

# **The linkages between farming systems and the rural community: a case study of Loch Lomond, Scotland**

## **Farming & Rural Systems Methodologies Workshop**

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### **Abstract**

As the role of farming within the rural community changes, farmers are increasingly faced with the challenge of how to be economically and environmentally sustainable. The farming system, which incorporates husbandry, business management and the interactions between the farming system and the wider community, is complex. The farmer has also to be cognisant of the demands of the consumers for not only the food produced but also for the aesthetic qualities of the landscape. Equally, the farming community interacts with the whole rural community both as a consumer and supplier of goods and services. The physical description of the farm is important in determining what the farmers can produce but this is modified by EU policy, market prices, technological advances and by the personal preferences of the farmer. Consequently, to understand this complex system requires the development of a framework that assesses the interactions between the physical aspects of the farm, the agri-business environment, the aesthetic qualities of the landscape and the rural socio-economics. In order to analyse the complex interactions between the farmer, the farming system and the wider rural community, a systems analysis approach has been adopted to create a socio-economic and rural development framework. In addition, an assessment of the role of detailed modelling approaches in defining the system has been made.

## Introduction

The role of agriculture in society is changing. It is increasingly moving away from the production of food, although this remains of utmost importance, to a role of sustaining a landscape and the environment. Thus, farmers are now faced with the challenge of how to be economically and environmentally sustainable. This changing role of agriculture within society has influenced the development of Agricultural Policy and hence the European model for agriculture currently has the following aims (European Union, 1998):

- a competitive agriculture sector which can gradually face up to the world market without being over-subsidised, since this is becoming less and less acceptable internationally;
- production methods which are sound and environmentally friendly, able to supply quality products of the kind the public wants;
- diverse forms of agriculture, rich in tradition, which are not just output-oriented but seek to maintain the visual amenity of our countrysides as well as vibrant and active rural communities, generating and maintaining employment;
- a simpler, more understandable agricultural policy which establishes a clear dividing line between the decisions that have to be taken jointly and those which should stay in the hands of the Member States;
- an agricultural policy which makes clear that the expenditure it involves is justified by the services which society at large expects farmers to provide.

Consequently, increasing importance is being placed by governments and the European Union on managing the impacts, both deleterious and beneficial, of agriculture on the environment. However, the farming system is complex as it incorporates husbandry, business management and the interactions between the farming system and the wider community, which includes users of the food products and users of the aesthetic qualities of the land, see Figure 1. Consequently, to study the farming and rural system, as outlined in Figure 1, a multi-disciplinary approach has to be adopted. At the first level, a systems analysis approach can be used to study the interactions at the macro-level between the major components. A systems approach can again be used in the second-level to study the interactions that contribute to the major factors identified in level 1, and thus the methodology is analysing the sub-system at a micro-level, Figure 2. In addition, this approach identifies interactions between the elements of the level 2 analysis of the sub-systems and consequently, these interactions can be identified at level 1. It must be recognised that some of the impacts of changing the farming system will only become apparent over a period, which may be several years. This is particularly the case for changes to the landscape. This paper will outline this approach, which has been used to identify the interactions between the users of the landscape in the Loch Lomond area of Scotland and how these interactions impact on the economic and environmental sustainability of the farming system in this area, the greyed area of Figure 2.

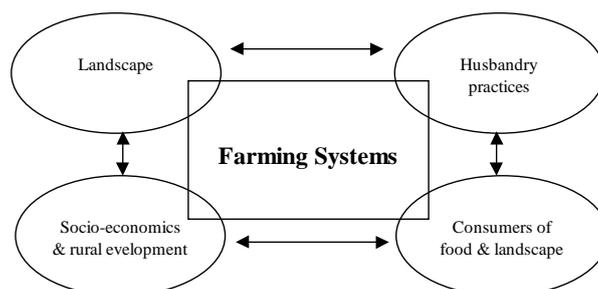


Figure 1 The level 1 diagram of the farming system analysis

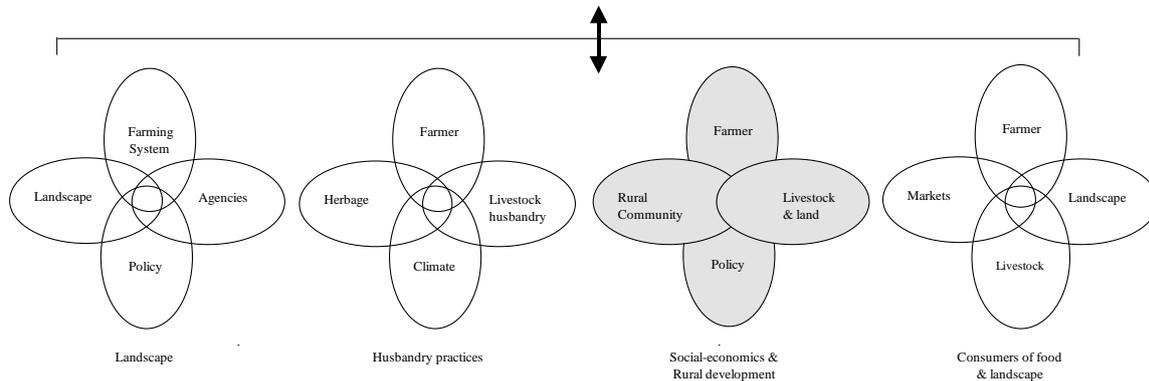


Figure 2 The level 2 diagram of the farming system analysis

### The Model

The methodology used to develop the model is systems analysis and is therefore attempting to look at the whole picture and the linkages between the different elements. The analysis of the socio-economic and rural development system requires an understanding of the decision-making process of the farmer and how these decisions are influenced by external factors and how the farmer's decisions impact on the landscape and the community. Consequently, the key issues the analysis requires to assess are:

1. Physical description of the farming system – what determines what the farmer produces?
2. Agri-business environment – how do changes in external factors affect the products produced and the systems used by the farmer?
3. Aesthetic qualities of the landscape – what effects do these changes have on the landscape?
4. Rural socio-economics – how the changes in the farming sector will knock-on to the economic and social stability of the local community?

These key issues have been addressed by analysing secondary data and interviewing strategic players in the Loch Lomond area. This data has been used to create a framework, which describes the linkages in the farming and rural system.

#### *Physical description*

The decision as to what the farmer will produce is largely affected by the land capability, which is influenced by the topography, climate and soil type. A fault line runs through Loch Lomond area, which broadly divides the area into two land capabilities. Below the fault line, the southern end of the area, the land capability is classified as capable of producing a moderate or narrow range of crops (Bibby *et al.*, 1982; Brown *et al.*, 1982). Conversely, above the fault line the land is classified as being suitable for rough grazing, with only small areas deemed suitable for improved grassland. The land capability affects the type of herbage produced, which provides a direct link between the socio-economic and rural development element, the husbandry practices element and the landscape element of the level 2 framework

In the Loch Lomond area, there are a few dairy farms at the southern end of the area but the majority of the land is used for the production of sheep and cattle, and hence the land capability has directly influenced the distribution of farm types. Nevertheless, there have been dramatic changes in the livestock numbers and the crops grown over the period 1955 to 1996, Table 1, with declines in cereal production, increased wooded areas and a change in the balance between grass reseeds and grass leys which are older than five years. In addition, there has been a change in the balance between dairy, sheep and cattle, Table 2.

Nevertheless, total cow numbers have increased by 2.3% over the period, while breeding ewe numbers have increased by 16.5%. Consequently, the agri-business environment, technological changes and other external factors have influenced farming within the area.

Table 1 The livestock numbers, cropping patterns between 1955 and 1996

	1955	1975	1985	1992	1996
Dairy cows (head)	3895	2996	2092	1730	1687
Beef cows (head)	690	3794	2685	2946	3002
Breeding ewes (head)	31269	37657	34332	36595	36436
Grass reseeds < 5 years (ha)	1433	1115	1021	711	561
Grass >= 5 years (ha)	2759	3444	3668	3985	4419
Total grass (ha)	4192	4559	4689	4697	4980
Rough grazings (ha)	42312	45001	41367	42510	37262
Cereals (ha)	717	462	274	161	97
Total crops (ha)	1159	571	331	181	149
Woodland (ha)	0	344	431	1439	828

Source: SOAEFD *personal communication*

Table 2 The relative importance of the sheep, beef cattle and dairy cattle breeding herds

	Percentage contribution				
	1955	1975	1985	1992	1996
Sheep	50.6	45.4	51.9	54.0	53.8
Beef	7.4	30.5	27.0	29.0	29.6
Dairy	42.0	24.0	21.1	17.0	16.6

Source: SOAEFD *personal communication*

#### *Agri-business environment*

The external factors that will influence the farmer's decision-making process include government and European Union agricultural policy, market prices, location, and assessing markets and technological advances. Equally, the farmer's personal preferences will also impact on the production methods adopted.

The impact of National Government and European Union policy on what the farmer produces has been explored for the Loch Lomond area by Topp (1999). However, the response of farmers to changes CAP may differ between farm types and hence this may result in regional differences. As well as policy changes affecting production, the market prices will also have an influence on production, Figure 3. During the period 1955 to 1975, the MAFF price index for the commodities produced tended to follow the retail price index. However, since 1975, milk and clean cattle have tended to increase more slowly than the retail price index, whereas the price of clean sheep prices has tended to follow the retail price index more closely. Accordingly, the relative prices may have been a major reason for farmers tending to increase breeding sheep numbers while the total numbers of cows has remained relatively static. However, as the percentage of farm income obtained from subsidies increases, Figure 4, farmers are becoming more responsive to changes in agricultural policy. Nevertheless, in

some cases farmers are trying to niche market their product, and this influences what they are trying to produce and how they produce it. This links the economic and sustainability framework in Figure 2 with the framework assessing the market and the consumer demands of the food and the landscape.

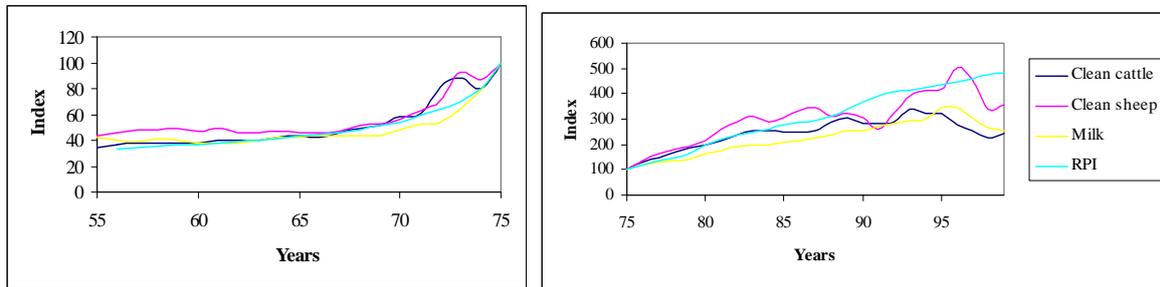


Figure 3 The MAFF for clean cattle, clean sheep and the retail index 1955 to 1999 relative to 1975 (Office for National Statistics, 1955—1999).

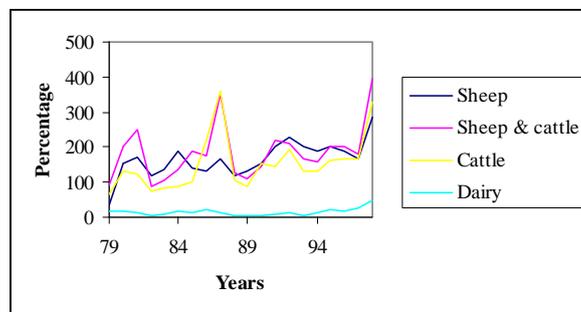


Figure 4 The percentage of income derived from direct subsidies for the different farm types relevant to Loch Lomond (SOAEFD, 1981—1999).

Within the Loch Lomond area, the statutory designation of Special Sites of Scientific Interest (SSSI) and the designation of an Environmentally Sensitive Area (ESA) may impact upon the management practices adopted by the farmer. This may not only have consequences for what the farmer produces but also for the appearance of the landscape. In the Loch Lomond area, there are 23 existing SSSI (Scottish Natural Heritage (SNH), 1997) covering approximately 6600 hectares. The farmer has to enter a management agreement regarding practices that could be potentially damaging to the site. Furthermore, in 1993, 89% of the eligible farmland in the Loch Lomond area was covered by ESA agreements. Under these voluntary agreements, the farmers are paid for avoidance of further damage to areas of conservation interest and for active measures, which will enhance the conservation interest on the farmland. While this creates some short-term economic activity and benefit for the local community, the long-term benefit through tourist activity and consumer purchase of the products of the area remains to be proven (ADAS, 1996).

Technological advances have resulted in farmers now tending to produce silage as opposed to hay as their means of providing a winter forage. From the survey of the practices of farmers, it is apparent that this has resulted in farmers tending to increase their application of fertilisers. Furthermore, some of the farmers are now ultrasonographically scanning their ewes for foetal burden so that they can manage their forage to maximise returns. In addition, over the last twenty years, farmers have also tended to change the breeds of livestock they are using. Accordingly, they have tended to switch to continental breeds of beef cattle and cross-bred ewes in order to produce a product that better meets the requirements of the market. The switch to silage, increased fertiliser applications and different type of stock all have

implications for herbage production and the landscape, and thus there is a direct link between this economics and sustainability element of the level 2 framework and the level 2 framework analysing husbandry practices. The farmers' personal preferences also impact on the products produced from the farm, for example the breeds used and whether they are producing a product for a niche market. In addition, the age of the farmer and whether or not the farmer has a successor also impacts on what is produced and the methods used in the production.

Nevertheless, the agri-business environment and technical changes have a major role in determining what is produced by the farmer, and this may have knock-on effects on the aesthetic quality of the landscape. However, it is currently unclear how these issues, which impact on the environment, and mainly influence the landscape framework in Figure 2, impact on the market framework through the consumers' objectives for both food and aesthetic quality of the landscape produced. In addition, changes in farming policies and practices also have wider socio-economic implications for the rural community.

#### *Aesthetic qualities of the landscape*

The aesthetic quality of the landscape is becoming increasingly important to the policy-makers and public, however, how has the landscape developed with changes in farming practices and policies? Data describing how the landscape has changed has been obtained from the SNH study of land cover change from the 1940s to the 1980s in Scotland (Mackey *et al.*, 1999). The major vegetation changes that have occurred in the Mid-Strathclyde and Stirling regions, which includes the Loch Lomond area are outlined in Table 3. Some of the changes will have occurred because of changes in agricultural policy. The increase in grass dominated blanket mire which may be associated with the decrease in heather dominated blanket mire and the relatively greater reduction in heather moorland than rough grassland may have resulted from increased stocking densities or changes in farming practices. Expansion in the area of forestry, influenced both by forestry and agricultural policy, has led to a reduction in the area of moorland and rough grassland. Consequently, forestry has become more important in the landscape mosaic. The changes in the landscape will have a direct impact on the potential to market the landscape to consumers and thus provides a direct link between the economics and sustainability element of the framework and the level 2 framework assessing consumers' demands of food and landscape. Over a much shorter time period, more detailed assessments of how changes in agricultural policy have impacted on the vegetation have been described by linking economic models with environmental models (e.g. Moxey *et al.*, 1995; Topp and Mitchell, 1999). At a more biological level, frameworks are also being developed to assess the linkage between land management and habitat biodiversity and landscape heterogeneity (Duelli, 1997). The form of the landscape and any changes that occur to the landscape will impact on the tourism potential of the area and hence have knock-on effects on the rural community, which therefore require assessment.

Table 3 Major changes in the vegetation in Mid Strathclyde and Stirling: 1940s—1980s

	1940s (km <sup>2</sup> )	1980s (km <sup>2</sup> )	Confidence
Young plantation	14	257	> 5%
Coniferous plantation	44	282	> 5%
Blanket mire – heather dominated	260	223	> 5%
Rough grassland	1420	1099	> 5%
Tall scrub	31	52	> 5%
Bare ground	2	16	> 5%
Arable	404	459	< 5%
Recreation	25	61	< 5%
Blanket mire – grass dominated	40	72	< 5%
Mixed woodland	59	42	< 5%
Lowland mire	51	34	< 5%
Bracken	161	140	< 5%
Intermediate grassland	321	261	< 5%
Heather moorland	857	606	< 5%

Source: Mackey, Shewry and Tudor *personal communication*

#### *Rural Community*

The influences on the rural community are twofold. Firstly, there have been changes resulting from changes in the pattern of rural employment, particularly declining agricultural employment. Secondly through the impact of farming on the aesthetic quality of the landscape and hence on the changing tourism potential of the area. The population of the area has increased by 11.3% between 1971 and 1991. The distribution of the population between age groups has also changed with an increase in the percentage of people between 40—59, and a decrease in the percentage of people over 60, Table 4. However, the ratio of people over 60 to those between 20 and 60 had a value of 0.27 in both 1971 and 1991. Nevertheless, the retention ratio, the ratio of the people aged 20—39 to the people aged 0—19, has increased from 0.75 in 1971 to 1.14 in 1991.

Table 4 The percentage population distribution by age of Loch Lomond, 1971 and 1991

	< 20	20-39	40-59	>60
1971	15.39	23.00	23.38	35.24
1991	17.99	23.50	31.68	27.83

Source: General Register Office for Scotland (*personal communication*)

It is also evident that the pattern of employment within the Loch Lomond area has changed over the last 20 years, Table 5. The percentage of the population employed in agriculture, fisheries and forestry has fallen, although the major change has been a reduction in the percentage of people employed in manufacturing and an increase in the percentage employed in distribution, catering and other services. This sector will include tourism-related employment. In terms of agricultural employment, the workforce has declined between 1955 and 1996, Figure 5. This will have been associated with a move towards more mechanised

agriculture, while at the same time the area devoted to arable crops, which in the 1955 would have been fairly labour intensive, has also declined, Table 1.

Table 5 The percentage of people employed by category in 1971 and 1999

Category	1971 (%)	1991 (%)
Agriculture, forestry & fishing	2.23	1.96
Mining, manufacturing, energy & water	44.56	23.74
Construction	9.71	8.20
Distribution, catering & other services	39.22	60.12
Transport	3.79	5.55

Source: General Register Office for Scotland (*personal communication*)

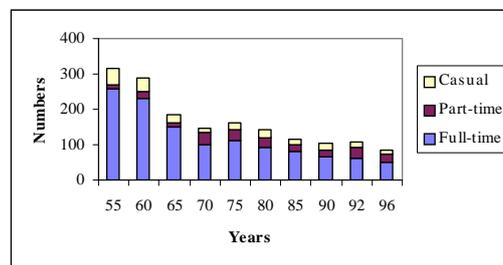


Figure 5 The number of people employed in agriculture in Loch Lomond, 1955—1996 (SOAEFD, *personal communication*).

Some of the farmers interviewed have sourced additional income from out-with the agricultural sector. In some cases, the farmer is running the farm as a full-time business, and additional income is being earned by another family member by either providing Bed & Breakfast or self-catering accommodation. In other cases, the farm itself is a part-time activity. In most cases, the farmers in the Loch Lomond area who are pluriactive are obtaining the additional income from activities related to tourism.

Although many of the farmers purchase the majority of their regular food shopping and petrol locally, they tend to shop in one of two towns that are situated out-with the defined study area. On the other hand, only a third of the luxury items are purchased locally. Similarly, approximately half the farmers use fencing and agricultural contractors that are located in the area, while they all purchase their concentrate feed and fertiliser from suppliers based out-with the area. In terms of changing the agricultural output of the area, the effects on regional income and employment for the industries supplying agriculture, upstream, can be determined using income and employment multipliers (e.g. Doyle *et al.*, 1997). Nevertheless, this methodology does not assess the effects on the downstream industries.

### The Framework

The above analysis has identified where linkages exist within the socio-economic and rural development level 2 framework, while at the same time identify links between the different level 2 frameworks identified in Figure 2. A schematic diagram of the framework is shown in Figure 6, with ellipses used to represent the other level 2 frameworks.

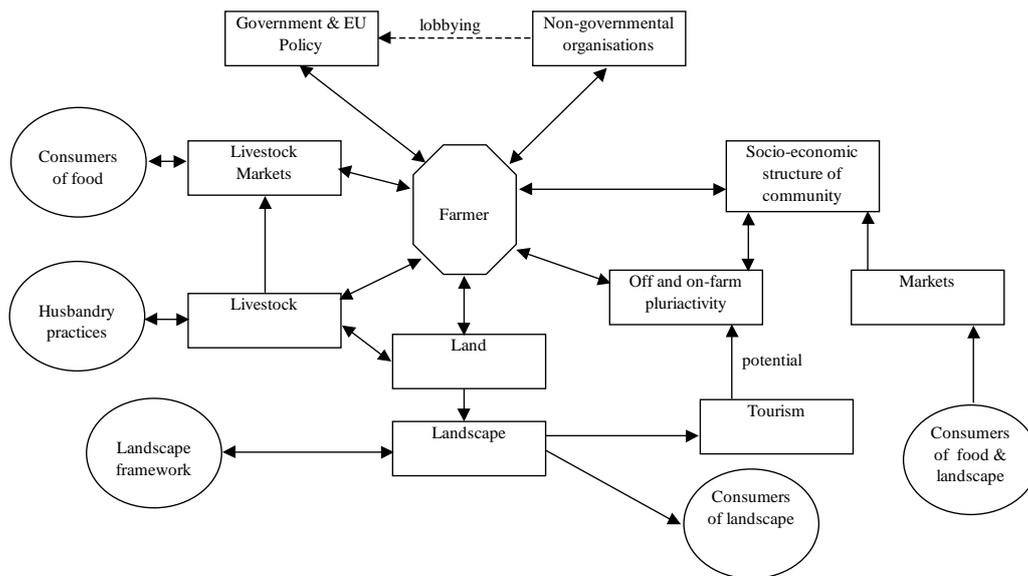


Figure 6 The schematic diagram of the socio-economics and rural development framework

The farming practices and the socio-economic structure of the rural community are constantly undergoing change, and the strengths of the linkages between the elements of the framework may therefore change. It is evident from the analysis that with the changes in EU policy and the increasing reliance of the farmers on subsidy for a substantial part of their income that the farmer has become more responsive to changes in policies. Nevertheless, in response to falling incomes, there is increasing interest by some farmers in niche markets in order to maintain or enhance the price obtained for their products. Consequently, the farmer, land, livestock linkages are influenced not only by the land capability, and therefore what the land can produce, but also by government policy. The impact of government policy has resulted in reduction in the area cropped in the Loch Lomond area, which is currently 13% of the area cropped in 1955, Table 1. Following from, for example the BSE crisis and other health issues, the public is becoming increasingly vociferous in its expectations of the food they buy, and are therefore demanding better standards of food production and traceability. Consequently, the strengths of the arrows relating consumers to animal production have increased over recent years. Similarly, with changing working practices and the increased leisure time of the public, the impact of tourism on the rural environment has increased and therefore the potential for conflict between farmers and the general public has increased. However, the opportunities for tourism related activities by the farmer have also increased.

In conclusion, the development of the framework has been used to identify how the farmer, the environment, the rural community and the users of the products of the farm interact. The framework also provides a mechanism for incorporating information from more detailed models into components of the framework. For example, the consequences of changing agricultural policy and prices on the enterprise mix on farms can be assessed by using linear programming model (e.g. CARD, 1988; Allanson, 1988), multiple goal programming (e.g. Dekoeijer *et al.*, 1985) or econometric models (e.g. Drake, 1989; Doyle *et al.*, 1997). In addition, the framework is flexible as it examines the linkages between the different elements, while recognising that the strengths of some of the linkages are modified by the changes to the system. Consequently, the framework can be used to analyse the linkages between the farming systems and the rural communities in different environments.

## References

- ADAS (1996) *Tir Cymen Socio-Economic Assessment Final Report*, A report by ADAS for the Countryside Council for Wales, 52pp.
- Allanson, P.F. (1988) *The Manchester policy Simulation Model of UK Agriculture*. Manchester: Department of Agricultural Economics, University of Manchester, Bulletin No. 217.
- Bibby, J.S. Hudson, G. and Henderson, D.J. (1982) *Soil and Land Capability for Agriculture, Western Scotland*. With contributions from C.G.B. Campbell, W. Towers & G.C. Wright. The Macaulay Institute for Soil Research, Aberdeen.
- Brown, C.J., Shipley, B.M. and Bibby, J.S. (1982) *Soil and Land Capability for Agriculture, South West Scotland*. With contributions from G. Hudson, D.J. Henderson & J.S. Robertson. The Macaulay Institute for Soil Research, Aberdeen.
- CARD (1988) *Annual Report, Centre for Agricultural and Rural Development*. Iowa State Univ.
- Dekoeijer, T.J., Renkema, J.A., Vanmensvoort, J.J.M. (1995) Environmental-economic analysis of mixed crop-livestock farming. *Agricultural Systems*, **48**, 515—530.
- Doyle, C.J, Mitchell, M. and Topp, K. (1997) Effectiveness of farm policies on social and economic development in rural areas. *European Review of Agricultural Economics*, **24**, 530—546.
- Drake, L. (1989) A regionalized non-linear dynamic model of the Swedish agricultural sector with environmental considerations. In: A. Dubgaard & A.H. Nielsen (Editors) *Economic Aspects of Environmental Regulations in Agriculture*, pp247—256.
- Duelli, P. (1997) Biodiversity evaluation in agricultural landscapes: An approach at two different scales. *Agriculture Ecosystems and Environment*, **62**, 81—91.
- Gourlay, D. and Slee, B. (1998) Public preferences for landscape features: A case study of two Scottish Environmentally Sensitive Areas. *Journal of Rural Studies*, **14**, 249—263.
- Mackey, E.C., Shewry, M.C. and Tudor, G.J. (1999) *Land Cover Change: Scotland from the 1940s to the 1980s*. Scottish Natural Heritage Lothian and Edinburgh Enterprise Limited, The Stationary Office, London, xxviii + 263pp + 8 plates.
- Moxey, A.P., White, B., Sanderson, R.A. and Rushton, S.P. (1995) An approach to linking an ecological vegetation model to an agricultural economic model. *Journal of Agricultural Economics*, **46**, 381—397.
- European Union (1998) "AGENDA 2000" - Commission proposals *The future for European Agriculture*, "[http://europa.eu.int/comm/dg06/ag2000/agprop/mot\\_en.htm](http://europa.eu.int/comm/dg06/ag2000/agprop/mot_en.htm)".
- Office for National Statistics (1955—1999) *Annual Abstract of Statistics*, The Stationary Office, London.
- Scottish Natural Heritage (1997) *SSSI Designations Loch Lomond*, SNH, Edinburgh.
- SOAEFD (1981—1999) *Farm Incomes in Scotland*, SOAEFD, Edinburgh.
- Topp, K. (1999) Trends in livestock numbers, cropping and employment in Loch Lomond. In: (Editors A. Waterhouse & E. McEwan) *Landscapes, Livestock and Livelihoods in European Less Favoured Areas* Proceedings of a Meeting of the European Funded Project, EQULFA (CT 95 0481), Greece 8-11 October 1998, SAC, Ayr, pp185-190.
- Topp, K. and Mitchell, M. (1999) *Forecasting the environmental and socio-economic consequences of changes in the Common Agricultural Policy*, Report to SOAEFD, 111pp.

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