside through the provision of new or improved access

Since 1996 landowners have had to first negotiate a 10 year agreement with a project officer employed by MAFF and the Farming and Rural Conservation Agency (FRCA) in order to enter the scheme. Before applying to join the CSS many landowners would have got advice from outside farming and conservation bodies on different management techniques available under the CSS which would be best suited to their land.

The scheme has been run on a competitive basis with regional targets and limited regional budgets. All applications for CSS agreements have been scored by MAFF/FRCA and only those above a given threshold have been funded each year. In most years the scheme has been oversubscribed in all regions. However, the threshold score required to obtain an agreement has varied from one region to another.

Each agreement has written objectives and a list of management prescriptions to be carried out, a set timetable of capital items to be bought and installed, and a map of the agreement land. The objectives for each agreement should have been written so that the agreement holder is aware of how wildlife, landscape, historical features and access will benefit over the 10 year duration of the agreement.

As with the ESAs the CSS has been evaluated. Agricultural Development Advisory Service (ADAS) and the Countryside and Community Research Unit (CCRU) of the Cheltenham and Gloucester College of Higher Education have undertaken an economic evaluation. ADAS, CCRU and the Centre for Ecology and Hydrology (CEH) have undertaken an environmental evaluation.

The environmental evaluation was split into two modules. The first involved the development of a multi-disciplinary technique of appraisal for individual CSS agreements and had the following objectives:

(a) to assess whether landowners were fulfilling the objectives of the CSS
(b) to highlight missed opportunities that the CSS could have identified
(c) to assess the effectiveness of FRCA project officers when setting up agreements
(d) to provide a transparent and traceable method of achieving the assessments

A team of experts was brought together to evaluate a sample of 500 CSS agreements that were in the first year of their 10 year programme. The appraisal team had information from farm surveys of ecology, landscape and landscape history as well as documentation from the files created when the agreement was being negotiated, background information from national databases, and the results of a farmer interview.

Using this information the appraisal team answered a series of questions concerning five criteria: the negotiation of the agreement; the appropriateness of the agreement; possible environmental effectiveness; the likelihood that the agreement holder would comply with his agreement; and any side effects produced by the agreement. Once all the questions were answered a score was given to each of the five criteria.

At the time of writing of this paper, the methodology and results from the economic and the environmental evaluations of the CSS were not available on the world wide web, but were expected to be posted in the future at the same address, or close to it, as the ESA monitoring reports given above.

In summary, the results of Module 1 showed that: the CSS was achieving its goals adequately (and this study ignored the budgetary constraints on the scheme) but small improvements could be made to improve the Scheme. Over the 3-year period of the study (agreements from 1996-1998) the scores increased for the five criteria. This was probably because the staff administering the Scheme had become much more experienced at running the Scheme by 1998 and also because MAFF/FRCA were constantly evaluating their own performance and making alterations.

For Module 2 of the environmental evaluation of the CSS, CEH have carried out a survey of the botanical quality of 500 CSS agreements. This sample was different to the sample of 500 used in Module 1 mentioned above and the age of agreements varied from 2-9 years. The survey was carried out using the same monitoring techniques as the Countryside Survey 2000 (CS2000) funded by the Natural Environment Research Council, the Department of the Environment Transport and the Regions and ten other government bodies, which involved a stratified random sample of Great Britain (www.cs2000.org.uk). The results of the CSS survey and the English part of CS2000 could therefore be compared and the relative quality of CSS land to the countryside of England as a whole has been inferred.

Module 2 showed that, in 2000, the CSS land was of a higher quality than the English countryside as a whole in terms of the habitats found, and also the vegetation and the number of species found within quadrats. The CSS had a higher proportion of grassland than the countryside as a whole but this reflected the scheme objectives that concentrate on agricultural grassland rather than other habitats.

Other agri-environment schemes

Several other smaller schemes, that although are not considered agri-environment schemes have an environmentally beneficial effect in the agricultural landscape, have been in place in England in the period 1987-2000. Two related schemes, the Woodland Grant Scheme and the Farm Woodland Premium Scheme were introduced to reverse the decline in the area of broad-leaved woodland. These schemes pay landowners a subsidy for planting relatively small areas of trees on their land. Another scheme was the Hedgerow Improvement Scheme (which was subsequently incorporated within the CSS) that specifically addressed the decline in the length and state of England's hedgerows by paying landowners to restore hedges.

There were several other schemes designed for specific areas of England that have now been superseded and these included: the Habitat Scheme; the Moorland Scheme; the Nitrate Sensitive Areas; and the Countryside Access Scheme.

MAFF have also been running a pilot Arable Stewardship Scheme to increase the biodiversity associated with arable farming.

In 1999 there were 22 ESAs with over 10,000 agreements with farmers and including over 0.5 million ha of land. The CSS had over 10,000 agreements in 2000.

The schemes in England like the rest of European Union were in transition in 2000 as the government and ministries responded to the European Community Council Regulation No 1257/1999 and the European Community Commission Regulation No. 1750/1999.

In October 2000 the ERDP was published (www.maff.gov.uk/erdp) highlighting amongst other things the future of agri-environment schemes, fuel crops and organic farming.

The future

At the end of 2000 the ERDP stated that ESAs and CSS were to continue with increased funding through modulation with the Common Agricultural Policy and there was to be a commitment to monitoring the impacts of the schemes on wildlife, the landscape and historic features. In addition to these two major schemes the Woodland Grant Scheme and the Farm Woodland Premium Scheme were to continue.

There were several new schemes to promote "sustainable farming" announced in the ERDP. The Hill Farm Allowance (that will replace the old subsidies based on headage) will aim to give support to farmers in upland areas that have been severely stressed economically over the last years of the 20th century. The switch from headage payments to area payments has been considered a priority by the UK government, its agencies and the Non Governmental Organisations (NGOs) because it is believed that area payments will help reverse the regional overgrazing in the uplands caused by the economic pressures from headage payments which led to increase stocking rates. Area payments are also considered a more sustainable way of protecting upland livelihoods.

The ERDP also aims to see 25,000 ha of energy crops grown in England by 2006. The crops will be short-rotation coppice or *Miscanthus*. The government sees these crops as a way to reduce greenhouse gas emissions and also a way of benefiting some wildlife. The siting of energy crops will always be a major issue for some wildlife protection groups and, because of their concerns, environmental assessments will be carried out on any site where energy crops are due to be planted.

ERDP commits the current government, and hopefully future administrations, to increase the proportion of English farmland that produces organic food. The organic farming scheme has been designed to provide financial help for farmers converting from conventional to organic production. This scheme began in early 2000 and was oversubscribed in a matter of weeks.

All of the above schemes were outlined at www.maff.gov.uk/erdp, at the time this report was written.

Conclusions

Using simple figures of scheme uptake is not, and could never be, an adequate method of judging whether agri-environment schemes are delivering environmental benefits and achieving Biodiversity Action Plan targets. The monitoring of the schemes over the last decade within England has been a laudable attempt to assess whether “value for money” was being achieved for the government. Unfortunately, none of the methods devised for monitoring the agri-environment schemes has been perfect, either because it was too costly, could not provide the information required or was not statistically rigorous. Any new methodology must be able to be cross-referenced to the old methodologies if an assessment of the first decade of the schemes is to be achieved. Development of a hybrid between the methods used for monitoring of the ESAs, those used for the evaluation of the CSS and the Countryside Surveys could be a useful way forward.

The monitoring of the schemes will become even more important as modulation of the CAP to the agri-environment moves forward. To date, the cost of monitoring of schemes has not been covered by the European Union, because it has been considered part of the administration costs. Therefore, monitoring of the highest quality is not likely to be carried out as budgets for the administration of the schemes are constantly being squeezed to ensure as much of the funds are delivered to the farmers as possible. It seems likely that unless the EU are going to pay, at least in part, for monitoring and administration, then it will be difficult to show that the agri-environment schemes are environmentally effective because governments will not have the inclination to pay for the full costs of adequate monitoring themselves.

The experience of agri-environment schemes in Greece

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Introduction

As is widely recognised, the environmental policy of the European Union (EU) in conjunction with agri-environment schemes, will have important repercussions in the way agriculture is carried out and on the spatial re-ordering of socio-economic activities in the rural sector in both the medium and long term.

Generally speaking, Greece belongs to the group of states that have delayed the application of environmental policy. Public opinion and politicians have had reservations about the dedication of public resources to the protection and conservation of nature. Furthermore, there is no tradition of environmental policy. The implementation of Regulation 2078/92, and of certain critical Directives of the EU environmental policy in Greece, has therefore had to fit into this political framework

The initial plan for Regulation 2078/92 was to address to a large extent the major environmental problems of the agricultural sector. However, in the process of its implementation, the priorities set by this initial plan were reversed. In particular the budget for the anti-erosion protection programme, which originally constituted 64% of the total budget, was never implemented. Also, no initiatives were undertaken under the education and information programmes.

The application of Regulation 2078/92

With considerable delay, between December 1994 and June 1995, Greece submitted the following schemes for approval:
(a) biological agriculture
(b) the reduction of nitrogen pollution from agricultural sources in the Thessaly plain
(c) the protection and conservation of biodiversity and genetic diversity, involving conservation of endangered species of farm animals and local varieties of cultivated plants
(d) long term set-aside of farmland
(e) protection of habitats of specific importance.
The first schemes were approved three years after the date of enactment of the Regulation, ie. in July 1995.

In Greece the land covered by these programs is 1% of the total Utilises Agricultural Area (UAA), whereas the corresponding figure for the EU is 19.5%. *Le Fonds Européen* *d'Orientation et de Garantie Agricole* (FEOGA) expenditure for Greece up to 1998 were 16.9 MEURO and these costs correspond to 0.3% of the total EU expenditure.

The following agri-environment schemes have now been implemented or are under discussion:

(a) the scheme for the reduction of nitrogen pollution from agricultural sources in the Thessaly plain.
Agriculture in the Thessaly plain consists mainly of an intensively irrigated monoculture of cotton. Farmers are obliged to introduce a crop rotation programme with durum wheat and to work towards a reduction in the quantity of nitrogenous fertilisers. Furthermore, farmers are obliged to use drip irrigation systems in order to reduce nitrogen leaching and soil erosion. An approved amendment of the above scheme in April 1999 is mainly concerned with extending the programme to include in the rotation plan other intensive crops such as maize, industrial tomato, sugarbeet, watermelon, honeydew melon, dry onions, dry garlic, dry beans and fresh green beans. It is a zonal programme acting as a pilot. Until now 29,516 ha have been included in the scheme. The programme has essentially been completed, as the plain of Thessaly has been included among the target areas for the Nitrogen Directive, EU 91/676, and the necessary measures arising from this Directive make it ineligible for payments under the agri-environment Regulation. Because the scheme has been applied to dispersed areas in only 5% of the plain, and since there was no selection criterion for which lands would be included in the programme, neither in terms of sensitivity to any ecological factor in the environment, nor based on contribution of lands to pollution, it is not expected to have beneficial impacts on water quality.

(b) The biological agriculture programme
The areas, which received overall priority, were those in the NATURA 2000 network but second priority was given to islands, mountainous and semi-mountainous regions. An amendment was approved in January of 1999, after three years of implementation. Only three out of the 52 prefectures of the country participated in the scheme, which effected 60% of olive orchards so that the objective of its implementation in ecologically vulnerable areas was only partially realised. However, through the amendment a more balanced and planned development was reached. The scheme could be considered satisfactory as it encouraged farmers to turn to biological agriculture. 1,165 biological farmholdings were included in the scheme. Recently the Union of Professional Bio-cultivators of Greece vehemently protested against the decision of the Ministery to cut the support after the completion of five years under this particular scheme.

(c) The scheme for long term set-aside of farmland
The programme includes two discreet measures; the first aims to create biotopes and ecoparks on areas of ecological importance and the second aims to protect water systems from agricultural pollution. Priority has been given to the implementation of the former. The projected area of implementation is 25,000 ha. Until now 20,000 ha have been included in the programme, 80% of which is in areas belonging to the NATURA 2000 network. The remaining 20% is in areas bordering on the network sites, in riversides, and other areas of ecological importance. The 20-year timescale of the programme is too long for the appraisal of the impacts at present.

(d) The scheme for the conservation of rare breeds of farm animals.
This is a scheme of five years duration, which has been applied since 1998. The objective of the programme is the maintenance and increase of animals belonging to breeds, which are under threat of extinction.

(e) Implementation of environmental Directives
Directives 91/676 on the control of nitrogen pollution and 92/43 on the conservation of habitats are still in the preliminary stages of implementation.

(f) Nitrogen Directive
Greece, eight years after the adoption of the Nitrate Directive, has not enacted the necessary measures for implementation. Recent acceleration of the necessary steps have now been taken to speed up the process because probably of Commission threats to take the country to the European Court. Already four vulnerable zones have been designated, although the scientific criteria for this designation have provoked some discussion. The proposed zones are large in area and are among the most agriculturally productive in Greece. The rules of appropriate agricultural practices were set by the Ministry of Agriculture in 1994 and are under a process of review. Paradoxically, initiatives have not been taken to inform and make farmers aware of the forthcoming changes of their farming practices.

The NATURA 2000 network

Under the 92/43 Directive, known as the Habitats Directive, 264 sites with a total area of 2,635,613 ha will be included in the NATURA 2000 network. This area corresponds to 20% of the country, whilst by early 1999, the proposed area corresponds to 9% of the EU. These areas include agricultural zones, which are currently of unknown size but are not negligible. Successful implementation of this directive is dependent on the degree of acceptance and compromise among opposing interests in various social groups and strata (eg. farmers, environmentalists, state officials and local authorities) which are inevitably involved. It seems likely that the creation of this network will provoke widespread concern amongst farmers. Unfortunately, despite the self-evident significance of the Directive, farmers lack adequate information, and there is a lack of communication between them and the authorities, at either central/regional or local levels.

Conclusions

In the case of agri-environment policy, the delays in submission and approval of schemes have led to limited implementation and limited take up of the allocated resources. The objectives regarding cultivated areas have remained very limited. The number of farm holdings and land that has been included in the schemes is, compared with that of the other member-states, small. It is therefore difficult to accept that, so far, the Greek agricultural sector has been much influenced by agri-environment policy.

Greece, despite the fact that initial designs had corresponded to agricultural and environmental reality, did not enact programs that would incorporate the problems of Mediterranean ecosystems, such as water shortage, forest fires or soil erosion.

The Ministry of Agriculture began to enact agri-environment schemes more because they were considered as a supplementary source of income for farmers, rather than because the Ministry was convinced of the necessity of such programs. Farmers considered such scheme as a solution to the difficulties they were encountered with the cut of subsidies for certain products, such as cotton.

When the efficiency of implementation is considered, the lack of previous administrative experience and the well known weaknesses of the Greek public sector combined with an underestimate of the need for a policy of farmers training and awareness. These factors however, are basic prerequisites for the success of agri-environment policies. The monitoring of the implementation process was not without problems, but the elementary mechanisms of public administration did function. However, such mechanisms were absent from the institutionally demanded process of policy evaluation.

Despite these problems, agri-environment schemes have become a constituent element of policy that is useful in the process of reforming the Common Agricultural Policy (CAP). They add to other measures, which aim to encourage environmental initiatives in the rural sector and increased awareness of the environment in society as a whole. However, the implementation of environmental Directives 92/43 and 91/676 has suffered at the hands of bureaucracy. The success of these highly important Directives in the restructuring of rural space and the role of farmers, is dependent mainly on the acceptance of such objectives by the public but, more specifically, by the agricultural policy network of policy makers, politicians and organised professional interests, as well as co-operatives and individual farmers. The political process for such acceptance is still behind schedule.

Implementation of agri-environment schemes in Northern Ireland

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Introduction

In Northern Ireland (NI), the Department of Agriculture and Rural Development (DARD) has over ten years experience in the development and implementation of agri-environment schemes. This paper will provide a summary of the development and implementation of agri-environment schemes in Northern Ireland.

The Environmentally Sensitive Area (ESA) experience and development of the countryside management schemes (CMS)

The primary agri-environment measure is the ESA Scheme which was introduced in 1988. Initially, two areas of national importance were targeted for their landscape, habitat and heritage value. Farmers were offered the opportunity to enter into voluntary five year management agreements. With the introduction of regulation 2078 /92, 20% of Northern Ireland was designated in five ESAs. Over 65% of eligible farmed land is now under ten year voluntary agreements. Participants receive an annual area based payment, in return for following management prescriptions, which aim to maintain and enhance biodiversity, heritage and landscape features. The majority of participants have carried out enhancement work such as hedge restoration.

In May 1999, the Department launched a new agri-environment measure – the Countryside Management Scheme (CMS). Agri-environmentalists have been employed to develop and deliver agri-environment schemes, to promote both the agricultural and environmental sustainability of Countryside Management Scheme measures. Management prescriptions were based on scientific research, monitoring of the ESA scheme and consultation with conservation organisations and the Environment and Heritage Service of Northern Ireland. Payments per hectare for adhering to prescriptions were costed according to income foregone and costs incurred. The scheme was finalised after a formal period of consultation with a wide range of farming, conservation and government bodies.

In the event of the number of applications exceeding the allocated budget, a ranking or selection mechanism was developed which could prioritise applications – identifying those that were likely to contribute most to the aims and objectives of the Scheme and therefore maximise the environmental benefit.

In this Scheme, each of the targeted habitats and features was allocated a score. The score given was a reflection of:

(a) the importance of the habitat or feature to biodiversity
(b) its vulnerability and sensitivity to agricultural threats or inappropriate farming practices
(c) the irreversibility of potential damage
(d) the extent of the remaining habitat both in a Northern Ireland and European context.

The Countryside Management Scheme was set up to integrate environmental objectives as one of the primary considerations of farm business management, the Countryside Management Scheme adopts a whole farm approach and has the following objectives:

(a) to contribute to biodiversity by encouraging sensitive management of target habitats and features
(b) to protect and enhance the rural landscape, including heritage sites and features
(c) to integrate a positive approach to waste and nutrient management
(d) to integrate environmental objectives as one of the primary considerations of farm business management.

Tier 0: code of good agricultural practice for conservation
Good agricultural practice must be established on all land on the farm. This is a European Union requirement for participation in any agri-environment scheme and will now include adhering to the terms of 'Good Farming Practice' as approved under the Rural Development Regulation. Payment can only be given for measures that go beyond this level and for which there are no compulsory legal obligations.

Tier 1: general measures
A general set of measures aimed at the maintenance of a more extensive farming system applies to all land classified under this tier. For example, participants must not increase the overall stocking density for the farm business nor exceed a stocking rate which is deemed agriculturally sustainable for the landholding. Additional measures include a fertiliser ceiling, development of a sustainable approach to waste and nutrient management, no ploughing and reseeding of unimproved grassland and the selective control of weeds using specialist equipment.

Tier 2: priority habitats or landscape features
Tier 2 and 3 measures are those which go beyond the baseline of good practice, whereas tier 1 is aimed at habitats or features where specific measures or management prescriptions must be applied. The following habitats or landscape features, if present on the farm, must to brought under agreement:

(a) species-rich grassland
(b) wetland
(c) upland breeding wader sites
(d) moorland
(e) farm wood / scrub
(f) land adjacent to lakes
(g) coastal farmland
(h) parkland
(i) archaeological features.

Tier 3: optional habitats or landscape features
Optional habitats can be created on farmland, for example buffer zones. The following optional habitats may be brought under agreement:
(a) arable fields managed for wildlife
(b) winter feeding sites for swans and geese
(c) lapwing breeding sites
(d) buffer strips next to Sites of Special Scientific Interest, National Nature Reserves, woodlands and rivers
(e) traditional orchards
(f) restoration of field boundaries.

Tier 4: specific conservation measures.
Tier 4 measures are required to assist with management of certain habitats. Specific conservation measures are as follows:
(a) heather regeneration
(b) *Rhododendron* control
(c) bracken control
(d) scrub control

Management and auditing of the CMS
The CMS implemented a comprehensive promotional strategy. Explanatory literature was produced, in the form of a simple colour leaflet and a much more detailed explanatory booklet listing priority and optional habitats and management requirements. During the two month window of application, over 20 articles were printed in the local and national press, and radio and television interviews were conducted to promote the CMS.

A staff training programme was undertaken to provide staff with knowledge of habitat identification, management and scheme implementation procedures. Detailed Technical Guidance Manuals provide reference material and staff are updated on scheme requirements by a series of printed instructions.

A computer system was also developed to record and search for all relevant information for example applicant / participant details, audit findings, issue claims and payments. This is essential to the implementation and monitoring of the scheme, as is a system for auditing the farms.

This was set up by requiring applicants to complete a detailed application form indicating areas of priority and optional habitats on their farm with a farm map. Countryside Management Staff visit each farm to complete a whole farm audit which involves:

(a) pollution risk assessment
(b) land classification tiers 0-3
(c) habitat management plans
(d) field boundary restoration plan
(e) identification of participant training needs.

Promoting an ethos of continual development is the key to the long-term success of any agri-environment scheme. This involves integrating a range of techniques, which will increase and assist participants understanding of the aims and objectives of the scheme, and allow them to develop the necessary competencies to deliver them. For example, in our Environmentally Sensitive Areas Scheme, demonstrations and training courses provide practical advice and 'Hands On' experience for habitat management skills, such as heather regeneration. 'Best Practice' is promoted through farm walks, whilst continual support is provided on an individual basis and through newsletters and information sheets. Specifically targeted mail shots, keep participants informed of developments and achievements, as well as providing them with timely reminders of their management obligations. Regulatory procedures are also required and involve three procedures:

(a) Inspections
A minimum of 5% of claims will be randomly inspected (based on risk analysis) to check adherence to scheme prescriptions. Spot checks will also be performed at appropriate times of the year, for example hay meadows spot checks in June to check no cutting prior to 1 July.

(b) Breach procedure
A breach procedure was initiated under the ESA scheme, where the environmental damage is assessed and a financial penalty applied. Financial penalties generally involve the loss of area payment for the habitat in which the prescriptions have not been adhered to, and an additional fine of 10% of the total annual management payment. The agreement may be terminated due to the serious nature of a breach or repeated breach offences. A similar procedure will operate in CMS.

(c) Monitoring and evaluation
An integrated scientific monitoring programme has been developed to evaluate the Countryside Management Scheme. This will involve biological, landscape, historical and socio-economic monitoring.

Conclusion

The ESA scheme has provided invaluable experience in the development of this new Countryside Management Scheme. The CMS and a revised ESA scheme are currently awaiting EU approval under the Rural Development Regulation. The revised ESA scheme prescriptions now mirror those in the CMS. As future policies to maintain biodiversity and support sustainable development evolve, agri-environment schemes will play a lead role in the future of farming in Northern Ireland.

References

Department of Agriculture for Northern Ireland, 1998, Environmentally Sensitive Areas - Implementing Agri-environment Regulation 2078/92 in Northern Ireland.

Department of Agriculture for Northern Ireland, 1999, Countryside Management Scheme. Explanatory Booklet.

The experience of agri-environment schemes in Spain

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Introduction

This paper summarises the design, implementation, and preliminary results of agri-environment schemes in Spain, which have constituted an important new initiative in the Spanish agricultural sector, for both farmers and administrative officials. The programme description is based on information published by the Ministeria de Agricultura, Pesca y Alimentación (MAPA) in 1994, when the Spanish programme was officially started. The analysis of implementation and the results are based on Oñate et al. (1998) and Peco et al. (2000). The most recent figures are still preliminary.

Environmental and socio-economic background

Spanish agriculture has been historically conditioned by the restrictions imposed by the physical environment. Only about a quarter of the country, mainly in the narrow northern belt, receives more than 800 mm of annual rainfall, although the precipitation regime is extremely variable both intra-and inter-annually: dry summers and torrential spring and autumn rains as well as pluri-annual periods of drought are widespread. The high average altitude (more than 88% of the country lies between 200-2000 m) and the irregular relief interact with the climatic factors to produce much variability in the quality of soils. Those in the moist oceanic region of Spain tend to be more developed, whilst low soil potential and erosion risk are the rule in the dry Mediterranean parts of the country.

In spite of these restrictions, the diversity of factors has created a series of gradients suited to a wide variety of agricultural practices, from horticulture to dry steppe farming. However, extensive land uses predominate amongst the production systems as follows: dry cereal farming (47%), dry pastures (24%), olive groves (8%) and vineyards (5%). These systems cover roughly 84% of the 19 Mha covered by the Utilised Agricultural Area (UAA) in Spain.

The socio-economic declining trends of the farming sector are similar to other EU Member States, with a loss of 35% of the farming population in the period 1950-1993, together with a 37% reduction in the contribution of agriculture to the Gross National Product (GNP). However, this general trend is not uniform and in some regions agriculture is still important both economically (8-10% of GNP) and demographically (12-14% of the total population). Three quarters of the total UAA is located in Less Favoured Areas (LFAs) and 77.7% of the country is considered to be in Objective 1 regions and 23.3% Objective 2 and 5b regions.

Finally, it has to be mentioned that Spain has a decentralised governmental organisation comprising 17 NUTS-2 level autonomous regions, as shown in Figure 1. The Regional Governments have full powers in agriculture and environmental matters and the corresponding National Ministries only act as transmission links for European Union (EU) policy decisions and implementation. Co-ordination at all levels is not always as flexible as would be desirable.

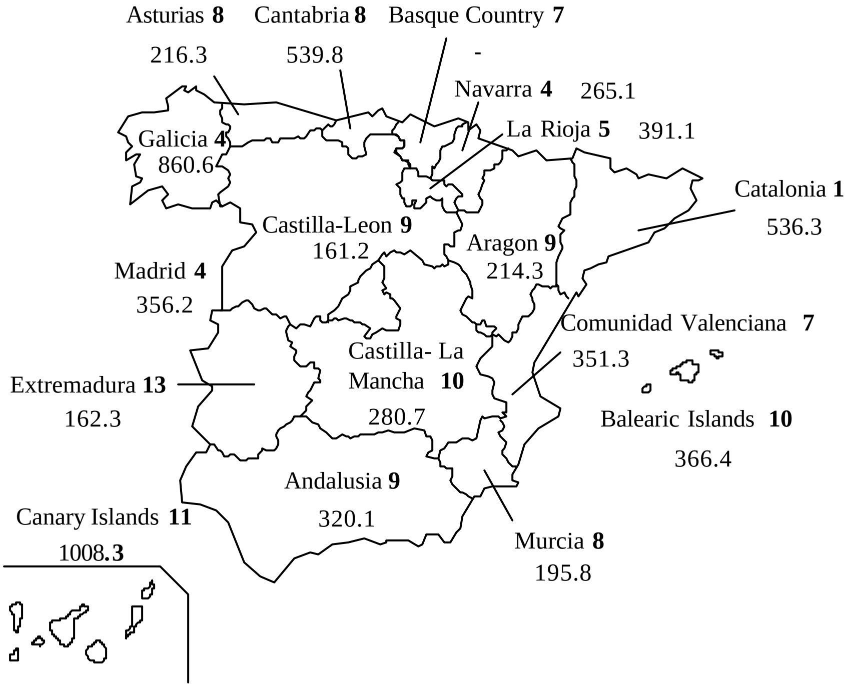

Figure 1. Number of schemes per region (bold) and regional distribution (MEUROs) of the Spanish agri-environment subsidies in the 1994-2000 period (Source: MAPA, 1994)

Agri-environment background and the Spanish programme

In spite of its generally extensive nature, Spanish agriculture has undergone a major increase in intensification since the 1960s, a process that is still continuing at the present time. Land consolidation and average field size has increased, fallow decreased and irrigation has been extended. In addition, there has been an increased used of fertilisers. All these practices have been encouraged by agricultural authorities and farmers at all levels. The effort to overcome the traditional structural deficiencies of Spanish agriculture was intensified following entry into the then European Economic Community (EEC) in 1986.

These circumstances explain why the application of pioneer agri-environment measures has not had a significant effect in Spain, as shown in Table 1, as well as a delay in the implementation of Regulation 2078/92. Thus, the Spanish agri-environment programme has constituted an important new initiative at all levels when passed by the European Parliament in 1994.

Table 1. Implementation of pioneer agri-environment measures in Spain (Le Fonds Européen d'Orientation et de Garantie Agricole (FEOGA), Non Governmental organiastions (NGOs))

Farm land set-aside

(a) 29.5% of total arable land were excluded from set-aside
(b) Spain chooses a rather low payment in the range of 100-606 EURO/ha
(c) In the period 1989-1992, 91,362 ha were affected by the scheme, mainly in the inland regions of Aragón, Castilla-La Mancha and Castilla-León
(d) The average size of plots has been aprox. 57 ha and the ratio average set-aside/average farm size has been aprox. 3.8, by far the highest in the EEC
(e) Fallow predominates as the use given to land once set-aside (aprox. 87%)
(f) No political interest

Extensification

(a) Not applied in Spain
(b) Spain did not recognise the values and needs of the numerous already existing low-intensity systems in the country
(c) Low-intensity systems were running the risk of undergo intensification processes due to Common Agricultural Policy (CAP) production subsidies mechanisms and FEOGA- Orientation subsidies

Mountain and Less-Favoured Areas (LFAs)

(a) Include 39.1 Mha., 77.5 % of the total surface area of Spain
(b) Payments have been very low when compared with EU standards: 2 EURO/ha
(c) Although the total budget is fairly large it has been allocated in a spatially scattered manner
(d) Implementation of the scheme has often been coupled with other measures, mainly direct payments in ewe and goat premiums

Environmentally Sensitive Areas (ESAs)

(a) No single zone was declared an ESA before 1993 in spite of proposals made from environmental authorities, NGOs and farmers unions
(b) The apparent lack of sensitivity of the Authorities supports the theory that preference is given to highly technological agriculture. ESAs have been perceived as luxury
(c) Coincidentally, ESAs may conflict with design and approval of the Transport Infrastructure General Plan in Spain

The structure of the programme is summarised in Table 2. In the case of "horizontal" schemes and those "zonal" ones in RAMSAR sites, Special Protection Areas (SPAs) and National Parks, the National Government co-finances 50% of the scheme with the regions (out of the natural funding), whilst co-financing of the remaining "zonal" schemes is the exclusive responsibility of the regions. The overall budget for the period 1994-2000 adds to 1,300 MEUROs, which are distributed among some 108 schemes around the country. Nevertheless, both the number of schemes per region and the regional budget allocation is highly variable as shown in Figure 1, with an average of seven schemes per region.

Table 2. The Spanish agri-environment programme

Horizontal schemes (a) Applicable to the whole of Spain (b) Include the following support schemes: - Organic farming - Extensification of production in herbaceous crops - Protection and improvement of livestock breeds under threat of extinction - Agri-environmental education and training for farmers
Zonal schemes (a) Applicable in the following four types of zones: - National Park influence areas - RAMSAR wetland influence zones - Special Bird Protection Areas (SPAs) - Specifically designed zones by Regional Governments (up to 42) (b) Include the following support schemes: - Integrated control of fertilisers and pesticides - Herbaceous cultures transformation into pastures - Stocking density reduction - Flora and fauna protection in inland extensive crop systems - Flora and fauna protection in coastland wetlands and marshes (*marismas)* - Landscape conservation and fire prevention in extensive grazing systems - Measures against land degradation and soil erosion - Environmental actions in the Canary Islands - Irrigation water conservation in wetland areas - 20-year set-aside land maintenance - Land management for outdoor and recreation public activities

The budgetary allocation to the different type of measures reflects the priority given to the extensification of production (30% of the budget for extensification, 20-year set aside and livestock reduction), and landscape protection (more than 50% for landscape protection and maintenance of abandoned land as shown in Figure2). On the contrary, there is little emphasis on the reduction of chemical inputs or on the promotion of organic farming, also shown in Figure 2. Estimated budget (in MEUROs) for different schemes in the Spanish agri-environment programme for the 1994-2000 period (Source: MAPA, 1994)

The consideration given to different conservation objectives is by no means uniform as shown in Table 3. Considering that the total percentage exceeds 100, since one scheme may consider more than one objective, the most frequent is related to conservation in natural protected areas, both terrestrial (28.7%) and wetlands (24.1%). Birds in extensive cereal systems are the next main conservation objective (19.4%) followed by local breeds in danger of extinction (12%), Mediterranean grasslands (11.1%), rural landscapes (10.2%), boundaries and hedgerows (8.3%) and Eurosiberian meadows (6.5%). Thus, it is clear that low intensity farming systems are the main focus of the conservation aim of schemes, both for enhancement and maintenance. More than 87% of the schemes are targeting such systems, which may therefore be considered as having the main conservation value of agri-ecosystems in Spain, both inside and outside protected areas.

Table 3. Main conservation objectives, their characteristics and the number of Spanish agri-environment schemes involved

Objectives	NR	Characteristics
Protected dryland areas	31	Conservation in natural areas catalogued / protected nationally / internationally for their terrestrial ecosystems
Protected wetlands	26	Conservation in natural areas catalogued / protected nationally / internationally for their aquatic ecosystems
Birds in extensive cereal systems	21	Great bustard (*Otis tarda*) and crane (*Grus grus*) conservation in extensive cereal systems
Breeds in danger of extinction	13	Husbandry of local livestock breeds and plantation of plant varieties under risk of genetic erosion
Mediterranean grasslands	13	Maintenance and regeneration of Mediterranean grasslands and their extensive usage
Organic farming promotion	12	Introduction and maintenance of organic farming methods in accordance with Regulations 2092/91 and 2381/94
Training and publicity promotion	12	Organisation of agri-environmental information courses and discussion groups; instructors training courses
Rural landscape	11	Conservation of valuable and traditional landscape elements of farming areas
Boundaries and hedgerows	9	Conservation of structural elements and vegetation between crop fields, for fauna feeding, refuge and breeding
Plant cover regeneration	9	Regeneration of plant cover by means of 20 years farmland set-aside
Public access and leisure activities	8	Actions such as signposting and conservation of roadways, visitors' centres, rubbish collection, for public use and recreation
Eurosiberian meadows	7	Maintenance and regeneration of extensive Eurosiberian grasslands and their characteristic composition
Forest fire prevention	6	Woodland improvement, ie fencing, firebreaks, clearcutting
Other objectives	6	Integrated protection against diseases and subsidy for table grape production (Murcia)

It is surprising that there is such little emphasis on organic farming, which is the objective of only 12% of the schemes, as well as on environmental problems related to agriculture, such as erosion and fires. The latter are only included in very few schemes, despite their occurrence on a significant scale in many parts of Spain. Finally, it is necessary to mention that there is not one scheme aimed specifically at the reduction of chemical inputs, in spite of the existence of localised pollution problems related to farming in the country.

The reality of scheme implementation

The pace of development and implementation of the schemes has been low and complicated, with the implementation of some schemes that were not identified initially and the abandonment of others originally planned. This is seen as a reflection of the difficulties of co-ordination between administrations, as well as budgetary cut-backs at the regional level and inappropriate provision of up-take in some schemes, such as organic farming.

The provisional data concerning take-up to the end of 1998, a shown in Table 4, shows an expenditure of 294.4 MEUROs, still short of the budgetary provisions for the 1994-2000 period of 1,300 MEUROs.

Table 4. Implementation results of Spanish agri-environment programme (Source: MAPA, Dec-98)

Year	Participants (nº)	Area entered (ha)	Livestock units (LU) Entered	Expenditure (M EUROs)
1993	1,135	41,950	0	12.2
1994	2,305	83,590	0	17.5
1995	7,533	144,980	3,476	29.6
1996	28,408	558,840	11,330	56.5
1997	33,323	866,840	33,245	75.9
1998	57,433	1,189,389	39,832	107.4

Furthermore many planned measures are still not implemented, as shown in Table 5. For example, only five National Parks have seen their schemes set in motion (70% of targeted area within National Parks), as well as only 28% of the initially targeted areas in SPAs (37 out of 120) and RAMSAR wetlands (8 out of 35). Nonetheless, up-take by farmers, area entered and expenditure have all increased steadily since the first schemes were established, in spite of the budgetary cut-backs that are generally hampering the Regional governments and the fact that most of the agricultural officials and farmers are still primarily concerned with production.

Table 5. Implementation degree of agri-environment schemes in Spain (Source: MAPA, Dec-98)

Single measure	H1	H2	H3	H4	A	B	C	D1	D2	D3	D4	D5	D6	E	F	G	H
Andalucía	■	■	■	■	□	▒	■	▒	■	□	□	□	□	□	■	▒	□
Aragón	■	■	■	■	□	▒	▒	■	■	■	▒	□	□	▒	▒	■	□
Asturias	□	■	■	■	□	□	□	□	□	■	▒	□	□	■	□	□	□
Baleares	▒	■	▒	■	□	▒	□	▒	▒	▒	▒	□	□	□	□	□	□
Canarias	□	■	■	■	□	□	□	□	□	■	▒	■	□	▒	▒	▒	□
Cantabria	□	■	■	□	□	□	□	□	□	■	▒	□	□	▒	□	□	□
Castilla-La Mancha	■	■	▒	■	□	▒	▒	■	▒	■	▒	□	■	▒	■	▒	□
Castilla y León	■	■	■	■	□	■	□	■	▒	■	▒	□	□	■	■	□	□
Cataluña	▒	▒	▒	▒	▒	▒	▒	▒	■	▒	■	□	□	□	▒	▒	□
Extremadura	■	■	■	■	□	▒	■	■	▒	■	▒	□	□	■	■	■	□
Galicia	□	▒	■	▒	■	□	□	□	■	■	■	□	□	□	▒	□	□
Madrid	■	■	■	■	□	▒	□	▒	▒	▒	▒	□	□	□	▒	▒	□
Murcia	■	■	▒	■	■	▒	□	■	▒	▒	▒	□	□	■	■	□	■
Navarra	▒	■	■	■	□	▒	□	▒	▒	▒	▒	□	□	▒	▒	□	□
La Rioja	■	■	■	■	▒	▒	▒	▒	▒	▒	▒	□	□	□	▒	▒	□
Valencia	■	■	■	■	□	▒	□	▒	■	■	■	□	□	▒	■	▒	□

■ Measures with payments already begun ▒ Measures planned but still non implemented □ Not considered

H1	Production extensification	D4	Erosion
H2	Education and training	D5	Actions in the Canary Islands
H3	Local breeds rearing	D6	Irrigation water saving in wetland areas
H4	Organic farming	E	Unkeep of set aside land
D1	Flora and fauna protection in extensive systems	F	20 years set aside
D2	Flora and fauna protection in wetlands	G	Public access and leisure activities
D3	Landscape conservation and fire prevention	H	Demonstration projects

The agri-environment debate should however be strengthened and the agriculture administrations should open the planning and decision-making process to environmental considerations, both at national and regional levels. This is specially needed in order to fully take advantage of the new Regulations on Rural development (EC/1257/99) and the Common rules for direct support schemes under the Common Agricultural Policy (CAP) (EC/1259/99).

Conclusions
Despite the fact that the agri-environment programme in Spain is still in its infancy, there are some promising signs, as many schemes have already been successfully implemented. More schemes are also likely to come on stream in the near future, with the establishment of a new programme, 2000-2006, which is at the moment of writing still under the approval process in the EU. A catalytic effect of the first schemes can be expected, once it has been proved to Spanish farmers that there can be advantages to be scheme participants. Implementation and acceptance by other farmers is then likely to follow. On this basis, the renewal and/or extension of schemes included in the first five-year period will play a key role, and there is a clear wish among increasing numbers of agricultural decision-makers in Spain for agri-environment schemes to continue beyond the initial phase. It is now the moment to start the reflections around a more ambitious agri-environment programme to be run in a post-Agenda 2000 scenario.

References
Ministerio de Agricultura, Pesca y Alimentación (MAPA), 1994, Programa de ayudas para fomentar métodos de producción agraria compatibles con las exigencias de protección del medio ambiente y la conservación del espacio natural, MAPA: Madrid.

Oñate, J. J., Malo, J. E., Suárez, F. and Peco, B., 1998, Regional and environmental aspects in the implementation of Spanish agri-environmental schemes, Journal of Environmental Management, 52, 227-240.

Peco, B. Suárez, F., Oñate, J.J., Malo, J.E. y Aguirre, J., 2000. Spain: first temptative steps towards an agri-environmental programme. In: Buller, H., Wilson. G. y Höll, A. (Eds.) Agri-environmental policy in the European Union. pp 145-168 Ashgate: Aldershot.

A European overview of the implementation and effectiveness of agri-environment schemes established under Regulation 2078/92

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Introduction

In recent decades, there has been a shift in Common Agricultural Policy (CAP) objectives from a focus on raising productivity, stabilising markets and ensuring consumer supply at reasonable prices (Treaty of Rome 1957), towards a consideration of the social and environmental aspects of agriculture. The first steps taken in this direction appeared in the European Commission "Green Book" published in 1989. This text sets the objectives for a gradual reduction in sectors with surplus production by means of a pricing policy based on market demand and the maintenance of income for small family farms. Support for agricultural activity in areas where it is indispensable for territorial planning, social balance and environmental protection was also considered. The need to make farmers aware of environmental problems, nature conservation and landscape protection is now also recognised. The political instruments used to implement these changes were Regulations 795/85 and 2328/91, but these with few exceptions, have had minimal uptake in most Member States. Another step in this direction was taken in 1992 under CAP reform measures where in certain sectors, support mechanisms for farm price maintenance were converted into direct aid for farmers in order to encourage farm extensificaton and reduce surpluses. There was also implementation of a range of accompanying measures aimed at facilitating the transition from the previous CAP. One of these measures was the agri-environment Regulation 2078/92.

The overall objective of Regulation 2078/92 is to encourage farmers to commit themselves to farming methods that are compatible with environmental protection and countryside maintenance by compensating them for any income loss caused by output reductions and increased costs. This Regulation considers a range of general measures (Table 1) and Member States were asked to design five-year programs in which these measures were implemented with horizontal or zonal approaches. Although implementation is compulsory (but not for all measures), the Regulation gives the Member States the freedom to adapt it to their own political, social and environmental idiosyncrasies, applying the subsidiarity principle with the only compulsory requirement of having to establish clear environmental objectives.

Table 1. Aid schemes under Regulation 2078/92

(a)	Substantial reduction in the use of fertilisers and/or pesticides, to maintain the existing reduction, or to introduce or continue organic farming methods
(b)	By other means than those in (a), to change to more extensive forms of crop and forage production, to maintain extensive production methods introduced in the past, or to convert arable land into extensive grasslands
(c)	To reduce the proportion of sheep and cattle per forage area.
(d)	To use other farming practices compatible with environment and natural resource protection or countryside and landscape maintenance, or to rear local animal breeds in danger of extinction.
(e)	To ensure the upkeep of abandoned farmland or woodlands.
(f)	To set aside farmland for at least 20 years for environment-related purposes, in particular for the establishment of biotope reserves or nature parks or for the protection of hydrological systems.
(g)	To manage land for public access and leisure activities.
(h)	Farmer training for environment-compatible agricultural or forestry practices compatible.

The approved programs were 75% co-financed by EU in Objective 1 Regions and 50% in other Regions. The schemes are established on a voluntary and contract basis. Farmers participating in the programmes are paid compensation for associated loss of income. The scheme requires farmers to commit themselves for at least five years, except for the set-aside scheme (which involves 20 years). The maximum premiums are fixed by the Regulation. In case of specific premiums set up on a national or regional basis, they must be justified in the context of zonal programs.

This paper summarises the main results of a three-year EU project (FAIR CT95-274) that analysed the implementation and effectiveness of Agri-environment schemes established under Regulation 2078/92 in nine EU countries and Switzerland, conducted between 1996 and 1999 (Institute für ländliche Struckturforchung, 1999).

Design and implementation of Regulation 2078/92

A review of the implementation after the first five-year contracts in most of the nine participating Member States (Buller et al., 2000) found both positive and negative aspects in the participating countries.

One of the conclusions of this review was that the diverse ways of implementation the scheme in EU countries, was the result of different environmental concerns and policy traditions. Different countries have different starting points determined by physical, structural and social concerns. At one extreme there are countries with low environmental constraints on agriculture, a long tradition of intensification and problems of pollution by farming activities (eg. the United Kingdom and Denmark), whilst at the other extreme there are countries with major environmental constraints, a short tradition of intensification and problems of land abandonment (eg., Spain, Portugal and Greece). At the same time, different countries have had different histories of conservation policy. The most widespread implementation was in countries in which there was a long tradition of the recognition of the value of extensive agriculture for both nature and cultural landscape conservation as well as previous agri-environment policies, ie. where Regulations 795/85 and 2328/91 had been successfully implemented. Implementation has met with more impediments in countries that lack previous experience in agri-environment policies and have had conservation policies focused within specific zones rather than being applied throughout the country.

The majority of the approved programs are at a zonal level (regions which are relatively homogeneous in terms of environment and countryside), although there are examples of horizontal programs (Table 2). Some countries have implemented the schemes at the regional level (Germany, Spain, France, UK, Portugal) while others have done so at a national level (Denmark, Austria and Sweden).

Table 2. Types of scheme organisation following Member States' adoption of Regulation 2078/92 (adapted from Baldock et al., 1998)

	BROAD FOCUS	MORE SPECIFIC FOCUS
HORIZONTAL SCHEMES	(a) ÖPUL (Austria) (b) KULAP (Germany) (c) MEKA (Germany) (d) GAK (Germany)	(a) Organic schemes (b) Grassland Premium (F) (c) Landscape and biodiversity scheme (Sweden) (d) Spanish extensification
TARGETED SCHEMES	(a) ESA (UK) (b) ESA (Denmark) (c) ESA (Sweden)	(a) NSA scheme (UK) (b) Local operations (F) (c) Spanish pollution-reduction measures

The schemes adopted by the EU Member States (Table 3) have also varied considerably in terms of their commitments and aims. In general, they can be classified as either improvement or protection schemes. Improvement schemes are those that propose profound changes in farming practices in order to correct environmental problems (mainly pollution). Protection schemes are aimed at the maintenance of extensive agricultural practices that have been proved to be linked to high environmental and nature conservation value.

Table 3. Schemes adopted in different EU member states: AU = Austria, DK = Denmark, F = France, DE = Germany, GR = Greece, ES = Spain, P = Portugal, S = Sweden, UK = United Kingdom (data for mid 1997)

Schemes adopted	AU	DK	F	DE	GR	ES	P	S	UK
Organic farming	X	X	X	X	X	X	X	X	X
Landscape protection	X	X	X	X	X	X	X	X	X
Reducing pollution	X	X	X	X	X	X	X	X	X
Extensification	X	X	X	X		X	X	X	X
Preserving local breeds	X		X	X	X	X	X	X	
Training and demonstration projects	X		X	X	X	X	X	X	
Non-productive land management	X		X	X	X	X			
Public access	X	X	X			X			X

The schemes also vary in character between regions and countries in the amounts of premiums, even in the case of schemes that have almost the same objectives. Per hectare premiums are higher in improvement than protection schemes because the premium rates have mainly been calculated according to costs incurred and income foregone.

In relation to the uptake of Regulation 2078 schemes, by mid 1997, 20 percent of European farms had joined one or more agri-environment schemes. There is however considerable variation both within and between Member States (Table 4).

*Table 4. Indicators of the degree in uptake of Regulation 2078/92 (data for mid 1997). *=Farmers potentially holding more than one contract (adapted from Buller et al., 2000) (Utilised Agricultural Area (UAA))*

Country	Number of contracts as % total farms	% of total UAA under contract	Average payment per ha under contract (EURO)
Sweden	77.6	51.0	156
Austria	75.9	72.9	140
Germany	90 *	37.0	89
France	24.1	20.2	42
Portugal	27.8*	15.4	137
Denmark	11.8	3.4	186
United Kingdom	9.16	8.1	55
Spain	2.3	2.1	81
Greece	0.2	0.3	N.D.

Measuring the effectiveness of Regulation 2078: a methodological approach

The methodology employed in the FAIR project was based on comparisons of policy on/policy off situations (between 1992-1997) and participant/non participant farmer populations. In order to ensure that the participants/non participants were comparable, 22 Comparable Selected Area's (CSAs) were selected (two per country) to cover an international variety of agricultural systems, landscapes and major agri-environmental issues.

Specific issue related methodologies were carried out by international teams in relation to participation, socio-economic, landscape, and environmental effects.

The analysis was mainly constructed on the basis of the answers by more than 1000 farmers (50 per CSA) to a common questionnaire regarding the values of specific indicators on land use and land management practices and socio-economic and attitudinal aspects. Additional information was based on in-depth interviews at the national, regional and CSA level.

Measuring the effectiveness of Regulation 2078: Results

Several patterns of participation across different agri-environmental programs were identified (Wilson & Hart, in press). Most farmers in the EU are driven by both financial motivations (farmers' cost-benefit calculations) and the "goodness of fit" of schemes (fitted with farm management plans). Nevertheless, conservation-oriented motivations are playing an increasing role in their decisions on whether or not to participate, especially in countries with a long tradition of agri-environment policy. Other socio-economic factors such farm size (large premium per farm), tenure, farm type, education, dependence of income, inter-scheme continuity and information availability about schemes has been revealed as important in understanding the reasons for participation in agri-environment schemes. The uptake of protection schemes was higher than in improvement schemes, probably because they require few changes in farming practices or serious physical, social or structural limitations on agriculture intensification.

In relation to the socio-economic effects of the agri-environment schemes involved under Regulation 2078 (Institute für ländliche Struckturforchung, 1999), it was found that the average premium per farm was 12% of the average gross farm income, with large variations between schemes (up to 41%). There was also a net contribution to farmer income in extensively farmed areas, whilst in intensive managed areas, more funding went to pay for increased costs and foregone income. Other socio-economic effects were less distinct. The succession of ownership over generations, farm survival and farmer confidence in the future improved, whilst the effects on external employment was low.

The evaluation of the environmental effects was carried out by comparing the value of land use and land management practices indicators (Table 5), before and after Regulation 2078 in participant and non-participant farmer populations (see methodology in Oñate et al. (2000), and a more detailed discussion of the value of this type of indicators in the evaluation of policy effects in Brouwer and Cabtree (1998) and Peco et al. (1998)). Significant improvement effects were mainly found in indicators for pesticides and N-fertiliser reduction (Institute für ländliche Struckturforchung, 1999). The results also highlight the difficulties in finding protection effects using the applied methodology. This difficulty is mainly due to the lack of non-participant farmers in areas where protection schemes have been implemented because they do not required bigger changes in farm practices and there are few other alternatives for farm management.

Table 5. Selected agricultural land use and management practices and indicators for the environmental analysis of Regulation 2078/92. (Adapted from Institute für ländliche Struckturforchung, 1999) (Utilised Agricultural Area (UAA), Livestock Units (LU), Contracted Area (CA), Eligable Area (EA), Rough Grazing Livestock Units (RLU))

		INDICATOR
LAND USE PRACTICES	Permanent grassland	**Permanent grassland/UAA:** Permanent grassland area per utilised agricultural area (%)
	Abandoned land	**Abandoned land/UAA:** Area of abandoned land per utilised agricultural area (%)
	Hedges	**Hedges/UAA:** Length (m) of hedges per utilised agricultural area (m/ha)
MANAGEMENT PRACTICES	Mineral N-Fertilisers CA/EA	**Mineral N-fertilisers CA/EA:**Mineral N-fertilisers usage on contracted area (CA) (for agreement holders) or eligible area (EA) (for the rest of farmers) (kg N/ha)
	Livestock density reduction	**LU/UAA Reduction:** Total livestock units per utilised agricultural area (LU/ha UAA) **RLU/Forage Reduction:** Rough grazing reduction livestock units per grassland and fodder crops area (RLU/ha Forage)
	Minimum livestock utilised	**LUIUAA Maintenance-** Total livestock units per utilised agricultural area (LU/ha UAA) **RLU/ forage Maintenance**: Rough grazing livestock units per grasslands and fodder crops area (RLU/ha Forage)
	Fallow land	**Fallow land/AL:** Fallow land area per arable area (%)
	Crop diversity	**Number of crops/AL:** Number of crops planted per arable area (%) **Crops in rotation CAIEA:** Number of crops in rotation on contracted area (for agreement holders) or eligible area (for the rest of farmers) (%)
	Pesticides	**Pesticides:** Actual (1997) use of pesticides (qualitative) and Changes from 1993 to 1997 (qualitative)

Recommendations for the design of future schemes

Some of the main recommendations in the EU project (Institute für ländliche Struckturforchung, 1999) for improvements to future scheme designs and implementation are listed below:

(a) There is a need to draft a clearer definition of the social and environmental objectives and evaluation tools. The design of a typology of agricultural systems and environmental problems and the definition of common and specific indicators that refer better to agricultural practices (driving forces) will help achieve this aim.

(b) More emphasis is needed on the continuation of extensive farming (protection effects), rather than the previous excessive focus on intensive farming (improvement effects).

(c) Target and zonal measures are potentially more effective for addressing environmental objectives.

(d) More emphasis should be placed on education in the relationship between agriculture and environment. There is a need for more demonstration projects built on local knowledge and experience.

(e) Tools should be designed to increase participation at the local level. Farmers should be encouraged to participate in the design and implementation processes.

(f) There should be control of synergistic effects between CAP compensation payments (cross-compliance) and improvements to the integration of structural and regional policy instruments (LFA, LEADER; Objective 1 and 2 programs) and other accompanying measures (eg. early retirement and afforestation) with agri-environment policies
(g) There should be an increased budget allocation for monitoring programs and the creation of relevant consistent databases.

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References
Baldock, D. Mitchell, K. Von Meyer, H. & Beaufoy, G., 1998,. Assessment of the environmental impact of certain agricultural measures, IEEP. London.

Buller, H. Wilson G.A. & Höll A. (Eds.), 2000,. Agri-environmental policy in the European Union. Ashgate, Basingstoke.

Brouwer F. & Crabtree, R. (Eds.), 1998,. Environmental indicators and agricultural policy. CAB International, Wallingford.
Institute für ländliche Struckturforchung, 1999,. Implementation and effectiveness of agri-environmental schemes established under Regulation 2078/92 (Project FAIR 1 CT95-274), Final Consolidated report. Frankfurt: IFSL.

Oñate J.J., Andersen E., Peco, B. & Primdahl J., 2000,. Agri-environmental schemes and the European agricultural landscapes: the role of indicators as valuing tools for evaluation. Landscape ecology, 15: 271- 280.

Peco B., Malo J.E, Oñate J.J., Suárez F & Sumpsi, J.M., 1999,. Agri-environmental Indicators in Extensive Land Use Systems on the Iberian Peninsula: some theoretical and practical problems. In: Brouwer, F. & Crabtree, R. (Eds.) Environmental indicators and agricultural policy. CAB International, Wallingford.

Wilson G.A. & Hart K. (in press). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environment and Planning A.

Potential strategies for the Guadiamar Green Corridor and their relationship with sustainable agriculture

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Introduction

The example given in the present paper describes a case study, which was developed as a response to a regulation and control strategy for agricultural systems in relation to a potential Green Corridor along the Guadiamar river. This project originated in a recent environmental incident in Andalucía and follows the design of an ecological corridor between the Sierra Morena mountains and the Doñana coastal area.

In the spring of 1998, a waste retention wall at a pyrites mine in the foothills of the Sierra Morena broke, emptying about five Mm^3 of sludge and water, contaminated with heavy metals into the Agrio and Guadiamar rivers. These two rivers, especially the latter, are essential elements in the hydrological structure of the Doñana National Park. There was a major impact on public opinion especially in relation to conservation groups. The disaster made national headline news, eg. in the daily newspaper El País, for more than a month after the incident.

At first, attention was focused on the possible consequences for the preservation of the ecosystems that make up the Doñana National Park. However, a few weeks later the consequences of the disaster became polarised, around the perpetual dilemma of development versus conservation. This conflict remains to be resolved, especially in situations such as those currently experienced by the inhabitants of the riverside municipalities. Such polarisation represents the balance between the consequences of the spill in relation to protected areas and natural ecosystems, but also to its impact on agricultural production between the source of the river and elsewhere in the Guadiamar Valley. The reservoir collapse was the result of mining, but effected agriculture and environment along the river corridor.

Despite the special ecological significance of the Doñana region, two groups essential to the understanding of the social and economic repercussions of the spill did not become involved at the outset. These groups were the miners of the villages situated in the foothills of the Sierra Morena, and the farmers close to the river whose land was inundated with toxic waste. This lack of contact suggests that there was not only a lack of awareness of the situation, but also an underestimation of the significance of the pollution to riverside ecosystems. These problems led to the initiation of the Green Corridor Project for the promotion of environmental regeneration. This project requires close collaboration between landowners and aims to encourage sustainable agricultural production close to the river.

The document for the setting up of the Guadiamar Green Corridor Strategy, involves proposals which reflect the role of the river basin as a natural link between two separate regions; that of the Sierra and that of the coastal marshes. These proposals will not be successful unless two essential prerequisites are met:

(a) recognition and identification of the processes of degradation in the catchment; which is currently in a poor ecological condition
(b) integration between ecological restoration and environmental conservation programs in the catchment as well as the encouragement of sustainable development of the populated areas.

Agricultural crops and cattle farms use most of the land in the catchment. These activities are therefore central to the business and employment structures of the active population. There is also a limited service sector. Any conservation proposal must therefore take into account economic factors and be aware of the dynamics of agriculture practices, as well as the political decision to create the Green Corridor. These are considered in the next section.

Problems detected in relation to agricultural practices

The floodplain of the Guadiamar river affected by the spill, was formerly occupied by a patchwork of agricultural crops. The sludge polluted olive groves, wheat and sunflower fields, as well as gardens. The work of removing the sludge destroyed all the natural vegetation and crops adjacent to the river as well as some tree species. Each farmer was paid compensation for the loss of crops by the Swedish company responsible for the pyrites mine and the tailings reservoir.

At first there was a rapid response to control the effects of the pollution from the mine, both beside the river and in the catchment to minimise the effect on agricultural crops. However, because the main objective was the restoration of the damaged ecosystems, it was also necessary to analyse and report on the levels of contamination of soil and water as well as plants and other organisms. The topsoil removal was to avoid influencing the international market for agricultural products from the affected area. After the removal of the crops, there was complete cessation of agriculture in the affected area, involving both the sowing of new crops and grazing. The two zones involved are therefore the polluted strip by the river and the wider area which will remain in agricultural use in future years.

The proposal for the creation of a Green Corridor introduced a further new idea, because it was necessary to purchase, or expropriate where necessary, the agricultural land belonging to local owners. The Junta de Andalucía (the administrative body responsible) has assigned nearly a quarter of the initial investment to the acquisition of the farms in the polluted zone, expropiating them where necessary. The *Confederación Hidrográfica del Guadalquivir*, which is the administrative organisation for the Guadiamar catchment area, has contributed to the process of expropriation in areas under its control.

Agricultural activity has affected by the disaster in three main ways:
(a) loss of the 1998 spring and autumn crops
(b) cessation of all agricultural and pastoral activities
(c) voluntary or forced acquisition of rural properties.

The future co-ordination of sustainable agricultural practices in the vicinity of the Corridor must involve all those activities.

Description of the agricultural activities of the catchment
The linear nature of the catchment results in a natural link between the ecosystems of the Sierra and the coastal region. It means that there is a wide variety of agricultural practices throughout the catchment, including the following types:
(a) grazing land and extensive cattle rearing in the north
(b) cereals and industrial crops production in the flatlands (*Campiña*), largely without irrigation
(c) small market gardens and citrus orchards
(d) olive groves and vineyards
(e) small areas of industrial crops under irrigation, and rice in the south.

The study area covers the wider river basin and extends its influence into the adjacent land. It is therefore possible to summarise the following features:
(a) the river valley utilised for the collection of water for irrigation or for the discharge of wastes from cattle rearing and agribusiness activities. Its “development” would lead also to its inclusion into the edge of the mountain exploitations
(b) the natural vegetation has virtually disappeared from the riverside and remains confined to scattered patches. Instead intensive irrigation activity has extended agriculture to parts where sediment is deposited
(c) the dominant land use here is orchards of citrus or other fruits such as nectarines
(d) the land dedicated to annual crops, eg. wheat or sunflower on the flat stretches, alternating with olive groves and vineyards in areas of more irregular ground
(e) the classical horticultural activity occurs in small patches adjacent to towns, and is orientated primarily to home consumption, with some sales to local markets. Fragmentation of ownership of these patches and their position in the urban periphery results in complex landscape mixtures of agrarian, residential and industrial uses.

The land use, as assessed before the spillage, is characteristically Mediterranean and the area for conservation objectives is similar to other delta areas in southern Europe. Where land has been abandoned but it has been possible to introduce new practices, this has been done at the cost of contravening fundamental agronomical priorities.

The north-south axis of the catchment will be followed so that agriculture and environmental problems can be identified. There are three broad zones:
(a) The upper section of the catchment is characterised by abandonment and marginalisation in many of the mountain holdings. A disease of pigs led to emigration

and to problems of some forests of *Quercus ilex* (holm oak) and *Castanea sativa* (sweet chestnut) which were formerly grazed by pigs. At the same time new land uses related to the introduction of olives began to appear.

The recent reintroduction of cattle grazing and establishment of tourism should have beneficial effects in this zone.

(b) The second zone is the flatlands (*Campiña*) which extend from the edge of the mining zone to the central area of intensive cropping under irrigation. In this zone, the trend over the past decades has been for agricultural modernisation and mechanisation, in order to extend the cultivation of herbaceous crops such as sunflowers and cereals at the expense of olive groves. The latter are now restricted to the steepest land which was the most difficult to mechanise. European Union (EU) support mechanisms have encouraged the maintenance of the olive groves and there has been an improvement in terms of productivity, contravening in most cases landscape conservation.

A recent development has been the gradual introduction near the river of citrus and other fruits, eg. nectarines and peaches that require irrigation. This has been possible only on holdings in the flat areas where previously herbaceous crops were present because of the availability of water for irrigation. This pattern follows the model of other agribusiness in the Guadalquivir Valley, including the eastern Andalusian coastal plains. Such introduction of irrigated fruit is related to the decline of profitability of traditional crops, eg. wheat, maize, sunflowers and cotton.

(c) The third zone occupies the lower section of the valley, which originally consisted of olive groves, vineyards and small market gardens. This zone shows a different trend because the former uses have declined, whereas local markets maintained the market gardens. However, EU policy measures have halted the decline in the production of olives and have revitalised the sector, although not as much as elsewhere in Andalucia. The negative aspect of this crop lies in the increased dumping of a dark fetid liquid (*alpechín)*, resulting from the industrial production of olive oil. Regular analyses of fresh waters have identified this substance in a subsidiary river of the Guadiamar, and it remains a cause for concern.

Vineyards are in decline, because of EU policy, as well as from competition from adjacent more favourable regions. Family market gardens were also declining before the disaster and have now been affected by concerns relating to contamination.

Proposals for agri-environment measures in the Guadiamar Green Corridor

The need for co-ordinated sustainable agricultural practices within the Green Corridor forms part of a wider exercise, termed SITCOVER, (basic recognition, diagnosis and advancement of proposals for the integration within the Guadiamar River Basin by the Green Corridor Project). Now, there is no agriculture within the designated area of the future Green Corridor because the pollution has led to cultivation being prohibited and the subsequent acquisition of the land. However, agrarian activities are still predominant in the surrounding land and it is here that the economy of the municipalities largely now depends. The proposal for the creation of a Green Corridor must therefore integrate all the agricultural activities present throughout the catchment. The participation and involvement

of the population that inhabits the surrounding municipalities is also essential. This interdependence is therefore central to policy determination and forms the primary basis of the present paper.
Within the Green Corridor, the principal factors are soil capacity, changes in land use, agricultural practices and the extent of agribusiness activities. The spillage of toxic sludge has made the relationships between these factors clear because of the absence of physical barriers between the component land parcels and their functional interdependence. The recognition of these connections must be central to the proposal for the sustainable development strategy within the Green Corridor.
The strategies for putting into action practices that are appropriate agri-environment measures relate to the principal problems identified in relation to agriculture. These include degradation of the landscape, changes in agricultural uses, increases in irrigated land, contamination, soil erosion and disposal of waste from agribusiness. There are also problems of illegal occupation of land in the public water domains above the tailing reservoir. The transformation of the landscape is linked on the one hand to the abandonment of farming, and on the other to intensification, a process present throughout Europe but especially in the Mediterranean region.

The importance of pasture in the landscape and its contribution to environmental sustainability is well known. The combination of land uses in the *Campiña* is not well known elsewhere in Europe. On the one hand, it has a high cultural value within the Mediterranean landscape. Conversely, the replacement of olive groves and vineyards with herbaceous crops and the extension of the land dedicated to olive groves in recent years has environmental consequences. The first proposal for the Green Corridor recognises that the landscape value of the traditional cultural landscapes and emphasises that a balanced plan is required in order to maintain them in conjunction with the remaining highly modified agricultural land.
The second proposal relates to the changes in agriculture within the *Campiña*. These changes are contributing to the degradation of the landscape, especially as they are directed towards intensification. These changes are in line with EU policy measures and involve the progressive loss of profitability of traditional agriculture. Agriculture intensification also affects soils through the application of fertilisers, herbicides, irrigation and the removal of stubble.

The following actions are consistent with sustainable agriculture:
(a) determination of the agricultural capacity of the soils and its link to erosion
(b) the rational use of herbicides, pesticides and fertilisers
(c) the use of crop rotations, including leguminous plants
(d) the avoidance of intensive irrigation practices as opposed to localised management
(e) the suppression of illegal practices, eg. stubble burning and *alpechín* dumping.

The proposal for a Green Corridor is to employ coercive measures eg. fines and legislation, in conjunction with voluntary measures involving industrial partners and farmers in order to produce a sustainable strategy for agriculture and the environment. The land above the reservoir must be included, otherwise the desired outcome will not be achieved and the integrated regeneration of the area will be threatened. Since the workshop described in this volume, a Nature Rescue has been established in January 2001 along the highly polluted area adjacent to the river.

An example of an agri-environment scheme in Spain - the case of water management in La Mancha

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Introduction

The results are presented from two research projects carried out concerning agri-environment problems and policies in the La Mancha which is part of the Castilla-La Mancha region. These projects are:

(a) regional guidelines to support sustainable agriculture through European Union (EU) agri-environmental programmes (EU Research Project AIR3 CT94-1296)
(b) a research project involved the conservation and restoration of wetland in the biosphere reserve of La Mancha Húmeda, including hydrological, economic and legal aspects .

Since 1993, La Mancha has been the site of the most important of Spanish's agri-environment schemes in Spain in terms of financial resources, the Income Compensation Scheme (ICS). This scheme aims to reduce irrigation and is popularly known as "the wetland plan".

Description of the region

The La Mancha region is about 8,000 km^2 and is located in the central part of Castilla-La Mancha, in the south-east of La Meseta, as shown in Figure 1. It is part of the Guadiana river basin. Because the area is so arid, the existence of a number of sizeable wetland areas is noteworthy. The most important are the Tablas de Daimiel; a National Park since 1973 and covered by the RAMSAR Convention. Since 1980 all the wetland areas have been collectively listed as a UNESCO Biosphere Reserve, under the name Mancha Humeda. Traditionally, agricultural activity in the area has relied on vineyards, dryland cereal production and sheep rearing. In terms of the conservation of nature and natural resources, this combination of activities has been particularly favourable.

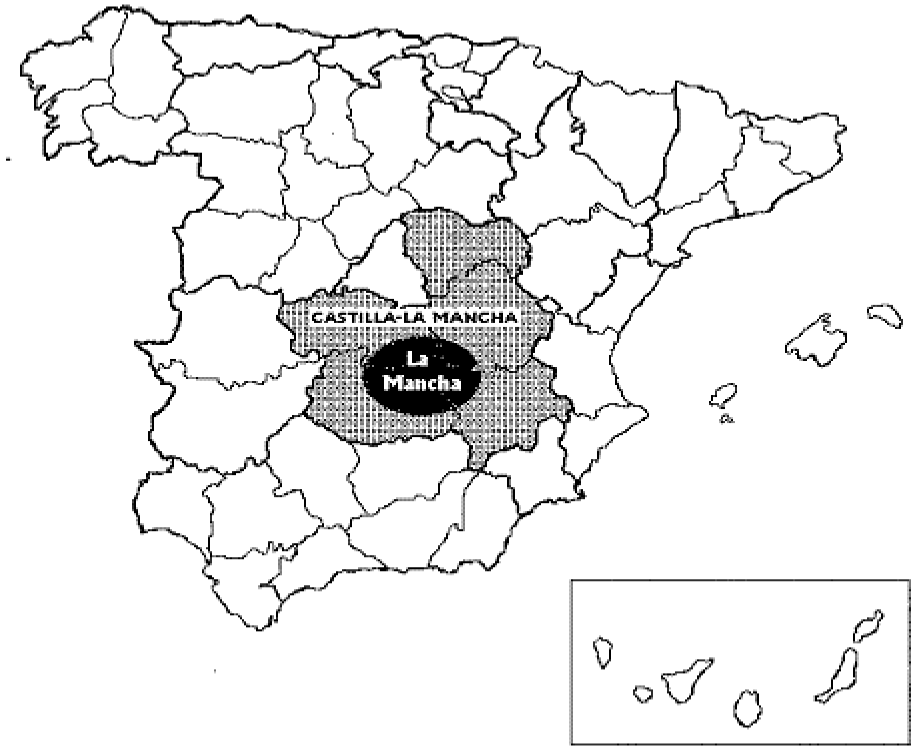

Figure 1. La Mancha

The problem

The increase in irrigation, which began in the mid-70s, transformed a vineyard and dryland cereal area into a region of farms producing crops such as sugar beet, maize, sunflowers and alfalfa. At the start of the 1970s, before the expansion of the use of water, only 30,000 ha were irrigated. 15 years later, it is estimated that irrigation had expanded to cover 135,000 ha of the 719,000 ha of the Utilised agricultural Area (UAA).The water supply came from aquifers. There is a large aquifer (Mancha Occidental aquifer) which extends for almost 5,500 km^2.

The spread of irrigation changed the hydrologic balance in the aquifers. The extremely rapid advance of water-intensive production - involving crops such as sugarbeet and alfalfa, together with removal of vines during the seventies and eighties, has made the process unsustainable. The over-exploitation of the aquifers has lead to the following problems:

(a) damage to Las Tablas de Daimiel National Park a wetland area of great importance in an arid context, as well as other wetlands and lagoons
(b) conflict amongst the local population
(c) some wells have dried up
(d) water quality has deteriorated.

Current measures: the extraction regime

In the case of over-abstraction from the aquifer, the Water Basin Authority (*Confederación Hidrográfica del Guadiana*) was charged with the duty to establish an annual extraction regime delimiting the available quantities, distributing them among the users and forbidding the construction of new wells, as well as deepening of the existing ones. The maximum volume of water to be abstracted by each farm was modulated with respect to the size of the holding. Exceeding these volumes gives rise to a penalty. Any economic compensation is not envisaged, as it is based on reduction of the available water.

Agri-environment policy: the Income Compensation Scheme (ICS) of La Mancha

In 1987 the aquifers in the area were declared to be overexploited and an extraction regime was imposed. Given the socio-economic impact of the measure (ie. the loss of income), the regional government sought mechanisms that permitted compensation to be paid for the decrease in the revenues. This mechanism emerged as an Income Compensation Scheme (ICS), as shown in Table 1, that was approved as an agri-environment zonal programme within Regulation 2078/92.

Table 1. Description of the Income Compensation Scheme (ICS).

Objectives	(a) to reduce the water consumption to the renewable resources of the aquifer's natural levels, (b) to reduce the use of fertilisers and pesticides and (c) to economically compensate the farmers affected by the decrease in water extraction
Measures	Based on an average consumption on irrigated land of 4,278m^3/ha/year, the reduction can operate at three levels: 100%, 70% and 50%. The reduction of water consumption, to whatever level, includes the obligation not to exceed certain levels of fertiliser and pesticide/herbicide use.
Subsidies	The subsidies received as compensation are calculated according to the estimated net marginal loss suffered as a result of the change from "thirsty" crops (maiz, alfalfa) to less thirsty or dry-land crops.
Requirements	Only the farmer with legal wells and legal irrigation rights may profit from the Scheme. The farmer is obliged to enrol all of his irrigated land.

Table 2. Summary of results from the Income Compensation Scheme (ICS) in 1998 (Source: Junta de Comunidades de C-LM, 1999)

Option	Subsidy per ha (EUROs)	ha enrolled	Saving m^3/ha	Total saving hm^3	Farmers enrolled
50 %	179	4,353.8	2,540	11.06	296
70 %	296	74,235.7	3,475	257.97	1,727
100 %	414	5,706.5	5,000	28.53	564
Total		84,295.0		297.56	2,587

Results
From the results of the survey conducted in 1996 the following facts emerged:

(a) the ICS has had a significant effect on crop changes: maize and sugar beet have almost disappeared and there is an increase in set-aside and other cereals, with more barley than wheat
(b) the principal reason for enrolling in the scheme is the limited volume of water to which they are entitled by the extraction regime, questions concerning conservation or promotion of natural resources are not perceived as relevant by farmers
(c) the limitations in the use of fertilisers and pesticides are widely accepted
(d) the decrease in the amount of labour used is significant, being around 50%
(e) while irrigators with recognised rights adopt the ICS and save water, there remain a others without recognised rights who continue to pump water and to open new wells. Almost all the criticism concerned the running of the Water Basin Authority (*Confederación Hidrográfica del Guadiana*). The lack of consensus on the allotment of water grants is causing a social conflict
(f) widespread indecision affects future investment plans.

Limitations of the scheme
The ICS is a special scheme with its own particular features. Because the extraction regime limited the amount of water to be abstracted, farmers are in fact paid not for adopting a voluntary measure (to save water). Instead they are compensated for accepting the legal restrictions on the use of ground water.

ICS has an excessive compensatory character and has been not sufficiently used to facilitate the adoption of agrarian methods that are more sustainable and environmentally appropriate to the features of La Mancha. The ICS is justified, as all the agri-environment programmes, by its capacity for "introducing or maintaining compatible agrarian methods with the environment". However, ICS does not contain elements that force a structural change in the agrarian methods beyond the temporary reduction in water use.

In addition, ICS can be an aid for a water management model but cannot substitute for such a model. At the moment, there is a lack of consensus on the allotment of water grants, which causes social conflict. The irrigators without recognised rights have a political lobby to support them; including some town halls, the explicit support at times of members of the regional government for certain Irrigators' Associations.
Finally, water problems are only one part of the agri-environment problems in La Mancha because these are more complex and require integrated treatment including several such facets as the regeneration of wetlands, agricultural pollution (eg. salt and nitrates), selective afforestation and improvement of landscapes. The ICS as it currently stands, takes no account of such problems. Part of the problem must lie with the fact that the ICS is oriented to specific groups of farmers, ie., those with the irrigation technology, rather than specific environmental problems. Within the scheme there are no measures to encourage and support these farmers practising dry-farming techniques, and no incentives to invest in

efficient irrigation technology in order to bring about longer-term sustainable agriculture to the region.

What should an integrated approach entail?

(a) to involve local actors in a participative development approach
(b) to link agri-environment schemes with a water management framework and extraction rights
(c) to promote an agrarian reconversion in the area to sustainable agriculture, more than being purely an income compensation to the farmers for not using water
(d) to take into account the entire environmental problems in the area including wetland conservation and restoration, agricultural pollution, afforestation and landscape maintenance).

References

Pineda, F.D., Férnandez Rubio, R., López Sanz, Rosell, J. & Tarjuelo, J.M., 1999, Comisión de Expertos sobre el Plan de Ordenación de los Recursos Naturales y Desarrollo Sostenible del Alto Guadiana. Dictamen Prospección, Diagnóstico y Propuesta de Actuaciones, informe para Organismo Autónomo Parques Nacionales (Ministerio de Medio Ambiente) y Consejería de Agricultura y Medio Ambiente (Junta de CC. de Castilla-La Mancha)

Rosell, J. & Viladomiu, L., 1998, Gestión del agua y política agroambiental, in Cruces, J. et altri (eds.), 1998, De la noria a la bomba. Conflictos sociales y ambientales en la cuenca alta del río Guadiana, Bakeaz, Bilbao

Rosell, J. & Viladomiu, L., 2000, Wine regime. In Brouwer, F. and Lowe, P. (eds.) CAP regimes and the European Countyside: Prospects for integration between agricultural, regional and environmental policies, CABI Publishing, Oxon, 2000

Rosell, J., Viladomiu, L. & Forcada, S. 2000,: Agri-environmental policies and water use: irrigation reduction scheme in La Mancha (Spain), paper presented to the XTH World Water Congress, 12-16 March 2000, Melbourne, Austrialia

Viladomiu, L. & Rosell, J., 1999, “El programa de compensación de rentas por disminución de regadíos en Castilla-La Mancha”. In Suarez, F. y Oñate, J.J. (eds.), Conservación de la naturaleza y mundo rural: experiencias y perspectivas para el s. XXI, Francisco Suarez editor, Madrid.

The ecological and economic rationale for transhumance practices in Spain

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Introduction

The displacement of pastoral people with their animals to take advantage of spatial-temporal variations in productivity of ecosystems is a widespread practice throughout the European mountain areas in traditional pastoral societies. This practice, which developed as a way of overcoming local environment constraints, can take different forms, both in time and space, along a recognisable continuum. Movements of nomadic groups distinguish the extremes over a wide area to take advantage of irregular rainfall episodes, as opposed to very regular movements along established routes over fixed periods of time. Transhumance is placed at the more regular end of the continuum. It corresponds to long seasonal migrations at fixed times of the year and follows well-delimited routes, called drove roads (*cañadas*). Their regularity, both in time and space, as well as the long distances involved (with the consequent need for dual permanent settlements of the population, at least for those actively engaged in transhumance), characterise this activity as opposed to other periodic displacements of animals.

Transhumance in Spain

Transhumance practices have a long history in the Iberian Peninsula. The earliest historical records regulating the practices date back to the ancient legislation (Fuero Juzgo of the Visigoths) in the VI Century AD, although they have certainly been present since pre-Roman times. The strong seasonality of the Mediterranean climate was the stimulus to control productivity, with a very marked peak associated to the co-occurrence (normally in spring, with a less marked peak in the autumn) of sufficient water and temperature. The pronounced distribution of relief in the Iberian Peninsula results in a displacement of two to three months of the main spring productivity peak, between the lowlands of the south and the uplands in the north. This is compounded by a general north-south gradient from the northern mountains to the southern lowlands with two extensive, relatively flat plateaux in between. Latitude, height and climatic gradients therefore reinforce each other in a way that forced a lateral spatial displacement of some 800 km in order to maximise the potential complementarity of the seasonal displacement in biological productivity.

In this environmental context, a combination of low population density, flexible, moving frontiers between different ethnic groups and other aspects of agriculture and livestock, eg. recycling stubble and fertilising land by post-harvest grazing of cereal field crops, led transhumance to fulfil a prominent role. Finally, some animal races like the Merino sheep, whose origins can be traced back to Iberian times, were developed and are particularly well adapted to long displacements. These sheep produce valuable wool, and resulted in a strong economic incentive to maintain transhumance. It is worth mentioning that transhumance in Spain also affects other animal husbandry activities, eg. bee-keeping, to take advantage of differences in the phenological variations in flowering seasons.

Transhumance reached its peak in Spain during the Middle Ages, with the creation in 1273 by Alfonso X of an association of transhumance people created to establish and defend their grazing privileges and to regulate their activity, called the *Honrado Concejo de la Mesta*. For several centuries, transhumance was one of the economic engines of Castilla, providing a substantial income to the Spanish Crown.
It reached its peak during the first quarter of the XVI Century, when over 3 million, mainly Merino sheep moved through the country in an annual cycle. At the end of the XVI Century, transhumance started to decline and by the XVII Century it was giving way to agriculture, its main competitor for land, in the winter quarters of the lowlands. Whilst the highland pastures represented a good land use response because of the severe climatic conditions, the modernisation of agriculture with the introduction of new techniques and an increasing population needing more land for cultivation created much pressure on formerly lowland pastures. Moreover, the introduction of Merino sheep in other European countries in the XVIII Century undermined the monopoly position of Spain, leading to a decrease in profits for this enterprise.

Beginning with different provisions in the XVIII Century, the privileges of transhumance people were finally terminated when the *Honrado Concejo de la Mesta* was dissolved in 1836. Large areas of commons, particularly in the lowlands, were then enclosed and privatised during the transfer from the church to the state (*desamortizaciones*) of the first half of the XIX Century.

Transhumance in the XX Century.
Three major events during the XX Century brought a further drastic reduction of transhumance flocks. Firstly, the intensification of agriculture and the general improvement in transport allowed a gradual encouragement of the flocks, to stay in one place. Secondly grain and fodder was progressively imported from distant areas. Thus, the reason for the displacement of animals to take advantage of seasonal variations in productivity was gradually replaced by a system of leaving animals in one place and bringing food to them.

A second factor was the rapid industrial development during the second part of the XX Century. This resulted in a major change in the composition of the population, from being a basically rural country in 1950 to being a fully industrialised country in 1980. Rural areas began a long process of population decline, leading to problems of finding people to carry out the difficult tasks and hard life of shepherds involved in transhumance.

Finally, the railway had introduced a new way of moving animals during the second half of the XIX Century followed by trucks half a century later, opening up more remote corners in the country. Nevertheless, transhumance was still carried out to a large extent on foot until the middle of the XX Century. The same development process that had brought agricultural intensification and rapid urbanisation of the country resulted in the destruction of the dense network of drove roads that made possible the animal displacements over long distances. The collapse of the wool market due to the development of synthetic fibres after the Second World War further reduced the profitability of Merino flocks, thus closing the circle of decline. By the end of the XX Century, transhumance had become a residual activity, undertaken by a few hundred thousand sheep, goats and cattle, on foot and over short to medium distances. These were geographically concentrated in some regions, eg. the Central system of mountains, or by trucks over longer distances.

Environmental values associated with transhumance

Transhumance has direct and indirect environmental benefits. The maintenance of a dense network of up to 75 m wide drove roads represented an extraordinary network of corridors that functionally linked different landscapes through the movements of animals, both domestic and wild because a cohort of predators and scavengers accompanied the flocks. The animals also played a role in seed dispersal and as long-distance corridors between the uplands and lowlands.

An overriding issue however, was the contribution of transhumance to the maintenance of the *dehesa* system, the savannah-like oak forest designed for grazing and production of acorns to feed livestock. The *dehesa* is considered as one of the best examples of environmentally sound traditional agricultural practice in Europe and offers a unique habitat for protected plants and animals. The *dehesa* is currently threaten by the concentration of animals and consequent overgrazing, leading to increased soil erosion and a limited and lacked ability of the trees to regenerate.

Livestock intensification and lack of dispersion has also lead to under-utilisation of large areas of mountain pastures that were once grazed by flocks involved in transhumance and are now progressively being abandoned, resulting in the loss of species and landscape diversity. At the same time, this process increases pressure in other areas to produce fodder, usually under irrigation, that utilises high volumes of water, fertilisers and good quality agricultural land.

Finally, the balanced grazing of lowlands and highlands carried out under transhumance was a important in the control of forest fires, that have now reached serious levels in recent times in Spain.

Transhumance as an agri-environment scheme.

Bearing the above facts in mind, the Spanish Ministry of Agriculture is now working on a proposal to include transhumance as part of the agri-environment package currently being negotiated. The measures would apply to both livestock and bee-keeping transhumance. The strategic purpose is to offer sufficient incentives to people, in order to maintain or resume activities with high environmental value, that otherwise will be abandoned. The compensation is intended to cover the supplementary costs of displacing the animals as well as the subsequent loss in productivity. The amount is higher for transhumance by foot, because of the higher costs associated with the labour involved.

An important innovation is that the compensation will be based on the estimated surface over which a reduction in livestock density takes place as a result of transhumance. This will help maintain extensive grazing systems that are a pre-condition to realise the potential environmental values. This scheme contrasts with headage payments that encourage intensification and increasing livestock densities, and their associated environmental costs.

The standard scheme is modified according to a maximum livestock density that is related to the prevalent type of land-use, soil quality and climatic conditions of each region. The distance of animal displacement is also considered when calculating compensation. It has been proposed that a minimum altitudinal gradient should be involved in displacement. In addition, a minimum period of time of three to four months, between May and September, should also be incorporated in the agri-environment scheme. This would reduce the risk of an spurious use of the measure by simply moving animals a few tens of kilometres along the same type of ecosystem and for a short period of time in order to get the benefits of any transhumance package.

It is hoped that such a scheme would help maintain a viable transhumance system that could offer the environmental benefits mentioned above, whilst allowing those who opt for it the opportunity to be involved in this traditional activity.

Livestock systems

The ecological rationale and nature conservation value of extensive livestock systems in the Iberian Peninsula

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Introduction

Spain has many examples of extensive agrarian systems as result of the integration of human activity with the natural environment. There are many instances of traditional uses that have led to sustainable models, compatible with a high natural value. These systems supply useful guidelines for planning the sustainable exploitation of resources. The distinctive structure of their associated landscapes bears functional and natural implications, which validate their inclusion within the nature conservation strategies.

Extensive livestock systems have shaped, to a great extent, traditional agricultural landscapes. The spatial organisation, management practices and type of herbivores involved in these grazing systems are very diverse. In general, they require multiple use of the resources, and are called sylvopastoral. The current pressure of industrial production systems obliges extensive breeding systems to face the challenge of applying new assessment perspectives in order to demonstrate their cultural and ecological significance. Therefore, an urgent initiative is required to conserve and adapt these systems, within current economic constrains, in order to maintain their cultural value and high biodiversity.

The present paper is a synthesis of topics that were previously discussed to some extent in earlier publications (Gómez Sal 1994, 1995, 1998 and 2000a; De Miguel & Gómez Sal, 2001).

Ecological significance

Productivity peaks of grasslands vary according to specific spatial and temporal patterns in relation to the climatic and topographic characteristics of the Mediterranean region (dry summers and complex relief): patterns of temperature and rainfall, aspect, type of vegetation cover (forest, scrub, open woodlands, herbaceous communities), water table (valleys, seepage sites, low-lying fertile land), parent material (limestone or acidic rocks, clay deposits), and nitrogen rich sites (livestock resting areas, zones favoured for deposition of manure). The numerous combinations in which these factors appear result in landscapes with characteristically complex patchy structures. This natural complexity has been traditionally produced by farming and grazing, with infrastructures that interfere and model natural processes (Gómez Sal, 1995).

Extensive livestock systems were built up based on the interaction between vegetation, large herbivores and man acting, at different scales in the landscape. These scales are closely related to the innate grazing strategies, ie. foraging behaviour, developed by the wild ancestors of livestock; strategies that have only been slightly modified by management. The consequences of such production systems for ecosystem conservation, range from negative impacts eg. overgrazing and erosion, to exemplary instances with a balanced and sustainable management. This interaction between man-controlled herbivores and plant productivity, results in agricultural landscapes that largely rely on semi-natural ecosystems to maintain their functionality and high natural value. These agricultural landscapes may be considered as a part of the natural heritage, which should be preserved and managed by means of continued use. According to the recommendations of the Rio Conference, many sylvopastoral systems should be included within national and regional conservation strategies, due to both their biodiversity and sustainability. However, the future of these systems is being endangered in Spain, particularly due to the Common Agricultural Policy (CAP), which is excessively influenced by productivity incentives, which give little weight to environmental issues. It is urgent to reinforce the arguments, to support the conservation of such systems, for example through the identification and protection of its basic ecological components and essential processes, as well as through updating the management models in order to ensure their preservation.

Climate is the primary determining factor at the scale of the Iberian Peninsula and two circumstances contribute to explain the complexity in the region. Firstly, it is located in the transition between the Temperate Zone, with regular precipitation, and the arid climates associated with the subtropical band of high pressures. This transition zone is strongly influenced by the inter-annual variations of large scales of atmospheric circulation. Secondly, the Peninsula has considerable orographic complexity, which produces rain shadow and modifies the climatic influences and produces regional climates, e. g. the strong contrasts between north- and south-facing slopes and altitude effects. The result is a complex mosaic of habitats and local conditions with different associated levels of primary productivity. There is also a shift of peaks in productivity, according to the trends in phenology which are linked to water supply, unpredictability of rainfall and the duration of the frost free period. The livestock breeding systems of the Iberian Peninsula are adapted to these contrasting environments.
Productivity in the Mediterranean region, therefore has the following distinctive features:
(a) it is generally scarce, scattered, and unpredictable
(b) it is concentrated in specific fertile zones, such as valleys in the lowlands with favourable conditions of water and nutrients
(c) it is limited in time and concentrated in one or two periods of the year
(d) it varies annually, with a random succession of good and bad years for harvests and pasture production.
This variability requires mobile livestock systems that are capable of adaptation to the different spatial and temporal variations in food supplies. The plant-herbivore systems of the Mediterranean landscape act at different scales in the ecosystems and are an important factor in regulating primary production. The activity of ungulates responds to different requirements, both individual needs, eg. physiological and the selection of diet, and group needs eg. the group survival and the organisation of their home range. Therefore, the

learning capacity of animals, the experience of individual leaders and the possibilities that the group has to move from place to place, play a very important role. Herbivores induce changes in the vegetation in such a way, that many characteristics of the landscape and plant communities may be interpreted as a response to their continued action. The mixtures of trees and grassland, which interact together are termed sylvopastoral systems (Gómez Sal, 1992; De Miguel et al., 1997), and have been controlled by humans by means of livestock. Grazing is not only an efficient way of concentrating the generally disperse production of the pastures, but also influences the composition of the plant communities, eg. stocks of trees and the types of grasses. It has also played an essential role historically in developing the current landscape structure and dynamics of ecosystems in the Mediterranean region. In this way, it can be said that pastoral systems have enhanced the natural complexity of landscapes. These interactions have created a landscape with complex mosaics and a rich spatial structure, with high levels of biological diversity (Naveh, 1991).
Some examples of typical livestock farming practices adapted to the Mediterranean conditions are the following (Gómez Sal, 2000b):

(a) the selective consumption of shrub species by browsers has transformed many areas of Mediterranean woodland, favouring the dominance of those species not consumed by herbivores
(b) the low savannah-like formations that formed many typical landscapes, termed *dehesas*, are common in south and western Iberia, with the trees being selected according to their fruit production, shelter and value as forage
(c) an annual cyclical displacement of livestock, linking zones whose maximum productivity is complementary in time
(d) itinerant grazing, in which the flocks are controlled by a shepherd and return every day to a central place, playing a role in maintaining fertility in pastures and arable fields, by using crop residues and stubble.

Different types of current landscapes may be interpreted according to the importance and representation of some basic models of land use systems derived from the above grazing practices (Montserrat & Fillat, 1990; Gómez Sal, 1994).

Agricultural activities and their relationship with biodiversity

(a) Extensive systems

A wide variety of extensive agricultural systems persist in Spain despite the intensification which has taken place throughout the most of Europe (De Miguel & Gómez Sal, 2001). The surface occupied by these systems has been estimated in more than 20 Mha: permanent grassland (> 5 Mha), fallow land (4 Mha) and scrub (5 Mha), both used by livestock systems, and non-irrigated arable land with low intensity herbaceous and woody crops (> 6 Mha) (Beaufoy, 1995).
These resource-consumption systems play an essential role in nature conservation in Spain. This is reflected by the fact that approximately 80% of the area specially used for bird protection (around 9 Mha) is managed under various types of extensive management or low intensity in small parcels (Beaufoy, 1995). Therefore, it is not strange that nature conservation in Spain implies maintenance and improvement of these agricultural systems,

as well as the protection and conservation of wilderness areas, which are rare in a region exploited by man from ancient times.
Some of the extensive systems have inherent characteristics that promote or maintain a high diversity of organisms, including species, races and varieties. The most relevant characteristics and the related associated processes are discussed in the following sections (De Miguel & Gómez Sal, 2001).

(b) Environmental adaptations
The disturbance of natural systems is often associated with directional changes in specific ecological parameters. However, the maximum levels of biodiversity are often associated with intermediate disturbance (Connell, 1979; Milchunas et al., 1988), questioning the original theory that biodiversity is progressively highest without exploitation.
Many diverse systems are linked to traditional agricultural practices because they are adapted to the inherent character of the environment. In ecological terms, their distinctive features are the efficient use of energy and nutrients. In many cases exploitation increases biodiversity in a range of taxonomic groups, perhaps because of the range of niches that have been developed over such long periods of time.

(c) Spatial and temporal variability
Traditional agriculture uses the soil in a variety of ways and temporal rhythms eg. by rotation or by changing the location of an activity called shifting agriculture. The latter is not structured over space or time because it depends on the weather in that year. This process creates patterns at the landscape scale. In this way the productivity of the soil is maintained, because the system is adapted to annual climatic variations. The result is a mosaic with species and habitats from different successional stages. Spain has many rural landscapes with these complex patterns, but some are changing or are threatened by modern pressures, eg. urbanisation and intensive agriculture.

(d) Simulation of natural processes
Many strategies of adaptation in agriculture imitate the functioning of natural systems, such as the movement of cattle across large distances. This agrarian system is one of the oldest and most characteristic of the Peninsula, as shown by early historical records (Caro, 1986). This system copies the natural migration of wild herbivores in dry climates to regions with seasonally higher food production.

(e) Local breed adaptation
One of the essential characteristics of these systems is the selection and diversity of local livestock breeds. This process has important implications for biodiversity, because the breeds are adapted to local conditions, both in terms of environment and human activity. The specialisation of domestic animals has been based on a compromise between production and environmental limitations. This strategy, maintained for centuries, has been fundamental in the reduction of the impacts of environmental fluctuations, as well as resource-supply and the maintenance of productivity. Thus Spain has 28 different cattle breeds, 18 sheep breeds and ten goat breeds, not taking into account those with very

localised distributions. It is unfortunate that, whilst much money is spent on the conservation of wild species, there has been a loss of 50% of local cattle breeds in Europe in the last 50 years. In Spain alone about 50 livestock breeds are in danger of extinction.

The different types of extensive landscapes in Iberia today may be interpreted according to the importance and representation of three model land use systems: pastoralism, polyculture and Mediterranean agriculture (Gómez Sal, 1994). In all of them livestock plays an essential role. The main features of these models will be analysed with more attention been given to pastoralism, because of its historical importance in the formation of modern Iberian landscapes. It is also especially important in the maintenance of some of its most original and valuable agri-ecosystems.

The Mediterranean climate has great environmental complexity and favours pastoral agriculture. The major gradient is associated with primary production, which depends on the season. There is also spatial dimension, because of the wide latitudinal range in Spain and the movement of animals is related to this pattern. The systems based on the extensive management of cattle can be grouped into the following categories:

(a) extensive mountain systems, including almost all the mountains of north and central Spain.
(b) extensive *dehesas* of the south and west of the Peninsula
(c) semi-extensive systems of sheep and goats in central Spain and the Ebro valley.

These three types have many links and complement each other in several regions. This network of extensive uses forms the structure of many Spanish landscapes. They are important for conservation and the links are further discussed below.

Transhumance

The mobility of herbivores may occur at a regional level, and connects the maximum vegetation growth of winter and spring, typical of south-western Iberia, with the summer peak, found in the mountain pastures of northern Spain. At the end of autumn the mountain pastures of north and central Spain start to be covered by snow, whereas in the *dehesas* herbage production has just started, reaching its peak at the end of winter and the beginning of spring. The main objective of long distance (latitudinal) transhumance is to take advantage of this pattern of growth.

Latitudinal transhumance is strongly adapted to the physical characteristics of the country (Ruiz & Ruiz, 1986) and links regions 300-600 km apart. This system is based on the use of a special type of mountain pastures in the northern ranges, which are only productive for about four months during the summer (*puertos* in Spain, *alpages* in France and *saeters* in Scandinavia). They are linked to the Mediterranean *dehesas* of the south, central and west of the country. The royal protection of transhumance began in the XIII century, safeguarding the profits of the wool industry by means of the creation of powerful associations of stock raisers (*Mesta*, see Klein, 1979). These associations greatly influenced the conservation of the pastures and drove roads (*cañadas)* and led to the development of the Merino sheep breed.

Dehesas and puertos

In the same way as large herbivores migrate in the dry tropical savannah environment, transhumance enables grazing animals to avoid periods of low productivity.

In central and south-west peninsula, the *dehesas* are mainly of holm oak (*Quercus rotundifolia*), or cork oak (*Q. suber*). In other regions pyrenean oak (*Q. pyrenaica*) or lusitanean oak (*Q. faginea*) are also frequent. These *dehesas* (*montados* in Portugal) constitute an important management alternative to more complex and dense forests and have many annual species.

These savannah-like landscapes cover large areas in west Spain. Some *dehesas* have multiple uses, combining long-term agriculture with livestock and wood products. Cork oak *dehesas* are especially profitable, since the high quality of livestock products is complementary with cork production, thus adding to the economic returns (Campos, 1994). Besides sheep grazing, the production system in *dehesas* includes local breeds of cattle, pigs and goats, as well as a number of agricultural and forest products.

Their origin is ancient and they were developed by progressive selection of the best acorn producing trees, which are used to feed livestock. As in other woody plantations, including trees such as olive, almond or carob, they contain other ecosystem components of higher productivity, eg. annual grasslands and crops. The *dehesas* represent the conversion of Mediterranean forests towards a more productive system. González-Bernáldez (1991a) describes these as the *frutalización* of the Mediterranean woodlands, a term which has no direct translation in English, but which involves the progressive selection of trees with fruit, nuts and acorns, but maintaining a great deal of naturalness and pristine ecosystem functions. From the conservation point of view, these landscapes have a high conservation interest because they provide habitats for a number of migratory bird species, coming from central Europe in winter and from Africa in spring and summer. They also hold populations of several Iberian endemics eg. the imperial eagle (*Aquila heliaca adalberti*) and lynx (*Linx pardina*). They have a particular value in making meat production compatible with the maintenance of a high quality of both landscape and biodiversity (Pineda et al., 1981). Moreover, the resources are managed in a sustainable and productive way.

The diversity of herbaceous plants is amongst the highest in the world and is integrated with the grazing regime (Pineda et al., 1981; González-Bernáldez 1991b). It is also combined with an optimal number of wild and domestic herbivores, eg. rabbits, deer, cows and sheep. The right equilibrium between these animals favours diversity in conjunction with disturbance (Pineda & Montalvo 1995).

Another relevant consequence of transhumance is a well-defined type of mountain pastures (*puertos*) distributed along the Cantabrian and Pyrenean ranges and the central Iberian system of mountains. These have been preserved from ancient times for transhumance.

These pastures form a steppe-like landscape that is highly productive in the sunny summer and is also able to support viable populations of wild and domestic herbivores (Rebollo et al., 1993).

Trees have an important role in buffering climate limitations and are an integral feature of many Spanish rural areas. The objective of maintaining some of the original forest cover was to maintain grassland productivity utilising the trees for shelter and to maintain fertility by leaf fall. The perennial leaves can also be used for forage in critical years, which are unpredictable in the Mediterranean climate.

The spatial structure of the dehesas

The landscape of the *dehesas* is determined by a regular distribution of the component elements (De Miguel & Gómez Sal, in press). It varies according to their position on the hillside, with more trees in the higher zones and pasture at lower levels. There is a movement of nutrients, because the trees extract minerals, which are then transferred to the pastures. Cattle free-ranging behaviour is the main mechanism that restores the losses of fertility. This is because, under Mediterranean climate conditions of the *dehesas*, cattle habitually concentrate in areas located at the middle and high parts of the slopes. Resting areas are usually sited in windy places to avoid fly attacks and night refuges are located in areas of dense trees in the higher zones.

Cañadas: a surprising heritage from latitudinal transhumance

From the XV to the XVII century the Merino fine wool represented such an important source of wealth, that at its peak, the system of sheep raising directed by the *Mesta* involved 3.5 million animals moving through a complex and strictly regulated net of drove roads (*cañadas*).

This is the origin of a surprising heritage, which consists of a long and extensive network of publicly owned drove roads, which connected different types of pastures. These have an important role in the Spanish nature conservation being ecotones, refuges and breeding areas for a range of species. They are never ploughed and may act as corridors for some species. This network, about 125,000 km long, still occupies at present 420,000 ha, almost 1% of the Spain.

Although several other Mediterranean countries have transhumance, Spain is by far the most important country where this practice was undertaken and the network of drove roads was very highly developed. In some areas, drove roads are still used by local sheep undergoing transhumance, as well as for moving cattle. The main category of drove routes, called *cañadas reales* which are up to 800 km long and 75 m wide, connect the three main types of pastoral systems mentioned above.

In recent years there has been an increased interest in preventing the loss of *cañadas* and in maintaining their cultural value. Several projects are under way to demonstrate their recreation and conservation value (FEPMA, 1996; Gómez Sal & Rodriguez Pascual, 1996).

Even although they are legally in public ownership, they are degenerating, especially through abandonment.

Altitudinal transhumance

When the production system is related to differences in altitude within a distance of 100 km it is local and is called altitudinal transhumance. This type of transhumance in Spain may be between different communities, which are in localities placed at different altitudes, whereas in northern Europe it is rather between individual farmers. Some of these systems are very old eg. the one that is connecting the mountain pastures of the north (the north side of the Cordillera Cantábrica) with the lowlands near the coast. Various types of pastoralism based on local movement of animals can be found along mountain ranges, almost throughout the peninsula. These systems are usually related to ancient common lands, which were not allowed to be privately owned because of their strategic importance. Many of these regions involve the grazing of local breeds of sheep, cows and goats.

An example of these pastures is the *pasiego* system in Cantabria, which involves scattered settlements on steep mountain slopes with an Atlantic climate (Montserrat & Fillat, 1990). Each family owns several houses with haylofts (*heniles*) which are situated close to the meadows. Traditionally the whole family used to move, with their goods and animals, from one house to another depending on the needs of the cattle and the grass phenology. The *pasiego* people increased the area of pastures by burning and manuring the heaths, which are now grazed by horses, cows and sheep. At present this system is changing due to intensification, with Friesian dairy cattle becoming the dominant breed. These types of itinerant pastoralism have a historical and ethnological interest, and are a source of practical knowledge about the use of resources in inherently poor environments.

Another example of the vigour and adaptability of transhumance, is the current trend towards a new kind of shorter migrations from the traditional *puertos*, used for centuries by Merino sheep, to lowland areas generally at the south of the northern ranges. These cattle movements are only 100 to 200 km in distance. These new winter areas consist of fallow and unused land, which are products of modern irrigated agriculture. They partially substitute the previous patterns of the long transhumance, but do not fulfil the full ecological role of these traditional systems.

Impacts on biodiversity

The general impact of transhumance on biodiversity is more related to the persistence of the activity itself, rather then the way it is carried out. Ecologically transhumance involves the linking of two landscapes, which are spatially separated, but share the same system of exploitation. Therefore, one of the landscapes is always in temporary low level of use, synchronised with the lifecycle of the cattle and climate. Some of the pastures of the *dehesas*, called *majadales*, are good examples of these systems. These are herbaceous communities with a cover rich in leguminous plants and perennial grasses that have a high ecological fodder value, compared with most surrounding areas that are dominated by annual species. These semi natural communities require certain humidity and soil fertility conditions with intensive grazing from the sheep in autumn and spring, but low grazing pressure in summer because of transhumance. An inverse system operates in the *puertos*, where the best pastures are only used in the summer, but should not be overgrazed. The density of the rarest wild herbivores especially, isard (*Rupicabra rupicabra*), is positively linked to the presence of sheep because of the maintenance of the pastureland (Rebollo & Gómez Sal, 1998).

Nowadays because of the lack of institutional support for transhumance, many of the cattle stay throughout the year in the *dehesas*, with the lack of natural food being overcome by supplying supplementary feed. The *dehesas* are therefore overexploited and there is damage to soil and vegetation, especially in the *majadales*. This kind of feeding has led to problems with Bovine Spongiform Encephalopathy (BSE) and has reduced the prestige of these extensive systems.

Currently long distance transhumance still takes place, although using railways and lorries as transport. In recent years there has also been an increase in the substitution of Merino sheep by non traditional breeds of cows, mainly because they are easier to keep and drive (Rebollo & Gómez Sal, 1998). This change poses a problem of nature conservation and resource management, which is becoming common in several countries of the EU, because the modern breeds have different behaviour patterns that have indirect ecological effects. The more gregarious behaviour of modern cattle means that they concentrate in resting and latrine areas. They are also not adapted to mountain conditions, which leads to erosion in overgrazed lower areas and abandonment of productive communities of the higher, steeper slopes and more remote parts of the *puerto*. The result is a degradation of the mountain pastures, which had been improved by the inherited family tradition of shepherds. These shepherds were working with the same group of Merino flocks (*cabañas*) involving about 10,000 animals, that belong to an important owner who kept his own selection lines as well as improving his pastures.

Mediterranean agriculture

(a) Open landscapes with sub-Mediterranean climates

These landscapes are called steppic in Spain but differ from those in eastern Europe where the winter temperatures are much lower, although otherwise the climate regimes are comparable.

These cereal fields cover large areas in the central plateaus (*mesetas)* of the *peninsula* and have important associated bird species, such as the great bustard (*Otis tarda*). In a similar way to northern Africa, Spain was an important granary for Rome. The cultivation of this steppe landscape involves from ancient times extensive crops of winter cereals of barley and wheat and is present in the cold high plains. The open fields and the lack of hedges have produced a distinctive landscape, which are the end product of the transformation of the original Mediterranean forest. They are important to nature conservation in Spain because of their unique fauna and flora. The majority form part of the European network Special Protection Areas for Birds. The *cañadas* and other strips with natural vegetation bordering the cereal crops may act as corridors or ecotones, and contain biodiversity, both flora and fauna, in this otherwise uniform landscape.

An example of the exploitation of the *cañadas* is one based on the Manchega sheep from the southern *meseta*. The flocks of this breed consume a variety of herbage depending on the time of year. They use permanent grasslands and fallow in the early spring and winter but stubble in the summer and vineyards as well as trees and shrubs in the autumn. Both cattle and sheep are an important source of fertility because of the associated manure. The high diversity of landscapes and organisms represents an efficient use of natural resources, and provides quality products, typical of this region such as wine and cheese.

(b) Woody plantations of mountain regions
In the Mediterranean region woody plantations become more important in mountain areas. Within a single landscape there may be a range of different uses coexisting eg. cereals, *dehesas*, olive groves, vineyards and fruit tree plantations as well as pasture and scrub on the less productive slopes. The complete landscape is used by flocks of sheep and goats, usually with local breeds.

There is a complex network of trees ranging from true silvopastoral systems, where the trees provide shade and forage to those where fruit is the main product. Some trees, such as the olive, the carob, and the fig, are for both purposes, with different levels of intensification. In southeastern Spain vines and palm trees are also used. These crops, which are present in the most arid areas of the Mediterranean environment, capture deep water and concentrate their production in summer, when most species are not able to grow (González-Bernáldez, 1995).

(c) Mosaic landscapes of the Atlantic region (polyculture)
In the western and northern ranges of the Iberian Peninsula there are landscapes which originated in the multiple use of the land developed by rural communities for traditional self-sufficiency. From an ecological perspective polyculture involves some mature and stable landscapes, consisting of mosaics of land uses. Towards the periphery of the villages and according to the type of land, the fields are arranged in zones of decreasing intensity, from vegetable gardens and orchards to meadows, cereal fields and pastures and finally woodlands. The high productivity of these systems arises from the complex crop rotations and production of manure from the woodlands such as gorse, heather, ferns, straw and leaves. These products acted as the engine of soil fertility and were important for livestock, mainly cows and pigs. This *bocage* landscape, has many hedges and small woods, and is also an important feature on sandy and erodible soils. Local breeds of cows, which have multiple uses, were an important feature of this system. Although polyculture is most common in the Atlantic environments of north-western Spain, they also appear in some Mediterranean transitional areas, which have a high variety of crops and domestic animals (Gómez Sal, 1994).

These landscapes are not only diverse in the land uses present, but also favour high biodiversity. This exemplified by the presence of large animals, such as the wolf (*Canis lupus* ssp *signatus*) and brown bear (*Ursus arctos*) and by birds of prey and vultures.

Conclusions

The most valuable and representative emblematic species of Iberian fauna are found in the savannah landscapes, *dehesas*, in the south and west, and in the mountain areas of the north including *puertos* and polyculture. These regions have been traditionally used for pastoralism, and were historically connected by latitudinal and altitudinal transhumance, although the former is now threatened.

Spanish extensive cattle systems are an important European cultural resource that is threatened by the conflict between traditional agriculture and modern economic models. If these diverse systems are to be conserved than it is necessary to produce a viable policy for their maintenance, otherwise they will be lost irreversibly. The valuable landscape structure will change if the traditional land uses and the associated production are lost. The only alternative is to substitute some of the land uses to maintain the functionality of the landscape.

Studies on the productivity of agrarian systems usually ignore the supporting semi-natual ecosystems and their functional role. The present paper emphasises the importance of the configuration of the component ecosystems, which make up the landscape. These processes are related to the distribution of the elements of woody vegetation and the dependent animals. The pathway of nutrients depends on the interactions between the animals, the pastures and the trees and maintains ecological sustainability.

Traditional livestock systems are faced with the challenge of adapting to the modern situation, where economic driving forces predominate. It is urgent to reinforce the arguments that support policy measures to maintain them. The present paper demonstrates the interdependence of many aspects of the ecology of pastoral systems and that they should be treated holistically. The component elements ie.
livestock and tree breeds, agro-ecosystems, grazing patterns and associated empirical knowledge, should all be treated as integral parts of the cultural landscape for the purpose of identifying appropriate management tools. A multi-dimensional evaluation is therefore needed to take account of all these issues (Gomez Sal 1998).
The role of ungulate herbivores in converting vegetation biomass and accelerating its incorporation into the soil is one of the key ecosystem processes involved. Local breeds are superior to introduced animals for this purpose, as they are able to utilise coarser herbage and are better adapted to local resources. They are also able to utilise land with low productivity, without imported feed, but still produce a quality product. They are efficient at searching for food as it becomes available during the year, in a similar way to wild herbivores. An understanding of their behaviour helps to facilitate extensive cattle management. Different breeds have been developed for both altitudinal and for latitudinal transhumance eg. Avileña cattle and Merino sheep. Another type of breeds are those that

have developed to live independently of shepherds eg. Lacha sheep in the Cantabrian mountains and numerous breeds of cows and horses. The latter ones are also resistant to predator pressure and disease.

Regional resources are now often underused and even abandoned, leading to an increase in vegetation cover. Such increases in biomass are a problem at the landscape scale, because of increasing homogeneity and the threat of large-scale fires. In addition, forests and agricultural policies eg. the CAP have aggravated the situation. It is therefor necessary to develop long-term policies based on the principle of sustainability and multiple use of resources. These should preferably not be based upon subsidies.

One of the main challenges for conservation management is to maintain viable agrarian landscapes so that their associated high cultural and biodiversity values are protected against modern trends of economic growth. Extensive cattle systems provide the best way to utilise marginal land but the ideal solution for the problem has yet to be achieved.

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References
Beaufoy G. 1995, The nature of Farming. Low Intensity Farming Systems in Nine European Countries. WWF, IEEP London and Joint Nature Conservation Committee (Eds.) U.K.

Campos, P., 1994, Economia de los espacios naturales. El valor económico total de las dehesas ibéricas. Agricultura y Sociedad, 71: 243-256.

Caro Baroja, J., 1986, España Antigua. Conocimiento y fantasía. Istmo.

Connell, J.H., 1979, Tropical rain forests and coral reefs as open non-equilibrium systems. In: Anderson, R.M., Turner, B. & Taylor, L.R. (Eds.): Population Dynamics: 141-163. Blackwell, Oxford.

De Miguel, J.M. & Gómez Sal, A., in press, Diversidad y funcionalidad de los paisajes agrarios tradicionales en España. En : La diversidad biológica en España . Pineda, F.D., De Miguel, J.M., Casado , M.A. y Montalvo, J. (Eds.) CYTED.

De Miguel, J.M., Rodríguez, M.A, & Gómez Sal, A., 1997, Determination of animal behaviour-environment relationships by correspondence analysis. J. Range Manage., 50(1): 85-93.

FEPMA, 1996, Documentación, análisis y diagnóstico del estrado de la red nacional de vías pecuarias. Prog. Life 94. Ed. El Viso, Madrid.

Gómez Sal, A. & Rodríguez Pascual, M., 1992, La montaña de León, Cuadernos de la Trashumancia, 3. ICONA .
Gómez Sal, A., 1992, Livestock free-ranging behaviour as a tool in modelling silvopastoral systems. In: De Jong, R., Nolan, J. and Van Bruchen (Eds.), Natural resource development and utilization. CEC and Wageningen University.

Gómez Sal, A., 1994, The rural landscapes of Northern Spain. Landscape Issues, 11(1):5-12.

Gómez Sal, A., 1995, El paisaje agrario desde la perspectiva de la ecología. En: Agricultura y Ecología Fundación Bancaixa. Valencia. 145-182.

Gómez Sal, A., 1998, Relationships between ecological and socio-economical evaluations of grazing in Mediterranean ecosystems. In: Ecological basis of livestock grazing in Mediterranean ecosystems. Papanastasis, V.P. & Peter, D. (Eds.) European Commission. 1998. 275-286.

Gómez Sal, A., 2000a, Las razas de ganado autóctono en la conservación de la naturaleza. En: Manual del técnico en medio ambiente natural. Rodríguez , F. et al., Colegio de veterinarios de Ourense , 61-69 pp.

Gómez Sal. A., 2000b, The variability of Mediterranean climate as an ecological condition of livestock production systems. In: Livestock Production and climatic uncertainty in the Mediterranean. F. Guessous, N. Rihani & Iíham, A. (Eds.). EAAP publication Nº 94. Wageningen. 3-12 pp.

González-Bernáldez, F., 1991a, La dehesa como sistema de uso múltiple. In: Junta d Andalucía. Curso: El uso múltiple del territorio. Sistemas agrosilvopastorales. Departamento de Producción Animal, Pastos y Forrajes. CIDA. Córdoba.

González Bemáldez, F.G., 1991b, Diversidad biológica, gestión de ecosistemas y nuevas políticas agrarias. En: Pineda, F.D., Casado, M, De Muguel,J.M. & Montalvo, J. (Eds). Diversidad Biológica/Biológical Diversity: 23-32. SCOPE-WWF-F.Areces, Madrid.

González Bemáldez, 1995, Western Mediterranean land-use systems as antecedent for the semiarid America. In: Global Land Use Change. A perspective from the Columbian Encounter. Turner, B.L., Gómez Sal, A., González Bemáldez, F. and di Castri, F. (Eds.) CSIC. Madrid. 131-151

Klein, J., 1919, The Mesta. Versión española de Alianza Universidad Madrid, 1979, Madrid.

Milchunas, D.G., Sala, O.E. & Lauenroth, W.K., 1988, A generalized model of the effects of grazing by large herbivores on grassland community structure. Am.Nat. 132:87-106.

Montserrat, P. & Fillat, F., 1990, The systems of grassland management in Spain. In: Managed Grasslands. A. Breymeyer (ed). Elsevier, Amsterdam.

Naveh, Z., 1991, Biodiversity and ecological heterogeneity of Mediterranean uplands. Linea Ecologica, 4: 47-60.

Pineda, F.D. & Montalvo, J., 1995, Dehesa systems in the western Mediterranean. pp.118-122. In: Halladay, P. & Gilmour, D.A. (Eds.): Conserving Biodiversity Outside Protected Areas. IUCN, Gland.

Pineda, F.D., Nicolás, J.P., Ruiz, M., Peco, B. & González-Bernáldez, F., 1981, Succession, diversité et amplitude de niche. Adv. Veget. Sci. 4: 267-277.

Rebollo, S. & Gómez Sal, A., 1988, Recent changes in transhumance systems: effects on mountain pastures management and conservation. In: Ecological basis of livestock grazing in Mediterranean ecosystems. Papanastasis, V.P. & Peter, D.(Eds.) European Commission. 1998. 312-317p

Rebollo, S., Robles, L. & Gómez Sal, A., 1993, The influence of livestock management on land use competition between domestic and wild ungulates: sheep and chamois *Rupicapra* pyrenaica parva Cabrera in the Cantabrian Range. Pirineos, 141-142: 47-62.

Ruiz, J.P.& Ruiz, M., 1986, Ecological history of transhumance in Spain. Biological Conservation, 37: 73-86.

Examples of traditional management patterns in central Spain.

Plate 1. Sierra de Gredos, Ávila, central Spain. A high mountain majadal, with acidic grassland, with emergent granitic rocks, heavily grazed mainly by Ávila and mixed breed cattle, but also by sheep. In the background are extensive broomfields, mainly of Cytisus purgens, interspersed with grazed and cut areas.

Plate 2. Sierra de Gredos, Ávila, central Spain. Dehesa *with ash (Fraxinus angustifolia), consisting of pollarded trees, beneath which there is intensively grazed grassland with many annual species and with a high biodiversity. The sward is mainly grazed by cattle of mixed breeds, but also by goats. The young branches are cut with the leaves on and fed to stock.*

Plate 3. Sierra de Gredos, Comunidad de Madrid, central Spain. A mixture of overgrown and well managed vinyards, showing the effect of abandonment. The background shows patches of scrub (matorral) *and woodland between the vineyards, and is an example of the complex mosaics which make up these landscapes.*

Examples of **cañadas** *and transhumance*

Plate 4. León, northwestern Spain. A royal drove road (cañada real) *in the western part of León, fringed by forest with transhumance taking place, involving a flock of sheep driven by a shepherd.*

Plate 5. León, northwestern Spain. A royal drove road (cañada real) *in the eastern part of León. The left hand flock consists of Merino sheep involved with transhumance. The right hand flock consists of Churras sheep, belonging to the local area.*

Plate 6. Aragón, northeastern Spain. Tensinas sheep undergoing transhumance in cabañeras *of Aragón, between the dry plains of the Ebro and the Cordillera Pirenaica.*

Two examples of transhumance and a sensitive plant species

Plate 7. León, northwestern Spain. Transhumance in the neighborhood of one of the puertos *in León.*

Plate 8. León, northwestern Spain. Merino *sheep gathered into a corral in a puerto in León.*

Plate 9. Ornithogalum umbellatum, a small vernal species that is dependent upon grazing to stop the development of scrub (matorral)

The application of a European Union classification of dairy systems to Denmark

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Introduction

This paper explores the possibilities for classifying Danish land dependent livestock enterprises, using dairy systems as an example. The main aim is to establish a classification that can be used for analysis of the environmental impact of changes in livestock policies. The possibilities of the inclusion of the economic and social effects of policy changes will be explored at a later stage. The paper begins with a classification of the farms in two small samples of dairy units in Denmark, following the land use-based classification constructed in the project carried for the European union (EU) by the Centre for European and Agricultural studies (CEAS) and The European Forum on Nature Conservation and Pastoralism (EFNCP) in 2000 (see Bignal, this volume). A short description of the different dairy systems is then provided before the usability of the classification is tested and assessed by exploring the natural capital, environmental pressure and policy adoption of the classified systems. Finally, the location of the different systems in Denmark is described.

A classification of Danish dairy systems

The classification of dairy systems suggested by CEAS and EFNCP has been tested on two different samples of Danish dairy farms. In the first case, a sample of 73 dairy farms was collected to explore the environmental effects of EU headage payments (Andersen et al., 2000). The second case was based on publicly available information from a sample of 31 dairy farms collected by the Danish Agricultural Advisory Centre for various research and advisory purposes (Landbrugets rådgivningscenter, 2000).

In these samples the farms fall into four categories from CEAS and EFNCP:
(a) conventional mixed
(b) organic mixed and low input
(c) silage maize
(d) Mediterranean commercial.

The first criterion applied in the classification was that the cows had to be at pasture for more or less than three months. Neither the samples used here, nor those available from other data sets, include information on grazing days. Instead, the farms have been classified into groups with or without grassland in rotation. Effectively, this splits up Danish farms into zero grazing systems and those where the dairy cows are at pasture. If the dairy cows are on grass, grazing periods of less than three months are rare. Furthermore, the oldest heifers on the dairy farms normally are grazed on permanent pastures.

In the farms where the cows are at pasture for more than three months, none of the units in the two samples had less than 50% of their Utilised Agricultural Area (UAA) in crops. However, some of the farms had between 25 and 60% of the area with crops in maize and are thus classified as silage maize, M1 in the CEAS and EFNCP typology. Because the rest of the crop based farms all have more than ten cows, they fall into the categories conventional mixed (CG1) and organic mixed and low input (CG2); the stocking rate and the milk yield then become the discriminating factor. Milk yield is generally not available in the larger agricultural data sets or in the sets used here. Furthermore, the milk yields suggested by CEAS and EFNCP, that is 5,000 to 6,000 or 4,500 to 5,500, are too low for Danish dairy farms, which have an average milk yield of more than 7,000 kg/year (Danmarks Statistik, 1999). Data on stocking rates can be calculated for the two samples used in this paper in Livestock Units (LU) per ha of UAA. It is however difficult to point to a certain threshold value, as shown in Figure 1. CEAS and EFNCP suggest 1.25 to 2.25 for conventional systems or 0.8 to 1.4 for low input and organic systems. For this papers a threshold value of 1.4 LU/ ha UAA was selected.

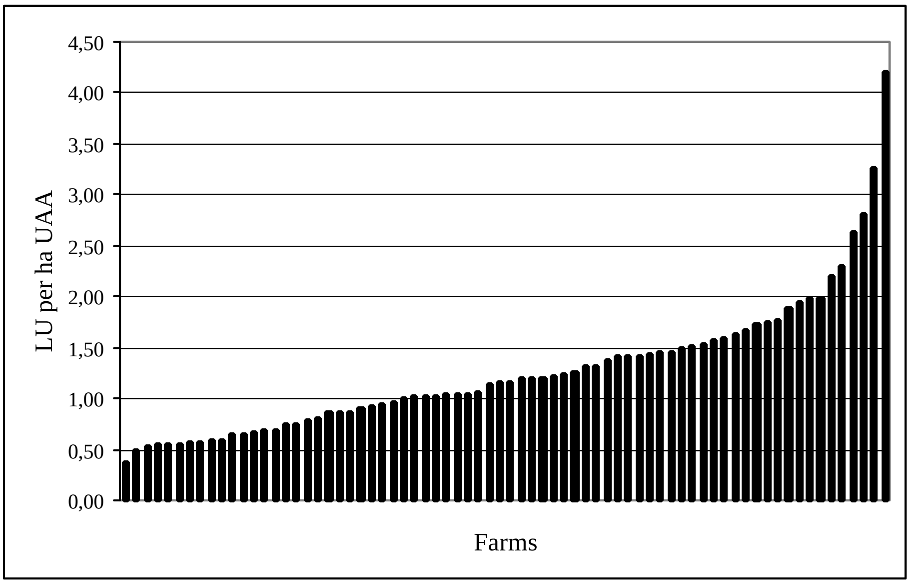

Figure 1. Stocking rates of the 73 farms in the first sample

In farms where the cows are at pasture for less than three months, there are no farms in the two samples that have more than 100 cows, and fodder is produced on the farm. The herd size of these farms is normally between 40 to 70 cows and milk yields 6,000 to over 8,000 kg/year. These farms are therefore categorised as Mediterranean commercial (L2) according to the CEAS and EFNCP typology. This might reflect a special Danish situation with many medium sized herds and a high degree of production of fodder on farm. As the farms are zero grazing systems, they do however differ from the three other categories present in the samples.

Table 1 shows the results of the categorisation used on the two samples. As it can be seen, there are some differences between the two samples. In both samples the most common systems are the crop based mixed systems, but the distribution between conventional and organic mixed and low input systems varies considerably. Also, for the two other systems the share of the farms varies. Silage maize does not occur at all in sample 2, and Mediterranean commercial occurs three times as often in the one sample as in the other.

Table 1. Distribution of the dairy systems in the two samples (%)

	Percentage of farms Sample 1	Percentage of farms Sample 2
Conventional mixed	23	54
Organic mixed and low input	54	39
Silage maize	5	0
Mediterranean commercial	18	6

There are three problems concerning the categorisation. Firstly, the definitions of LU, cows and herds, as well as the area of pastures, crops and forage need to be clear. Size-classes and stocking rates can be derived from these data. Secondly, the usefulness of new variables to discriminate between some of the categories should be investigated. In the two Danish examples it is difficult to argue that the discrimination between conventional and organic/low input systems should be exactly 1.4 LU per ha UAA, so that another discriminator could be considered. Thirdly, the classification of some of the farms in both samples as Mediterranean commercial calls for a change, because this term is not appropriate for Danish farms. The term small scale industrial, is therefore proposed for these farms, and will be used in the rest of this paper.

Description of Danish dairy systems

This section gives a short description of the four dairy systems identified above. Key variables for all systems are shown in Table 2.

The conventional mixed system is a traditional type based on a relatively high proportion of grass and roughage. The average size of the farms are small being only 35 ha, whereas the size of the herd is medium compared to the other systems. As a consequence, the average livestock density is highest for this system. The other traditional system is the small-scale industrial class, based on utilising on farm production of cereals. The average size of these farms is somewhat higher than for the conventional mixed system, which together with the medium size herd gives a slightly lower livestock density. The two other systems in Denmark are more modern, one of them being relatively intensive, the other being more extensive. The organic and low input mixed systems are the most extensive, with the lowest livestock density with a medium sized herd and an area above average. The land use places the system in between the conventional mixed and the small scale industrial with medium sized shares of grass and fodder. Finally, taking account of the small size of the sample, the silage maize class has larger farms and bigger herds than the other classes. For all the systems the range in the value of the different variables shows much variation and there is also a degree of overlap between the classes. Further analysis of larger samples and statistical tests are therefore required for better differentiation.

Table 2. Main characteristics of the dairy systems (based on sample 1). Livestock Units (LU), Utilised Agricultural Area (UAA).

	Conventional mixed	Organic and low input mixed	Silage maize	Small scale industrial
Average LU	65	54	119	62
Range	16-198	10-133	40-313	8-146
Average UAA (ha)	35	63	79	45
Range	11-75	13-152	23-192	2-102
Grass % of UAA	41	32	21	16
Range	15-78	5-62	17-31	0-75
Fodder % of UAA	73	53	76	32
Range	26-100	13-100	56-94	6-75
Average LU/UAA	1.9	0,9	1,5	1,6
Range	1.4-3.3	0.4-1.3	0.9-1.9	0.6-4.2

The usability and relevance of the classification.

In order to make a preliminary assessment of the relevance of the classification, three categories of environmental impact assessment issues related to livestock systems were considered. The analysis of (a) and (c) was based on the 73 farms from the first sample, and (b) from the 31 farms from the second sample.

(a) Natural capital

The proportion of grassland that is permanent grassland is the first measure, followed by the share of that category which is natural grassland, which is unploughed and without application of fertilisers. More than 90% of all permanent grassland in Denmark is under protection by the Nature Protection Act and is a major target of the nature conservation policy. More than two thirds of all dairy farms in Denmark have permanent grassland and farms with dairy cattle therefore involve the management of almost half of the area with permanent grassland, according to the experience of the author. The management of grassland on the dairy farms can therefore be used to test the relevance of the classification of farms suggested above.

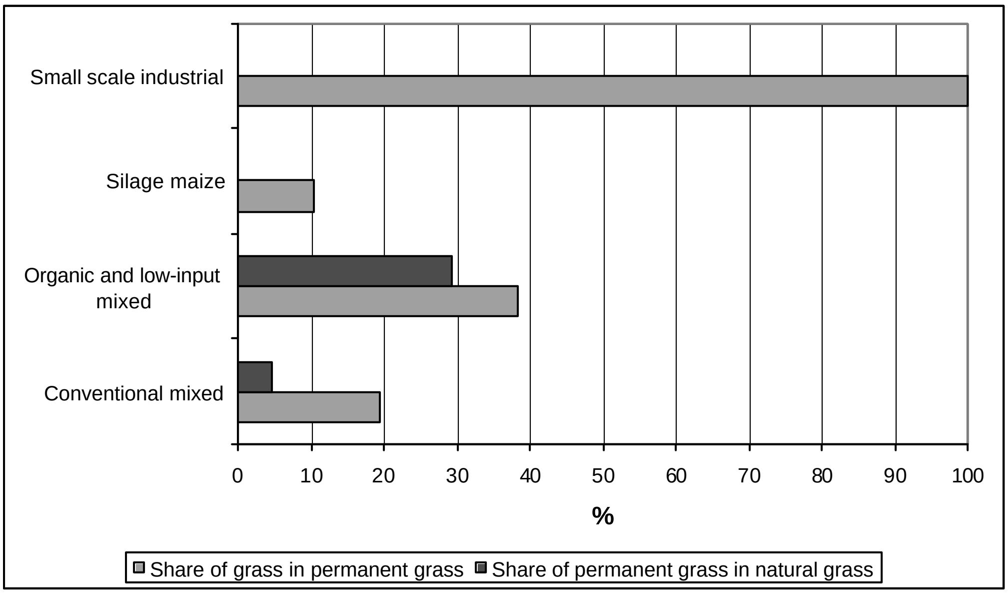

Figure 2. The distribution of permanent grassland and natural grassland in the dairy systems

As can be seen from Figure 2, the proportion of grassland as permanent pasture varies between the different systems. Small-scale industrial systems show the highest figure, due to the definition used for zero-grazing systems. For the other systems the organic and low input mixed have the largest proportion of grassland as permanent grass. Natural grassland is only found on mixed farms, with a clearly higher share of the permanent grass on the organic and low input farms. These results indicate that the mixed systems, and especially the organic and low input systems, manage their grassland resources less intensively than the other systems, which provides a benefit for the environment.

(b) Environmental pressure

The calculation of nitrate-surplus gives a good indication of the loss of nutrients from farms to the environment (Brouwer & Hellegers, 1997). The analysis of nitrate-surplus is based on the second sample of farms and is therefore lacking results for silage maize systems. As is shown in Figure 3, the conventional mixed systems presents the highest nitrate-surplus with more than 250 kg/ha/year. Compared to this the organic and low-input mixed systems only have an average nitrate-surplus of less than 150 kg. The small-scale industrial systems are placed in between the two mixed systems with about 185 kg/ha/year.

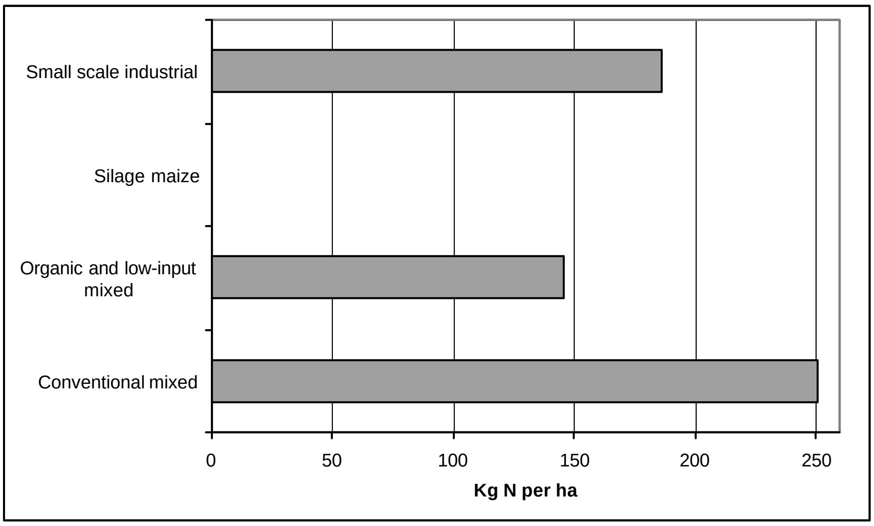

Figure 3. Average nitrate-surplus on the dairy systems (kg N/ha/year)

(c) Policy adoption

The proportion of farms with husbandry eligible for livestock premiums is used to assess the differences between the systems in regard to their response to policy changes. Beef production in Denmark is to a high degree integrated with the production of milk, giving special problems for the dairy farms in relation to the support for beef production (Andersen et al., 2000). In sample 1 information was available on the distribution of the headage payment under the reformed livestock support of 1992.

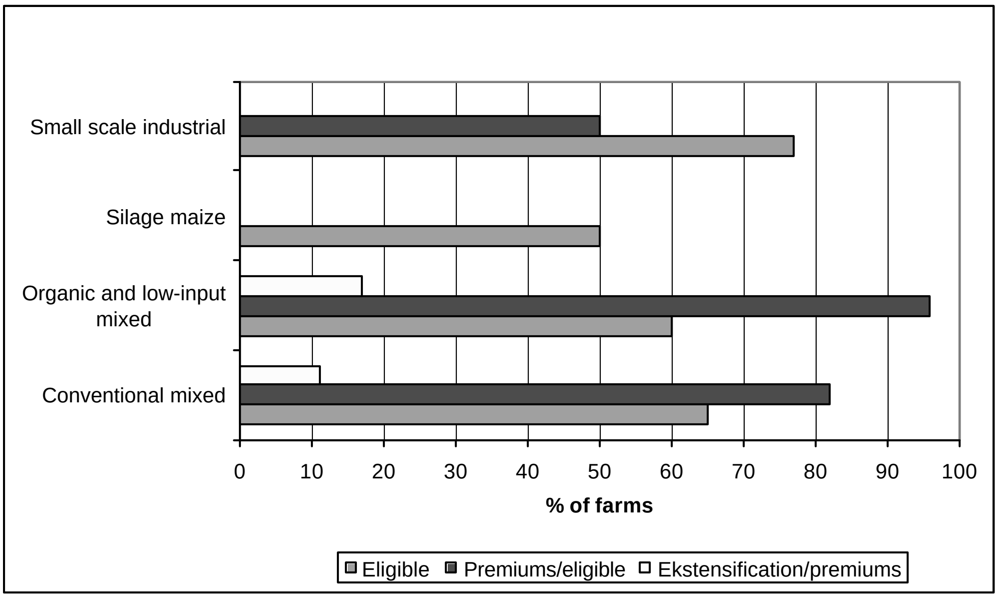

Figure 4. Distribution of livestock premiums on dairy systems. Eligible = the share of farms with eligible animals; premiums/eligible = the share of farms with eligible animals actually receiving premiums; extensification/premiums = the share of the farms receiving premiums that also receives extensification supplement.

As can be seen from Figure 4, the systems do not differ widely in relation to the proportion of farms with eligible husbandry (suckler cows, young bulls and bullocks), compared to differences in the distribution of the premiums. None of the silage maize farms receive any payments, whereas almost all-organic or low input mixed farms receive premiums. Furthermore, only the mixed systems receive extensification premiums, probably because these farms are the only ones that fulfil the required stocking rate. One the one hand this shows that the different systems react differently towards a uniform measure such as the headage payments, but on the other hand it reveals a potential for implementing policies differentiated according to the systems described in the present paper.

Distribution of systems in Denmark

In Figure 5, the location and type of system of sample 1 farms are shown. The general picture is that the different dairy systems occur together in most part of the country although some concentrations of types are shown, eg. the organic and low input system in the south of the mainland. In addition, although only a small number of silage maize systems were included in the sample, these are only located in coastal areas. Denmark is on the northern border of economically feasible maize growing, so the milder climate in the coastal areas might be the reason for this pattern. Small-scale industrial systems in the sample are concentrated in mid-Jutland and on the islands. Organic and low input mixed farms are located throughout the country, whereas the conventional systems are more concentrated in mid-Jutland and on the island of Funen.

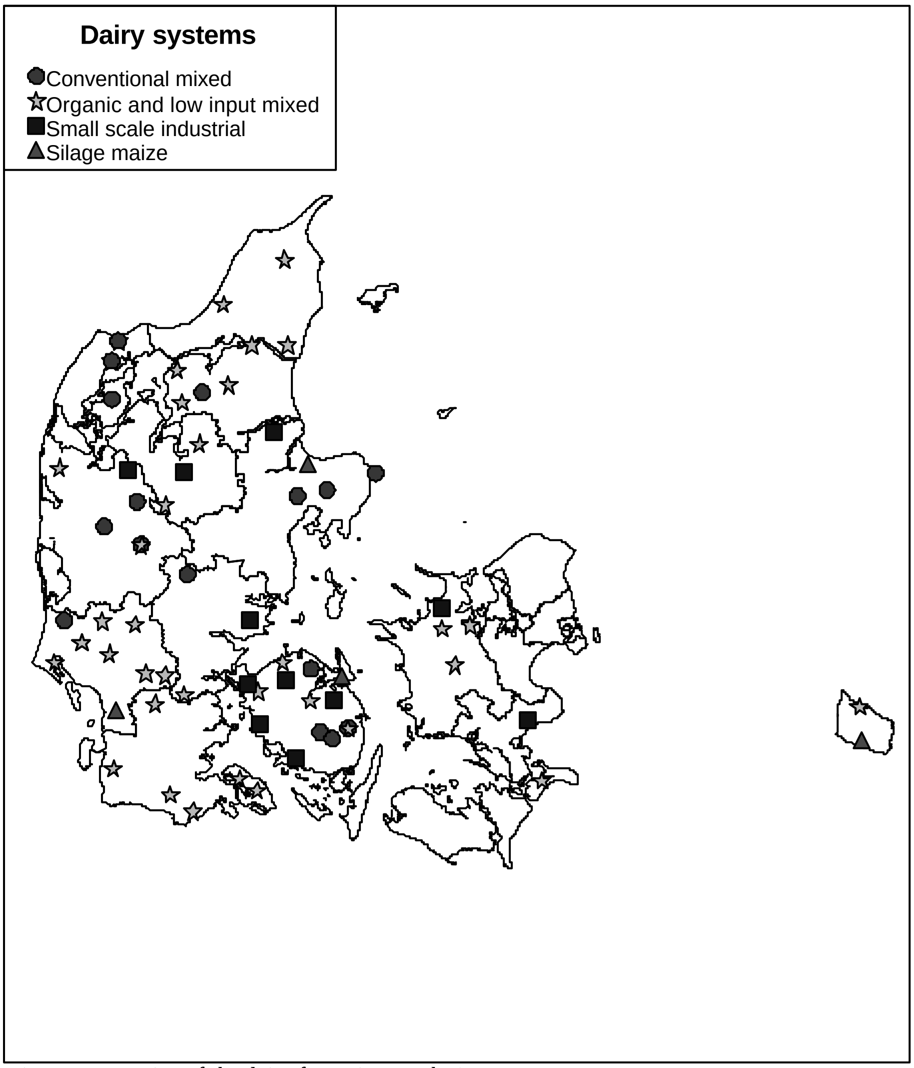

Figure 5. Location of the dairy farms in sample 1

Data on land use and husbandry are available in Denmark from the Integrated Administration and Control System (IACS) constructed for the administration of the Common Agricultural Policy. Rules can therefore be applied that use only land use and husbandry data, enabling the classification of all livestock farms in Denmark. Furthermore, the integrated system provides the possibility to place the individual farm spatially and determine distribution patterns. This can be done based on the so-called block-map, a map covering all agricultural land in Denmark. The block map is based on stable borders in the landscape and consists of blocks of an average size of eight ha and with a maximum of about ten fields. The land within one block can however be managed by more than one farmer, which means that the individual farm cannot always be mapped precisely.

Conclusions

The small exercise described in this paper provides only indications of the feasibility of working with the CEAS dairy systems and the following conclusions may be drawn.

(a) It is possible to fit the Danish dairy farms into the CEAS and EFNCP typology. However, lack of data and the sensitivity of some of the threshold values need to be explored further. Some farms were classified as Mediterranean commercial in the typology, but were actually better described as small-scale industrial.
(b) The analysis of the different dairy systems showed differences between them regarding natural capital, environmental pressure and adoption to policies. This indicates that it is relevant to use the classification for assessing and shaping policies on nature and the environment.
(c) The analysis of the distribution patterns shows no exact match between systems and specific regions, but some regional patterns are present.
(d) The relationship between the CEAS and EFNCP typology and the typologies used in the agricultural censuses (Farm Structural Surveys) and the economic agricultural statistics Farm Accountancy Data Network (FADN) needs to be explored further. For example is the CEAS and EFNCP typology a supplement or an alternative to these typologies? Do the more fine-scale approach of the CEAS and EFNCP typology fit hierarchically with the other typologies?
(e) The exercise described here shows that a typology based on land use and management, could be useful in the assessment of the environmental impact of livestock policies.

References

Andersen, E., Rutherford, A. & Winter, M., 2000, The beef regime: In Brouwer, F. and Lowe, P. (Eds): CAP regimes and the environment. CAB International, Wallingford.

Brouwer, F. & Hellegers, P., 1997, Nitrogen Flows at Farm Level Across European Union Agriculture. In Romstad, E., Simoinsen, J. and Vatn, A., (Eds): Controlling Mineral Emissions in European Agriculture: Economics, Policies and the Environment. CAB International: Wallingford.

CEAS and EFNCP, 2000, The environmental impact of dairy production in the EU: practical options for the improvement of the environmental impact. Final report for DGXI. Centre for European Agricultural Studies and The European Forum on Nature Conservation and Pastoralism.

Danmarks Statistik, 1999, Landbrugsstatistik 1999. København.

Landbrugets rådgivningscenter, 2000, Information downloaded from www.lr.dk, June 2000.

A European Union classification of dairy systems

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Introduction

The assessment and development of economic, social or environmental measures aimed at influencing the management decisions of farmers in the livestock production sectors needs a definition of the range of variation of farm types. With such knowledge (a typology) it is possible to model the systems within the sector, identify where they are and predict how they will respond to pressures or incentives. It should also be possible to prioritise, target and refine the most appropriate actions (whether these are constraints or incentives). In 1999 the Centre for European Agricultural Studies (CEAS) and the European Forum on Nature Conservation and Pastoralism (EFNCP) carried out a study for The Environment Directorate of the European Union (EU), which addressed some of these issues in relation to the environmental impact of dairy production in the EU. The aim of the study was to identify some practical options for the improvement of the environmental impact of the dairy sector.

However, at a European level, appraisal and evaluation of this kind are severely constrained by availability of suitable data and a lack of typologies and models of farming systems from an environmental perspective. Whilst there are existing typologies of farming systems these are not adequate for environmental purposes. Policy is applied in the livestock sector, mainly using simple distinctions between production systems based on crude thresholds, such as the number of livestock units or number of hectares.

The Agenda 2000 reforms, which introduce a further shift in emphasis of the Common Agricultural Policy (CAP) from production to broader rural objectives, make the need for typologies of livestock systems urgent. For example, in the Rural Development Regulation (1257/1999) the scope and objectives specifically mention the promotion of sustainable farming systems and the maintenance and promotion of low-input farming systems. To be successful these new, wide-ranging policies, must be clearly targeted at the production systems they are designed for.

In this desk study the method involved cross-tabulating categories of production and bio-geographical region with fodder and forage resources (land use categories) to produce 12 dairy systems which describe all EU dairy farms. The systems are differentiated by reference to threshold values of agricultural indicators such as fertiliser use, concentrate use, farm size, herd size, milk yield, livestock density and main winter fodder. A dendrogram was developed to show the linkages between them and a profile of each system provides descriptions of the management objectives, location, farm structures and forage resources, animal system and feeding system. For each system the number/share of EU dairy cows and milk production has been estimated. In the main report the systems have been grouped according to predicted environmental impact; as a result it is estimated that ecologically valuable systems account for only 6% and 8% respectively of EU milk production and dairy cows.

The typology produced in the CEAS / EFNCP Research

A variety of potential approaches to grouping European dairy farms are outlined in the main report. However, for the purposes of relating groups of similar farms in relation to the environment, the Environment Directorate stipulated a number of conditions for this work. These may be summarised as follows:

(a) groups should be relatively stable ie. that there should be greater variation between groups than within
(b) they should be broad enough to apply to a large number of farms over extensive areas
(c) they should be capable of being easily differentiated by a small numbers of indicators
(d) they should be clearly related to the bio-geographical regions and to environmental impacts.

In practice there are a variety of regional descriptions of dairy farms in Europe which can be used to form the basis for a classification structure and which do meet the above conditions. However, some of the parameters used in these studies are not reflected in the variables collected as data for both EU and national objectives.
On the other hand when considered only from a biological and a landscape viewpoint, probably the best initial discriminator between different types of dairy farms is in the management of the grazing land and cultivated land involving both forage and fodder resources. It is therefore possible to define a small number of categories of land-use that reflect the proportion of the farm under broad types of pasture and crops, and with the following management practices:

(a) Semi-natural pastures:
Semi-natural pastures form over 80% of the forage area and include a variety of vegetation types from grassland, heath, scrub and woodland. Winter fodder is predominantly on-farm produced hay, silage and some cereals. Traditional, locally adapted regional breeds are used, often involving short or long distance transhumance to the summer pastures. Crops are grown in different locations to the pastures.

(b) Grasslands:
i Ley (sown) grassland dairy farms
Maximum use is made of rotational and permanent grasslands to provide both winter fodder and summer forage. Crops (barley, maize, fodder beet or lucerne, depending on locality) represent less than 40% of the Utilised Agricultural Area (UAA). Maize is increasingly being grown for silage but over 60% of the UAA is forage composed of rotational grassland.

ii Permanent grassland dairy farms
Permanent grassland accounts for 80-100% of the Main Fodder Area (MFA). Little if any cereals are grown and then only for on-farm consumption.

(c) Cereals and grains 1: maize
At least between 25% and 60% of the MFA is used to grow maize in association with grass. Over 80% of the UAA is suitable for ploughing and the cultivated land not used for growing maize or cereals is under grass, with swards based on rye grass (*Lolium perenne*). In some areas maize cultivation exceeds 60% of the MFA.

(d) Cereals and grain 2: mixed cropping
Many of the northern European dairy farms, ie. in the United Kingdom UK, The Netherlands, Denmark and Sweden, combine grasslands with a variety of arable crops to provide grain and arable silage. There are strong regional differences in crops, reflecting soils and climate. For example, in Denmark, a typical combination on a conventional dairy farm would be 12% permanent pasture, 26% rotational grass/lucerne, 10% fodder beet, 16% whole crop silage, 32% grain for harvest and 3% cash crops (Halberg et al., 1997). In southern Europe, ie. in Greece, Spain, Portugal and Italy, small family enterprises with low yielding cows (grazed for only three months in spring and early summer) cultivate a wide variety of fodder crops which are cut and fed to the cows by hand.

(e) Limited grazing farms
These include two types of dairy enterprise at different ends of the spectrum. However, in both, the cows spend most of their time housed. In the north and east large dairy herds are involved with up to 500 milking cows which may be permanently housed. They are high yielding cows fed concentrates, maize or lucerne silage. In the south it includes many of the commercial Mediterranean dairy farms, in Italy and more recently in Greece and southern Portugal, where cows are permanently housed and fed concentrates and purchased fodder (eg. maize silage, alfalfa hay and straw).

The distinctions between categories (a) to (e) above are shown in Table 1. The boundaries between them are not rigid and there is overlap between farm types and the regions where they occur. However, the classes do reflect the key differences in the impact on the character of the land made by dairy farming.

Table 1. Main forage and fodder resources
Utilised Agricultural Area (UAA) = the farm area (crops and grazing); Main Fodder Area (MFA) = fodder crops including grass

Semi-natural pastures	Natural pasture 80%+ of forage area Winter fodder mostly hay or silage (little grain)
Permanent grassland	80-100% of MFA is permanent grassland Virtually no cereals grown
Ley grassland	60%+ of UAA is rotational grassland Less than 40% of UAA is under crops
Maize	At least 25-60% of MFA is maize with the remainder based on rotational ryegrass Over 80% of UAA is cultivated
Mixed cropping	50%+ of UAA is arable crops for grain or silage Wide variation in crops grown
Zero grazing	Forage area virtually zero Fodder production variable depending on region

These categories however only describe one dimension of dairy farms; to produce the typology it was necessary to add to them two other dimensions – production intensity and the region.

Accordingly, the forage and fodder resources have been combined with production intensity and biogeographical region to produce a typology into which all EU dairy farms can be allocated. The classes can be regarded as the “EU dairy systems” and these are shown in Table 2.

Table 2. EU dairy systems. See Table 2 for typical threshold values for indicators of each system

		FODDER AND FORAGE RESOURCES (LAND USE CATEGORIES)				
CATEGORIES OF PRODUCTION AND REGIONS		***SEMI-NATURAL PASTURES***	***GRASSLANDS***	***CROPS & GRAIN MIXED***	***CROPS & GRAIN MAIZE***	***LIMITED GRAZING***
CONTINENTAL ATLANTIC BOREAL MACARONESIAN	***HIGH INPUT/OUTPUT***		**G1** INTENSIVE GRASSLAND SYSTEMS (LEYS) GRASS 60% + CROPS	**CG1** CONVENTIONAL MIXED SYSTEMS CROPS 50%+	**M1** INTENSIVE MAIZE SILAGE SYSTEMS MFA = Maize 25%-60% CROPS 50%+	**L1** INDUSTRIAL
	LOW INPUT/OUTPUT		**G2** PERMANENT GRASSLAND SYSTEMS (Lowland) GRASS 80%-100%	**CG2** LOW-INPUT AND ORGANIC MIXED SYSTEMS		
ALPINE AND BOREAL	***LOW INPUT/OUTPUT***	**P1** TRANSHUMANT SYSTEMS	**G3** PERMANENT GRASSLAND SYSTEMS (Mountain) GRASS 80-100%			NOT DESCRIBED (TOO SMALL)
MEDITERRANEAN	***HIGH INPUT/OUTPUT***					
	LOW INPUT/OUTPUT			**CG3** MEDITERRANEAN MIXED SYSTEMS (SMALL SCALE)		**L2** MEDITERRANEAN COMMERCIAL SYSTEMS

In Table 2 not all of the intersecting boxes produce combinations that can be regarded as a system. For example, high input/output does not occur with semi-natural pastures, nor does maize cultivation combine with Alpine or Boreal dairy farms. However, there are 10 combinations, which do describe systems into which most of EU dairy farms can be allocated. It is possible to technically identify two more classes, L1 and CG2, but the number of farms within them is too low to allow detailed descriptions to be made at present. They may assume greater importance in the future.

Although these systems are not derived in a strictly objective way, they can be characterised quantitatively as well as by description and it is possible to differentiate the systems by reference to threshold values of some key indicators where data exists as shown in Table 3. These are further expanded in Table 3 below to provide a profile of each system. Selected indicators can also be used produce the dendrogram, as shown in Figure 1, which can then be used to allocate any EU dairy farm to one of the systems.

The three rows at the bottom of Table 3 show in which biogeographical region the systems occur and give an estimate of the proportion of dairy cows and milk production.
In the main report the systems were then used as a framework for describing the main trends and environmental issues in EU dairy systems under the heading of soil, water, air, biodiversity and landscape and habitats. Finally the same structure is used to suggest practical options for delivering good agricultural (and environmental) practice and environmental enhancement focusing on the main issues, the options, benefits, costs and policy mechanisms available.

Table 3. EU Dairy systems: Typical threshold values for indicators of each system

		PRINCIPAL EU DAIRY SYSTEMS				
		P1	***G1***	***G2***	***G3***	***CG1***
INDICATOR	***NAME OF SYSTEM***	**TRANSHUMANT**	**INTENSIVE GRASSLAND (Leys)**	**PERMANENT GRASSLAND (Lowland)**	**PERMANENT GRASSLAND (Mountain)**	**CONVENTIONAL MIXED**
	FERTILIZER USE KgN/ha/year	Very low mineral + manure	100-150 (Fr) 150-350 (UK+NL)	50–100 (up to 200 in the UK)	40-80	150–230
	MAIN WINTER FODDER (IN ORDER)	Hay	Grass silage/cereals	Grass silage/hay/cereals	Hay/grass silage	Grass and arable silage/cereals/beet
	CONCENTRATES FED kg/cow/year	500-1,000	1,000–1,200 (Fr) 1,600–3,000 (UK)	100–2,000	800-1,500	1,000-2,000 (including grain)
	FARM SIZE UAA (ha)	10–30 in valley 100–500 in mountain	70–140 (UK) Others 20-60	20–80 more in the UK 100-140 on collectives in FR	30–50	50–70 (Dk) 60-90 (D), more in UK
	AVERAGE HERD SIZE	5-150 (av. 20)	30-60 (Fr), 30 (Sw/Fin) 55-200 (UK)	30–100	25–45	40–60 (Dk) 80-200 (UK)
	BREED (most common)	Regional	Holstein-Friesian	Holstein-Friesian	Red & White, Regional And Dual Purpose	Holstein-Friesian
	MILK YIELD Litres/cow/year	3,000-4,000	6,000–8,000 (UK/Sw)	4,000-6,000 7,500 (UK)	4,000–5,500	5,000–8,000
	LIVESTOCK DENSITY LU/ha	Traditionally <1.0 but increasing	1.4–2.0	0.6–1.4 (1.9 Ire)	0.4–1.4 most <1.2	1.25–2.25
	MAIN LOCATIONS	Alps, Pyrenees, Cantabrian	UK, Brittany, NL, Sweden & Finland	Normandy & Ireland	Mt. Foothills & plateaux France & Germany (Bavaria) Boreal	Denmark UK, German Old Länder
	BIO-GEOGRAPHICAL REGIONS	Alpine	Atlantic, Boreal, Continental, Macaronesian	Atlantic	Alpine, Boreal, Continental	Atlantic, Continental
	NUMBER/SHARE OF DAIRY COWS ('000s)	150 (1%)	13,863 (62%)	1,239 (6%)	1,112 (5%)	2,063 (9%)
	NUMBER/SHARE MILK PRODUCTION ('000 tonnes)	695 (1%)	71,791 (64%)	5,392 (5%)	4,537 (4%)	11,097 (10%)

Table 3 (continued)

		PRINCIPAL EU DAIRY SYSTEMS				
		CG2	***CG3***	***M1***	***L1***	***L2***
INDICATOR	***NAME OF SYSTEM***	**LOW-INPUT & ORGANIC MIXED**	**MEDITERRANEAN MIXED (SMALL-SCALE)**	**INTENSIVE MAIZE SILAGE**	**INDUSTRIAL**	**MEDITERRANEAN COMMERCIAL**
	FERTILIZER USE KgN/ha/year	<170 (no mineral)	None	120–150 (Fr)	-	No data
	MAIN WINTER FODDER (in order)	Grass silage & arable/hay/cereals/beet	Cereals/dryland rye grass silage and hay	Maize silage	Maize silage and bi-products	Maize silage/rye grass silage
	CONCENTRATES FED kg/cow/year	500 and cereals (1,000)	300-600	1,300-1,800	c.2,000+	2,000+ 3,000 (Italy)
	FARM SIZE UAA (ha)	50 (Dk)	No data (very small)	30-35	Detached from land	20
	AV. HERD SIZE	50-60	1–10	25-35	100-500	50-60
	BREED (Most common)	Jersey, Guernsey Red & Whites	Wide variety	Holstein-Friesian 80%	Holstein-Friesian	Holstein-Friesian
	MILK YIELD Kg/cow/year	4,500-5,500 (7,000) organic	2,000-3,000	7,000–8,000	Est. c. 9,000+	6,000-8,000 6,000 (Gr)
	LIVESTOCK UNITS LU/ha	0.8–1.4	1-0	1.7–2.2 (Fr)	Zero grazing	Zero grazing
	MAIN LOCATIONS	Denmark UK	Portugal Greece S. Italy S. Spain	Brittany & Basse-Normandie, N.Italy, Germany(Rhine valley)	New Länder N. European lowlands (NL and UK)	Spain, Portugal, Italy
	BIO-GEOGRAPHICAL REGIONS	Atlantic, Continental	Mediterranean	Atlantic, Continental	Atlantic, Continental	Mediterranean
	NUMBER/SHARE OF DAIRY COWS ('000s)	674 (3%)	365 (2%)	1,405 (6%)	729 (3%)	864 (4%)
	NUMBER/SHARE MILK PRODUCTION ('000 tonnes)	2,826 (3%)	1,489 (1%)	7,350 (7%)	3,375 (3%)	4,469 (4%)

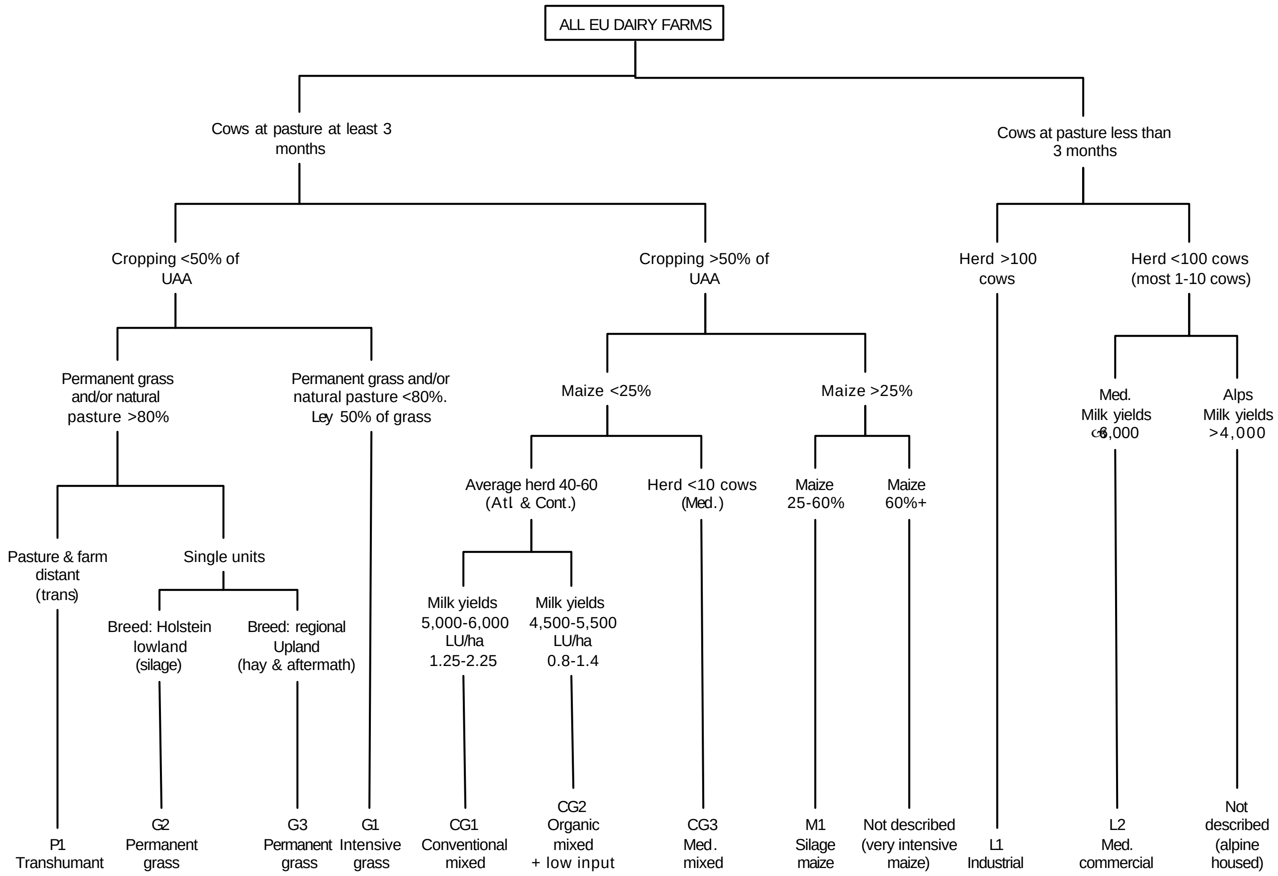

Figure 1. Dendrogram showing the principal indicators of the EU Dairy Systems.

Dairy system profiles

(a) Transhumance systems (P1)

Management objectives

The seasonal exploitation of natural high altitude pastures to graze dairy cows producing milk for specialist high value products. The objective is to exploit the consumer and producer perception that the taste and quality of alpine cheeses is attributable to the oils and aromatic substances in the grasses and herbs grazed by the cows.

Location

Restricted to mountain areas such as the Alps, Pyrenees and the Cantabrian chain.

Farm structures and forage

Farms are composed of two main sub-units. The valley farm, usually close to or in a village, where the cows are milked and housed from October to May, and the facilities on the mountain pastures used to milk the cows from June to September. In the mountains the cows are hand milked and units consist of a main building for milking, where the cheese is produced and stored, accommodation for the farmer and a cow shed. Typical transhumance dairy farms in the Italian Alps have between 10 and 30ha in the valley and around 200ha in the mountains. Summer stocking rates vary between 1.0–2.0 Livestock Units (LU)/ha in the most active areas but are lower where abandonment is happening. Slurry is spread in the mountains on pasture close to the cowsheds or more widely using elaborate systems of ditches and distribution channels.

Animal system

Local regional mountain breeds adapted to the rough and cold conditions (eg. Grey Alpine, Dappled Red and Rendena) are used depending on the area. Herd size ranges from 10 to 200 cows (average around 50) with milk yield averaging 3,400kg/cow/year. Approximately 100kg of milk makes 1kg of cheese. Calving is in the spring to maximise summer milk production. During the winter cows are housed in cowsheds.

Feeding system

In spring the cows graze valley and mid altitude meadows and again in autumn when they are utilising aftermath. During the summer they graze sections of pasture in rotation to allow regeneration. In winter they are fed on hay from the natural valley meadows. Concentrates and silage are generally restricted to cows producing milk used to make cheese.

(b) G1 Intensive grassland (ley) systems

Management objectives

To meet the industrial demand for constant all year round milk supply using intensive animal production. To produce milk of suitable composition for specialist uses (cheese, chocolate, milk products) by meeting the herds nutritional requirements with high-quality grass forage. In northern latitudes maximising the production per hectare of high quality grass silage for the long indoor feeding period whilst minimising the high concentrate costs. In the UK and Holland soils and climate make intensive grassland management the most economic option for maximising output per cow and per hectare.

Location
The wetter and cooler parts of the Continental and Atlantic regions where conditions are unsuitable or marginal for maize cultivation, and in the Boreal zone. Also on potentially intensive farms where extensification is an objective. The Netherlands, south-western England and Wales, south-western Scotland, Ireland, western France (eg. La Mayenne), Sweden and Finland, northern Spain, parts of the Azores.

The Atlantic and Continental regions account for 69% of all temporary grass and nearly 80% of all dairy cows, the majority of which are reared in either this system or M1 (see below).

Farm structures and forage
This system is found on large specialist modern dairy farms (from between 70-140 ha) and although there is wide variation in farm size (largest in the UK, smallest in Brittany and The Netherlands). The intensity of production is always high with two or three cuts of silage. Fertiliser application ranges from 150kg to 300kg N/ha. Clover-safe herbicides are often used on the grasslands. Stocking rates are high (eg. 1.0-1.4LU/ha in France, 2.00-2.5LU/ha in UK). Grass silage is complemented with the cultivation of fodder crops including small grains (barley), fodder beet and silage maize. However, the cropped area rarely exceeds 25% of the UAA.

Animal system
Average herd size is between 30 and 60 cows (higher in the UK, lower in Sweden and Finland) and the most common breed is the Holstein-Friesian. Milk yield is between 6,000 and 8,000kg/cow (typical for southern Sweden and the UK). Calving may be in spring or autumn, depending on location. Cattle are housed for a large part of the year, up to eight months in the north.

Feeding system
More than 60% of the farmland is grass and crops, and summer grazing consists of intensively managed grass pasture and silage and arable aftermaths. Supplementary feed is fed throughout the year in the highest yielding herds. Concentrate quantities can exceed 1,500kg/cow/year (eg. 1,600-1,800kg in the UK) representing as much as 40% of the feed consumption. An increasing proportion of farms (10%) provides a complete mixed ration and, on the more technologically advanced units, concentrates are fed on an individual basis.

(c) G2 Permanent grassland systems (lowland)
Management objectives
To take advantage of summer grass production by feeding cows primarily at grass pasture in the summer in regions where tillage is difficult, soils shallow or temperatures low,

making conditions unsuitable for cereal and maize cultivation. High rainfall favours maximum use of grass. Organic and biodynamic dairy farms are also included in this class.

Location
Northern and eastern France, Ireland, northern and western UK, parts of the Azores.

Farm structures and forage
These systems are found on modernised specialist dairy farms. Farm size varies considerably (20-80ha), but in general these are large holdings, especially where farms are run collectively as in the UK and in France eg. *Groupement agricole d'exploitation en commun*.

Most of the UAA is not under forage crops, cereals occupy less than 30% of UAA often in rotation with maize, wheat and brassicas. The rest of the land is under grass, mainly in the form of permanent grassland. Forage growing areas are managed on a relatively extensively, with mineral nitrogen applications being between 50-100kg/ha/year. Stocking rates are on average 1.0-1.4 LU/ha up to 1.9 LU/ha in Ireland and locally at higher levels in parts of France and the UK.

Animal system
Average herd size is 30-60 cows in France (higher in the UK) usually Holstein-Friesian. Farms often produce beef as well, with a fattening unit for dairy and cross-beef bull calves born on the farm. Many farms also have suckler cows. In the UK, sheep may also be reared. Average milk yield is around 6,000 l/cow. If grazing is well managed, concentrate input can be as low as 500 kg /cow. Calving is mainly in the spring in Ireland, but in the autumn in some regions such as Brittany and Normandy. The objective is always to maximise the economic return from quota using grassland management. Farms are often family concerns with simple feed systems; technical performance is sometimes not the prime concern or objective of the system.

Feeding system
The feeding system involves a mixed winter diet of grass silage, hay and maize silage and a summer diet based on grazing. The most widespread feeding system is individual troughs or with self-help silage feeders with concentrate feed in the milking parlour.

(d) G3 Permanent grassland systems (mountain)
Management objectives
These specialist dairy systems are based on hill grasslands with the intensity of management reflecting the milk production possibility (quota) per hectare. At the intensive end of the scale, where quota is not limiting, production is derived from grass silage plus concentrate feeding to obtain higher yields per cow. The more traditional hay plus aftermath system occurs where limiting production costs is the prime concern or where there are requirements for cheese making. The smaller, less intensive holdings are often managed part-time.

Location

In the uplands, high plateaux and mountain foothills of the Atlantic, Continental and Alpine regions, eg. the Massif Central, Auvergne, the Black Forest and the foothills of the Alps, Pyrenees and Cantabrian mountains.

Farm structures and forage

Holdings generally have a UAA of 30-50ha, with the smallest in the Alps and the largest on the plateaux, ranging from 40-80ha in the Franche-Comte, 50-70ha in the Black Forest to 25-40ha in the French Alps. Farms have virtually all their land under grass with just a few hectares of cereal for on-farm consumption. Natural grassland accounts for 80-100% of the MFA. Stocking rates range on average from 0.4 to 1.4LU/ha depending on farm size and quota. Mineral fertiliser use is low (40-80kg N/ha) but this intensification enables and earlier first cut of hay or silage and the possibility of silage or barn-dried hay, followed by high-quality aftermath.

Animal system

Holstein-Friesians are common on the more intensive farms, but red and white breeds are common elsewhere, and in many areas, small regional breeds are still common (Montbeliard, Tarin, Abondance, Hinterwald, Vorderwalder, Hinterwalder and Eringer). Herds are generally composed of between 25 and 45 cows (20-30 in the Black Forest). Average yields are very variable from 4,000-5,500 kg/cow/year (ranging from 3,800 kg/cow/year in southern Germany to 6,000kg/cow/year in Franche-Comte). Calving is generally from September to December to take advantage of winter fodder and higher milk prices. On the less intensive farms calving is later and more protracted to take advantage of the spring flush of grass and reduce winter feed distribution.

Feeding system

Virtually all the farmland is under grass. Grazing lasts six months, generally in rotation with hay, silage and aftermath. Supplementary feeding at grass is limited (100-300 kg hay or silage) but can be as much as 300-500kg in hay systems. Winter rations consist of hay or grass silage plus concentrates. The later strongly determining the output of milk per cow (eg. 1,000 kg/cow for a yield of 5,000 l and 1,500 kg for 6,000 l yield). At the same level of output, systems using the most direct-cut silage use more concentrate than the less intensive systems; use of barn dried hay economises even more on concentrates. Farm buildings vary widely but are generally closed and functional – with loose housing (free stalls or slatted) or tethered housing with or without a dunging mechanism, feeding alley and milk pipeline. Hay is usually stored in the same building, silage outside. The latter is fed mechanically, but hay is often fed by hand.

(e) CG1 Conventional mixed systems

Management objectives

To meet the industrial demand for year round fresh milk using intensive cultivation of farm produced fodder crops, adjusted to soil type and climatic conditions to maximise yields. Dairy production is often combined with grain production.

Location

These farms are found throughout the lowlands of the Atlantic and Continental regions eg. Denmark, UK and western Germany, where soils make crop cultivation viable but where temperature restricts the possibility of intensive maize cultivation..

Farm structures and forage

These farms employ a system of rotational arable cropping with cereals, fodder beets and cash crops in combination with temporary grassland, usually with only a small area of permanent pasture. Proportions vary between areas, on the relative price of bought-in feed to home grown fodder and on the proportion of concentrates fed. Typically 50% of the UAA is under crops. Average farm size is between 60 and 90ha, smaller in Denmark and larger in the UK. Stocking rates range from 1.25 to 2.25LU/ha. Mineral fertiliser use is in the region of 150-230kg N/ha

Animal system

The most common cows are large heavy breeds, mostly Holstein-Friesian, but also regional breeds eg. Ayrshire, Danish Friesian and Danish Red. Average herd size is 40-60 cows, up to 70 in the UK, with milk yield averaging 5,000-6,000 kg/cow/year, but higher on intensive farms using a high proportion of concentrates.

Feeding System

These are intensively managed dairy farms with cows at grass in the summer (temporary grass and aftermath) and in open sheds or yards in winter where they are fed a ration of grass and arable silage, small grains and harvested fodder beet. Concentrate supplements are fed in the milking parlour or at individual feeders and vary considerably between farms, depending on target milk production. For example, up to 2,000 kg/cow/year (including grain) on conventional Danish mixed dairy farms with a milk production of 7,800 kg milk/cow/year.

(f) CG2 Low input and organic mixed systems

Management objectives

To meet the rapidly increasing demand for organic milk and milk products. Also where environmental schemes seek to reduce the damaging effects of intensive mixed dairy farming.

Location

Throughout the lowlands of the Atlantic and Continental regions wherever conventional mixed cropping systems (CG1) occur.

Farm structures and forage

Although essentially based on a rotational arable cropping system there are some important differences from the intensive system. The hectarage of permanent pasture and temporary grass tend to be similar, but the area of fodder beet and arable (whole crop) silage can be only half that of conventional systems, the balance generally being met by a larger area of rotational clover-grass and lucerne for silage. The average yields per hectare of grain crops, beets or grass fodder can be expected to be 15-30% lower than using conventional methods. Stocking rates are around 40 % less ranging from 0.8-1.4 LU/ha. On organic farms the use of mineral fertiliser is prohibited and the use of animal manure is restricted to that produced from 1.4 LU/ha/year. The latter would lead to greater N losses to the atmosphere, for example, 102kg N/ha/year compared with 33kg N/ha/year in conventional systems in Denmark (Halberg et al., 1995). There is no pesticide use on organic farms.

Animal system
Breeds such as Jersey and Guernsey are used in addition to Holstein-Friesians. Average herd size is 50-60 cows (larger in the UK) with milk yields between 4,500 and 5,500kg/cow/year.

Feeding system
Cows are at grass in the summer (temporary grass and aftermath) and in open shed or yards in winter where they are fed a ration of grass and arable silage. Organic systems are restricted as to the amount of purchased non-organic fodder that can be included in the diet (usually 15%). A typical organic mixed farm in Denmark might use on average 10% rapeseed cake and 20% grain in the total ration. For a target production of around 7,200kg of milk/cow this would equate with 500kg of rapeseed cake and 1,000kg of grain.

(g) CG3 Mediterranean mixed systems
Management objectives
Small scale production of milk using family labour to provide local milk factories.

Location
Widespread throughout the Mediterranean region in the wetter parts of northern Portugal, in the less fertile and arid areas of Spain, Italy and Greece, in areas where irrigated maize cultivation is not feasible.

Farm structures and forage
Farms are small, generally less than 20 ha, with cows kept intensively or semi-intensively with grazing restricted to three to four months in the spring depending on the area. Traditional polyculture systems include a mixture of tree crops, vegetables and cereals eg. oats and rye, grown in small unfenced plots to produce roughage for harvesting. Slurry and manure is used in the cultivation system but there is virtually no use of mineral fertilisers.

Animal system
Both Holsteins and multipurpose breeds (some of local origins) are used. Holsteins and regional breeds are crossed with beef bulls such as Charolais or Limousain. Housing facilities are often antiquated and most cows are milked by hand for seven to eight months. Average milk yield is about 2,000-3,000kg/cow/year. Calving is mainly in the spring and calves are either sold to a fattening unit or kept for a suckling period of two to three

months and fattened and sold for slaughter at a live-weight of 450-500kg aged 15-18 months.

Feeding system
Cattle are often grazed in the day on poor pastures and stubble and housed at night. Feed is a combination of home produced fodder and a small amount of purchased concentrates (300-600kgs/cow/year). Supplementary green fodder fed in the summer is often hand cut.

(h) M1 Intensive maize silage systems
Management objectives
To use intensive animal production to meet the industrial demand for a year round milk supply for processing into cheese and fresh milk products. To meet the herd's nutritional requirements of the herds from high quality forage (maize) while keeping production costs as low as possible.

Location
Those lowland parts of the Atlantic and Continental regions where climate and soils favour the growing of early to semi-early maize, eg. parts of western France, south-western France, northern Italy and the Rhine valley. These farms have over 80% of the UAA suitable for cultivation and are highly productive. More than 45% of French milk is produced by this system, most of which is situated in western France.

Farm structure and forage
Holdings have 30-35ha UAA on average (less in Italy, more in Germany) but everywhere farm size is increasing annually eg. by 1 ha/year in France. These are low lying regions (below 400m) with good conditions for cultivation. Stocking rates are 1.7-2.2 LU/ha with mineral fertiliser applied at the rate of at least 120-150 kg N/ha.

Animal system
Over 80% of cows are Holstein-Friesian. Average herd size is 30–35 cows and milk yield is between 7,000 and 8,000 kg/cow/year. Calving is concentrated in the autumn between September and December to take advantage of higher milk prices. Over half of the herds are housed loose, the others being usually kept in free stalls.

Feeding system
The balance of arable land not under maize is usually under rotational grass based on rye grass. Maize usually covers 25-60% of the UAA, but can sometimes be over 60%. Maize silage usually provides at least two-thirds of stored feed because of its uniform nutritional value and high forage yield. Concentrates are fed in quantities varying from 1,300-1,800 kg/cow/year consisting of 60-70% N-enriched concentrate and 30-40% pulp or cereals. At 60% of farms silage is fed at the trough, at the rest at self-feed clamps.

(i) L1 Industrial systems
Management objectives

Economies of scale are used in specialist industrial-like enterprises in order to produce cheap milk for the industrial market.

Location
These systems occur in the "New *Länder*" which are in the former East Germany.

Farm structures and forage
Milk production is essentially detached from the land, making effluent and slurry disposal difficult.

Animal system
Cows are all Holstein-Friesians with very large herds with up to 500 cows, kept in specially designed buildings. Milk yields are high (no average figures but estimated at 9,000) with individual cows likely to yield up to 14,000 kg/cow/year – a figure not dissimilar to comparable intensive systems in the UK.

Feeding system
Cows are zero grazed and fed concentrate and roughage in a complete ration and minerals to maximise output per cow.

(j) L2 Mediterranean commercial systems
Management objectives
To produce milk for cheese making and dairy products using modernised facilities and taking advantage of the availability of fodder produced from irrigated cultivation and concentrate feeds.

Location
Occurs throughout the Mediterranean region in central and northern Greece, northern Italy, Spain and Portugal.

Farm structures and forage
This system is composed of medium to large commercial dairy units with fully modernised facilities for milking high yielding cows. Irrigated maize silage and dry-land rye grass gives two to three cuts per year.

Animal system
Herd size is large in the southern European context eg. 50-60 cows in Greece and Portugal. The cows tend to be almost all Holsteins and are milked mechanically for ten months; average milk yields are about 6,000kg/cow/year. Calves are usually born in the spring and sold five to ten days after calving to specialist fattening units.

Feeding system
Cows are kept indoors all year round and fed a supplementary diet of farm produced and purchased roughage together with large amounts of concentrates (over 2,000

kg/cow/year). Around 70% of the cow's energy requirements are met by these concentrates (cereal grains, wheat middlings, soybean meal, cotton seed cake, sugar beet pulp and minerals and vitamins) and roughage is mostly maize silage or ryegrass silage, alfalfa hay and straw.

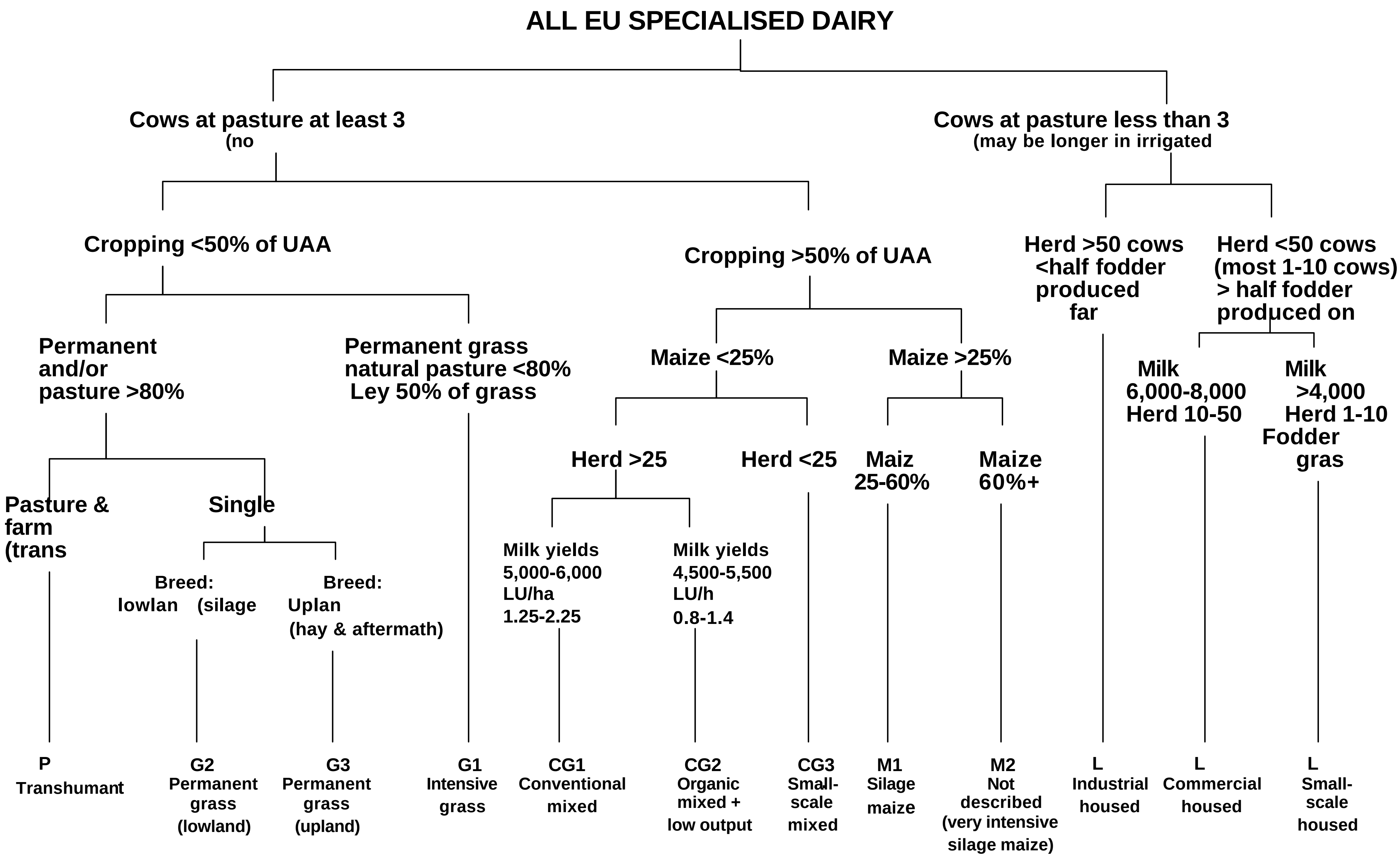

Figure 2. Revised Dendrogram showing the principal indicators of the EU Dairy stsystems.

Table 4. Revised EU dairy systems

CATEGORIES OF PRODUCTION AND REGIONS		***SEMI-NATURAL PASTURES***	***GRASSLANDS***	***CROPS & GRAIN MIXED***	***CROPS & GRAIN MAIZE***	***LIMITED GRAZING***
		FODDER AND FORAGE RESOURCES (LAND USE CATEGORIES)				
CONTINENTAL ATLANTIC BOREAL MACARONESIAN	***HIGH INPUT/OUTPUT***		**G1** INTENSIVE GRASSLAND (LEYS) GRASS 60% + CROPS	**CG1** CONVENTIONAL MIXED CROPS 50%+	**M1** SILAGE MAIZE MFA = Maize 25%-60% CROPS 50%+ **M2** V. INTENSIVE SILAGE MAIZE	**L1** INDUSTRIAL HOUSED
	LOW INPUT/OUTPUT		**G2** PERMANENT GRASSLAND (Lowland) GRASS 80%-100%	**CG2** ORGANIC MIXED + LOW OUTPUT **CG3** SMALL-SCALE MIXED		
ALPINE AND BOREAL	***LOW INPUT/OUTPUT***	**P1** TRANSHUMANT	**G3** PERMANENT GRASSLAND (Upland) GRASS 80-100%			**L3** SMALL-SCALE HOUSED
0 MEDITERRANEAN	***HIGH INPUT/OUTPUT***					**L2** COMMERCIAL HOUSED **L1** INDUSTRIAL HOUSED

Conclusions
During the workshop some modifications were suggested. These comments involve mainly an addition of very intensive silage maize system and a further breakdown of the limited grazing systems in the Mediterranean and Alpine/Boreal regions, but descriptions have not been included in the present text. Further alterations may also be required, following consultations with other experts, but the overall outline is robust and is unlikely to change, except in detail.

References
CEAS and EFNCP, 2000, The environmental impact of dairy production in the EU: practical options for the improvement of the environmental impact. Final report for DGXI. Centre for European Agricultural Studies and The European Forum on Nature Conservation and Pastoralism.

Web reference for the report-
A link to the Executive summary only (ie. a small - c. 0.07mb - pdf file and hence easier for many to access) which is located at: http://europa.eu.int/comm/environment/agriculture/pdf/dairy_xs.pdf

A link to the Full Report (ie. a large - c. 1.3 mb - pdf file) which is located at: http://europa.eu.int/comm/environment/agriculture/pdf/dairy.pdf

The application of a European Union classification of dairy systems to the Netherlands

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Introduction

Livestock farming has an important impact on the environment in relation to soil, water, air, landscape and biodiversity. One of the main aims of the European Livestock Policy Network (ELPEN) project is to create a decision support system for investigating the environmental impacts of livestock practices and livestock policy changes. The construction of a classification of livestock systems present in the European Union (EU), is a necessary requirement for the investigation of the environmental impacts of livestock systems in a policy support system. This paper therefore explores the possibilities for classifying Dutch dairy systems. The main aim is to establish a classification that can be used for analysis of the environmental impact of changes in livestock policies. The European dairy system classification already produced in April 2000 by the Centre for European Agricultural Studies (CEAS) and the European Forum for Nature Conservation and Pastoralism (EFNCP), referred to as the CEAS classification in the rest of this paper, is used as a starting point for the classification. Combined national statistical indicators are used to group Dutch dairy farms into different classes. A description of the classes is then provided, together with their location. Comparing the characteristics of the dairy classes between Dutch regions assesses the usability of the classification. Finally, analytical results are presented on the environmental impacts of the different dairy classes.

Dairy farming in The Netherlands

Dairy farming has always been an important activity in the Netherlands. Already in the Middle Ages cheese and butter production were very common and the latter was an important export product. Through the centuries dairy activity was always found on mixed farms spread throughout The Netherlands and on the more specialised pasture farms, called *weidebedrijven*. The pasture farms consisted mainly of grassland and were predominantly found on peaty and sandy soils, which were not suitable for arable farming. Overall one can see that most of the present dairy holdings are still concentrated in the areas where in former times the pasture farms and mixed farms were found.

As in other countries since the Second World War, Dutch agriculture went through an intensive specialisation phase, which resulted in a concentration of dairy production on specialised and highly efficient farms. At this moment almost a quarter of all farms in the Netherlands, are specialised dairy holdings and more than one third of all the farms have at least ten milk cows. Most of the dairy farms are located on peaty and sandy soils, as shown in Fig. 1. On the relatively small number of dairy farms where dairy is not a single activity, dairying usually takes place in combination cattle, sheep and granivor enterprises.

The average size of a farm with dairy cows is 32 ha and 113 European Size Units. In the northern parts of The Netherlands, especially on the heavy soils, the largest farms in terms of area and economic production capacity are found. The Dutch polders contain the largest and most modern farms. Since the dairy production in the Netherlands is mainly focussed on efficiency and high productivity, the most common breeds found are Friesian Holsteins and Dutch Friesians. Other breeds only occur sporadically. Average milk production, around 7,000 kg per cow per year, is among the highest in Europe. The regional variation in milk yields per cow is however large and varies from 6,000 kg in the lowest production areas to 9,000 kg per average milk cow in the Dutch Ijsselmeer polders.

The Dutch polder areas and the central, east and south sandy areas have the highest animal density. The farms with the larger herds are found in the north of the country and in the Dutch polders. There is however no direct relationship between herd size and animal density. Overall, one can see that the areas with the highest stocking density are found on sandy soils. This gives extra environmental problems, as these areas are also more sensitive to nitrogen leaching.

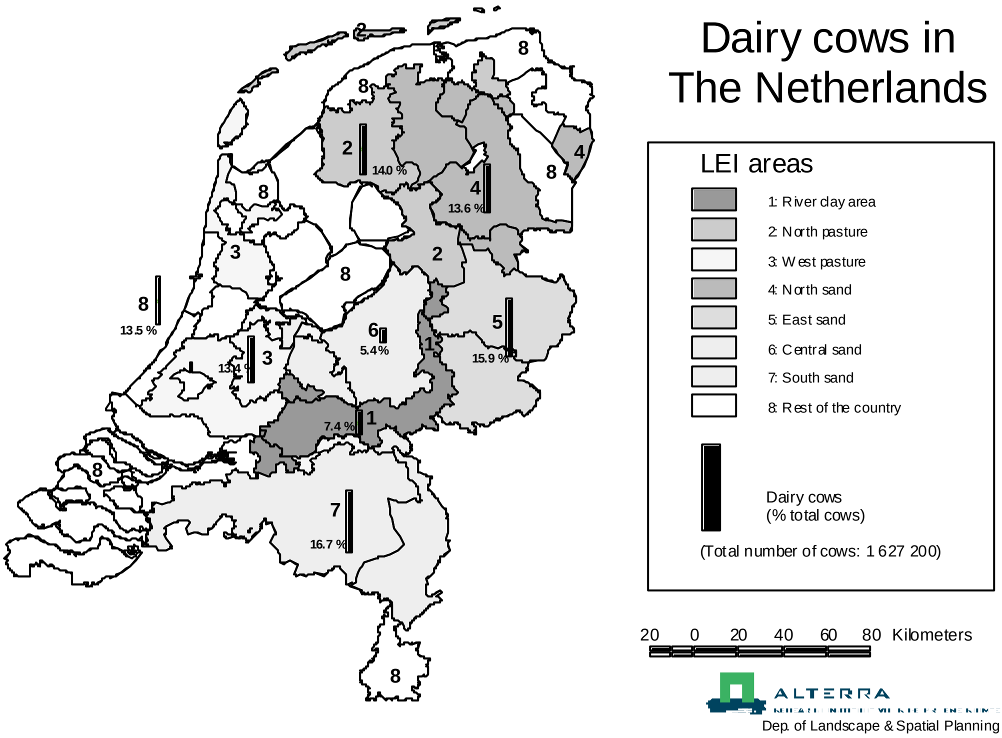

Figure 1. Regional distribution of dairy cows over the Netherlands (Source: CBS, Landbouwtelling 1998)

Classification of Dutch dairy farming and characteristics per dairy class

The CEAS classification was applied to the national farm survey database (Landbouwtelling, 1998), which contains a total of 108,829 farms. The Landbouwtelling 1998, which contains a large number of characteristics at the farm level, is updated annually through a population survey. Following the CEAS classification, all farms that had ten or more dairy cows were included in the analysis, resulting in a total population of 30,514 dairy farms, which is 38% of the total.

The division of dairy farms in the six CEAS classes was done on the basis of seven criteria, which have been included in the hierarchy of Figure 2. The first criterion in the CEAS classification is the days that cows are at pasture. Unfortunately, this information was not available in the Dutch farm survey data set (Landbouwtelling, 1998) but from another survey research on grazing practices in the Netherlands (Steekproef Graslandgebruik, Praktijkonderzoek PR, 1997), it could be assumed that industrial systems do not exist in the Netherlands. This grazing research indicated that eight percent of the Dutch dairy farms keep their cows in for the whole year; the so-called 'summer feeding systems', shown in Table 1, but these farms still produce their own rough silage by cutting. It is therefore still logical to call them land dependent systems and not industrial, as they do not fit to the characteristics as described in the CEAS classification for industrial systems. The Dutch grazing research further indicated that more than 90% of the Dutch dairy farms leave their cows outside in the period from April until October. Grazing throughout the year does not occur, because the Dutch climate is not suitable.

Table 1. Cows at pasture in The Netherlands (Source: Steekproef graslandgebruik, Praktijkonderzoek PR, 1997)

Cows at pasture: dairy farms	% of total
Whole year	0%
Never →Summer feeding	8%
April/May-October: Day and night	48%
April/May-October: only day	45%

The next classifying criterion in the CEAS classification, as shown in Figure 2, is the proportion of Utilised Agricultural Area (UAA) used for cropping. As already indicated, most Dutch dairy farms are very specialised and mainly focus their production on dairy and on the production of fodder such as grass, maize and other fodder crops. Therefore, not even ten percent of the dairy farms in the Netherlands have more than 50% of their UAA under crops, whilst the rest have more than 50% or even over 80% of their UAA in grass. This means that more than 90% of the dairy farms in the Netherlands fall into the classes permanent grass or intensive grass of the CEAS classification.

The proportion of maize of the total UAA, is the fourth classifying criterion and in the CEAS classification it only needs to be applied to the farms with more than 50% crops in order to distinguish between the mixed classes, silage maize and intensive silage maize, as shown in Figure 2. The result is that the majority of these farms fall in the mixed class or the silage maize class. All silage maize farms are concentrated in the sandy areas, especially in the south. The intensive silage maize class, with more than 60% of the UAA under maize is hardly found in the Netherlands, except some in the southern sandy region.

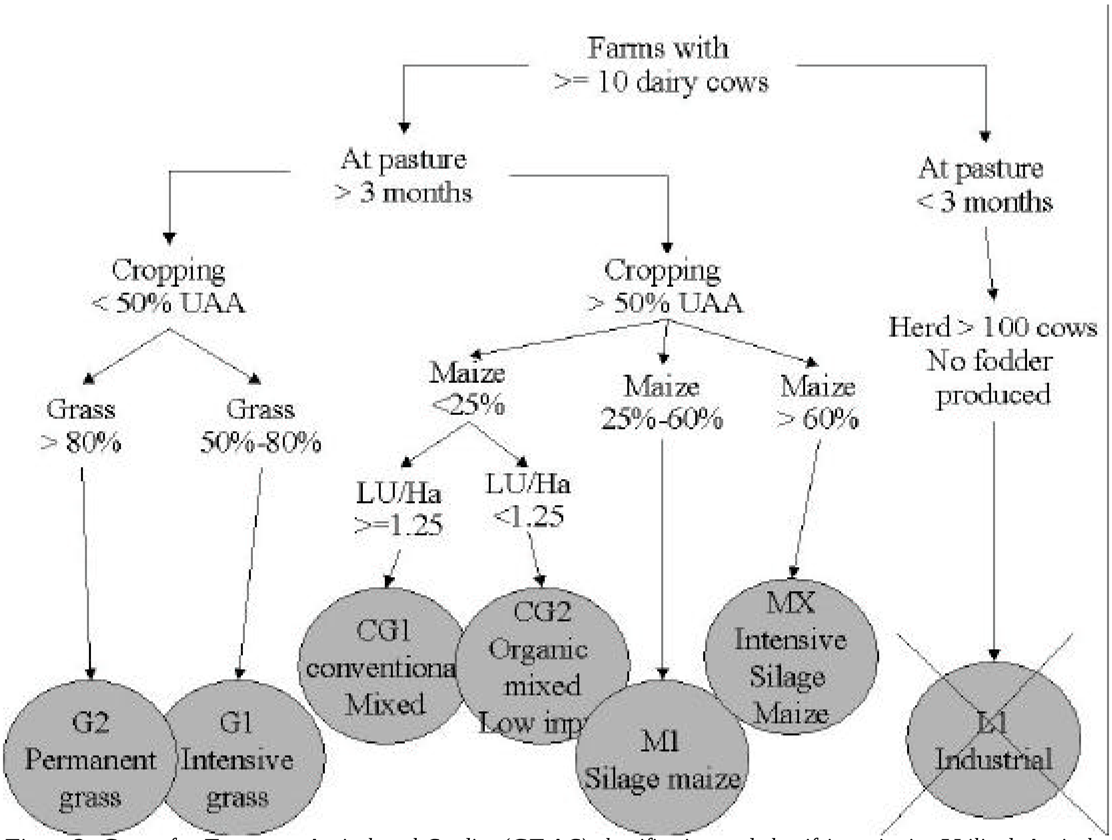

Figure 2. Centre for European Agricultural Studies (CEAS) classification and classifying criteria: Utilised Agricultural Area (UAA) and Livestock Units (LU)

The final classifying criterion is the stocking rate, which in the CEAS classification only needs to be applied to determine the proportion of farms that are conventional mixed and organic/low input. It is clear that there is only a very small proportion of farms that have less than 25% maize and a stocking rate under 1.25 Livestock Units (LU), and that almost all of these organic mixed low input farms are outside the main dairy production regions, as shown in Table 2 and Figure 3.

From Table 2 and Figure 3 it is clear that Dutch dairy farms are distributed over six CEAS classes with a clear over-representation of the permanent and intensive grass classes. There is however a strong regional difference in the relative distribution of the dairy farms over the farm classes which can partly be explained by the physical and farm structural characteristics of these regions. For example, the reason that the permanent grass class is most strongly concentrated in the northern and western pasture areas is because of the presence of peaty soils that are only fit for grass and not for the production of fodder maize. In the sandy areas of the east and south, and in the river clay areas, the intensive grass and silage maize classes are more numerous, as the physical circumstances, ie. sandy soils and better climatic conditions, make the production of fodder crops like maize more attractive. Another reason for the relatively higher number of livestock-cropping combinations in the southern and eastern sandy areas might be that traditionally these areas have always contained mixed livestock systems and relatively small farms.

Table 2. Distribution of farms with dairy, over Centre for European Agricultural Studies (CEAS) farm classes, in the main dairy production regions and in the whole of The Netherlands (Source: Landbouwtelling, 1998)

	River clay area	North Pasture	West Pasture	North Sand	East Sand	Central Sand	South Sand	Rest country	Total
Permanent grass	63	89	92	65	40	71	12	53	58
Intensive grass	34	11	7	28	55	27	65	30	34
Organic low input	0	0	0	2	0	0	0	4	1
Conventional mixed	2	0	1	3	1	0	4	10	3
Silage maize	1	0	0	2	3	1	15	3	3
Intensive silage maize	0	0	0	0	1	1	4	0	1
Total	100	100	100	100	100	100	100	100	100
Total farms (n)	2267	3938	4297	3835	5623	2171	4622	3699	30452

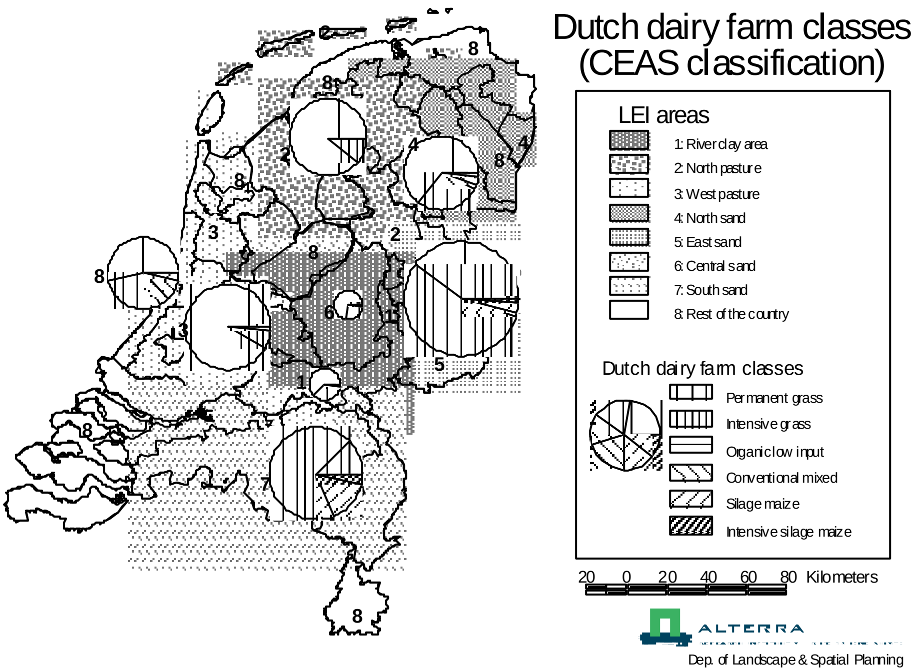

Figure 3. Regional distribution of Centre for European Agricultural Studies (CEAS) classes in The Netherlands (Source: CBS, Landbouwtelling 1998)

Table 4. Characteristics per Centre for European Agricultural Studies (CEAS) farm classes. LU, Livestock Units of all grazing animals, including dairy cows; UAA, Utilised Agricultural Land (Source: Landbouwtelling, 1998)

	Permanent grass	Intensive grass	Organic low input	Conventional mixed	Silage maize	Intensive silage maize	Total
Average LU	67	73	38	68	79	75	69
Range	10-521	10-1388	11-167	13-425	10-1041	10-282	10-1388
Average UAA (ha)	31	32	66	49	34	22	32
Range	1-346	3-547	14-355	1-373	3-304	1-125	1-547
Grass % of UAA	95	69	25	37	41	25	81
Range	80-100	50-80	0-50	0-50	0-50	0-50	0-100
Maize % of UAA	5	27	6	11	44	73	15
Range	0-20	0-49	0-24	0-25	25-60	60-100	0-100
Average LU/UAA	2.4	2.6	0.7	1.7	2.8	4.0	2.5
Range	0.5-17.6	0.5-13.9	0.2-2.21	0.7-8.2	0.4-10.9	0.5-15.5	0.2-17.6

In Table 4, the characteristics of the different CEAS classes for the Dutch dairy systems have been summarised. The range for these characteristics per class is however large, making it rather difficult to determine how representative the average characteristics of each class are. Overall, one can see that the classes permanent grass and intensive grass most strongly determine the Dutch average, as they are the most important classes both in absolute and relative numbers. The average size of these two farm classes in UAA is small and the size of the herds is around 70, but there is a large range in herd size. In general it is clear that the two extensive classes have relatively more land and a low livestock number, while the very intensive classes have many cows and relatively little land. Overall, the stocking rate (LU/UAA) and the proportion of maize in the UAA indeed indicate that the silage maize and intensive silage maize classes are the most intensive, the organic and conventional mixed classes are most extensive and the grass classes are intermediate. This confirms that the sandy areas in The Netherlands, especially those in the south, also contain most of the more intensive systems and are therefore also at a greater risk of environmental degradation.

Nitrate excess as measure of environmental impact

For the determination of the environmental impacts of the different dairy classes an average nitrate surplus has been determined per class. The total nitrate-surplus has been calculated on the basis of a factor for nitrate surplus per animal type as determined in the Dutch Mineral Accounting system (MINAS, Dutch Ministry of Agriculture, 1998). This surplus is the net-nitrate application, which equals the total manure production per animal minus a correction factor for ammonia volatilisation. Per farm all grazing animal categories were multiplied with this N-factor which resulted in an average nitrate surplus per farm per hectare per farm class, as shown in Table 5.

Table 5. Number of farms, Livestock Units per hectare (LU/ha) (only of grazing stock) and nitrate-surplus (N) per hectare (N/ha) per Centre for European Agricultural Studies (CEAS) class in the main dairy production areas (Source: Landbouwtelling, 1998)

	River clay area	North Pasture	West Pasture	North Sand	East Sand	Central Sand	South Sand	Rest country	Total
Permanent grass:	1429	3496	3924	2494	2257	1502	565	1957	17624
- LU/ha	2.6	2.2	2.3	2.2	2.9	2.8	3.7	2.3	2.4
- N/ha	341	303	320	298	394	372	489	317	334
Intensive grass	760	408	305	1089	3119	585	2988	1096	10350
- LU/ha	2.5	2.4	2.5	2.2	2.6	2.7	3.0	2.2	2.6
- N/ha	321	319	333	287	345	350	406	299	349
Organic low input	9	3	7	72	4	6	5	155	261
- LU/ha	0.8	0.6	0.7	0.7	0.7	0.4	0.7	0.7	0.7
- N/ha	99	85	95	89	78	55	89	89	89
Conventional mixed	30	12	32	117	36	8	173	372	780
- LU/ha	1.5	1.3	1.6	1.3	2.0	1.5	2.5	1.4	1.7
- N/ha	199	185	231	173	262	206	316	192	222
Silage maize	28	9	15	55	145	22	688	106	1068
- LU/ha	2.7	2.6	3.0	2.1	2.6	2.3	3.0	2.4	2.8
- N/ha	339	271	368	253	317	293	388	295	358
Intensive silage maize	4	3	3	6	43	13	158	7	237
- LU/ha	4.2	2.0	4.3	3.1	4.2	3.7	4.1	2.6	4.0
- N/ha	449	177	424	343	448	496	503	316	477
Total	2260	3931	4286	3833	5604	2136	4577	3693	30320
- LU/ha	2.5	2.2	2.3	2.1	2.7	2.7	3.1	2.1	2.4
- N/ha	331	304	320	286	364	364	413	288	336

Overall, one can see that nitrate surplus on dairy farms is very high and exceeds in all cases, except the organic/low input farms, the maximum of 170 kg Nitrate of the EU Nitrate Directive. Starting from the assumption that the CEAS classification of dairy farms is aimed at classifying farms on the basis of their environmental impact, there are some observations to be drawn from Table 5. Firstly, it is clear that the nitrate surplus of dairy farms within one class varies between regions, making the environmental impact of farms in the same class different between regions, eg. in the permanent and intensive grass classes, the sandy areas contain farms that consistently show a higher nitrate surplus than in most of the other regions. One can therefore ask whether it is logical to put the farms of the intensive grass class in the north pasture area in the same class as the farms in the intensive grass class in the south sandy area.

Secondly, it is clear that there is indeed a lower nitrate surplus in the organic low input class and the conventional mixed class in comparison to the other classes. The nitrate-surplus of both the permanent and intensive grass classes and the silage maize class is very high in all sandy areas, making them consistent in their environmental impact. Thirdly, Table 5 clearly indicates that nitrate surplus and livestock density are strongly related. This is also confirmed by the strong correlation between livestock density (LU/UAA) and nitrate production per hectare $r = 0.975$, with $P > 0.001$. Stocking rate should therefore be a key classifying factor in the CEAS classification.

Conclusions

After applying the CEAS classification to Dutch dairy farms, it was found that six different farm classes of the 12 CEAS classes were present in The Netherlands. The classification distinguishes between the grassland based systems, which are mainly concentrated in the peaty regions of the country, and the maize silage systems which are more often found in the sandy areas.

Lack of data on grazing practices made it difficult to completely apply the CEAS classification, but on the basis of other survey data, assumptions could be made to fill in the gaps. Also, another dairy class was found, the summer-feeding system, which was not included in the CEAS classification. Therefore, because of data deficiency, this class was not further considered.

The analysis of the different characteristics of the dairy CEAS classes that are present in the Netherlands shows clear differences per class in average size, proportion of grass and maize area, and LU/ha. However, the range of these variables within a class is usually relatively large, which makes it very difficult to explicitly characterise a class on the basis of characteristics, such as size or land use. The application of the CEAS classification to Dutch dairy farms also reveals that it could be difficult to explore the relationships between the CEAS classification and other farm classifications in the European databases such as FSS (Farm Structural Survey) and FADN (Farm Accountancy Data Network). This relationship needs to be explored further as it is useful to know how the CEAS classification fits hierarchically to other classifications and whether the CEAS classification can be of help to refine other existing farm classifications.

Since the CEAS classification aims at classifying dairy farms on the basis of environmental pressure, the nitrate production per farm class was explored. The organic low input and the conventional mixed classes show a lower nitrate-surplus than the other four CEAS classes present in the Netherlands. There was however no clear difference in nitrate surplus between the other four other CEAS classes. Furthermore, the nitrate-surplus within the same dairy class usually showed much variation between regions. In general, the farms located in the sandy parts of the Netherlands, especially in the south, showed a much higher nitratesurplus, especially in the classes that are most common in The Netherlands and the intensive silage maize class. A high nitrate-surplus was also directly correlated with the stocking rate on a farm. Since the CEAS classification does not use stocking density as a classifying variable for all of the CEAS classes, the stocking density varies widely within the four most common classes in The Netherlands, which automatically leads to much variation in nitrate-surplus within the classes. Given this, and the fact the CEAS classification is meant to be an environmental classification, it would be logical to take stocking density as one of the primary classifying variables in the CEAS classification.

References

CBS, 1999, Landbouwtelling 1998

CBS, 1997, Steekproef graslandgebruik 1997

CEAS and EFNCP, 2000, The environmental impact of dairy production in the EU: practical options for the improvement of the environmental impact. Final report for DGXI. Centre for European Agricultural Studies and The European Forum on Nature Conservation and Pastoralism.

Eck, W.; B. van der Ploeg, K.R. De Poel& B.W. Zaalmink, 1996, Future Cow. The spatial quality of dairy farming systems in 2026. National Spatial Planning Agency: The Hague.

NRS, Jaarstatistieken, 1999. Arnhem

Livestock production systems in Belgium

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Introduction

Belgium is divided into three regions, the Flanders region, the Walloon region and the Brussels region, but the latter has no agricultural production. Each region has, from 1992, its own agricultural and environmental policy. The agricultural production differs widely between the two regions, reflected in the number of animals, as shown in Table 1. The 3.1 M cattle are equally divided between the Flanders and Walloon regions, whereas 95% of the pigs and poultry are present in Flanders.

Table 1. Animal livestock in Belgium (1997) (Source: National Institute of Statistics (NIS))

	Flanders	Walloon region	Belgium
Cattle	1,638,249	1,518,336	3,156,585
Pigs	7,036,797	276,424	7,313,221
Poultry	35,572,921	2,019,368	37,592,289
Sheep	97,618	57,082	154,700
Horses	17,271	4,177	21,448

In 1994, there were 49,528 farms keeping cattle, as shown in Table 2, of which 15,000 kept milking cows, 18,000 kept suckling cows, 8,000 had milk production and suckling cows, 586 had veal production and 7,000 had beef production. Approximately, 41% of the cattle farms that kept cows mainly sell lean animals, of which 37% regularly fatten up young stock, 21% sell eight day old calves, and 1% mainly produce veal calves. It is also assumed that in 1994 about 40% of all young animals for slaughter came from farms keeping suckling cows.

Table 2. Number of farms in Belgium with livestock production (1994)

	Number	%
Farms for milk production	15,115	30
- With beef production	2,805	18
- Selling lean animals	2,102	14
- Selling eight day old calves	10,208	67
Farms with suckling cows	18,587	37
- With beef production	6,111	33
- Selling lean animals	12,476	67
Farms with milk production and suckling cows	8,226	17
- With beef production	2,508	30
- Selling eight day old calves	5,718	69
Farms with only veal production	586	1
Farms with beef production	7,014	14
Total	49,528	100

In 1996, the value of dairy production amounted to 925 MEURO, which is about 15% of the total agricultural production in Belgium, with beef production amounting to 825 MEURO. In recent years the beef cattle sector has been through an unprecedented crisis due to a variety of causes, eg. hormones and Bovine Spongiform Encephalopathy (BSE). At the time of writing, the sector has recovered.

After a small increase at the beginning of the 1980s, milk production in Belgium has declined since 1983 from 3.9 Mtons to 3.4 Mtons in 1996, and the deliveries to dairy factories were also reduced. The role of the latter in total production grew and now amounts two about 88%. Milk production per farm rose from 70 tons to 190 tons/year. For most of the milk products, ie. concentrated milk, butter and yoghurt, self-sufficiency is over 100%, except for cream and cheese.

The slaughter quality of the White-Blue Belgian breed accounts for the exceptional character of Belgian beef production. More than 40% of all carcasses produced in Belgium fall in the two highest classes of the classification scheme for profile and muscle development in the beef sector. About 60% of all bulls are also classified in these categories, whereas in the other countries of the European Union this proportion is much lower. The White-Blue Belgian breed predominates in Belgium, and has led to a 40% increase in the average carcass weight over the last twenty years. Due to these changes, the Belgian beef production has grown from under 300,000 tons in the early 80s, when Belgium became self-sufficient, to 375,000 tons in 1994. However, overall meat consumption per person, especially beef, is declining because of changes in consumer habits.

In Belgium there are also some 155,000 sheep, 12,000 goats and 21,000 horses kept on grasslands for wool and meat production, as well as for recreation. These numbers have been declining since 1970.

Historical background to livestock production in Belgium

Until recently, beef and milk production were joint activities on livestock farms in Belgium. Cows not suitable for milk production were fattened up with fodder produced on the farm. Farmers were therefore able to utilise land unsuitable for crops, as well as other by products, eg. beet pulp, at low labour costs. Milk production took place in about 80% of the farms in the 1950s. Beef production was widespread, but by 1980 only 15% of the farms keeping cattle specialised in beef production (Hellemans & Vard, 1994).

Grassland and fodder production is central to cattle production in Belgium. In the past, agricultural practice was based on the principle of recycling. Man and animals used minerals taken up by the plants, and manure was used as a fertiliser. The use of chemical fertilisers and purchased feed, changed this system and led to conflicts between production and the ecological function of grasslands. The increase in overall productivity meant that natural grasslands could no longer produce an adequate food supply. Technical innovations, eg. fertilisers, maize and silage production, were therefore required to enable the productivity to be increased. Natural grasslands were therefore either converted to new crops or were changed by addition of fertiliser.

Regional location of livestock production

Cattle are present on 62% of all farms in Belgium, but the number of farms keeping cattle varies between provinces and agricultural regions. In the Walloon provinces of the south, over 70% of farms keep cattle, as shown in Figure 1, but in Antwerp and Limburg only 50% of the farms have cattle. Although in Flanders the number of farms keeping cattle is lower than in the Walloon region, 60% of all farms that have cattle are situated in the provinces of Antwerp and eastern and western Flanders. Only 40% of the cattle in Flanders are suckling cows, whereas farms in the Walloon region have concentrated on suckling calf production. In 80% of the farms keeping cattle in Luxemburg and Namen, there are suckling cows and in 60% there are only suckling cows, as shown in Figure 2. The majority of beef production takes place in the Flemish provinces, and is based on concentrates, with more than 40% of the farms keeping animals for fattening. In these provinces, 74% of the farms that have no milking cows, produce beef. Milk production is concentrated in the Campine (Antwerp), Henegouwen, and the grassland region of Luik, representing almost 70% of the specialised dairy farms in Belgium. In the province of Luik about 50% of the farms keep milking cows but in the province of Antwerp this figure is only 30%. In the whole of Belgium, there is milk production in 29% of the farms.

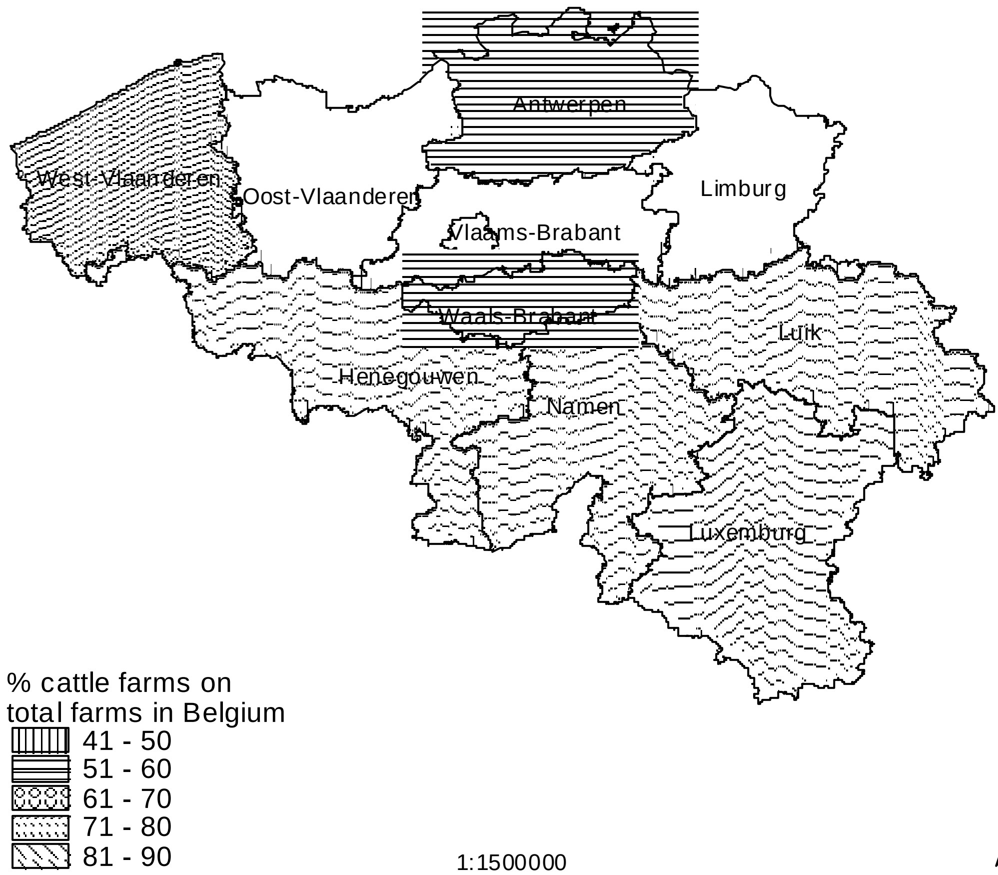

Figure 1. Percentage of cattle farms on total number of farms in the Belgian provinces. (Source: National Institute of Statistics (NIS), own calculations)

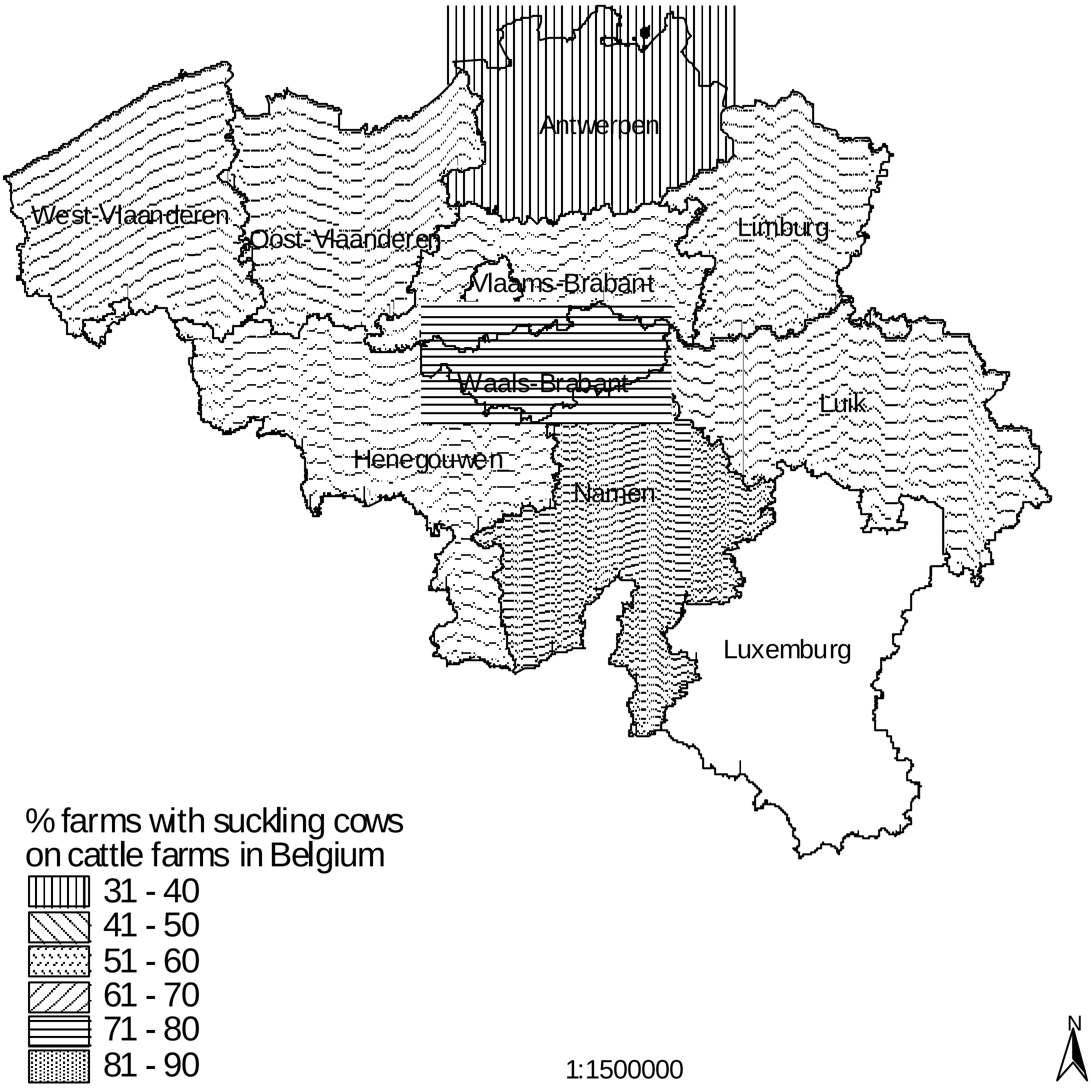

Figure 2. Percentage of farms with suckling cows on number of farms with cattle in the Belgian provinces. (Source: National Institute of Statistics (NIS), own calculations)

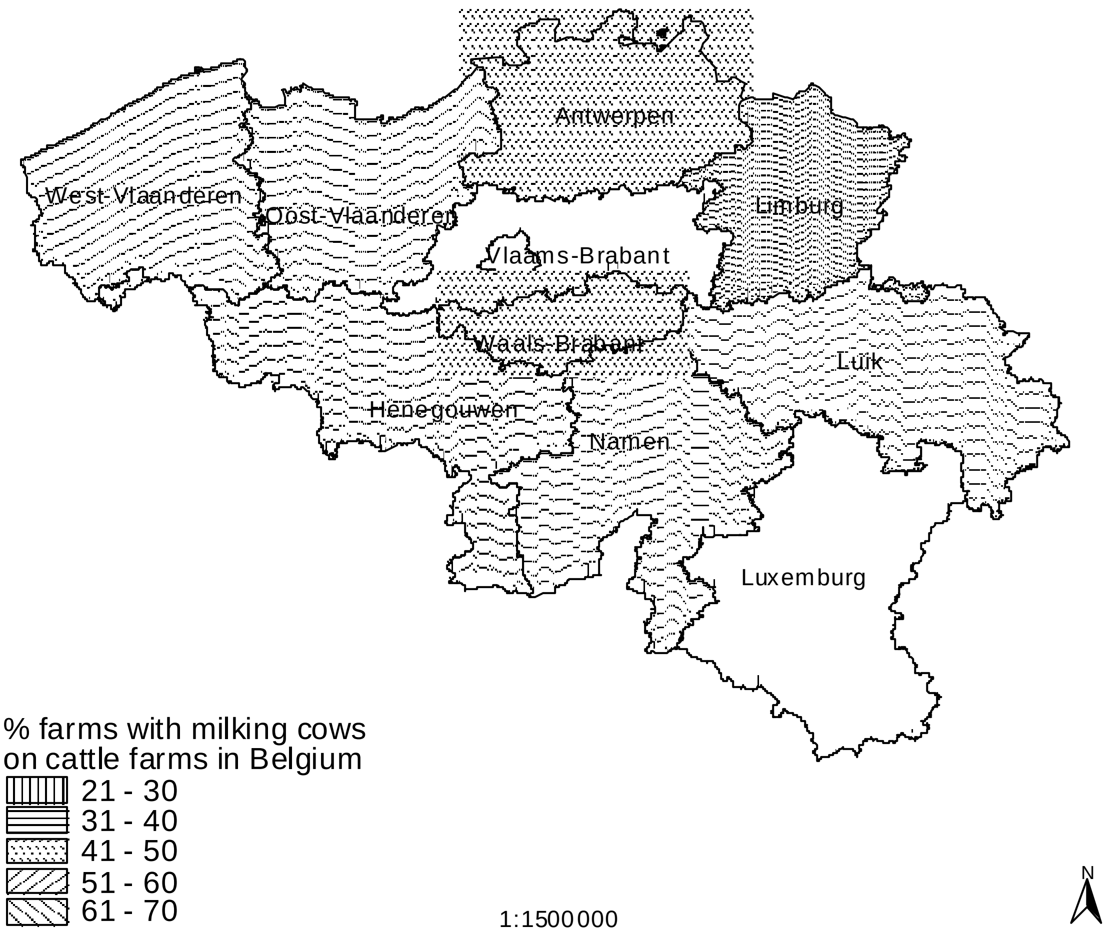

Figure 3. Percentage of farms with milking cows on total number of farms with cattle in the Belgian provinces. (Source: National Institute of Statistics (NIS), own calculations)

Breeds and animal numbers

Different breeds of cattle are used in Belgium for milk and beef production. The former is usually based on Holstein and the latter on the Belgian White-Blue breed, as shown in Table 3. The other breeds are local and mixed breeds, suitable for milk production and as suckling cows.

Table 3. Belgian cattle breeds: number of animals (Source: National Institute of Statistics (NIS))

	Flanders region	Walloon region	Belgium
White-Blue Belgian	214,013	372,015	586,028
Red Holstein	104,179	30,503	134,682
Black Holstein	153,657	131,699	285,356
Red West Flanders	12,625	2,273	14,898
White-Red East Flanders	41,491	2,901	44,392
Others	24,703	46,914	71,617

Milk quota was introduced in 1984 and led to a major restructuring of the dairy sector, involving a reduction in dairy farms by 60% in 15 years and milk cows by 32%, as shown in Table 4. In contrast there was an increase in specialisation as shown in Table 5. The number of cows per farm increased by 69% and, because of improved milk yield, milk production per farm expanded from 70 to 190 tons. The White-Blue Belgian breed expanded because of the Common Agricultural Policy (CAP) and a related change in the balance between the mixture of milk and beef production on farms.

Table 4. Evolution of the number of dairy cows, number of farmers holding dairy cows and number of dairy cows/farmer (Source: National Institute of Statistics (NIS))

Year	Number of dairy cows	Number of farmers holding dairy cows	Number of dairy cows/farmer
1981	941,911	47,242	19.9
1986	925,398	36,871	25.1
1991	788,637	26,354	29.9
1996	643,120	19,060	33.7

In 1981, 31% of the dairy cows were kept in herds of less than 20 dairy cows, whereas in 1996 this figure was only 10%. In 1981, only 4% of the farms kept more than 50 dairy cows, representing 14% of the total number of dairy cows, but by 1999, this had risen to 20% and 37%, respectively.

Table 5. Number of dairy cows in different typologies in 1996 (Source: National Institute of Statistics (NIS))

	Number of cows	%	Number of farms	%	Cows/farm	%
Very specialised milk production	277,737	43	6,161	32	28	45
Specialised milk production	117,130	18	3,149	16	23	37
Beef and milk production	97,031	15	3,766	20	17	26
Different animals and beef production	22,327	3	854	4	15	26
Pigs and beef	47,640	7	1,652	9	16	29
Crops production and milk production	45,967	7	1,516	8	19	30
Crop production and beef production	19,916	3	1,070	6	15	19
Others	15,372	2	892	5	9	17
Total	643,120	100	19,060	100	20	34

Farm size and production economics

In 1999, 21% of the farms holding cattle were between 30 and 50 ha, with 16% over 50 ha, as shown in Table 6. For farms with dairy cows the figures are 20% and 18% respectively. A further measure of intensification is provided by the increase in stocking density (number of cattle/ha grassland), which rose from 3.64 in 1970 to 5.24 in 1996, as shown in Table 7.

Table 6. Differences in farm size (ha) for cattle farms, farms holding dairy cows and farms holding suckling cows in 1999 (Source: National Institute of Statistics (NIS), own calculations)

	Number of cattle	%	Number of farms holding cattle	%	Number of dairy cows	%	Number of farms holding dairy cows	%	Number of suckling cows	%	Number of farms holding suckling cows	%
No crops	22,933	1	119	0	100	0	9	0	171	0	32	0
0,01 < 2 ha	29,448	1	2,278	6	626	0	199	1	3,212	1	1,130	5
2 < 5 ha	75,106	2	3,952	10	2,415	0	491	3	12,751	2	2,508	10
5 < 10 ha	144,231	5	5,193	13	11,733	2	1,159	6	30,752	6	3,541	15
10 < 20 ha	379,599	12	7,525	19	67,480	11	3,451	18	66,744	12	4,680	19
20 < 30 ha	482,289	16	6,333	16	123,045	20	4,121	22	68,769	13	3,467	14
30 < 50 ha	888,167	29	8,232	21	236,625	38	5,867	31	127,222	24	4,473	19
50 < 80 ha	666,638	22	4,318	11	136,539	22	2,804	15	129,509	24	2,834	12
80 en + ha	396,759	13	1,878	5	52,384	8	952	5	97,094	18	1,376	6
Total	3,085,170	100	39,828	100	630,947	100	19,053	100	536,224	100	24,041	100

Table 7. Changes in stocking density in Belgium (Source: National Institute of Statistics (NIS), own calculations.)

	1970	1990	1996
Number of cattle/ha grassland	3.64	5.13	5.24
Number of cattle/ha fodder crops	3.34	4.12	3.92

The highest density of Livestock Units (LU)/ha fodder crops is found in the province of Henegouwen (4.5). Throughout Flanders the average stock density is above 3.0 LU/ha, whereas in the southern Walloon provinces, the stock density is 2.6 LU/ha, as shown in Figure 4.

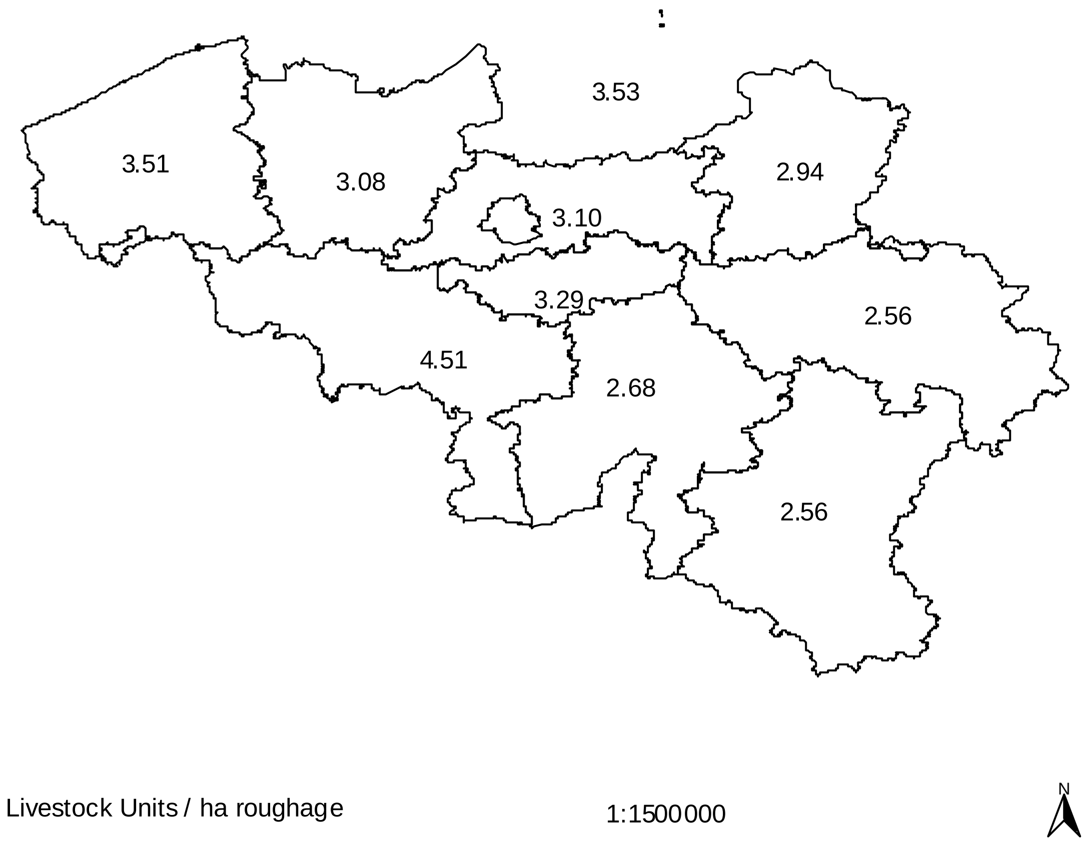

Figure 4. Livestock Units/ha fodder crops in the provinces of Belgian (Source: National Institute of Statistics (NIS) ,own calculations).

The profitability of dairy farms increased by over 30% between 1987 and 1994. In this period, the labour income per labour unit generally exceeded the comparable income in the very specialised dairy farms, and fluctuated between 70-80% of the comparable income in the less specialised farms, as shown in Table 8. The capital invested exceeded 0,5 MEURO and the initial capital brought in by the farmer represents 57%. Also Table 8 indicates the differences in farm structure, milk production and farm income between the different dairy farm systems (Bouquiaux & Hellemans,1998).
In 1996 for very specialised farms, the milk quota required for the comparable income amounts to about 272,000 litres per farm, ie. approximately 18,000 litres per labour unit.

Table 8. Farm structure, milk production and farm income in very specialised farms, farms specialised in milk production and farms specialised in beef and milk production

	Very specialised milk production	Specialised milk production	Beef and milk production
Surface / farm (ha)	32.4	36.3	38.1
Workers equivalent	1.5	1.6	1.7
Number of animals:			
- Milking cows	47.1	44.4	30.8
- Suckling cows	0.4	3.4	17.1
- Other cows	44.1	58.0	79.4
- Pigs	0.2	13.9	4.1
Farm Milk production (1000 l)	251.0	235.0	136.0
Cow milk production (l)	5,337.0	5,294.0	4,411.0
% fat (g / l)	43.4	42.3	40.5
Total farm income (EURO / ha)	3,105.0	3,075.0	2,600.0
- Of milk production	2,450.0	1,950.0	1,000.0
Total costs (without labour) (EURO / ha)	2,112.0	2,467.0	2,137.0
- Feeding costs	542.0	622.0	657.0
- Rent	520.0	507.0	410.0
Farmers income (EURO / ha)	992.0	852.0	467.0

In dairy farms, labour income varies widely between farms, leading to differences in production costs, without labour, varying from 0.1 to 0.3 EURO per litre of milk in 1996. In the same year, the average milk production amounted to 0.2 EURO / litre. The production costs are generally higher, in cases where farmers younger than 45 had invested heavily.

Beef farms can be divided into those selling lean or fat animals. The standard margin per animal remained at the same level because of the CAP. The difference observed between both types of farms is because most of the lean animals were sold before the drop in prices, as shown in Tables 9 and 10 (Bouquiaux & Hellemans, 1996).

Table 9. Differences in farm structure and income for beef production farms and relation to stocking rate

	Stocking Rate: 1.0-1.9	1.9-2.2	>2.2
Agricultural Area	50.3	53.9	45.8
Livestock Units/farm	67.2	106.7	118.9
Suckling cows/farm	43.2	67.8	76.2
Income from farm products (EURO/farm)	60,375.0	87,775.0	87,750.0
Total costs without labour (EURO/farm)	48,725.0	72,215.0	69,675.0
Grants (EURO/farm)	7,025.0	9,800.0	9,975.0

Although CAP reform encourages extensive husbandry, Table 9 shows that farms with higher stocking rates have higher incomes. The CAP reform measures have significantly reduced the profitability of intensive beef producers. Not only was the compensation inadequate but also their stocking densities were typically higher than eligibility ceilings for the compensatory premia. For most intensive beef producers, it has not been a viable option to extensify, and many have therefore ceased production. For those that remain, further intensification has been encouraged by lower prices and the premium for maize under the arable crop regime, leading to increased environmental pressure.

Table 10. Economics of beef production in 1994

1994	Farms with suckling cows selling lean animals (EURO/cow)	Farms with suckling cows with beef production (EURO/cow)
Beef production	1,215	1,397
Grants	189	177
Feed	263	412
Other costs	195	229
Standard margin	756	756
Structural costs	633	681
Farm income	123	74

Cattle rearing is based on grassland and fodder production. In Belgium, 45% of the agricultural area is grassland and the remaining 65% is used for fodder (grass, maize and beet). The introduction of maize as fodder has led to a decline in grassland. Thus, the area of permanent grassland has declined, involving a shift to temporary grasslands and maize, whereas fodder beet has almost disappeared. Grassland is primarily used between April and October for cattle and for the production of silage to be used in the winter, as shown in Table 11. In 1984, 45% of the milk production was based on fodder, but by 1996 this had increased to 53%. The use of concentrates has diminished from 1,000 kg/cow to 921 kg/cow, in 1997, representing more efficient use. At the same time, the use of by-products rose from 239 kg/cow to 418 kg/cow and the use of wheat from 139 to 285 kg/cow, with better utilisation of fodder. The rise in average stock density per ha grassland indicates the rise in productivity, but also because of the substitution of grassland by maize. Under the hypothesis that all grassland and fodder crops are used for cattle production, a hectare of fodder crops has an economical value of 2,887 EURO, which had risen by 47% between 1970 and 1996.

Table 11. Changes in grassland and fodder crops in Belgium (ha) (Source: National Institute of Statistics (NIS), own calculations)

	1970	1996
Grassland	794,582	619,116
- Temporary grassland for cutting	47,483	28,712
- Permanent grassland for cutting	178,268	51,619
- Temporary grassland for grazing	19,508	35,675
- Permanent grassland for grazing	549,323	251,822
Fodder crops	70,965	208,527
- Maize	37,632	198,072
- Beets	33,333	10,285
Total agricultural surface	1,542,422	1,375,284

Environmental problems related to cattle production in Belgium

Total nitrogen production in Belgium amounts to 323 M kg, 65 % of which comes from cattle, 25% from pigs and 8% from poultry, as shown in Table 12. Livestock production in Flanders is responsible for 63% of this total nitrogen production. The average animal nitrogen use is 230 kg/ha in Belgium, varying from 341 kg/ha in Flanders, to 168 kg/ha in the Walloon region. Table 13 shows the phosphate production which total 131 M kg in 1997, with cattle producing over 50% of the total (Michiels & Verbruggen, 1997).

Intensive dairy farming with high nitrogen fertilisation rates and high stocking densities creates major risks of nitrate pollution of the freatic layer. The nitrate concentration < 50 mg/l in groundwater used for drinking water, set by the Nitrates Directive can be exceeded under grassland.

The ammonia emission from livestock buildings, storage, grazing and manure application was 94,531 kton in Belgium in 1997. This figure is lower than in 1991 because of more efficient application of manure. In the Walloon region, cattle production is responsible for 92% of the ammonia emission, whereas in Flanders the figure is 35%, compared with 57% for pigs and 7% for poultry.

Table 12. Nitrogen production in Belgium in 1997 (,000 kg). Source: National Institute of Statistics (NIS)

	Flanders region	Walloon region	Belgium
Cattle	98,104.0	111,734.0	209,838.0
Pigs	78,664.0	2,817.0	81,481.0
Poultry	24,367.0	1,187.0	25,554.0
Other	3,974.0	2,612.0	6,586.0
Total	205,109.0	118,350.0	323,459.0

Table 13. Phosphate production in Belgium in 1997 (,000 kg). Source: National Institute of Statistics (NIS)

	Flanders region	Walloon region	Belgium
Cattle	32,973.0	35,132.0	68,105.0
Pigs	42,776.0	2,596.0	45,372.0
Poultry	13,873.0	1,280.0	15,153.0
Other	2,034.0	854.0	2,888.0
Total	91,656.0	39,862.0	131,518.0

Implications for biodiversity

Biodiversity has been significantly affected by the intensification of agriculture. The increased levels of application of fertilisers and herbicides, as well as lowering of the groundwater table, reseeding, increased cutting frequencies and grazing densities, has reduced biodiversity in many species rich grasslands. These grasslands can only be restored by positive management (Martens et al., 1998).
For example, in the Flanders region only 10% of the total grassland area is still species rich.

For this restoration management to succeed, at least four conditions should be fulfilled:
(a) the original hydrological conditions should still be present or should be restored
(b) the original management practices should be restored
(c) nutrient availability should be reduced
(d) propagules of the appropriate species should be available. Botanical restoration is only possible if the seeds of the original plant community are available.

The total acreage of grassland has diminished in recent years due to the reforming of the CAP in favour of maize. The premiums for maize have caused this shift, together with the intensification of the dairy sector. The use of maize has probably caused losses of biodiversity, and has also increased soil erosion, as well as the use of atrazine, and nutrient leaching over the short and medium term.

References

Bouquiaux J. & Hellemans R., 1996, Problématique de la production de viande bovine en Belgique. IEA, Etudes 73.

Bouquiaux J. & Hellemans R.,1998, Analyse économique de la production laitière en Belgique. IEA, Etude 80.

Hellemans R. & Vard T., 1994, Etude comparative des adaptations des producteurs laitiers a l'instauration des quotas. IEA, Etudes 62.

Martens K., VanBeek E. & Kuijken E, 1998, Restoring botanical diversity by reintroduction of plant species. In: Ecological aspects of grassland management 17th General Meeting of the European grassland federation.

Michiels J. & Verbruggen I., 1997, In-and output in Flemish dairy farming: the mineral balance. In: Proceedings of the 11th World Fertilizer Congress.

Classification and location of Finnish livestock and dairy systems

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Introduction

Livestock production is the main enterprise for about a half of Finnish farms, as shown in Table 1. Dairy husbandry is the main enterprise, with 30.7% of all active farms being specialised in milk production. Beef production, including suckler cows, or other cattle husbandry is the main activity for 7.6% of all farms. There are also 5,300 pig farms, accounting for 6.0% of all farms. Sheep farms are less important with about 1,000 units. Goats are negligible in Finnish livestock production.

Table 1. Distribution of enterprises on active Finnish farms in 1998

Whole country	Number of farms	Share of farms(%)
Crop production	40,908	46.4
Dairy husbandry	27,043	30.7
Other cattle husbandry	6,726	7.6
Pig husbandry	5,300	6.0
Poultry husbandry	1,561	1.8
Sheep husbandry	1,048	1.2
Goat husbandry	59	0.1
Horse husbandry	2,256	2.6
Other	3,169	3.6
Total	88,070	100.0

Finland extends 1,100 km from north to south and, therefore, climatic conditions differ through the country restricting the type of crops, crop varieties and the location of livestock production. In southern Finland crop production predominates. Pig and poultry production, linked to this grain production, is concentrated in southern and western parts of Finland. Cattle production, which utilises forage, has an important role in the eastern and northern parts of Finland, as shown in Figure 1.

The value of production also shows the importance of livestock production in Finnish agriculture. Gross returns to Finnish agriculture (at market prices) were FIM 9.870 million (1.67 M EURO) in 1999. The share of livestock enterprises was FIM 7.927 million (1.34M EURO) accounting for 80% of the value of total production.

Northern Finland	
Crop production	30.0%
Dairy husbandry	46.1%
Other cattle husbandry	9.6%
Pig and poultry husbandry	2.1%
Other	12,2%

Central Finland	
Crop production	45.0%
Dairy husbandry	31.2%
Other cattle husbandry	7.7%
Pig and poultry husbandry	10.0%
Other	6.1%

Eastern Finland	
Crop production	27.8%
Dairy husbandry	48.7%
Other cattle husbandry	11.1%
Pig and poultry husbandry	3.0%
Other	9.4%

Southern Finland	
Crop production	58.8%
Dairy husbandry	19.5%
Other cattle husbandry	5.7%
Pig and poultry husbandry	9.8%
Other	6.2%

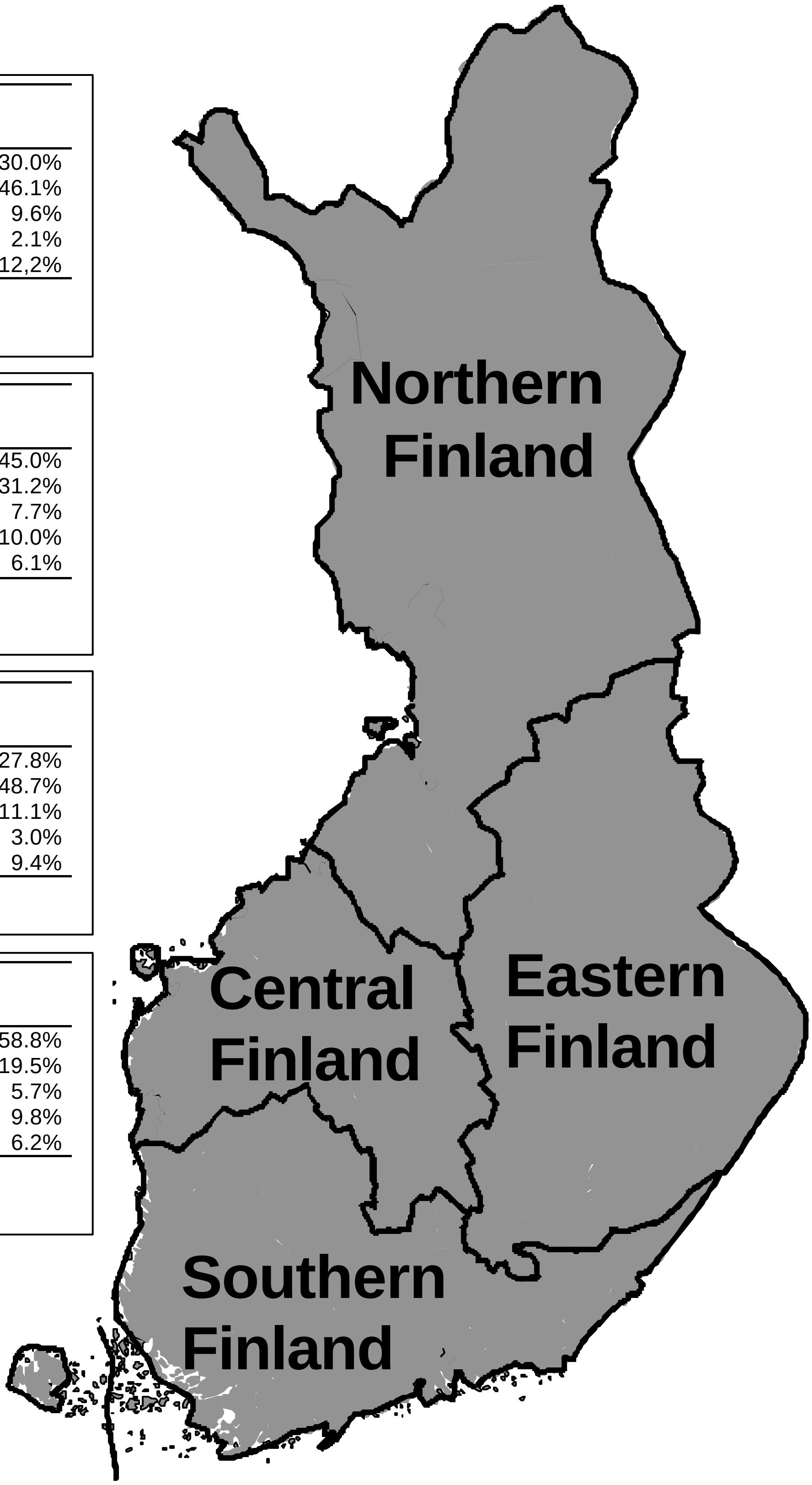

Figure 1. Distribution of enterprises on active farms in 1998. Source: Information Centre of the Ministry of Agriculture and Forestry.

The total number of Livestock Units (LU) is low compared to the area of cultivated arable land. Animal density is one of the lowest in Europe, about 0.5 LU/ha arable land. The number of cattle is about 0.28 LU/ha and the number of pigs about 0.14 LU/ha. Rigid environmental regulations guarantee that farms with livestock production also have a proportion of cultivated land.
Organic production has increased rapidly during 1990s, and continues to grow among crop and livestock producers. The total number of organic farms was 4,975 in 1998. The area under organic production was 103,000 ha in 1999 (4.7% of the cultivated arable land). When the area under conversion was taken into account, the total area under organic production was 140,000 ha (6.4%).

Description of the dairy system
(a) Type of production
The economic and technical systems associated with Finnish dairy production can be characterised as 'high input/output systems' (Final Report of European Commission (DGXI): The Environmental Impact of Dairy Production in the EU). Finnish milk production fulfils many conditions of intensive production but there are also features that are typical to 'low input/output' systems.
Systematic breeding, a high replacement rate and intensive feeding have resulted in high yields from milking cows. Feeding is based on grass silage, cultivated grassland and cereals that are mainly produced on the farm, provided it is climatically possible. The standard level of fertiliser use is 90 kg N/ha for cereals, 150 kg N/ha for pasture and 180 kg N/ha for silage. The average yield for silage is 4,000-4,500 fu/ha, for pasture 3,000-3,500 fu/ha, for hay 2,500-3,000 fu/ha and for cereals about 3,000 fu/ha.
Herd size on Finnish dairy farms is small in comparison with other intensive systems in Europe, in spite of the fact that there has been a rapid structural change in Finnish dairy production during the last ten years. Farms are still mainly family enterprises, where the only labour input is from family members. Families are, however, able to take care of bigger herds than earlier by utilising new technology. Structural change is going on all the time and herd size will continue to increase.
Finnish dairy farms are generally specialised but the standard dairy farm also produces some beef by fattening the bull calves of dairy cows. Dairy farms have a large arable land area compared to the herd size. Thus, the livestock density is lower than in typical intensive production systems.
Cows are housed during the winter months. About 94% of dairy farms have still conventional cow houses but new buildings that have been built during the last few years have been almost without exceptions free-range housing systems. Organic production is an increasing production system. At the moment the share of organic milk is still marginal, being only 0.7% of the total milk delivered to dairies (May 2000).

(b) Historical background of the system
After World War II, Finnish agricultural policy favoured increasing of domestic agricultural production. The number of dairy farms reached its maximum in 1959, being then 307,709 farms. The number of dairy cows was at that time 1,121,180 (3.6 cows/farm). By 1998 the

number of farms with dairy cows had decreased by 90% and the number of cows by 66%. The average herd size has increased by about ten cows.
The structural change is partly the result of several measures that have been undertaken to restrict the surplus production of milk. These restrictions have also prevented the farmers, who have continued their milk production, to increase their herd sizes. On the other hand, agricultural policy has had other objectives, for example, the settlement of rural areas, which might have been in contradiction with the aims concerning structural development of dairy farms. Environmental legislation, as a part of agricultural policy has become more important during recent years, which is also affecting the development and the production systems of dairy farms.

(c) Total number of dairy farms

The total number of dairy farms that have at least one dairy cow, were 28,689 in the year 1998. Dairy production is the main production line for about 27,000 farms. 26,350 farms delivered milk to dairies in 1998. In 1999 the number of milk deliverers was 24,340, ie. 7.6% less than the year before.
Even if the number of cows has been decreasing, increasing yields per cow have kept the aggregate production quite stable since 1991. Production is about 2,300 million litres per year.

(d) Regional location of the dairy systems

Milk is produced in all parts of Finland, including Lapland. But, the most important dairy production regions are 8, 9, 11 and 13, as shown in Table 2, which account for more than half of the total milk output in Finland. Most dairy farms are located in region 13, with about 3,300 farms. The share of dairy farms is highest in region 14 where about 57% of all active farms are in dairying, as shown in Table 2.

Table 2. Number of dairy farms by region (Employment and Economic Development Centres, as shown in Figure 2) in 1998.

Region	Number of farms with cows	Number of dairy farms	The share of dairy farms of all active farms (%)
1. Uusimaa	806	727	13.60
2. Varsinais-Suomi	956	853	9.01
3. Satakunta	1,121	1,017	16.25
4. Häme	1,643	1,535	24.51
5. Pirkanmaa	1,835	1,695	27.93
6. Kaakkois-Suomi	1,904	1,797	32.20
7. Etelä-Savo	2,021	1,904	42.25
8. Pohjois-Savo	3,238	3,172	51.54
9. Pohjois-Karjala	1,979	1,865	48.47
10. Keski-Suomi	1,813	1,699	36.77
11. Etelä-Pohjanmaa	3,225	3,052	30.71
12. Pohjanmaa	2,492	2,306	28.62
13. Pohjois-Pohjanmaa	3,395	3,291	45.66
14. Kainuu	924	858	56.93
15. Lappi	1,172	1,125	47.63
16. Ahvenanmaa	165	147	18.54
Total	28,689	27,043	30.71

(e) Breeds

There are no statistics concerning breeds on all dairy farms in Finland. However, 75% of cows belong to a milk recording system, under which much information is collected. According to this milk recording statistics, the shares of different breeds were in 1999: Ayrshire 74.8 %; Friesian 24.0 %; Finnish cattle 1.0 %; and others 0.2 %.

(f) Average number of animals on each farm and range

There were 383,053 milking cows on 28,689 farms in the year 1998. The average number of cows per farm was therefore 13.4. The average number was 15.3 in 1999, if only farms that delivered milk to dairies were taken into the count. Most farms have 10-14 cows and very few farms have more than 50 cows. Most cows are in herds with 15-19 cows and more than 75% of dairy cows are on farms, which have from 10 to 30 cows, as shown in Table 3.

Table 3. Number of farms by herd size in 1998.

Herd size	Number of farms	Share of farms, %	Number of cows	Share of cows, %
1	959	3.34	959	0.25
2	593	2.07	1,186	0.31
3	513	1.79	1,539	0.40
4	682	2.38	2,782	0.73
5-6	2,099	7.32	11,673	3.05
7-9	4,601	16.04	37,006	9.66
10-14	8,018	27.95	96,265	25.13
15-19	6,182	21.55	103,923	27.13
20-29	4,229	14.74	97,301	25.40
30-39	632	2.20	20,905	5.46
40-49	114	0.40	4,939	1.29
50-74	51	0.18	2,965	0.77
75-99	8	0.03	640	0.17
100-	8	0.03	1,033	0.27
Total	28,689	100.00	383,053	100.00

Dairy cows account for a half of the total number of LU on cattle farms as shown in Table 4. The average number describes the Finnish production system where heifers for replacement are usually grown on the same farm with dairy cows. Besides, some dairy farms also fatten bull calves for beef production. The average number of livestock units was 25 LU per cattle farm in 1998. The share of cows of all livestock units is highest on farms with 15-30 hectares arable area as shown in Table 4. These figures may be, however, misleading, because suckler cows are in the same table with dairy cows and in practice there are no farms having both dairy cows and sucklers on the same farm.

Table 4. Number of cattle on farms by field area group in 1998.

Field area ha	Dairy cows	Suckler cows	Heifers 1 year or over	Bulls 1 year or over	Calves 6-12 months	Calves Under 6 months	Cattle total, heads	Cattle total, LU
0.00-0.99	2,001	204	691	1210	386	361	4,853	3,577
1.00-1.99	122	11	72	78	43	31	357	249
2.00-2.99	135	13	67	81	62	37	395	274
3.00-4.99	1,140	128	595	571	640	501	3,575	2,352
5.00-9.99	10,329	752	4,793	4,157	5,376	4,810	30,217	19,677
10.00-14.99	27,572	1,867	12,743	9,125	13,760	13,341	78,408	50,816
15.00-19.99	44,249	2,106	20,474	11,680	20,865	20,511	119,885	78,166
20.00-24.99	52,367	2,496	24,043	12,959	24,609	24,500	140,974	91,830
25.00-29.99	52,164	2,369	24,746	12,108	24,630	24,649	140,666	91,423
30.00-39.99	79,242	4,287	39,220	19,769	39,833	38,926	221,277	142,822
40.00-49.99	47,476	4,064	24,220	15,240	27,002	25,966	143,968	91,417
50.00-74.99	47,519	6,052	26,438	18,103	30,143	29,090	157,345	98,381
75.00-99.99	11,018	2,636	6,568	5,636	8,028	7,836	41,722	25,793
100.00-	7,719	3,592	5,675	4,032	6,217	6,199	33,434	20,865
Total	383,053	30,577	190,345	114,749	201,594	196,758	1,117,076	717,643

There is much specialisation on cattle farms. Cattle farms have therefore typically only cattle and no other livestock. About 54.5% of livestock farms have dairy cows or other cattle. Only 0.6% of livestock farms have both pigs and cattle and 0.8% both chickens and cattle. Finally, 3.6% of livestock farms have some other animals in addition to cattle.

(g) Average farm size and range

The average size of a Finnish farm is 80 hectares, of which 43 ha are forest and 25 ha are cultivated land. The average cultivated area on dairy farms is 28.5 ha. The range in different regions, as shown in Figure 2, is from 20 ha in region 7, to 40 ha in region 1.

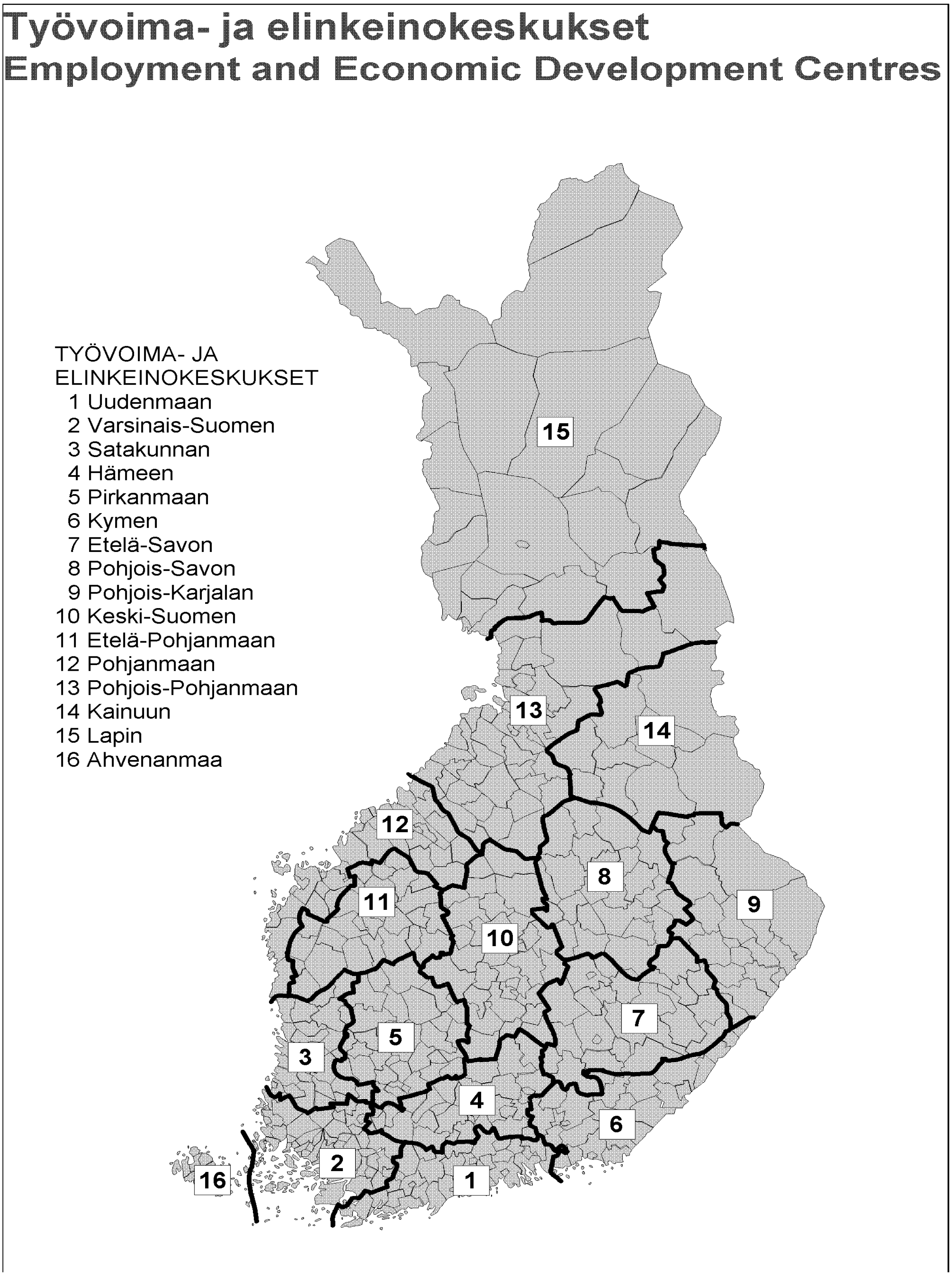

Figure 2. Employment and Economic Development Centres.

(h) Quotas and premium rights

The dual price system for milk was applied for the first time at the beginning of 1985 when the surplus of milk production was about 30%. A quota was set for each farm on the basis of their milk production in either 1981/82 or 1982/83, whichever was higher. If the amount of milk delivered to dairies exceeded the quota, a quota charge was collected. All farms that produced milk at the beginning of 1985 could, however, produce up to 30,000 litres a year without any quota.

At the beginning of 1988 a quota system for dairies came into force. The goal was to prevent dairies from taking advantage of the free quotas of farms (farms that produced less than 30,000 litres a year) or, in general, from increasing milk production for economic reasons. The quotas for dairies were abolished in 1993.

At first quotas were non-tradable. Thus the system impeded the structural development of dairy production. Some decisions were made to relax the quota system during the years 1989-1990 but the most important reform took place during the years 1993-1994, just before the Finnish EU membership. Since then it has been possible to rent and purchase quotas, at first when a farmer bought the quota and land from other farmer, who quit the production. Later the trade for quotas was separated from land transaction such that quotas, alone, became tradable.

Since 1995 the Finnish milk production has been regulated by the quota system of the European Union. In the accession treaty the dairy milk quota for Finland was set at 2,342 M kg and the direct sales quota at 10 M kg. In the quota year 1999/2000 milk production exceeded the national quota of 2,395 M kg by 14 M kg ie. the production of a couple of days. It was the first time in Finland the national quota was exceeded.

This production above the national quota means that an additional quota charge must be paid. Since 1992 the additional charge has been 115% of the target price for milk according to the CAP. The penalty is collected from those producers who have exceeded their quotas. Farmers, producing milk completely without quotas, have to pay a full penalty for every litre of milk they deliver to dairies. For those, who have a quota, the penalty per litre is lower, because their penalty depends also on the total amount of litres that exceed the quota on a farm level. The national penalty is collected from producers in the proportion of total exceeding litres. Producers will also lose national subsidies for all the litres they pay the quota charge for.

If total milk production is lower than the national quota, farmers will get all the production premiums normally for all the litres that they produce. There are, however, some investments subsidies that can be granted only if a farm has a certain amount of milk quota.

(i) Average net income and range

The economic performance of Finnish dairy farms is presented here according to the European Union Farm Accountancy Data Network (FADN) standards. Because of the annual variation, the results of the three years are collected into table 5, which also includes statistics on size and the land use of FADN-dairy farms.

Table 5. European Union-Farm Accountancy Data Network (EU-FADN) results, accounting years 1995-1997, Finland, dairy farms.

	1995	1996	1997
Farms represented	25,900	24,646	24,718
Sample farms	489	462	450
Exchange rate	5.71	5.83	5.88
Economic size – ESU	20.88	22.06	22.6
Labour input – AWU	2.11	2.08	2.04
Utilised Agric. Area – ha	26.20	27.57	28.26
- cereals	6.24	7.42	8.43
- other field crops	0.27	0.3	0.21
- vegetables and flowers	0.00	0.01	0.01
- forage crops	18.65	18.96	18.79
- agric. Fallow	0.38	0.24	0.16
- set aside	0.61	0.54	0.57
Total livestock units	23.37	24.41	24.6
- dairy cows	14.07	14.67	15.0
- other cattle	9.13	9.61	9.6
Graz. Livestock/forage ha	1.18	1.23	1.3
Milk yield – kg/cow	6,867	6,622	6,840
Total output	42,850	43,389	43,917
Total input	43,935	44,623	45,589
Subsidies	25,646	24,902	24,337
Family farm income	24,461	23,577	22,605
Family farm income/FWU	12,027	11,732	11,510

The variation of profitability of dairy farms is large. Profitability depends on the region, on the farm size and also on the farmers' management skills. For example, the production cost of milk was FIM 3.09 per litre on an average bookkeeping farm in the year 1996. The lowest cost was FIM 1.94 and the highest cost FIM 7.03.

(j)Ownership

There are exact statistics on the ownership of all active farms but not on dairy farms separately (Table 6). The distribution of the ownership on all active farms reflects, however, the ownership of dairy farms, too. Virtually all dairy farms are therefore privately owned.

Table 6. The share of active farms by owner in 1998 (%).

Owner	Share of active farms
Private individual	87.82
Heirs, family company	11.53
Stock company	0.32
Foundation, school etc.	0.07
Municipality	0.06
State	0.05
Others	0.14

Company ownership has been increasing recently. It can be assumed that this trend will continue since the need for capital and labour will continue to increase with the growing farm size.

(k) Land use

There are only approximate statistics concerning the land use on dairy farms, as shown in Table 7. More exact information is included to the results of FADN farms in Table 5.

Table 7. Land use of dairy farms by region, as shown in Figure 2, in 1998.

Region	Total agric. And hortic. Area	Average area of arable land	Rented arable land	Arable land under cultivation	Rough grazing and pasturage	Forest land	Other land	Total
1	28,717	39.50	8,008	28,649	468	26,845	5,347	60,909
2	26,394	30.94	5,490	26,317	638	19,389	7,104	52,887
3	25,955	25.52	7,302	25,887	455	37,676	10,468	74,099
4	46,904	30.56	10,844	46,782	629	62,761	9,394	119,059
5	49,435	29.17	15,895	49,274	843	75,143	14,467	139,045
6	51,707	28.77	13,961	51,588	401	78,249	11,897	141,853
7	39,477	20.73	11,805	39,274	998	121,216	15,694	176,387
8	87,583	27.61	23,232	87,178	1,655	179,349	26,501	293,433
9	49,665	26.63	14,055	49,485	867	100,755	16,419	166,839
10	41,986	24.71	12,804	41,814	691	105,446	16,430	163,862
11	88,985	29.16	25,730	88,800	253	110,624	45,179	244,788
12	70,573	30.60	20,203	70,384	350	113,093	51,973	235,639
13	111,289	33.82	33,061	110,834	1,109	204,651	122,714	438,654
14	20,085	23.41	6,215	19,814	416	74,501	30,536	125,122
15	27,546	24.49	9,790	27,111	651	143,162	108,124	278,832
16	4,108	27.95	1,460	3,869	2,508	5,586	7,209	16,903
Total	770,409	28.49	219,853	767,061	12,931	1,458,447	499,453	2,728,309

Total agricultural and horticultural area of dairy farms is 770,409 ha (28.5 ha/farm), part of which is rented. The rented arable area is 219,853 ha (8.1 ha/farm, 11.9ha/rented farm). Arable land under cultivation is 767,061 ha. The area under rough grazing and pasture is 12,931 ha on 5,830 dairy farms. The area of rough grazing and pasture, which is not utilised, is about double, 24,463 ha on 13,315 farms (included in the area of other land). If forest land (53.9 ha/farm) and non-productive land (18.5 ha/farm) is included to the area of dairy farms, the total area is 2728,309 ha (100 ha/farm).

The cultivated area of dairy farms is allocated to two main crops: two thirds forage crops and one-third cereals, as shown in Table 5.

(l)Average stocking density and range

The aggregate number of LU on cattle farms with more than 1 ha arable area is 714,065. The arable land area on the same farms is 986,950 ha. Thus the livestock density is on the average 0.72 LU/ha. The density is higher on small farms. On average, all farms with 5 or more hectares of arable land have less than one livestock unit per hectare.

Table 8. Total number of Livestock Units (LU) by arable area and the livestock density on cattle farms in 1998.

Field area group	Arable area (ha)	Number of cattle (LU)	Livestock Units/ha
1.00-1.99	56	249	4,45
2.00-2.99	114	274	2,40
3.00-4.99	2,171	2,352	1,08
5.00-9.99	22,476	19,677	0,88
10.00-14.99	59,967	50,816	0,85
15.00-19.99	93,748	78,166	0,83
20.00-24.99	112,186	91,830	0,82
25.00-29.99	116,427	91,423	0,79
30.00-39.99	192,459	142,822	0,74
40.00-49.99	134,364	91,417	0,68
50.00-74.99	157,600	98,381	0,62
75.00-99.99	49,466	25,793	0,52
100-	45,916	20,865	0,45
Total/Average	986,950	714,065	0,72

(m) Grazing and feeding practices

Dairy cows are on pasture on about 85% of farms. About 5% of farms feed cows in an outdoor yard in summer. The rest (10%) of farms do not have any grazing system. 95% of dairy farms keep the cows totally inside in winter. The length of grazing period is on average 110 days, from the last week of May to the middle of September. There is, however, variation in different parts of Finland, from 85 days in Lapland to 125 days in the south. The grazing land is mainly cultivated grass. Only suckling cows and heifers are typically grazing on meadows and rough grazing land, if those areas are utilised at all.

According to the results of milking records, cows receive on the average around 800 feed units from pasture. It is 14-15% of the total demand of feed units. The share of feed units from pasture is only 8-9% in Lapland and 17-18% in some south-eastern parts of Finland. Grass, including silage, hay and pasture, accounted for 56% of feed units in 1999, most of which is produced on farm. The average rate of self-sufficiency in feed varies annually from 70% to 80% depending on weather conditions during the growing season.

References

Agriculture. Census of Agriculture. Volume I. General Section, 1959, Official Statistics of Finland, III:53. Helsinki 1962

Dairy statistics. Information Centre of the Ministry of Agriculture and Forestry. Helsinki 2000

Elintarviketalous, 2000, (Food business 2000). Food and Farm Facts Ltd. Helsinki 2000.

Farm Register, 1998, Information Centre of the Ministry of Agriculture and Forestry. Helsinki 2000. Finnish Agriculture and Rural Industries 1999/2000. Agricultural Economics Research Institute, Finland. Publications Helsinki, 2000.

Maidontuotannon tulosseminaari, 1999, (Milk recording results 1999). Association of Rural Advisory Centres. Helsinki 2000

Yearbook of Farm Statistics, 1999, Official Statistics of Finland. Agriculture, forestry and fishery

Information Centre of the Ministry of Agriculture and Forestry. Helsinki, 1999, 1999:12.

Three examples of agricultural landscapes from Finland.

Plate 1. Southern Finland. This picture was taken in the coastal area and shows the traditional system of drying hay for winter. This system is now being replaced by silage, which forms the basis for most cattle fodder in Finland. If hay is being used it is now normally baled. This drying system is more often seen in northern and eastern parts of Finland.

Plate 2. Southern Finland. Large open cultivated areas are typical of southern Finland. Most farms are specialised in crop production and dairy cows in fields are unusual. The concentration of milk production in central Finland and changes in grazing practice, has negative effects on biodiversity.

Plate 3. Western Finland. Vernacular rural architecture is distinctive on the western coastal region of Finland. Beef production is not important in Finish agriculture and is mainly based on bull calves of dairy cows. Beef cattle may, however, be locally important and have an important role in maintaining meadows and pastures in agricultural use.

The allocation of dairy systems in the 15 countries of the European Union based on farm statistics and land cover: a case study from The Netherlands

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Introduction

In the appraisal and evaluation of the European livestock policy it is essential to locate the broad distribution of the principal livestock systems. It is not sufficient for policy makers to know what the impact of a policy change will be, but also where the impacts will occur and how they will vary within different regions. The European Livestock Policy Evaluation Network (ELPEN) decision support system is therefore designed to be spatially explicit and needs to combine a range of spatial and statistical data. The regional variations in climate, soil, vegetation and social structures within the European Union (EU), together with the increasing policy trend to de-centralisation, implies that the system needs to be spatially explicit, not only at national levels, but also at regional or, if possible, local levels. The latter is however dependent upon the level of detail available.

This paper is focused on dairy systems since they are land-dependent and are likely to change substantially in the near future. In order to locate dairy systems within the 15 EU countries, it is necessary to connect the different dairy farming types with the bio-physical features of the areas in which they are located. However, statistical data sources do not contain such information in the necessary detail. Therefore, expert knowledge is necessary to combine available statistical and geographical data. In the first section of the paper, the available statistical and geographical data sources that are related to dairy systems are described at a European level. The problems encountered when using them to precisely locate these systems are then defined. Statistical data from Eurostat Luxembourg were selected to identify the dairy farming types. European (Co-ordination of Information of the Environment, CORINE) and national (LGN-3 for the Netherlands) land cover databases were then used in conjunction with the Eurostat data to locate the dairy systems. In the second section of the paper, the Farm Structure Survey (FSS) database of Eurostat is used to analyse the land use of dairy systems in the European agricultural space. The objective of the analyses is to examine the differences in the measures of the area of land used by dairy systems between the 15 EU countries. Finally, national data from the Netherlands are used to specify the location of dairy systems as an example of the value of using more detailed data.

Statistical sources on dairying

At a EU level the main regional specific statistical data sources about livestock are the Regional databank (REGIO) and the Farm Structure Survey (FSS/Eurofarm) of Eurostat,

and the Farm Accountancy Data Network (FADN) of the European Commission (DG VI Agriculture).
REGIO consists of the regional socio-economic statistics produced annually by Eurostat, which cover the main economic and social agricultural facts related to the EU. The Member States are spatially divided into statistical territorial units NUTS (*Nomenclature des Unités Territoriales Statistiques*), in French; Nomenclature of Territorial Units for Statistics. The NUTS situation in 1995, before the large changes around 1999, subdivides the territory of the EU into 15 NUTS-0 regions, 77 NUTS-1 regions, 206 NUTS-2 regions and 1031 NUTS-3 regions, as shown in Table 1. The cattle, pig, sheep and goat populations are taken from the EU livestock surveys carried out by the Member States in December each year. However, for The Netherlands, United Kingdom and Denmark, the results of the December survey have been regionalised based on another survey carried out during that year.

Table 1. Regional land divisions of the 15 EU countries. REGIO (Regional databank of Eurostat), FSS (Farm Structure Survey/EUROFARM of Eurostat) and FADN (Farm Accountancy Data Network of the European Commission, DG Agriculture). HARM is the abbreviation for the harmonised divisions created by the Dutch Agricultural Economics Research Institute (LEI).

Code used in this paper	Source	Code used in source	Number of territorial units in EU15 (1995)
NUTS-0	REGIO	Member State	15
NUTS-1	REGIO	NUTS-1	77
NUTS-2	REGIO	NUTS-2	206
NUTS-3	REGIO	NUTS-3	1031
FSS-0	FSS/EUROFARM	Member State	15
FSS-1	FSS/EUROFARM	Region	129
FSS-2	FSS/EUROFARM	District	502
FADN-0	FADN	Member State	15
FADN-1	FADN	Region	104
HARM-0	LEI	Member State	15
HARM-1	LEI	Region	100
HARM-2	LEI	Subregion	482

The FSS data published by Eurostat are aggregated by region, farming type and size class and are available since 1975. The aggregated data are based on individual agricultural holdings, larger than certain FSS specific thresholds. They are collected in agricultural census surveys every ten years, or three intermediate sample surveys on the nineties in 1993, 1995 and 1997. Data for basic surveys are available in a three level geographical breakdown of the whole country (FSS-0), the regions (FSS-1), and the subregions (FSS-2), as shown in Table 1. However, data for intermediate surveys are only available for FSS-0 and FSS-1 levels. The calendar for the basic and intermediate surveys is broad, the time intervals being, respectively 27 and 15 months.
The Directorate General Agriculture of the EU, created the FADN database in order to provide information on the level of farm incomes and analyses of the effects of policy options. FADN is based on the annual accounting results for a sample of commercial farms in the EU Member States. Commercial farms refer to farms, which are large enough to provide a main activity for the farmer and a level of income sufficient to support the

farmer's family (CEC, 1989:4). Farms are classified as 'commercial' when they exceed a minimum economic size, measured in European Size Units (ESU). Because of different farm structures in the Union, the thresholds applied for the economic size of farms vary among Member States. The farms in the sample are rather heterogeneous. FADN stratifies farms according to region, economic size and farming type to reflect this heterogeneity adequately. Data at an individual farm level are confidential, so that only results aggregated for a group of farms are available. Nine types of farming are used in FADN publications based on the more detailed farming types specified in the Community typology of agricultural holdings. There are 104 FADN regions, which vary in size from whole member states in small countries (eg. Denmark, Ireland and The Netherlands) to regions in large countries (eg. four regions in Greece and 22 in France). The time period for data collection relates to a period of 12 months. Member States have accounting years starting on different dates and in some Member States the beginning of the accounting year is not the same for all farms.

Therefore, the main problems encountered when using these statistical data are:

(a) different definition of territorial units. There are several regional divisions of the European national areas, depending on the statistical sources used. To harmonise the differences between the territorial units in REGIO (NUTS division), FSS and FADN, the Dutch Agricultural Economics Research Institute (LEI) has created the HARM divisions, as shown in Table 1. However, this harmonised re-classification of regions involves loss of regional detail.

(b) the available spatial details at a regional level vary within data sources per country.

(c) the available spatial details at a regional level vary within data sources per year. The agricultural statistics from REGIO analysed in our study are only available up to 1997 at NUTS-2 level, and for UK only at NUTS-1 level. In addition, there are major gaps, eg. recent FSS data are only available up to 1997 at FSS-1 level. On the other hand, the FSS tables are relatively complete.

(d) data reliability. Most data are produced from sample surveys, the size of which varies with country and survey year, eg. the sample size varies between 3% and 40% of the total population of agricultural holdings for FSS, although also the intermediate surveys are census surveys for a few Member States. On the other hand, the number of farms covered by FADN represented, on average, 57% of the total amount of farms in the EU, in 1985. In addition, the time given for carrying out the surveys is in general large, varying from 12 to 27 months, depending on the source. Finally, the size of the regions varies widely between Member States. These three factors inevitably result in inconsistencies of the statistical data between the sources.

(e) the FSS data available at a subregional level are out of date, with 1990 being the most recent year because the survey takes place only every ten years.

From the three statistical sources presented, the FSS database was selected for the allocation procedure for the Netherlands presented in this paper, because it provides the most complete and homogeneous information about land use by farming type.

Spatial Data Sources: CORINE and the national land cover database of the Netherlands (LGN-3)

Land cover information plays a key role in the allocation of dairy farms. The CORINE land cover database was used as a source of geographical reference.

The CORINE program was set up by the then EEC, in 1985. Several databases were created to provide environmental information. One of them is the CORINE Land Cover database, which defines land cover in 44 classes of vegetation and land use, is also grouped into three levels and covers the entire land surface of the EU. CORINE Land Cover was used as the main geographical database to locate the dairy systems because:

(a) it is available for all the 15 EU countries at level three (44 land cover classes), except for Finland and Sweden, for which only level one with seven classes currently exists.
(b) it is based on a relatively consistent computer assisted visual interpretation derived from satellite imagery, combined with complementary information.
(c) it is the only source of information available concerning land cover at such a detailed scale (1:100,000). CORINE uses a minimum-mapping unit of 25 ha.

Study revealed that the following seven CORINE land cover classes were the best associated with land-dependent livestock systems, ie. pastures, annual crops associated with permanent crops, complex cultivation patterns, land principally occupied by agriculture with significant natural vegetation, agro-forestry areas, natural grasslands, and moors and heath lands. Inevitably, the area covered by the seven classes does not consist entirely of grazing land, eg. it may include scrub or patches of woodland. Therefore, further information is required to estimate the percentage of grassland within each of the seven CORINE classes. In the case study for the Netherlands presented in this paper, this additional information was obtained from the third version of the national land cover database of the Netherlands (LGN-3 database), developed at Alterra by the Centre for Geo-Information. The LGN-3 version is more accurate, detailed, more recent than CORINE, and is based on a pixel-by-pixel automatic classification of satellite images (Landsat TM and SPOT) from 1995-1997. The spatial resolution of the database is 25 m. The classification procedure integrates multi-temporal satellite imagery, digital and analogue ancillary data, reference data and expert knowledge (Thunnissen & de Wit, 2000). The LGN-3 database consists of 39 classes, from which two, natural grassland and maize, are relevant for the location of dairy farms, as the latter is only used for cattle feed in the Netherlands. In general, the accuracy of classification of most agricultural crops is high (>70%), unless the total crop area in a specific 'agricultural stratum' is relatively low or the concerned crops show a large spectral variability (Thunnissen & de Wit, 2000).

The comparison between CORINE and LGN-3 given in Table 2, shows that grassland is found in a significant proportion in several CORINE classes. The pastures contained 64%, but also other classes associated with land-dependent livestock, ie. land principally occupied by agriculture contained 52%, annual crops 45%, and complex cultivation patterns 41%. This is caused by the methodology used by CORINE, which is landscape orientated, and therefore most of classes actually contain mixtures of land uses. It is also notable that in the Netherlands, the CORINE agroforestry areas do not include any grassland according to LGN-3, indicating the problems of definition associated with satellite images.

Table 2. Summary matrix of CORINE and LGN-3: composition of the seven CORINE classes associated with land-dependent livestock, according to LGN-3 (%).

	CORINE						
LGN-3	Pastures	Annual crops associated with permanent crops	Complex cultivation patterns	Land principally occupied by agriculture	Agro-forestry areas	Natural grasslands	Moors and heath lands
Natural grassland	64.1	44.6	40.8	51.5	0	3.6	12.8
Maize	6.3	3.4	14.3	13.1	0	0.2	3.9
Potatoes	1.7	9.6	3.6	1.0	0	0.3	2.0
Beets	0.9	0.4	2.9	0.5	0	0.2	1.0
Cereals	1.7	3.1	3.3	0.8	0	0.5	1.2
Other agricultural crops	1.7	3.7	5.6	1.4		0.3	1.2
Deciduous forest	2.6	25.7	3.9	8.6	0	7.9	6.1
Coniferous forest	1.3	0.0	4.5	5.9	0	1.8	24.2
Heath	0.1	0.0	0.1	0.0	0	0.0	13.0
Nature with low vegetation	1.9	3.3	1.4	1.4	0	46.4	24.6
Rest	17.7	6.2	19.6	15.8	100	38.8	90.0
Total	100.0	100.0	100.0	100.0	100	100.0	100.0

Land use statistics of dairy farms in the 15 EU countries

The FSS data on the land use types by each farming type, were used in order to make rules that will enable the presence of dairy farm types in the different European countries to be linked with the specific CORINE land cover classes. The FSS data give the total area of all agricultural holdings per land use type. The following combination of farm and land use types were selected:

(a) specialist dairying as the principal type of farming (code 41)

(b) the land uses whose area contributes significantly to the total area of the holding:

- (b1) permanent pasture and meadow, termed grassland,
- (b2) forage roots and brassicas, forage plants and fallow land, termed fodder as a whole,
- (b3) arable land excluding fodder, termed other arable land,
- (b4) unutilised agricultural land
- (b5) and finally woodland

(c) the most recent national data available: 1995 for Portugal and Sweden and 1997 for the other 13 EU-countries.

For this selection, the percentage of the total area of all dairy holdings that was occupied by each of the main five land uses was the calculated for each country, as shown in Table 3.

These percentages indicate the relative importance of a land use on specialised dairy farms (farming type 41), according to the FSS data. This is termed the Land Use Percentage (LUP). The sum of the LUP of the five land uses is approximately 100 for all the 15 countries, which indicates that these five land use types occupy the total area of all dairy holdings in each country.

Table 3. Land Use Percentage (LUP) of dairy farms (farming type 41) in the 15 EU countries. Source: Eurostat (FSS/EUROFARM), Luxembourg. Data are from 1997, except for Portugal and Sweden (1995).

	LUP (%)					
Country	Grassland	Fodder	Other arable land	Unutilised agricultural land	Woodland	Sum
The Netherlands	74	19	2	2	3	100
Ireland	72	20	2	4	2	100
United Kingdom	64	25	8	1	2	100
Germany	53	18	17	2	10	100
Belgium	52	35	11	2	0	100
Luxembourg	52	22	20	1	5	100
Austria	50	6	5	3	36	100
Spain	47	18	12	9	14	100
France	45	36	14	2	3	100
Italy	39	32	8	6	15	100
Portugal	36	32	13	4	13	98
Denmark	13	48	35	2	2	100
Greece	5	21	69	2	0	97
Sweden	7	23	13	10	47	100
Finland	0	17	9	19	55	100

Based on the LUP, the 15 European countries were clustered according to the relative surface occupied by grassland, fodder crops and woodland, as shown in Figure 1. Grassland is the main land use associated with grazing livestock, and it is therefore used as first criterion. As is seen in Figure 1, grassland indeed occupies more than 30% of the total area of the dairy holdings in eleven countries.

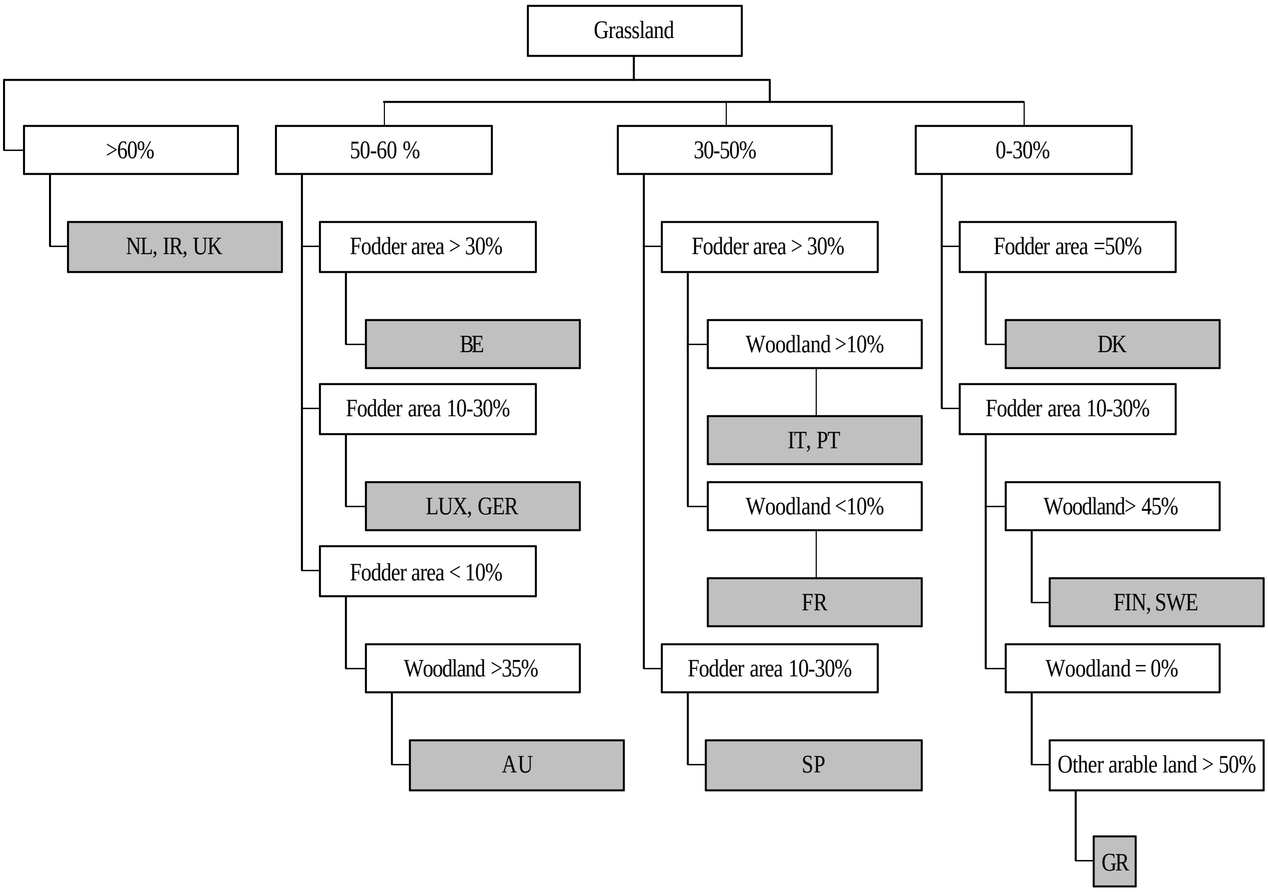

Figure 1. Land use of dairy systems (farming type 41) for all EU countries. Source: Eurostat (FSS/EUROFARM), Luxembourg. Data are from 1997, except for Portugal and Sweden (1995).

Surprisingly, grassland is not the main land use by dairy farms in the four countries on the right side of Figure 1:

(a) in Denmark fodder is the main crop, agreeing with the high production of fodder in Danish dairy farms (Andersen, this volume)
(b) in Greece, other arable land predominates, indicating that on average, grassland occupies a small area and is located amongst other arable land
(c) in Finland and Sweden there is much woodland on the farms, which shows that on average dairy farms are located in areas mainly covered with trees or forest shrubs with very little grasslands, as shown by Heikkilä (this volume).

It is also interesting to notice that, on average, the importance of fodder area increases from north to south in Europe, where fodder-LUP is similar to grassland-LUP in France, Italy and Portugal. The importance of the extensive grazing systems, *dehesas* in Spain and *montados* in Portugal, as described by Pineda and Gómez Sal (this volume), is reflected in the relatively high LUP of woodland (14%).

Location of dairy farms in The Netherlands

The Netherlands has the highest percentage of grassland area in dairy holdings in Europe, covering 74% in 1997, as shown in Table 3. However, there are large regional differences within the country, as shown in Table 4. In the northern and western regions, dairy farms have 88% of grassland and a very small proportion of fodder, ie. 5%, whereas in the eastern and especially in the southern region, grassland covers 71% on average, as opposed to a fodder area of 23%.

Table 4. Land Use Percentage (LUP) of dairy holdings in the four Dutch regions in 1990. Source: Eurostat (FSS/EUROFARM), Luxembourg.

	LUP					
Region	Grassland	Fodder	Other arable land	Unutilised agricultural land	Woodland	Sum
North-Netherlands	86	7	2	6	0	100
East-Netherlands	78	16	1	4	1	100
West-Netherlands	89	3	1	7	0	100
South-Netherlands	64	29	3	3	0	100

Because of the significant differences in land use on farms between regions, it was decided to use a more detailed geographical level for the analysis. The 12 Dutch provinces, which are equivalent to the FSS-2 and HARM-2 subregions, were therefore used. A general assumption made was that most of the dairy farms (code 41 in FSS), would be located in the classes linked with grassland and fodder, as shown in Table 4. To calculate the accuracy of this assumption, an integrative approach was followed by calculating an Area Index. The Area Index relates the area of dairy farms according to statistics, with the area of grassland and fodder obtained from the land cover sources. Two methods were then compared. The first method was a general approach, in which we compared FSS land use statistics, at a FSS-2 level, with CORINE land cover statistics. We calculated then the Area Index for the dairy enterprise according to the first method, called Area Index 1, as:

$$\text{Area Index 1} = \frac{\text{total area of dairy holdings (FSS)}}{\text{total area of the seven selected CORINE classes}} \text{ x } 100$$

The figures for this Area Index are given in Table 5.

The second method was a more detailed approach, in which we compared the National Farm Survey of the Netherlands (Landbouwtelling 1998) with LGN-3 land cover statistics. We calculated then a second Area Index for dairy as:

$$\text{Area Index 2} = \frac{\text{area of grassland} + \text{area of fodder used by dairy (Landbouwtelling)}}{\text{total grass} + \text{maize area (LGN - 3)}} \text{ x } 100$$

This Index assumes that in the Netherlands all fodder is maize, and is given in Table 5.

Table 5. Area Index 1 and 2 for dairy (%) for the 12 Dutch provinces based on two methods (see text). Sources: Eurostat (FSS/EUROFARM), Luxembourg, data from 1990, CORINE Land cover (1986), National Farm Survey of the Netherlands, termed Landbouwtelling (1998) and LGN-3 (1997)

Province	Total dairy area FSS (ha)	Total area seven CORINE classes (ha)	Area Index 1 (%)	Total grass + fodder area Landbouwtelling (ha)	Total Grass + maize area LGN-3 (ha)	Area Index 2 (%)
Groningen	47,280	74,596	63	53,160	84,076	63
Friesland	176,490	279,118	63	173,089	237,337	73
Drenthe	66,550	142,059	47	60,215	115,853	52
Overijssel	138,910	255,558	54	139,575	224,370	62
Gelderland	134,660	343,157	39	136,778	269,932	51
Flevoland	10,750	17,075	63	10,959	22,726	48
Utrecht	51,300	94,407	54	49,224	77,541	63
Noord-Holland	55,910	124,194	45	53,921	94,377	57
Zuid-Holland	63,970	126,302	51	61,492	107,161	57
Zeeland	5,270	20,212	26	6,903	24,970	28
Noord-Brabant	117,000	310,619	38	107,847	229,627	47
Limburg	31,690	107,802	29	27,594	79,789	35

As was expected, the second Area Index is in general higher than the first, as shown in Table 5 and Figure 2. However, the differences in the results of integrating European, ie. CORINE with the FSS and national, ie. LGN-3 and Landbouwtelling databases are small, being, on average, 48% compared with 53%, respectively for Area Index 1 and 2, as shown in Table 5. The small difference is probably due to the predominance of grassland and fodder on Dutch dairy farms. Larger differences between the indexes would be expected in other European countries, where other land uses such as cereals or alfalfa also contribute significantly to the total farm area. Both indexes decrease in value from north to south, showing the diminution in the use of grasslands in the dairy farms of the southern provinces, where the silage maize farms are concentrated, as shown by Elbersen & Pérez-Soba (this volume). It should also be emphasised that grassland in the north is mainly highly productive, fertilised ryegrass whereas in the south it is of low productivity and consists of native species.

The values obtained for both indexes are below 51% on average, and show the major difference between estimates of dairy area based on land cover and as compared with those based on land use statistics. This gap is mainly caused by the overestimation of dairy area in CORINE and LGN-3 when assuming that the selected land cover classes are completely occupied by specialised dairy farms (farming type 41). Inevitably, not all the area is occupied by specialised dairy farms, but also by other grazing livestock, eg. sheep and goats, and only a certain percentage of the CORINE land cover class is grass.

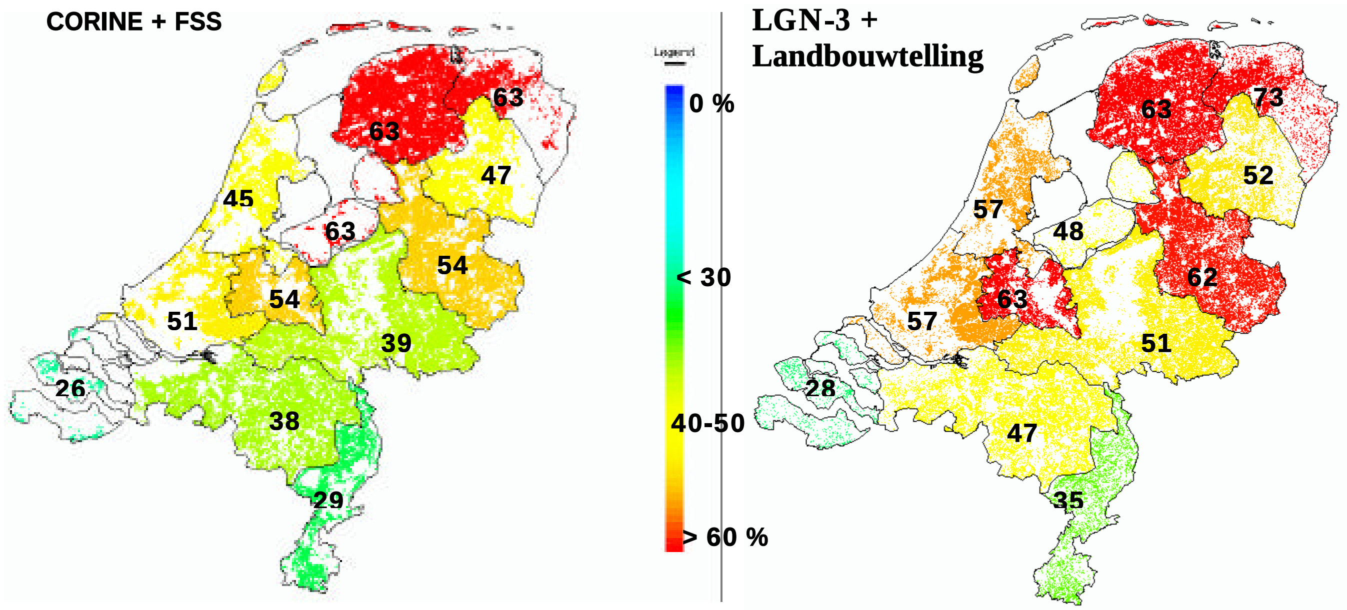

Figure 2. Comparison of the two Area Indexes used to estimate the relation between land cover and land use statistics based on European and national databases.

Taking in account the last factor, it is possible to calculate a grass weight that can be used to distribute the FSS dairy area among the seven CORINE classes by determining:

(a) the area of each of the seven CORINE classes per province, by overlaying CORINE with the 12 Dutch provinces

(b) the grass area for dairy for each of the seven CORINE classes (class i; i= 1…7) as:

Grass area class i = area class i * grass % in class i according to LGN-3

(c) the grass weight as:

Grass weight class i = Grass area class i / Grass area class i

Conclusions

The different data on mixtures of crops and grassland on farms are useful because they indicate the type of enterprise involved. However, such information is difficult to relate directly to specific land cover classes, even at a national level. This is because there is much regional variation within an individual satellite land cover category, varying both, within and between biogeographical regions. These variations include contrasts in intensity of grassland use, as well as differences in species composition. To increase the accuracy in the location of dairy systems it is necessary to use additional sources. Altitude might be important for some countries, eg. Greece and United Kingdom, whilst for others the soil type might be a more valuable determinant factor, eg. the Netherlands, where dairy farms are mainly located in peat and sandy areas and much less in clay areas, as discussed by Elbersen & Pérez-Soba (this volume). The future use of geo-referenced systems will show the exact position of fields on every farm and will increase the accuracy of the location, despite the aggregation of information requested to protect the privacy of the farmers. This information is currently under development in some European countries, eg. the Netherlands and in the UK, but is not yet available at European level. In addition, the combination of CORINE with national land cover databases can be used to calculate grass and fodder weights per geographical region/subregion. These indexes are based on combinations of land cover data and land use statistics and may help to distribute and locate the dairy areas.

References

CEC, 1989, FADN, An A to Z of methodology. Brussels, Commission of the European Communities.

CEC, 1993, CORINE Land Cover technical guide. European Union. Directorate-General Environment, Nuclear Safety and Civil Protection. Luxemburg. ISBN 92-826-2578-8.

Thunnissen H & de Wit A., 2000, The national land cover database of the Netherlands. ISPRS, Vol. XXXIII, Amsterdam

A typology and zonation of dairy farms in France

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Introduction

The diversity of soils and climatic, structural and socio-economic conditions in the cattle farming regions of France is reflected in the wide range of production systems and methods of processing dairy products (Chatellier et al, 1997). After decades of stock and forage intensification together with increasing specialisation that preceded the introduction of milk quotas, the trend in the 1990s was a shift back to more diverse systems. In the light of this, it is useful to review the criteria used for classifying dairy farming systems and make them more precise.

This contribution is taken from an analysis of data from the Farm Accountancy Data Network (FADN) from cattle farms in 1995 and 1997 (Colson & Chatellier, 1999) correlated with a typology of technical systems proposed by regional experts of the Institut de l'Elevage. The purpose of the study was to characterise the various French beef and dairy farming systems and quantify them proportionally, particularly as regards national beef output. The present paper summarises only the part concerning dairying systems, with a few technical additions and personal comments.

Classification criteria and methods

The typology used here is the result of correlating forage systems (closely linked to soil and climate conditions) with the various combinations of dairying and beef production .

Soil and climate conditions are firstly grouped into two zones:

(a) foothills and mountains
(b) lowlands, including lowland Less Favoured Areas (LFA).

Forage systems are then defined according to the percentage of maize in the Main Fodder Area (MFA) .

In the foothills and mountains there are only two groups:

(a) grass systems (<10% maize / MFA)
(b) systems with a limited amount of maize fed to dairy cows only.

In the lowlands there are three groups:

(a) grass systems with < 10% maize / MFA
(b) limited-maize systems (10 to 30% of MFA) (main winter forage source)
(c) unlimited-maize systems (>30% / MFA). Maize is often fed all year round, except for 2-3 months in spring.

The final stage is to divide the production types of dairy herds as follows:
(a) with or without Suckler Cows (SC) (>5 SC)
(b) with or without fattening of males of two types:
- young bulls (males < 2 yr)
- bullocks (males > 2 yr).

A breakdown of 132,000 dairy farms, using data from 1997 identified 13 combinations that had significant numbers, ie. over 1% of the total.

The characteristics of the main dairy systems

The lowland specialised dairy systems account for about 50% of the farms and of these there are over 55,000 farms running lowland all-dairy systems with maize, producing over half the French quota. These systems are used mainly in the west but also in mixed farming areas in the northern and eastern part of France, as well as in the south-west.
In areas suitable for growing maize, unlimited maize systems have on average, 43% of MFA sown to maize, allowing a mean annual stocking density of 1.9 Livestock Units)(LU)/ha MFA. These intensive forage systems with a high proportion of maize and 3 to 4 year grass leys, entail a risk of water pollution by nitrates and pesticides. The trend is to use less input and grow a cover crop instead of bare soil in winter, rather than to reduce maize production. In these systems dairying therefore continues to intensify, with Holstein herds, in order to ensure the future of the farms.
By contrast, lowland grass systems are still decreasing They are run by older farmers, many without an heir. Their herds are smaller, less productive (5000 l/year) and generally make economical use of fertilisers and concentrates.
However, there are some young farmers in this group, either new to farming, or reorganising their production systems by reducing or eliminating maize and maximising grassland, even if this means lower output per cow. These systems are still a minority, but they are stimulating interest because they require less capital and labour, whilst providing a good income and environmental benefits.
Limited-maize systems are intermediate between the above types, the limitations usually being climatic conditions (temperature, altitude, dryness) or land types that are better suited to grassland (steep or otherwise impossible to plough). These systems are close to the national average in size (land area, herd size and quota) and in technical and economic performance. Reducing costs by using less fertiliser and concentrates and prolonging the grazing period, are both common trends on these farms, but without a major focus on water quality or the image of the products, most of which have no quality identity.

The specialised dairy systems with maize, in the foothills and mountains zone, account for 16% of the farms and have similar characteristics to the limited-maize lowland systems, despite the constraints of slope and altitude, which are reflected in lower stocking densities. The foothill areas are often densely populated, so that land is expensive, structures are smaller and more intensive in terms of both cattle and land area, are also soils sensitive to pollution eg. nitrates and phosphates.

The are found in the French Comté, Alpes du Nord and Massif Central cheese-making regions. Because of their small size and constraints of soil and climate together with expensive forage stocks constraints, their mean income is among the lowest. However, thanks to the high value-added milk and high reputation regarding their restricted production areas (*apellation controllées*), some of these dairy regions are still quite active, with enough young farmers starting up to ensure continuity. This applies at least to the French Comté, where the farms are larger, and the Alpes du Nord, which have strong cultural identities based on such renowned cheeses as Comté, Beaufort and Reblochon. These regions also have a strong tourist industry.

The dairy farms that also fatten males account for 16% of the farms, which also have young bull production as a complement to dairying. Such farms have expanded since quotas were introduced, to the detriment of specialist indoor fattening farms. The system is practised on larger farms with high milk quotas, high forage intensity involving a stocking rate of 1.9 LU/ha, high-output herds of Holsteins with over 7000 l production and a high proportion of silage maize in the MFA. These farms are widespread in the west and have to cope with the same environmental constraints as the unlimited-maize all-dairy systems. They are often joint enterprises (*Groupements Agricole d'Exploitation en Commun* (GAECs)), making it easier to run an indoor livestock unit and achieving a good compromise between income and labour.

The dairy systems with beef cattle are often on smaller farms with a higher percentage of grassland and are more similar to the low-intensity specialised grassland dairy group. In the north-west these systems have more Normandy cows and bullocks, which have a recognised added value on slaughter, but in the north and east Holstein bullocks are not so easy to exploit commercially.
Over the past twenty years, bullocks have declined sharply in France, while exports of young bulls to Italy and Spain have increased (Kempf et al, 1997). Beef production has only survived where it is combined with dairying at low stocking rates and low margins, because despite a positive image, the market makes little difference between steers and young bulls.

The dairy farms with suckler cows account for 18% of the farms and belong to two groups:
(a) the first group consists of historical dual purpose breeds like Salers (Massif Central) or Maine Anjou (Pays de Loire), where milking was a compromise between the calf and milk sale. Since the quotas and Common Agricultural Policy (CAP) premiums, most of the cows became sucklers, while the quotas was reached with a smaller number of dairy cows (Montbeliardes). The milk quota remains small in the mountains, but almost all suckler cows (over 80%) get full premiums and involve hardy breeds, such as Salers and Aubrac, serviced by bulls of beef breeds eg. Charolais).
(b) the second group consists of larger dairy herds with a trend towards diversification, since the introduction of the quota regime. They are mainly located in the lowlands, where growing maize is possible. The milk quota is often exceeded, so less than 40% of the suckler cows get premiums. In the short run, these farms would probably make the same income with less work, just fattening bulls or bullocks.

Two-herd systems with young bulls are mainly found in the far west, with some in the east on large farms over 100 ha with 100 LU of 40 dairy cows, 20 suckler cows and 20 young bulls, which are fattened each year. These are intensive systems giving good incomes but require considerable labour. Such systems are not frequent, and are mainly concentrated in Basse Normandie and the Pays de Loire. Herds are smaller than the preceding category, with 30 dairy cows, 14 suckler cows and 15 bullocks. All these mixed systems are usually labour-intensive, with variable indoor units situated in old buildings that are hard to mechanise.

Conclusion

This typology is more precise than the OTEX classification and provides a better grasp of the contribution that each technical system makes to the production of the national quota. It also provides a mean of understanding the advantages and constraints of the different systems, and hence their sensitivity to new regulations or economic conditions. Some systems are marginal in terms of their contribution to the national quota, yet are indispensable for maintaining the rural fabric and a vigorous tourist trade in their regions. Further, as many of these are mountain farms, much of the milk is made into cheese with restricted production areas giving good value-added, which should therefore be less sensitive to drops in milk prices under the Berlin agreement. However, the main worry for foothill and mountain dairying regions is still the abolition of quotas, which will inevitably lead to a further shift of milk production to intensive lowland systems with a high proportion of maize. This will bring more pollution problems, because of the high stocking rates present on most lowland farms. This process will lead to the decline of grassland farms elsewhere, which often have higher associated biodiversity.

References

Chatellier V., Colson F., Arnaud F., Guesdon J.C., Kempf M., Legendre J. & Perrot C., 1997, La diversité des systèmes d'élevage bovin en France et leur contribution à la production de viande bovine. INRA Prod. Animal., 10 , 227-240.

Kempf M., Perrot C. & Chatelier V., 1999, The beef production system in France. Classification and quantification thanks to FADN and Structural inquiry - Renc. Recherche Ruminants 6, 31-34

Colson F. & Chatellier V., 1999, Differences of economical performance between French dairy farms (FADN 1997) - Renc. Recherche Ruminants 6, 35-38

Three landscapes in France showing the variation within a single country.

Plate 1. Pas de Calais, northern France. In the foreground are some small gardens, behind which is a field used for small scale sheep grazing. Apart from the riparian woodlands, the rest of the landscape consists of intensive dairy farms, utilizing a mixture of intensive grassland beside the rivers and fodder maize on the chalk downland above.

Plate 2. Bretagne, western France. A representative of bocage *landscapes with small fields bounded by hedgerows and many trees. There is a mixture of fodder maize and intensive grass, mainly for small scale dairy farms but with horticulture being locally important.*

Plate 3. Dordogne, central France. The landscape is a complex mosaic of different land uses, with grass used for both sheep and dairy farming, some cereal fields, nut orchards, sylvopastoral systems and, locally, vinyards. The vegetation is often diverse, in contrast to the virtual monocultures of the north. This landscape is therefore comparable to polyculture in Spain, described by Gómez Sal, this volume.

A comparative description of recent developments in Greek livestock production systems: the cases of sheep / goat, beef and dairy sectors

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Introduction

Since accession to the European Union (EU) in 1981, the Greek livestock industry has undergone marked changes (Damianos et al., 1998). The beef, poultry and pig sector have expanded considerably expansion whilst others have remained relatively stable, ie the sheep and goat market. The expansion of the sectors is based mainly on imported feedstuffs, so that most of agricultural land used for to livestock production has generally remained unaffected. The most common form of traditional farming is an extensive system for sheep and goats for milk and meat, with the livestock often herded in mixed flocks. This system covers much of the mainland and is important for nature conservation in the mountains. The development of this system in response to the Greek environment is particularly distinctive and is the product of a long history of continuous interaction between man and nature (Thanopoulos et al., 1998).

Greece, in contrast to popular perception can be characterised as 'mountainous' country (Beopoulos and Skuras, 1997) with an average altitude of 500 m. 39% of the land surface is beneath 200 m., 28% between 201 and 500 m. and 30% between 501 and 1500 m.. Around 3,900 km2 (2.9% of the land surface) is above 1,500 m. and 500 km2 above 2,000 m.. About 30% of the land in Greece is covered by crops, 40% by pasture, and 20% is by forest. Almost all (98%) of the crop area is private property. In contrast, while 83% of the pasture is state owned or communal, the residual area of 7% is private. The pasture is divided according to altitude into lowland (18%), hill or semi-mountainous (31%) and upland (51%) (Polyzos, 1991).

The grazing areas are covered by grass (32%), scrub (15%), mixed scrub, forest and grass (27%), and forest with grass (26%). According to this classification, 58% of this area is suitable for sheep and beef cattle, whilst the remaining 42% is better suited to goats. Furthermore, some land is usually left fallow each year and is then used for grazing, mainly by sheep. Arable systems are often combined with seasonal grazing by sheep, utilising stubble and fallow land.

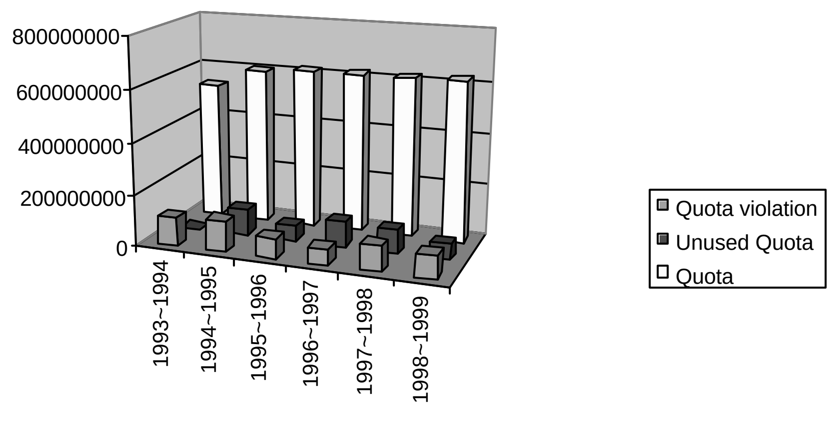
According to Hatziminaoglu et al. (1991) the forage includes not only pasture, hay, silage and coarser forms of semi-natural vegetation, but also locally trees and scrub. Some systems involve the cultivation of forage crops, eg. alfalfa (for hay), and cereals (eg. barley). Maize forage is usually associated with more intensive systems and is used mainly for silage making and beef production.

This paper provides information about dairy farming collected during field survey in the plains of Thessalia, Central Greece and Thessaloniki, Northern Greece conducted in the framework of the European Livestock Policy Evaluation Network (ELPEN). Information on beef and sheep/goat sectors was derived from earlier studies by the authors, as well as expert knowledge and secondary data. Interpretation of this information produces an example of recent developments in modern livestock production in Greece, a southern member state of EU.

The dairy sector

Dairy farming in Greece is a significant agricultural activity because it contributes 12.8% of the national output. However the Greek cow milk output of c 770,000 tons represents only 0.6% of total EU production. After Luxembourg, Greece is the country with the lowest number of dairy cows (only 172,000 head, 0.8% of the EU total), the lowest quota (0.5 % of the EU total), that is still 60% self-sufficient in cow milk. The latter is a result of the restrictions in production based on the quota level agreed for Greece during the negotiations for into the EU and currently this quota is considered by all responsible official agencies as a miscalculation of the future needs for national fresh milk consumption. The volume of milk production in Greece has reached a plateau because of the presence of dairy quotas and the lack of transferability. The Greek dairy industry considers this quota too low, which is the reason for consistent violation. The penalty, which had to be paid this year by the farmers for over quota production was high (160 EURO/ton). On the other hand there is always a certain unused of quota rights because, either they are kept as a national reserve, or belong to farmers who went out of business, as shown in Figure 1.

Figure 1: Production surpluses and quotas use (Source: ELOG, 2000)



According to estimates derived from field research by the authors farm sizes fall within a range of two to ten ha, but are generally less than ten ha. These are intensive animal production units with the main targets of meeting the industrial demand for a year round milk supply, primarily for fresh milk products. The dairy farms are located in areas were irrigated maize cultivation is possible, as well as in less fertile and non-irrigated areas where cows were kept traditionally. Cows are kept intensively indoors, housed loose or mostly in free stables, with grazing options to be from limited to zero. Few farmers have available grassland for grazing for only three to four months. Dairy farms are not necessarily associated directly with farmland and usually do not have enough land to produce their own fodder to support the herd. From this point of view dairying in Greece could not be characterised as land-dependent. However, some dairy farms grow maize for silage on their own land or rent private land in irrigated areas. Wheat is also cultivated in non-irrigated areas, with the straw used for feeding. Thus, the self-sufficiency in forage varies from zero to 50%. The commonest practice is to buy a ready for harvesting maize crop for silage making at a price of 23.5 to 26.5 EURO/ton with an average yield of 65 tons/ha (35% dry matter) which works out a cost of 38-41 EURO/ton in the silo in the farm. Cows are also fed purchased alfalfa, hay and straw, which represent on average 15% of the roughage. Concentrates are 100% purchased and offered usually to cows at high levels (2,000 to 3,000 kg/cow/year).

A high proportion of dairy farms in Greece today use a high input/output system, in which feed tends to consists predominately of maize silage with reasonably high levels of concentrates, offered to cows as Total Mixed Rations (TMR system), which is all purchased by the farm.

The commonest or the predominant breed of cows is Holstein-Friesian. Cows are milked mechanically for ten months with a milk yield of between 5,000 and 8,500 kg/cow/year. The well-organised and managed farms have an annual yield of at least 6,500 kg. Average herd age tends to be young (about 3.5 calvings), which implies a relatively high replacement rate of 20-25%, and consequently a higher milk production cost. The great majority of the dairy farms use artificial insemination with high quality imported semen, provided by the Greek Ministry of Agriculture or by private companies.

Calving tends to be all year round. Calves are kept and fattened in the dairy farm itself, and sold for slaughter at a live weight of 500-550 kg aged of 13-14 months, and an average price of 3.6 EURO)/kg carcass.

There are also a few large farms with 400-1000 meat and dairy cows with yields of 8,000 kg/year, which sell the calves five to ten days after birth to specialist fattening units, and the milk at high prices using 100% purchased feed.

During the last four years there have been changes in the number of farms and cows, although not all in the same direction. As is shown in Figures 2 and 3, from 1981 to 1998, the number of dairy farms and cows declined by 79% and 23% respectively, whilst the average yield per cow increased. The reduction in the dairy cows was due to the milk quota system and to a continuous increase in the productivity of cows (Zervas, 1995).

Figure 2: Evolution in the number of cattle and dairy cow holdings 1981-1998 (Source: Ministry of Agriculture, 2000. Data elaborated by authors)

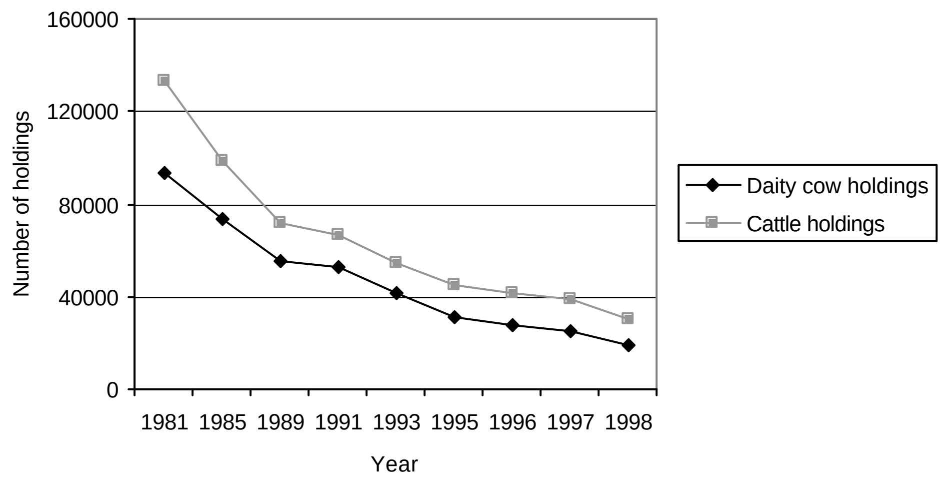
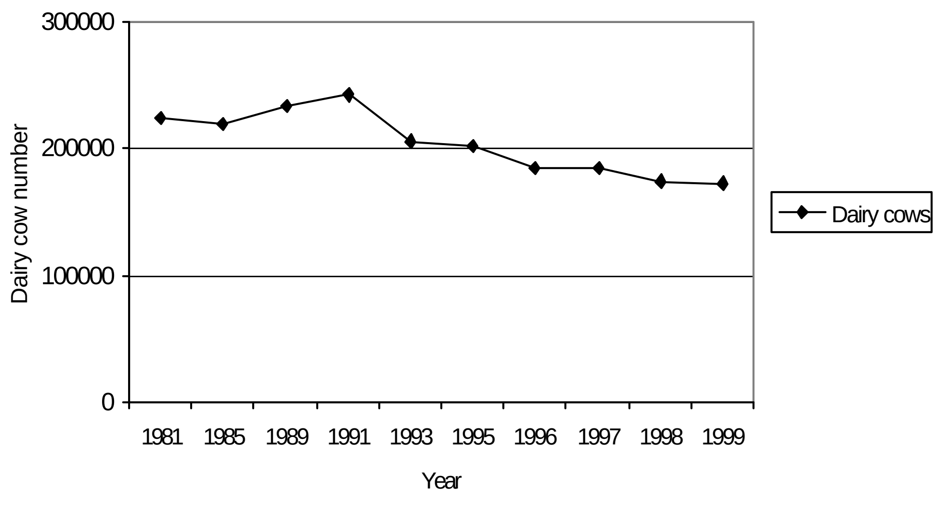
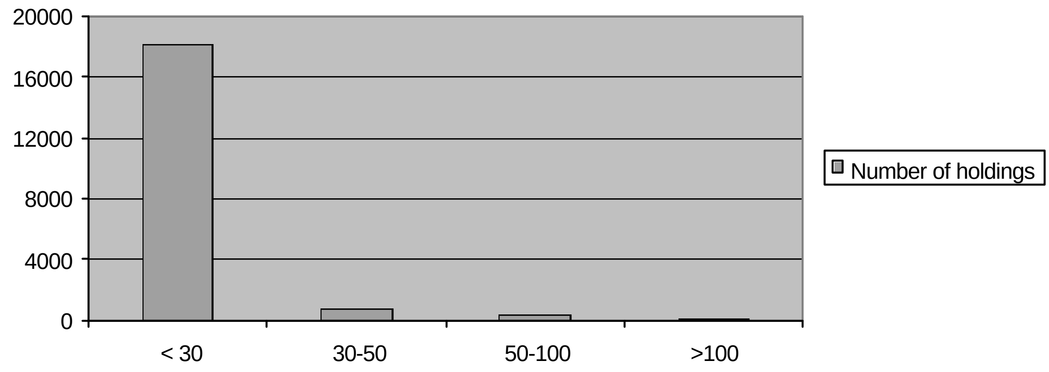


Figure 3: Evolution of dairy cow number 1981-1999 (Source: Ministry of Agriculture, 2000. Data elaborated by authors)



Dairy farms today represent 65% of the total cattle farms, with the remaining 35% being suckler cows and calf fattening units. The majority (93.4%) of the dairy farms has up to 30 cows, 4.1% 30-50 cows, 1.8% 50-100 cows and only 0.7% has over 100 cows, with 60%, 16.4%, 12.5% and 11.1% of the total dairy cows population respectively, as shown in Figure 4.

Figure 4: Number of holdings according to their herd size (Source: Ministry of Agriculture, data elaborated by authors)



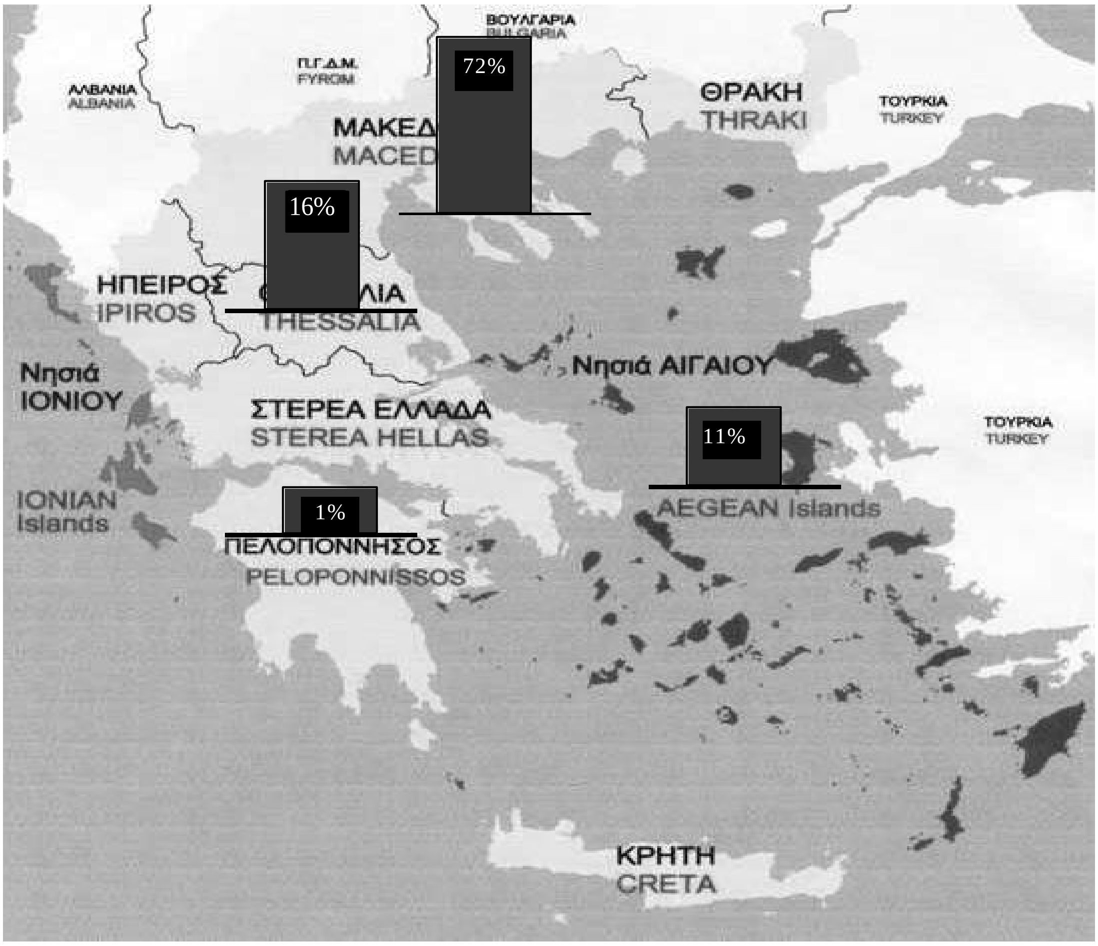


Figure 5: Geographical distribution of dairy cow holdings

Geographically, as it is shown in Figure 5, there is a significant concentration of milk production in certain areas of the country. Most of the dairy farms (72%) are located in northern Greece, 16% in central Greece, 1% in southern Greece and the remaining 11% on the islands. The corresponding percentages of the cows kept in these areas are 72%, 17%, 5.1% and 5.9% respectively. 56% of the dairy farms and 36% of the dairy cows are located to the plains of Thessaloniki, Attiki (Athens), and Larissa (Central Greece), whilst the Greek islands have a large number of small units.

In the last decade significant changes have taken place concerning the size of farms and their production capacity. Dairying has become concentrated on fewer, larger farms resulting in a corresponding decrease of the total number of farms employed in the sector and more importantly an increase in the abandonment of small sized holdings. Two of the leading private dairies in Greece for example, used to collect milk from 18,000 farms in 1981, while today they collect 20% more milk from only 2,400 farms. The primary driving force behind this trend was, and still is, economic, although further explanation is required. The economic framework is itself heavily influenced by a compilation of socio-economic and political factors such as the nature of the market regime (largely price support), biotechnology development and structural change in the production sector. For example farmers, who deliver less than 1000 kg milk per day to the dairies, get a reduced price of almost 20-25% per kg. of milk (range of milk price at farm level 330-383 EURO/ton depending on milk quantity, quality and hygiene level). According research by the author the total cost of milk is 250-265 EURO/kg at the farm level. Small size dairy farms (<30 head) therefore do not get sufficient income to modernise housing and milking facilities. They also do not have access to the loans given by the dairy industries, and are therefore unable either to modernise or to overcome problems, leading to closing and selling of their quotas rights. The minimum herd size today in Greece which could guarantee an acceptable farm income is considered to be 50 milking cows, while the 4-5 big private dairies in Greece recommend, as optimum size, 80-100 cows for a family farm, giving employment to two of its members, usually a couple, two brothers, father and son, as well as an underpaid foreign worker for the harder manual work. These big Greek dairies, which collect, over 80% of the cow milk production has to become more intensive, more specialised and at the same time more efficient. Overall Greek dairy production therefore continued to follow a trend towards increased intensification on a smaller number of larger, more specialised units with the problems to small producers mentioned above.

The environmental impact of dairy production is likely to be limited because the manure is used in the forage cultivation system and there is virtually no use of mineral fertilisers. However, environmental protection in Greece is not a priority of the state and so the monitoring and evaluation of pollution is hardly effective. For example there is no adequate data source for the monitoring of liquid waste from dairy farms, which may involve poor waste management regimes.

The beef sector

The beef sector in Greece relies heavily on state and EU market support and consists of suckler cows and calves fatted on farms usually owned and managed by families. The suckler cows belong to local breeds or are crossbred with imported breeds. In certain cases pure or crossbred bulls, mainly Limousin and Simmental, are used to upgrade meat quality and calf performance. The cows are kept outside in hilly and mountainous areas in order to graze natural vegetation, and in winter, for two to three months, they are offered some straw and concentrates for supplementary feeding. The suckling period is five to six months. Usually in September or October, after calves have been weaned they are housed for intensive fattening. The indoor fattening period lasts 10-15 months and is based on concentrates, alfalfa hay, maize silage and straw. The live weight of calves at slaughter is 300 to 500 kg.

The calf fattening units are usually large in size (up to 3000 calves), involving high capital cost, mainly for building construction, as well as for mechanisation and purchase of concentrates. Because Greece produces only 30% of its beef meat consumption, most of the calves of these units are imported from abroad at various live-weights (150-350 kg). This is marginally profitable. Consequently, nowadays this system works at only 60% of its capacity.

Over the last twenty years the number of suckler cows on farms has declined, while herd size has increased. The same trend is observed in the calf fattening units, with 45% of the fattening calves located in Northern Greece, specifically at the prefecture of Veria.

The sheep and goat sector

The sheep and goat sector is characterised by different production systems. These can be divided in four main classes (Hatziminaoglu et al., 1995), according to the degree of intensification measured by factors such as dependency, size of herds, feedstuff origin and volume of production:

(a) home-fed, where a small number of dairy sheep and /or goats of breeds with high productivity are kept intensively or semi-intensively, by the family near to the farm

(b) intensive system, which are mainly in the lowlands, dairy sheep/goat family farms are small to medium sized (30-60 head) with high productive breeds upgraded by crossbreeding. The animals usually graze in pastures adjoining the farms and are supplemented with concentrates and hay

(c) extensive without transhumance, where dairy sheep and goats belong to local breeds and the units of family type are medium or large in size (200-600 head). The animals are not moved to other areas, but stay in permanent buildings near the villages and graze nearby. Supplementary feed (concentrates and hay or straw) is given only during the winter period for 5-6 months (Zervas et al., 1996).

(d) extensive with transhumance, according to Beaufoy et al. (1994), remains an important activity in many areas of Greece because of physical and economic constraints in the land use eg. dry climate conditions, fragility of soils and the public ownership of the majority of pasture and rough grazing land. The pattern of movement is shown in Figure 6. The local breeds are fitted to the unfavourable environmental conditions of this system are usually moved from hill areas to nearby mountains during the summer period. There is a difference from a corresponding system of some sheep farms where the local breeds are also moved to other more favourable areas. Most of their nutrition is based on grazing and only during the winter period are some concentrates provided.

Figure 6: Sheep transhumance on mainland Greece in autumn 1984. The width and shading of arrows varies with the number of animals moved and the location of the pasture. The map shows the importance of the Pindos mountains as a source of spring and summer grazings (Source: G. Beaufoy et al., 1994)

The sheep and goat farms are distributed throughout the country, with the highest proportion being in central and southern Greece, including the Greek islands. The changes in sheep and goat numbers have not been significant in the last 20-30 years. However, the number of sheep and goat farms has declined, as shown in Figure 7. The flock size has therefore increased. The distribution of sheep and goat farms according to their flock size is shown in Figure 8. There is a continuing trend for intensification, despite the fact that mechanical milking is expanding only slowly (Sinapis & Thessalos, 1998). Greece, for a number of years has been almost self sufficient in sheep and goat milk and meat.

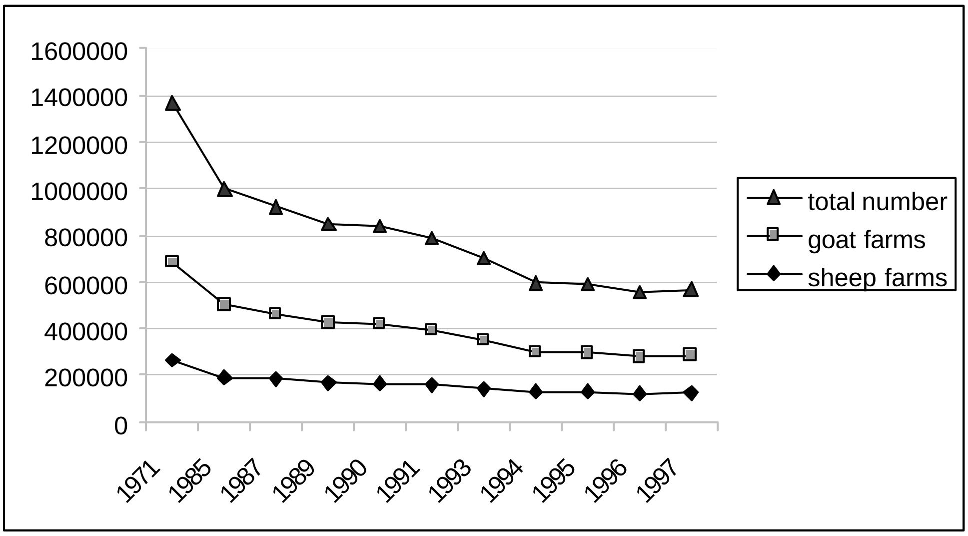


Figure 7: Evolution of sheep and goat farms 1971-1997 (Source: Ministry of Agriculture, 2000. Data elaborated by authors)

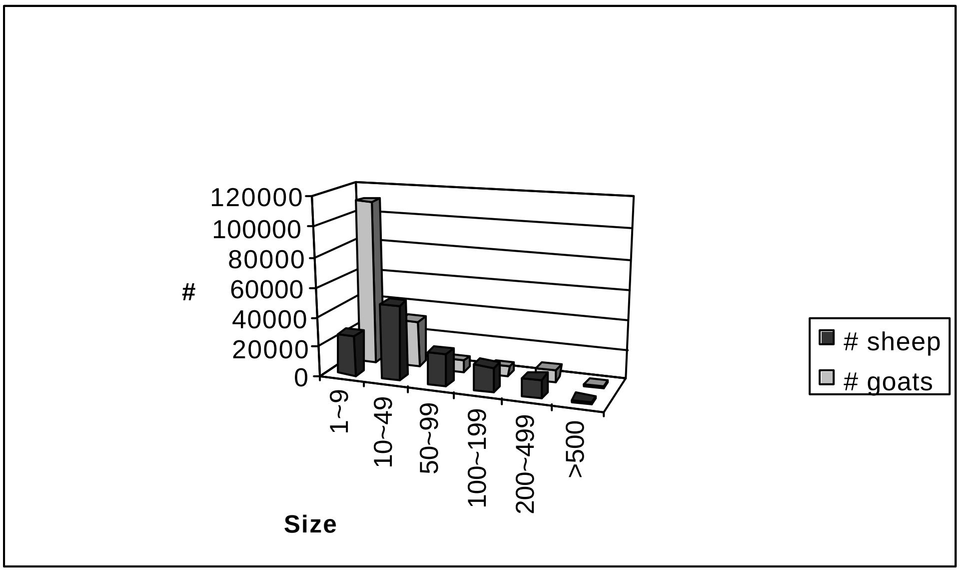


Figure 8: Distribution of sheep and goat farms according to their size 1995 (Source: Ministry of Agriculture, 2000. Data elaborated by authors)

The free range pig farming sector

Another significant extensive livestock production system in Greece is free range pig farming which is based on natural resources and accounts for only a small proportion (15%) of the pig sector. It is characterised by small sized family farms, which require a small labour force. Capital investment is low, due to the absence of modern housing and limited supplementary feeding. The system could be described as organic, since no medication or other treatments are applied to the animals, and more than 90% of their feed is obtained by free range grazing in oak and chestnut forests (Deligeorgis et al, 1999).

Conclusions

This paper has provided a broad description of the developments, which are under way in the three main livestock production sectors, which are most important in Greek agriculture. They share some common characteristics but also differ in many respects. From a sociological point of view, the ownership, the responsible labour and the management of the productive units remain within the boundaries of Greek nuclear rural families. The contribution of underpaid labour from immigrants from neighbouring Balkan countries has helped to increase the performance of productive units. The spatial distribution differs both between and within sectors. Although varying in their degree of intensification sheep and goat systems are found throughout the country, but especially in central and southern Greece. In contrast, the beef sector is mainly located in a specific prefecture of northern Greece while the dairy sector is mainly located in the proximity of urban or semi-urban plain areas of central and northern Greece.

The sheep/goat sector is more dependent on land and the animals usually graze pastures managed by traditional rules and owned by the agricultural communities. The dairy sector is mainly dependent on bought feedstuff, although in recent years there is a trend to increase local production. The beef sector is intermediate.

Environmental impacts vary according to sector and the farming system. In the case of beef and sheep and goat sectors the most serious problem arises because of uncontrolled grazing by flocks and high stocking rates, leading to soil erosion in the mountains. In the dairy sector, liquid wastes are the main environmental problem with the risk of contamination of the ground water, especially during the winter.

References

Beopoulos N. & Skuras D., 1997, Agriculture and the Greek Rural Environment, Sociologia Ruralis, 37, 255-269

Beaufoy G, Baldock D. & Clark J., 1994, The Nature of Farming: Low Intensity Farming Systems in Nine European Countries, Institute for European Environmental Policy, London

Damianos D., Dimara E., Hassapoyannes K. & Skuras D., 1998, Greek agriculture in a Changing International Environment, Ashagate Publ. Co.,. 61-84

Deligeorgis S., Rogdakis E., Fegeros K. & Papavasiliou P., 1999, The extensive pig farming system in mountainous regions of Greece. Proceedings of the 5th International Symposium on Livestock Farming Systems, Friburgh, Switzerland, EAAP Publication No 98 (In Press)

Hatziminaoglou I., Polyzos N., Magoulos I., & Boyazoglou J, 1991, In: Ferres collectiver et domanialer en Mediterrane: Legislation, mode d' utilization par les animaux et perspectives. Le car de la Grece (editors Rubino R. and Boubouze A.)

Hatziminaoglou I., Zervas N. & Boyazoglou J, 1995, Goat production system in the Mediterranean area: the case of Greece, In : Goat production system in the Mediterranean, EAAP Publication No 71 82-109

Polyzos N., 1995, Exploitation of rangelands (actual situation, problems and perspectives), Animal Science Review Sp. Issue No 7, 154-167 (in Greek)

Thanopoulos R, Vlachos G. & Louloudis L., 1998, Differentiation between mountain livestock production systems: The impact of social and environmental factors in S.M. Williams and I.A. Wright (editors) ELPEN, Proceedings of two International Workshops, Macaulay Land Use Research Institute, 73-86.

Sinapis E. & Thessalos K., 1998, Le development de la traite mecanique des petits ruminants en Grece, In: Milking and Milk Procducts of dairy sheep and goats (ed. F. Barillet and N. Zervas), EAAP Publication No 95 Washington Press, 221-226

Zervas G., 1995, Beef, sheep and goat production systems and extensification in Greece In: Extensification of Beef and Sheep Production on Grassland, Occ Publ. No 2, (ed. M. G. Keane and A. Pflimlin), Paris 1995

Zervas G., Fegeros K. & Papadopoulos G., 1996, Feedings system of sheep in a mountainous area of Greece, Small Ruminant Research, 21: 11-17

Zervas G., 1998, Quantifying and optimizing grazing regimes in Greek mountain Systems, Journal of Applied Ecology 35:983-986

ELOG, 2000, http://www.elog.gr/posostos/statistics/epikrateia.html

Local studies

Changes in socio-economic structure and their influence on land use in the village of Cadalso de los Vidrios (Madrid), central Spain

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Introduction

This work was undertaken as part of the doctoral course at the Complutense University, directed by the senior author of this volume. The study was carried out in order to examine the changes in the balance of habitats near the village of Cadalso de los Vidrios (Madrid), and how they might be linked to the socio-economic structure that was now present in the village. The objectives will therefore to analyse the current situation in the agricultural sector and then to assess the associated environmental impacts and to identify management measures for sustainable agriculture. Cadalso de los Vidrios has a traditional central area with shops and houses, but has a large housing estate adjacent to it, consisting mainly of second homes. During the summer the population doubles. Only 6% of the population work in the agricultural sector; 30% in industry; 26% in construction; and 37% in the service sector.

Methods

Visits were made to the village in order to identify people who would be able to provide information on the situation in the agricultural sector. Initially 11 people were interviewed who were active in the town and were involved in the agricultural sector. These respondents suggested other people who could be interviewed to expand the range of landowners included in the study. As there are no farmhouses in the countryside in this part of Spain, this procedure identified a reasonable representative sample of the likely composition of people working on the land of the neighbourhood of the village. The interviews were used to classify the landowners according to the level of intensity of use of their land. In addition to the interviews, a day was spent in the field within a polygon inside the village boundary in order to establish the current state of maintenance of vineyards registered on the 1982 cadastral map.

Results

Four groups of landowners were identified:

(a) group A1: retired owners and owners with an external income who manage fields as a recreational activity. These owners are restricted in number, and manage the land in a traditional way but work only a few hectares. They have no descendants who were likely to continue to manage the land. In the future, therefore change is likely to take place on such land

(b) group A2: young people who are entrepreneurs who use the money from the bars they own in order to modernise their vineyards. The old stocks of vines are replaced by new varieties using modern grafts. The vineyards are planted so that there is sufficient space to use tractors for cultivation. Although there are few owners in this group, many hectares are involved in their operations.

(c) group B1: these owners have inherited their land and work in the fields only in their free time, pruning and harvesting the grapes themselves. This is a large group of owners covering many hectares but their land is likely to be abandoned when the current owners die, because it is probable that their descendants will not want to follow the same practices

(d) group B2: these owners have inherited their land but no longer manage the fields any more. They retain their land ownership because in Spain there is a tradition of keeping the family property, but also because they may wish to subsequently use their land for development for building or other purposes.

Therefore, currently there is not only abandonment caused by the lack of management of group B2, but also the likelihood of this trend becoming more widespread from owners of group A1 and B1. Agricultural abandonment has the following effects on landscape and biodiversity:

(a) changes in landscape structure where the small scale pattern of patches becomes merged into larger units following a colonisation initially by shrubs, but eventually by trees. Linear features and boundaries are lost and the biodiversity the traditional landscape changes from a complex mixture of open habitats, to forest cover
(b) the area of vineyards has decreased and they are all stages of decline from colonising annual species to grasses, dwarf shrubs, shrubs and trees
(c) the implication of these changes is that biodiversity increases at first but then progressively declines as the canopy of trees and shrubs closes
(d) the increase in cover means that there are more refuges for fauna as well as more food from the seeds and fruits of the colonising vegetation.

Conclusion

Several suggestions for future work were made to follow the study. The methodology could be repeated on a regional scale to increase the range of views included. In addition, people could be interviewed from government departments and the local agricultural census could also be consulted. Finally, the impact of the changes on biodiversity could be further investigated by the use of aerial photographs in conjunction with field survey of vegetation and species, both plant and animals. It was concluded that the abandonment of the fields was due to socio-economic factors where local employment was now more profitable in hotels, quarries and construction, rather than traditional agriculture. These changes have direct effects on both biodiversity and landscape structure. It was finally suggested that a combination of traditional knowledge and technological innovation could redress the changes that are now taking place to the detriment of the cultural landscapes with their associated diversity of structure and biodiversity.
Finally, the local Spanish saying *"Podarte te podaré, labrarte lo pongo en duda, pero la huerta de Octubre esa sí la tienes segura"* which translated means: you do the least amount of work to get a harvest, could well apply to the situation in Cadalso de los Vidrios.

Estimation of the changes in habitats in the village of Cadalso de los Vidrios (Madrid), central Spain

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Introduction

This work was undertaken as part of the doctoral course at the Complutense University directed by the senior author. The study was carried out in order to examine the changes in the extent of habitats near the village of Cadalso de los Vidrios (Madrid).

Methods

The survey was carried out in Cadalso de los Vidrios, a village about 80 km from Madrid. Topographic maps of 1:25000 were used as the basis for mapping landuse. Five stratified units of 1 km2 were selected for the mapping. However it was found that because of the increase of the urbanisation it was necessary to map the whole of the village to obtain a better picture of the urban expansion. The field survey was used to identify the habitats defined according to standard descriptions linked to a European habitat classification. The data about the existing habitats were collected and the changes were validated in the field. The historical data were derived from a comparison of the situation in 1999 with that in 1973, using aerial photographs.
The habitat change was estimated by calculating the area occupied by the different types of habitat in the observed years for each of the sampling units, and afterwards the difference between the proportions corresponding to the complete area of each type of habitat in the unit for 1973 and 1999. The complete area of each habitat was obtained by adding the areas from the entire sample 1 km2. Finally the habitat change was estimated by calculating the difference between the areas over the two periods.

Results

Over the whole sample, Mediterranean conifer forests increased in area by ten percent in the study period, although locally there were losses probably because of fire. The pine forest expanded at the expense of well established Mediterranean scrub, presumably because of the decline in grazing animals, representing the general reduction in agricultural activity in the vicinity of the village. Likewise, there was an increase of mixed conifer/deciduous forest (8.7%) and Mediterranean evergreen forest (5%). Both these categories were linked to the invasion of abandoned perennial crops by expansion from existing patches that remain in the landscape. New Mediterranean scrub is also expanding (3 %) at the expense of abandoned perennial crops. This trend is the same as that observed in both the other student projects reported in this volume and confirms the widespread decline of agricultural activity in the region.

The perennial crops—mainly vineyards—showed a correspondingly negative trend (15.3%), although varying between 34.7% and 4.7% in the sample sites. These later figures agree with the initial estimation that about 25% of the vineyards were now abandoned.

Urbanisation has also increased by about 3.3% over the entire study area, mainly at the expense of perennial crops and Mediterranean scrub. By contrast, the quarries expanded into the Mediterranean conifer forest, taking about 5% of the total area of this habitat.

Conclusion

The combined approach used in this project shows that changes in habitat can be detected and related to the probable underlying causes, principally agricultural decline and urban expansion. Whilst aerial photography was able to detect abrupt changes, it did not help to detect more subtle differences which need field validation.

Estimation of the changes in habitats in the village of Navaluenga (Ávila), central Spain

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Introduction
This work was undertaken as part of the doctoral course at the Complutense University, directed by the senior author of this volume. The study was carried out in order to examine the changes that had occurred around the village of Navaluenga (Ávila). The main objective was to use the available information from maps, aerial photographs, and other sources such as local information in order to determine the habitat changes over the last twenty years. Such information is likely to be available in many countries and the principles of historical searches can be applied elsewhere. In the context of the present volume the results are important in that they demonstrate the patterns of change which are taking place in many regions of Spain.

Methods
Maps of land use were available for 1978 at the scale of 1:50,000. The area around the village was divided into 1 km2, with only those squares included that contained more than 80% of land within the geographical boundary. Aerial photographs were also available for 1985 and 1996. Information was also obtained from local people about previous land use. Initially five squares were chosen at random but two had to be replaced because of problems of access.

Results
Square I was mainly urban, including gardens, buildings, recreation areas and roads. The Alberche river crosses the square, and the urban area has increased concentrically from the initial settlement pattern. There are small areas of crops and strips of poplar (*Populus* spp.) besides the river. In 1978 there were 34 ha of perennial crops; 27 ha of grassland; 18 ha of trees (mainly poplar); 7 ha of bushes; and 5 ha of urban. By the year 2000 the urban area had increased from pastures and perennial crops to about 30 ha, which is almost a 300% expansion. The area of trees had changed little but the cultivated land had declined as well as the vineyard area.
Square II, in 1978 was mainly covered by cultivated land between vineyards and peach trees (59 ha). They were also 31 ha covered by meadows and 10 ha with trees and shrubs such as ash (*Fraxinus* spp.), juniper (*Juniperus* spp.) and Pyrenean oak (*Quercus pyrenaica*). There were also some vineyards and cultivated land. By the year 2000, the grassland had lost 11 ha to the urban area but 19 ha of the cultivated land had also moved in the same direction;

showing the importance of the urbanisation in this region. The *dehesa* had also expanded by 4 ha from grassland and abandoned perennial crops. In addition, 19 ha of perennial crops had now been converted to grassland. Therefore, although there are still some vineyards, there has been much abandoned cultivated land and a general increase in herb cover with species such as *Sinapsis* spp. and *Lavandula stoechas*.

In 1978, square III consisted of 88 ha of *matorral* with trees such as juniper, pine (*Pinus pinaster*), pyrenean oak (*Quercus pyrenaica*) and holm oak (*Q. ilex*) and 12 ha of grassland. By the year 2000, the tree cover in the *dehesa* had increased presumably due to less intense management of grazing animals. This was confirmed by examination of the aerial photographs from 1996.

In 1978, square IV was covered by 73 ha of *dehesa*, with the main species being similar to square III. They were also 22 ha of vineyards, with cultivated ground between them, similar to square II, as well as 5 ha of grassland. In 1985 the aerial photograph showed that the *dehesa* had mainly open vegetation with small trees. The 1996 aerial photograph showed that the overall tree cover had increased. The field work in 2000 showed that the *dehesa* had increased to 80 ha and that the tall grass habitat had increased at the expense of pasture. The vineyards had also declined to some extent. The *dehesa* is still exploited for grazing although probably less intensively than formerly.

In 1978, in square V there were 60 ha of grassland mixed with trees mainly of ash (*Fraxinus* sp.) and oak (*Q. pyrenaica*); 23 ha of heathland and 17 ha of grassland. In 2000, the field survey showed that much of this area included 10-50% rock, but that this had probably not changed significantly since 1978. Overall the square changed very little over this period, probably because the rock had protected the land against the habitat changes seen elsewhere.

Conclusion

This study shows clearly the local impact of the urbanisation, which is occurring in most small towns and villages within a radius of about 100 km from Madrid. This trend is highly localised and differs markedly from the patterns of grazing decline and abandonment also seen in the study, which is a process going out throughout much of rural Spain. The decline in cultivation, especially in the small fragmented vineyards, is also a widespread process caused by changes in social economic conditions. As noted elsewhere in this volume there is a close interaction between livestock systems and the character of the landscape and the way it is changing.

Conclusions

English

The main outcome of the workshop was that agri-environment policies need to be placed into context. Firstly, policies have to be seen in a spatial context of cultural landscapes to be successful. Secondly, there is a lack of knowledge on agricultural systems, or more specifically livestock systems, and their specific links to cultural landscapes. Thirdly, other European policy instruments and national policies already in place, are a major factor influencing the success of the current agri-environment measures. Finally, the importance of local participation and active co-operation with the farmers must be recognised. The conclusions below are directly relevant to the emerging Rural Development Regulations and parallel reforms of the European Union (EU), including the switch towards area, not headage, payments. It is recognised that one policy instrument is not enough to modify the present situation. Agri-environment policies and other agricultural support mechanisms should be integrated in order to succeed fully in achieving environmental goals. As long as the majority of the Common Agricultural Policy (CAP) supports production, it is inevitable that farmers will continue to optimise their businesses for this sole objective. All rural policies also have to be seen in the context of global trade and the wider social changes which are taking place, including food policy and the delivery of goods to the market.

A principle-overriding conclusion is that agri-environment schemes depend very much on the policy objectives of the national governments concerned. This was also acknowledged in Regulation 2078/92, which was specifically designed as a framework to allow for national differences according to the principle of subsidiarity. In reality, there is little in common between agri-environment schemes, except some general measures for the promotion of wildlife conservation. In theory the idea of the conference was that the experience gained from schemes currently under way should enable other countries to learn from this accumulated knowledge. In practice however, the schemes are fragmented, lack coherence and adequate interpretation of their effects, which makes international comparisons difficult. Therefore, virtually no recommendations can be made on how to use the experience of agri-environment schemes in one country to enhance the benefits of such measures elsewhere. Instead, the conclusions outlined below at least identify the problems and some potential policy suggestions as to how the situation could be improved in future.

It is therefore necessary to go back to first principles and to identify the resources of biodiversity and cultural landscapes in Europe and then to understand the driving forces, which are determining their composition. Only then can policy instruments be identified which can maintain or enhance their ecological value. As has frequently been stated in the Pan European Forum for Countryside and Landscape Monitoring (ECOLAND), as well as in the European Livestock Policy Evaluation Network (ELPEN) project, it is essential that a consistent approach is made across the whole of Europe in order to identify the ecological resources and their associated agricultural systems. Otherwise, it is inevitable that support cannot be targeted in an effective and efficient way. A final critical point made during the workshop was that it could be considered that agri-environment schemes are irrelevant because of their lack of consistency and because farmers may anyway be farming in a traditional manner even without targeted support. There is also the absence of statistically reliable evidence to show their effectiveness. This alternative view favours giving support directly to farmers for maintaining traditional agricultural practices.

Throughout the workshop a consistent theme was that the CAP has been too successful in supporting agricultural production. Outside such an expert group this conclusion would be surprising to many people who are more familiar with the popular concerns regarding the CAP, as mentioned in the Introduction. Within the workshop it was considered essential to identify new policy instruments in order to redirect money towards the maintenance of an environmentally sustainable agricultural sector that not only maintains production, but also yields ecological and cultural benefites.

Over the last decades agricultural policies have induced the same directional changes, ie. increases in productivity, regional concentration on single enterprises, on-farm specialisation and rationalisation. There has been a consequent reduction in agricultural labour, a decrease in the number of farms, shifts in land use types, and an increased pressure on the environment. There is no evidence that this trend will change although there are some indications that it may slow up. The implications are that there will be a surplus of land in some regions and also that environmental quality will continue to decline. International organisations such as the Organisation for Cooperation and Economic Development (OCED) are identifying indicators in order to assess the degree of such degradation. National governments, eg. the United Kingdom and Norway are also working on national indicators in order to comply with European directives.

The intensification of production is usually concentrated in furtile areas, but in direct contrast abandonment is taking place in areas with low productivity, because of factors such as aging population and low economic returns. Such polarisation is the key proces that is at work throughout Europe. They may even take place within a single landscape unit, eg. where the Pyrenees meet the Mediterranean plain, because mechanisation is not possible on steep slopes. Marginalised landscapes are usually in mountain areas, with some exceptions such as the poor soils in Poland, where market forces are now operating. At a larger scale where agricultural systems are in widely displaced landscapes, eg. in Spain, where transhumance takes place over large distances, their decline has complex effects. There is also an associated link in the decline of traditional breeds and the type of stock, eg. goats and donkeys, again because of increased specialisation.

Losses of biodiversity have been well documented in some European countries, although there are major gaps across the continent. The concept of the cultural landscape should provide a focus for more integrated studies in order to recognise the interdependence of farm systems, biodiversity and habitats within the overall landscape. It should be recognised that some cultural elements, eg. complex dike patterns and hedgerows, maybe maintained whereas biodiversity may have largely disappeared, as can be seen in Holland and northern France. In general however there is a strong link between landscape elements and biodiversity. A further point is that in some regions traditional management has all but disappeared, eg. in western Norway, and that reconstruction is the only way to recreate past land use patterns. By contrast, many areas of Spain still maintain traditional agricultural practices, which will probably only survive in the long term if appropriate support is provided. Many of the papers at the workshop from Spanish participants identified relevant examples.

In order to understand the link between agricultural systems and landscape, it is important to include the socio-economic background to agriculture. For example the loss of farm labour in Britain means that hedges and ditches are not maintained in the traditional way. Furthermore, landscapes that have been managed for hundreds of years under one livestock system can change in a very short time into a situation that is irreversible and has a poor relationship to the original state. For example, a Mediterranean hillside grazed by goats will have a diverse flora that will then become dominated by a few woody species, if grazing were to be removed. These measures are however only part of the story and other instruments, reflecting social and global changes are also necessary.

The design of these more integrated policy-instruments should be based on scientific studies that take account of the concept of cultural landscapes and their relationship with agricultural systems, especially those involving extensive grazing. Otherwise the support mechanisms will not produce the required environmental benefits. For example grazing in calcareous grasslands throughout Europe is necessary to maintain biodiversity. In contrast, overgrazing of woodlands leads to their eventual destruction. The lack of an adequate scientific base for much conservation management and policy development is a source of real concern because decision-makers are not always in touch with the relevant scientific principles.

A further conclusion was that isolated case studies, without a theoretical context and unrelated to a defined population cannot be generalised. Quantitative databases are essential so that experience can be built up, compared and transferred to similar situations elsewhere. Otherwise money will be wasted and appropriate European policies cannot be developed. These databases will also help to identify how and where cross-national co-operation would be useful. The indirect effects of policies also need to be considered, for example money given for protection of habitats within one designated area may be used to further intensify agriculture in an adjacent region.

A further consequence is that the introduction of new schemes without monitoring may not yield benefits, because there may be no evidence of their success in comparison with control areas. In addition, the objectives of the scheme must be clearly identified, otherwise criteria for success can never be measured. The publication of the results of such exercise must be widely publicised, otherwise the wider community cannot benefit from the money spent and the experience gained. Certainly, within the workshop there was inadequate information on the success or otherwise of existing schemes for all the above reasons. It could be true that such data are available, but they are not in the public domain.

It also became clear that there is a strong diversity in the organisation of the rural policy implementation and planning traditions between countries, making the integration of agri-environment policy difficult. For example, because the multi-functional use of rural areas in northern European countries started earlier than in many southern European countries, the integrated approach in rural policy is also stronger in the north. This may be one of the reasons for the earlier uptake of agri-environment measures in countries such as the UK, the Netherlands and Denmark, as compared with southern European countries such as Greece and Spain. Another complicating factor is the difference in government structures and division of responsibilities over the different agencies. In addition rural policy formulation is increasingly taking place at a European level while at the same time there is a tendency in many countries to decentralise powers to lower ties of government. This process might complicate the implementation of agri-environment measures in rural policy, as the distance between policy making and policy implementation becomes bigger.

As far as policy implementation is concerned, there were several general conclusions, which are summarised below. Firstly, there is a need to draft a clearer definition of the social and environmental objectives of agri-environment measures, as well as appropriate evaluation methods. Only then, target and zonal measures can be made more effective for addressing such environmental objectives.

Secondly, apart from the scientific requirements discussed above there is also a policy requirement for more emphasis on the scientific analysis of the relationships between agriculture and environment in order to provide demonstration projects built on local knowledge and experience. On the one hand this is essential to obtain knowledge of traditional systems before the practical experience is lost. On the other hand, scientific knowledge is required to understand the relationship between modern agricultural systems and ecological values in order to obtain sustainability. For example, although the changes in lowland heaths in the Netherlands are mainly due to loss of traditional management, nitrogen deposition has caused the final shift into grassland. New scientific research was therefore required in order to enable the reconstruction of heathland.

Thirdly, it was pointed out that uptake of schemes was uneven and that there were wide differences in the views of farmers to the environment in different countries. A stimulus should therefore be found to increase understanding and participation at the local level. Farmers, or preferably groups of farmers, should be encouraged to participate in the design and implementation processes.

Fourthly, it is essential that there is continuity in the support mechanisms otherwise the effectiveness of the payments is lost as many ecological processes are irreversible in the short term. For example, it is of no value to maintain a species rich hay meadow for five years and then to withdraw support and allow intensification to then proceed under normal agricultural practice.

Finally, there should be control of synergistic effects between CAP compensation payments, eg. cross- compliance, and improvements to the integration of structural and regional policy instruments, eg. Less Favoured Areas (LFAs). Other policy initiatives, eg. afforestation, also need to be linked to agri-environment measures because of their indirect effects. There should also be an adequate budget for monitoring the success, or otherwise, of the schemes.

Spanish

La principal conclusión del congreso fue la necesidad de situar la política agro-ambiental dentro de un contexto. En primer lugar, las medidas políticas deben ser interpretadas en un contexto espacial de paisajes culturales para tener éxito. En segundo lugar, se puso de manifiesto la falta de conocimiento sobre sistemas agrícolas, en particular los sistemas ganaderos, y su conexión específica con los paisajes culturales. En tercer lugar, se reconoció la importancia de otros instrumentos de la política que ya están en funcionamiento, en el ámbito Europeo y nacional, como principales factores determinantes del éxito de las medidas agro-ambientales existentes. Finalmente, se resaltó la importancia de la participación local y la cooperación activa con los agricultores. Las conclusiones que se mencionan a continuación son directamente relevantes para las recién aparecidas Regulaciones de Desarrollo Rural (Rural Development Regulations) y reformas paralelas, que incluyen el cambio a pagos por superficie y no por cabeza de ganado Se reconoció el que un único instrumento político no es suficiente para modificar la situación presente. Las políticas agro-ambientales y otros mecanismos de apoyo agrícola, deberían ser integrados para poder lograr los objetivos ambientales de una forma total. Mientras la mayoría de la Política Agraria Comunitaria (PAC) apoye la producción, será inevitable que los agricultores continúen optimizando sus negocios en aras de la producción. Todas las políticas rurales deben ser también consideradas dentro del contexto del comercio mundial y de los amplios cambios sociales que están teniendo lugar, incluyendo la política alimentaria y la distribución de mercancías.

Una conclusión fundamental fue que los esquemas agro-ambientales dependen mucho de los objetivos políticos de los gobiernos nacionales implicados. Esto también fue reconocido en la Normativa 2078/92 de la Unión Europea (UE), que fue específicamente diseñada como marco en el que se permitieran diferencias nacionales según los principios de subsidio. En realidad, hay poco en común entre diferentes esquemas agro-ambientales, a excepción de algunas medidas generales para el fomento de la conservación de la naturaleza. En teoría, la idea esencial del congreso era que la experiencia obtenida de los esquemas en vías de realización, permitiría a otros países aprender del conocimiento obtenido. Sin embargo, en la práctica, los esquemas están fragmentados y carecen de coherencia y de una interpretación de sus efectos adecuada, y esto hace muy difícil las comparaciones internacionales. Por lo tanto, no se pueden dar recomendaciones sobre cómo utilizar la experiencia adquirida en esquemas agro-ambientales en un país, para aumentar los beneficios de tales medidas en otros países. En vez de ello, las conclusiones que se mencionan más adelante identifican, al menos, los problemas y dan algunas sugestiones para políticas potenciales para mejorar la situación en el futuro.

Por todo lo mencionado anteriormente, es necesario volver a principios básicos e identificar los recursos de biodiversidad y paisajes culturales existentes en Europa, y después comprender las fuerzas que determinan su composición. Solamente así se podrán identificar los instrumentos políticos que pueden mantener o estimular su valor ecológico. Como se ha mencionado a menudo en el Foro Paneuropeo para el Monitoreo del Campo y del Paisaje (Pan European Forum for Countryside and Landscape Monitoring), así como en el proyecto Europeo ELPEN (European Livestock Policy Evaluation Network), es esencial que se realice una aproximación coherente para toda Europa, que identifique los recursos ecológicos y sistemas agrícolas asociados. De lo contrario, será inevitable que no se consiga apoyo de una forma efectiva y eficiente. El último punto de crítica hecho durante el congreso, fue la posibilidad de que se considerasen irrelevantes los esquemas agro-ambientales debido a su falta de consistencia, al hecho de que los agricultores puedan continuar ejerciendo la agricultura tradicional sin necesidad de un apoyo especial y a la ausencia de evidencia fiable estadísticamente, que muestre su efectividad. El punto de vista alternativo, presentado en el congreso, favorece el dar apoyo directo a los agricultores para que mantengan las prácticas agrícolas tradicionales.

A lo largo de toda la conferencia un tema constante fue el que la PAC ha tenido demasiado éxito en su apoyo a la producción agrícola. Fuera de un grupo de expertos, esta conclusión sorprendería a mucha gente que conoce la actitud general, reticente sobre la PAC, como mencionamos en la introducción. En el congreso se consideró esencial el identificar nuevos instrumentos políticos, para reorientar el dinero hacia el mantenimiento de un sector agrícola sostenible desde el punto de vista medioambiental, que no sólo mantenga la producción sino que también rinda beneficios ecológicos y culturales.

En las últimas décadas, las políticas agrarias han inducido el mismo tipo de cambios de dirección, es decir, aumento de productividad, especialización regional y especialización y racionalización de las explotaciones agrarias. En consecuencia, ha habido una reducción en mano de obra agrícola, una disminución en el número de explotaciones, modificaciones en los tipos de utilización del suelo, y un aumento en la presión sobre el medio ambiente. No hay evidencia de que esta tendencia vaya a cambiar, aunque hay algunas indicaciones de que va a aminorar. Las implicaciones son un exceso de tierra no utilizada en algunas regiones, y la continuación de la disminución de la calidad ambiental. Organizaciones internacionales como la Organización para la Cooperación y el Desarrollo Económico (OCDE) están identificando indicadores que estimen el nivel de esta degradación. Gobiernos nacionales, como el de Gran Bretaña y Noruega, están también trabajando en la creación de indicadores nacionales para cumplir las directivas Europeas.

La intensificación de la producción está normalmente centrada en las áreas de alta productividad. En contraste, el abandono tiene lugar en áreas con baja productividad debido a factores como el envejecimiento de la población y baja compensación económica. Esta polarización es uno de los factores clave que tiene lugar en este momento en Europa. Pueden darse incluso dentro de una única unidad de paisaje, por ej. en la unión de los Pirineos con la llanura Mediterránea, debido a que la mecanización no es posible en pendientes inclinadas. Los paisajes marginales están normalmente en áreas montañosas, con algunas excepciones como los suelos poco fértiles de Polonia en los que las fuerzas del mercado están operando ahora. A un nivel superior en el que los sistemas agrícolas están en paisajes ampliamente extendidos, por ej. en España, el declive de la trashumancia latitudinal, que tiene lugar en distancias largas, tiene efectos complejos. Hay también una relación entre el descenso de las razas tradicionales y el tipo de ganado, por ej. cabras y burros, de nuevo debido a un aumento de la especialización.

Las pérdidas de biodiversidad han sido bien documentadas en algunos países Europeos, aunque todavía hay importantes lagunas. El concepto de paisaje cultural debería servir para centrarse en estudios integrados, que reconocieran la interdependencia dentro de la totalidad del paisaje, entre los sistemas de explotación y la biodiversidad y hábitats. Se debería reconocer que algunos elementos culturales (estructuras complejas de diques, hileras de setos) se mantienen a pesar de que la biodiversidad ha desaparecido hace tiempo, como se puede observar en los Países Bajos y el norte de Francia. Sin embargo, hay en general una fuerte relación entre los elementos del paisaje y la biodiversidad. Otro punto es que en algunas regiones la gestión tradicional ha desaparecido totalmente, por ej. al oeste de Noruega, y la reconstrucción es la única manera de volver a crear estructuras de utilización del suelo antiguas. En contraste, muchas áreas de España mantienen todavía prácticas agrícolas tradicionales, que probablemente sólo sobrevivirán a largo plazo si se provee el apoyo adecuado. Muchos de los trabajos presentados en este congreso por los participantes españoles identifican ejemplos relevantes en este aspecto.

Para entender la conexión entre los sistemas agrícolas y el paisaje es importante incluir la base socio-económica de la agricultura. Por ejemplo, la pérdida de mano de obra agrícola en Gran Bretaña implica que los setos y diques no son mantenidos de la forma tradicional. Asimismo, paisajes que han sido gestionados durante cientos de años bajo un sólo sistema ganadero, pueden pasar en muy poco tiempo a una situación irreversible, que tiene poca relación con el estado original. Por ejemplo, una ladera Mediterránea pastada por cabras tendrá una flora diversa que pasará a convertirse en una flora dominada por unas pocas especies leñosas, si el pastoreo desaparece. Sin embargo, estos ejemplos sólo representan una parte del problema, y es necesario el tener en cuenta otros instrumentos que reflejen también cambios sociales y globales.

El diseño de estos instrumentos políticos más integradores, debería estar basado en estudios científicos que tengan en cuenta el concepto de paisajes culturales y su relación con los sistemas agrícolas, especialmente aquellos que incluyen pastoreo extensivo. De otra forma, los mecanismos de apoyo no resultarán en los beneficios ambientales esperados. Por ejemplo, el pastoreo en praderas calcáreas es necesario en toda Europa para mantener la biodiversidad. Por el contrario, el pastoreo excesivo en zonas de arbolado conduce a su posible destrucción. La falta de base científica adecuada para gran parte de la gestión de conservación del medio ambiente y del desarrollo político, es una fuente de preocupación porque los encargados de decidir no siempre están en contacto con los principios científicos relevantes.

Otra conclusión fue que los estudios de casos aislados no pueden generalizarse sin un contexto teórico y sin relacionarse con una población definida. Las bases de datos cuantitativas son esenciales para que se pueda crear, comparar y transferir la experiencia de unos a otras situaciones similares en otros lugares. De otra forma, el dinero se gastará ineficazmente y no se podrá desarrollar una política Europea apropiada. Estas bases de datos también ayudarán a identificar cómo y dónde es útil la cooperación transnacional. Los efectos indirectos de la política también necesitan ser considerados, por ejemplo el dinero otorgado para la protección de hábitats dentro de una área seleccionada, podría ser usado para intensificar más la agricultura en una región adyacente.

Una conclusión adicional es que la introducción de nuevos esquemas sin monitoreo podría no rendir beneficios, debido a la falta de evidencia de su éxito en comparación con áreas de control. Además, los objetivos del esquema deben ser claramente identificados. Si no es así, los criterios para evaluar el éxito no pueden ser medidos. Los resultados de éste ejercicio deben ser ampliamente diseminados, pues sino la comunidad internacional no puede beneficiarse del dinero empleado y la experiencia ganada. Ciertamente, durante el congreso no se obtuvo una información adecuada sobre el éxito o fallo de los esquemas existentes, por todas las razones mencionadas anteriormente. Puede ser que éstos datos existan, pero no son del dominio público.

También quedó clara la existencia de una fuerte diversidad en la organización de la ejecución de la política rural, y en las costumbres de planificación entre países, que hacen difícil la integración de la política agro-ambiental. Por ejemplo, debido a que el uso multi-funcional de las áreas rurales, comenzó antes en los países del norte de Europa que en muchos de los países del sur de Europa, el método integrado de aproximación en política rural es también más avanzado en el norte. Esta puede ser una de las razones por las que se han tomado más pronto medidas agro-ambientales en países como el Reino Unido, los Países Bajos o Dinamarca, en comparación con países del sur como Grecia o España. Otra dificultad es la diferencia en estructuras gubernamentales y división de responsabilidades entre las diferentes administraciones. Además, la expresión de la política rural está aumentando a escala europea, mientras que a la vez hay una tendencia en muchos países a descentralizar poderes para así reducir las ataduras con el gobierno. Este proceso podría complicar la aplicación de medidas agro-ambientales en política rural, al aumentar la distancia entre la política y su aplicación.

En lo que se refiere a la aplicación de la política agro-ambiental, hubo varias conclusiones generales que se resumen a continuación. En primer lugar, hay una necesidad de esbozar una definición más clara de los objetivos sociales y ambientales de las medidas agro-ambientales, así como de los métodos de evaluación apropiados. Solamente entonces se podrán hacer más efectivas las medidas zonales y objetivas para responder a tales objetivos ambientales.

En segundo lugar, aparte de los requisitos científicos discutidos con anterioridad, hay también un requisito político. Éste debe poner más énfasis en el análisis científico de las relaciones entre agricultura y medio ambiente, para suministrar proyectos demostrativos basados en el conocimiento y experiencia local. Por un lado, ésto es esencial para obtener información sobre sistemas tradicionales antes de que se pierda la experiencia práctica. Por otro lado, se requiere conocimiento científico para entender las relaciones entre los sistemas agrícolas modernos y los valores ecológicos para conseguir una agricultura sostenible. Por ejemplo, aunque los cambios en los brezales de tierras bajas de los Países Bajos son debidos principalmente a la pérdida de la gestión tradicional, la deposición de nitrógeno ha provocado la conversión final a praderas. Es decir, una nueva investigación científica ha sido necesaria para permitir la posible reconstrucción del brezal.

En tercer lugar, se señaló que la interpretación de los esquemas era desigual y que había amplias diferencias en la visión del medio ambiente por los agricultores de diferentes países. Por la tanto se debería buscar un estímulo para incrementar el entendimiento y la participación a un nivel local. Agricultores, o preferiblemente grupos de agricultores, deberían ser estimulados a participar en los procesos de diseño y realización.

En cuarto lugar, es esencial el que haya una continuidad en los mecanismos de apoyo, pues sino la efectividad de los pagos se perderá debido a que muchos procesos ecológicos son irreversibles a corto plazo. Por ejemplo, no tiene valor el mantener una pradera para heno rica en especies durante cinco años, y luego retirar el apoyo financiero y permitir la intensificación para luego continuar bajo una práctica agrícola normal.

Finalmente, debería haber un control de efectos sinérgicos entre los pagos de compensación de la PAC (cross-compliance) y las mejoras para la integración de instrumentos políticos regionales y estructurales, tales como las Áreas Menos Favorecidas (Less Favoured Areas, LFAs). Otras iniciativas políticas, por ej. la repoblación forestal, también deberían ser conectadas con medidas agro-ambientales, debido a sus efectos indirectos. Debería haber un presupuesto adecuado para controlar el éxito o no de los esquemas agro-ambientales.

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English

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