Alternative payment approaches for non-economic farming systems delivering environmental public goods

May 2011

Barnes A.P., Schwarz G., Keenleyside C., Thomson S., Waterhouse T., Polokova J., Stewart S., McCracken D.

Disclaimer
This report was produced by the authors on behalf of Scottish Natural Heritage, Scottish Environment Protection Agency, Countryside Council for Wales and Northern Ireland Environment Agency. The views expressed within the report are those of the contractors and do not necessarily reflect the views of the agencies.

Scottish Natural Heritage
Scottish Natural Heritage (SNH) is a government body established to secure conservation and enhancement of Scotland's unique and valued natural heritage – the wildlife, habitats and landscapes that have evolved in Scotland through long partnership between people and nature. SNH advises on policies and promotes projects that aim to improve the natural heritage and support its sustainable use. Its aim is to help people to enjoy Scotland's natural heritage responsibly, understand it more fully and use it wisely so it can be sustained for future generations.
www.snh.org.uk

Scottish Environment Protection Agency
The Scottish Environment Protection Agency (SEPA) is Scotland's environmental regulator. SEPA's main role is to protect and improve the environment, and it does so by regulating activities that can cause pollution, and by monitoring the quality of Scotland's air, land and water. SEPA reports on the state of Scotland's environment and publishes a wide range of environmental data and information.
www.sepa.org.uk

Countryside Council for Wales
The Countryside Council for Wales champions the environment and landscapes of Wales and its coastal waters as sources of natural and cultural riches, as a foundation for economic and social activity, and as a place for leisure and learning opportunities. It aims to make the environment a valued part of everyone's life in Wales.
www.ccw.gov.uk

Northern Ireland Environment Agency
The Northern Ireland Environment Agency takes the lead in advising on, and in implementing, the Government's environmental policy and strategy in Northern Ireland. The Agency carries out a range of activities, which promote the Government's key themes of sustainable development, biodiversity and climate change. Our overall aims are to protect and conserve Northern Ireland's natural heritage and built environment, to control pollution and to promote the wider appreciation of the environment and best environmental practices.
www.ni-environment.gov.uk

FOREWORD

As future proposals for the CAP post 2014 are developed it is important to consider the types of payment which will be required to support agri-environmental management and farming systems that deliver environmental public goods.

Under the Rural Development Regulation (Council Regulation (EC) No 1698/2005), payments are made to support agri-environmental management (Article 39) and areas with natural handicaps (Article 37). Existing agri-environment scheme payments are restricted by the requirement to base these primarily on income foregone and additional costs[1]. However, for farming systems that exhibit very low levels of profitability or declining profitability, existing agri-environment payments simply perpetuate the low levels of profitability that tend to characterise the extensive farming that is often particularly associated with biodiversity and other environmental goods and services. Where systems are not profitable, the income foregone formula is clearly irrelevant and, where there is a public interest in supporting such farming systems, other approaches are needed. For the purpose of this study High Nature Value farming provides a clear rationale for developing alternative payment approaches to support farming systems that deliver environmental public goods.

The main objective of this research was to consider the scope for developing alternative types of payment that would be compliant with the WTO Green Box rules, and to test these as possible models for environmental support. In order to do this, financial modelling of farm types was undertaken, so parts of the final report are of a very technical nature.

The following assumptions were made:

- WTO Green Box rules are non-negotiable,
- The suite of Pillar 2 measures will not change radically in the forthcoming reform of the CAP
- The basic structure of cross-compliance will remain, although the detailed requirements (and hence the reference level) may change.

The report concludes that there is scope under the WTO rules for taking the absence of land management (or cessation of specific land management activities) as the baseline for calculating agri-environment payments in certain circumstances. Payment calculations could then consider as 'additional costs' the full cost of environmental management of a parcel of land, or, the opportunity costs incurred by continuing to farm in a manner associated with 'high nature value'.

Three alternative payment approaches were tested:

1. Full Cost of Management (FCM) Approach. The FCM formula is proposed as an agri-environment type, site-specific payment, which would be justifiable where a management activity is unprofitable. The calculations are based on the full cost of management, including a proportion of the fixed costs.

[1] Article 39, paragraph 4, of the Rural Development Regulation (Council Regulation (EC) No 1698/2005) establishes that the payment shall cover additional costs and income forgone resulting from the commitment made; where necessary, they may also cover the transaction costs.

The other approaches are based on the Less Favoured Areas formula:

2. Holding–wide (HW) Payment Approach - based on assistance for disadvantaged regions where farming systems provide environmental public goods. This approach explores the scope to develop holding-level payments based on a whole farm agri-environment undertaking and is based on estimated gross margins.

3. Opportunity Cost (OC) payment approach. This also involves a holding-level approach, but is based on the opportunity cost of farming expressed in the form of alternative income options within areas subject to natural handicaps.

The report highlights that there is a strong case for developing alternative payment approaches in certain circumstances and that these are likely to be compatible with WTO requirements. The analysis provides a valuable contribution to the debate about how best to support the delivery of environmental public goods where farming provides the best mechanism but where the financial returns are marginal (as with much HNV farming).

Peter Pitkin
Principal Advisor
Scottish Natural Heritage

Citation: Barnes, A.P., Schwarz, G., Keenleyside, C., Thomson, S., Waterhouse, T, Polakova, J. and Stewart, S., McCracken, D., (2011). Alternative payment approaches for non-economic farming systems delivering environmental public goods. Final Report for Scottish Natural Heritage, Scottish Environment Protection Agency, Countryside Council for Wales and Northern Ireland Environment Agency, May 2011. Scottish Agricultural College, Institute for European Environmental Policy, Johann Heinrich von Thünen Institut

Executive Summary

A number of farming sectors are generally populated by low income groups and are subject to seasonal fluctuations in yield and fragmentation towards peripheral areas. These factors have tended to provide the rationale for public support both at the British and the EU levels. The growing agenda towards the environmental and social benefits of maintaining farming production has led to increasing policy focus on how these systems can be maintained. Non-economic farming systems tend to be extensive, managing larger proportions of land under rough and common grazing and, as a result are generally low income or non-economic operations. However, they also tend to been environmentally valuable given the large tracts of land under less intensive management. The aim of this report is to examine the rationale for supporting these so called 'non-economic' farming systems and compare the possible impacts of a change in payment mechanism on these farms.

The objectives of this report are: i) to establish the context, and describe the scale of the problems faced by low or non profitable farming systems, ii) to review the context for agri-environment scheme payments under the EAFRD[2] rules, iii) to explore alternative payment approaches for non-economic farming systems delivering public goods, iv) to test alternative payment approaches through an economic analysis, and v) to make recommendations on what technical scope there is to develop formulas that more effectively support such systems.

A number of farming systems produce environmental goods and are 'non-economic' in nature. Fragile farming systems, generally seem to be upland and hill farming, livestock dependant in the UK. Though there are also permanent crops and arable systems of High Nature Value (primarily in Mediterranean andnew Member States). Since reform of the Common Agricultural Policy there are increasing pressures on these systems to survive under decoupled payments and significant reductions in stocking rates has been observed which will affect the underlying ecosystems which emerge under extensive livestock systems.

Arguably most hill farms and small holdings can be classified as non-economic, but other systems, such as upland cattle and beef farms also inhabit a spectrum which includes non-economic farming types. Farms who are 60% below the median farm business income over the years 2005 to 2008 (within the Farm Account Data) were identified as non economic farming types. Within this category, we further identify non-economic farming types which could also create a public good benefit by using higher nature value criteria, centred around stocking densities and the proportion of grass and rough grazing to total areas.

Payment calculation formulas in axis 2 rural development measures clearly reflect the requirements defined in the EU Regulations and by WTO, namely i) **General calculation formulas** of the different rural development measures are similar in the different Member States based only on income foregone and additional (variable) costs, and ii) **Natural handicap payments** follow a compensatory approach and are generally calculated based on the assumption of lower agricultural income and higher production cost in comparison to non-LFA farms. Opportunity costs of farming are **not** considered or full costs of land management are not considered.

[2]Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

In order to satisfy WTO rules, any changes to the framework for payment calculations in agri-environmental and other area-based rural development measures would need to demonstrate only limited production and trade effects. But this maybe less of a problem for 'non-economic' farming systems whichgenerally have rather little market impact, if the environmental objectives of these farming systems are clearly defined and linked to government policy.

Under the existing EAFRD Regulations, *continuation of agricultural activity* is implicitly assumed to be part of the counterfactual baseline, i.e. part of the hypothetical situation of what would happen in the absence of public support. In this logic, the costs considered as incurred and income forgone in the relevant payment formulas under EAFRD are understood to be only those going above the counterfactual baseline, i.e. above 'normal' agricultural management that would take place without support. Following this logic, payment formulas under the current EAFRD measures aim to provide either a premium for farming practices which deliver environmental benefits going beyond the reference level and hence carry higher opportunity costs (measure 214), or compensation for a natural handicap of land management in certain areas (measure 212). However, recent trends in non-economic farming systems show that this may not fully reflect, firstly, the recent changes in the counterfactual situation in these systems, i.e. that without adequate support, complete cessation of land management involving complete land abandonment is likely to take place. Secondly, it may not fully reflect the changing public demand for the provision of ecosystem services and public goods, which requires the continuation of agricultural land management for this purpose in these areas.

Three payment formulas were tested and meet the criteria of WTO AoA rules[3], these are:

Full Cost of Management (FCM) Approach: The FCM approach takes into account the full cost of the continuation (or introduction) of specific farming activities on identified areas of land, in situations where the required management is not economically justified as part of the farm business, and the land is therefore at risk of abandonment (or has recently been abandoned). The agri-environment requirements could be low-level (topped up by higher level agri-environment payments) or they could be higher level. In either case it is envisaged that the FCM payment calculation would normally be used for non-economic but environmentally important parcels of land within a farm.The logic of this is that the farmer is being paid to farm some land which would otherwise be abandoned or converted to non-agricultural uses, and to ignore the fixed costs attributable to this land would mean that the profitable enterprises on the farm would effectively be subsiding the agri-environment management.

The FCM calculation compares the payment (on a per ha basis) of an alternative practice on the same piece of land. As such it requires information on a farm's variable and fixed costs which are obtainable from the FADN. In this case comparison of different levels of rough grazing under various levels of management was undertaken. Hence the base level practice is the costs related to managing livestock on this land, principally labour, treatment and feeding costs on cattle and sheep farms. This is compared with an alternative practice which engenders the same ecological benefit, i.e. control of vegetation through crop protection and labour.

[3]GATT (1994).Agreement on Agriculture. The Green Box WTO rules are understood to be the rules governing measures specified by Agreement on Agriculture (AoA), in force as from 1995, as those that have no direct effect on production, in contrast to support measures that stimulate production directly. Within the range of measures which AoA considers as not affecting production directly, the particular focus in this paper is on both the general and measure-specific rules that govern payments under environmental programmes and under regional assistance programmes (Art 12 and 13 of Annex 2 of AoA,, for details see Box 5.1, pp. 32)

The fixed cost element requires allocation of fixed costs on a per ha basis to the treated area. To do this the total fixed cost expenditure multiplied by the share of treated land is taken and then divided by the area of treated land to get a per ha value. Whilst simple to implement there is an assumption that fixed costs are equally spread across the farm and more sophisticated weights could be examined in the future. The final calculation multiplies the sum of the livestock practice by the activity level (stocking density on this land) plus the alternative practice by the share of land to be treated, plus the fixed cost components on this share of land. This gives a per ha payment value which can be aggregated over the area of land to be managed.

Holding Wide (HW) Payment Approach:, the holding-wide (HW) approach is aimed at securing the continuation, across a geographically defined area, of a type of farming in which the necessity of adapting to natural handicaps limits the agricultural income but at the same time delivers environmental public goods. This contrast to the site-specific, agri-environment management defined by the FCM approach.Considering these farming systems at both a landscape scale and a farm scale, the greater the proportion of land that is managed in a way closely adapted to the natural conditions, and the more public goods are likely to be delivered.

The payment calculation is structured to recognise both the relative lack of profitability of these farming systems and the potential benefits of scale in the delivery of public goods. This approach *does not consider fixed costs* in relation to maintaining the farm – the assumption is that once the financial disadvantage due to the natural handicap is paid, the farm should be economically viable.

The approach requires information to be collected on stocking densities per ha and some distinction criteria to be made on the share of naturally disadvantaged areas (NDA) on the farm compared to non-NDA areas[4]. Similarly it requires some derivation of environmental coefficients which could be simply calculated as the ratio of rough grazing to total agricultural area. However further simplified rules could be applied to test this approach.

Figure 6.13**Opportunity Costs (OC) Approach:** The third approach aims to secure farming in disadvantaged areas (based on the opportunity cost of farming). The OC approach would reflect a natural handicap payment, either as a separate payment scheme or as a component of the SFP, based on the opportunity cost of farming in disadvantaged areas.This approach considers the opportunity costs of farming in relation to other (alternative) uses of labour or land. The main assumptions are that the opportunity cost of farming expressed in alternative income options are higher than the income from farming (or the farm household income) and that the lower income from farming reflects the impact of natural handicaps on farm incomes, in comparison to the average income in the region. The payment would reduce the income gap between farming and other sectors in specific regions and thus reduce the incentive for land managers to abandon agricultural land management activities in order to generate income in other sectors.

Opportunity costs of management are based on the costs foregone of managing a disadvantaged area compared to alternative use for labour or land. The assumption of this approach is that the natural disadvantage is reflected in the lower incomes compared to other sectors within the same region. This is a whole farm approach, though another approach could relate to the income returned from management of environmental land compared to management of land for agricultural production. However, there is little, if any data available on this aspect which is further complicated by separating and defining environmental and agricultural activities. Hence, to apply this method there is a requirement for detailed data on farmer incomes, which is usually imputed within farm account data sets.

[4]Calculation of naturally disadvantaged area is based on: a) agricultural disadvantage due to natural handicaps expressed as difference in gross margins, and b) environmental coefficients which adjust the payment based on different defined environmental qualities.

This is one aspect that is complex or where further parameters or guidelines to delimit the use of the approach would be required.

Payment for these farms increase incomes up to sustainable levels under all three formulas. There is therefore an eligibility issue which needs to be explored further under the three payment options as some formulas have a redistribution effect. We base our calculation on rough grazing and stocking densities and these could provide a more sophisticated basis for developing a payment, or ensuring a phased in approach by offering quite restrictive criteria for the most disadvantaged and higher nature valued farms. Another issues with the payments increase is that eligibility will change over time and whilst we use farm business income as the main parameter for indicating 'non-economic' farming, other criteria could be tested. A key point however is that if the Single Farm Payment were removed or reduced, as may be likely in the mid-to longer term, then a much larger number of farming systems could become non-economic by our definition. This would have the impact of widening the farming types which would enter this category. This in turn would require further development of an indicator which captures the public good element of various cropping based systems to help target the most valuable public goods being produced.

Conclusions

- A number of farming systems across the EU are under threat and extensively farmed land is being abandoned as systems fail to maintain a sustainable level of income to survive. Farming in the Hill and Uplands provides a number of ecosystem services which would be lost if land were abandoned.

- The present funding schemes tend to ignore the labour element required under the 'income foregone, or 'additional costs' formula. For farms operating at a loss there is no income to forego and the economically realistic alternative is abandonment. Therefore the full cost of farming that land, is an 'additional cost' in itself.

- The availability and suitability of consistent EU-wide data is a problem, which needs to be solved whether or not new payment calculations are introduced. This is also the case with environmental data, particularly up to date electronic data not just on land cover and land use but also on intensity of management.

- Testing the formulas directly for Scottish and English farms tends to generate much higher levels of payment than the present agri-environmental and LFA type support presently expended. However, this should not be a disincentive to explore these mechanisms as it is recognised, within this report, that the farms here are a special case for protection, provide important ecosystem service and therefore merit a higher level of support from society. Hence, further work is required to test these formulas further at a farm level.

- Applying these formulas at an EU level requires greater linkage across present data collected as a number of important systems are not represented within these data. In particular, a number of countries have very small scale or part time farming systems which are not represented in the present EU sampling frame.

- Focusing on the non-economic farming element reduces the restriction related to incurring a trade distortion or production effect, as these farms have a rather limited market impact. Similarly, if the environmental objectives of these farming systems are clearly defined and linked to government policy then these formulas are justifiable under the WTO agreement.

- There is sufficient scope within the existing WTO agreement if member states and the EU to use it to its full potential. As long as the measures satisfy the measure-specific and generic requirements and as long as the justification is clear, accurate and transparent, Annex 2 of the Agreement on Agriculture provides the basis for policy-makers to justify the realistic costs involved in supporting land management for environmental or regional assistance objectives linked to government policy.

Table of Contents

Executive Summary ii
List of Tables viii
List of Figures ix
1 Introduction 1
1.1 Aims and Objectives 2
2 Environmental Context 3
2.1 HNV concept 3
2.2 Generation of public goods in non-economic farming systems 4
2.2.1 Underlying ecological principles 5
2.2.2 Ecological relationships with farming systems 7
2.3 A simplified definition of HNV systems 8
3 Economic Context 10
3.1 3.1. Economic Context for these systems 11
4 Agri-environment and other axis 2 payments 15
4.1 Rationale for payment for eco-system services 15
4.2 Agri-environmental schemes and WTO requirements 16
4.3 Agri-environmental payments 18
4.4 Natural handicap payments 20
4.5 Forestry measures 22
4.6 Forest environment payments 25
4.7 Synthesis 26
5 Alternative payment approaches for non-economic farming systems delivering public goods. 28
5.1 The scope of the WTO framework for pillar 2 payments 30
5.2 Payment Calculations 33
5.2.1 Full cost of management (FCM) payments 33
5.2.2 Holding-wide (HW) payments 35
5.2.3 Opportunity cost (OC) payments 37
6 Identifying Non-Economic Farming Types 39
6.1 Identifying non-economic farming systems 39
6.2 Financial performance of non-economic farms 42
6.2.1 Scotland 42
6.2.2 England 46
6.3 The impact of a change in activity on public goods provisions 48
6.3.1 Full Cost of Management 48
6.3.2 Holding-wide payments 53
6.3.3 Opportunity Cost of Management 55
6.4 Summary of Impacts 56
7 Conclusions 57
8 References 60
Annex 1 Articles of EC Regulations cited in the report 69
Council Regulation (EC) No 1698/2005 69
Annex 2 Definition of Financial Terminology 71
Annex 3 Context for sheep systems in the UK 73
Annex 4: Regional Variations in Biodiversity Potential in the UK 80
Annex 5: Payment Formula 82

List of Tables

Table 1.1 SPS implementation model and degree of decoupling 1
Table 2.1 Percentage of agricultural land by MAFF agricultural land classification grade in each of the 4 constituent countries of the United Kingdom. UK figures are 1977 MAFF estimates reported in Burrell et al. (1990). 5
Table 2.2 Major broad farming systems considered to occur in Scotland 8
Table 3.1 Farm Business Incomes for the 6 livestock farming types within Wales 13
Table 3.2 Farm Business Survey Data for Wales 2008/9. Hill Sheep Farms, differentiated by business size 13
Table 4.1 Types of intermediary-based transaction in developing countries (left) and developed countries (right) (%) (reference). 16
Table 6.1 Financial indicators of farms operating under the above criteria, Scotland 41
Table 6.2 Physical Data from Non-economic Farms 2005 to 2008, average, Scotland 44
Table 6.3 Financial Indicators from Non-economic Farms 2005 to 2008, average, Scotland 45
Table 6.4 Financial Ratios from Non-economic Farms, 2005 to 2008, Scotland 46
Table 6.5 English HNV farms by farm type 46
Table 6.6 Descriptive statistics of non-economic farming types, England 47
Table 6.7 Main financial indicators for top and bottom performing farms by lowland and LFA categories, England 47
Table 6.8 Main robust indicators for top and bottom performing farms by lowland and LFA categories, England 48
Table 6.9 Agri-environmental payments under various land management scenarios using the full costs of management formula, Scotland £ mean 49
Table 6.10 Distribution of payments (£) by non-economic farms under the FC formula in England 51
Table 6.11 Impact of an increase in the difference between farming and non-farming income on payments per ha 56
Table 6.12 Average payments under the various formulas at country level, £ 56

List of Figures

Figure 2.1 The surrogates being used to identify the amount of potential HNV grazing systems in Scotland 9
Figure 3.1 Average Scottish Hill Breeding Enterprise Margins 12
Figure 4.1 Logic representation of existing payment calculations in the measures 221, 222 and 223 (Schwarz et al.,2007) 24
Figure 5.1 Methodological framework for the development of alternative payment approaches 29
Figure 6.1 Distribution of net profit per hectare, Scotland, 2005 to 2008 average 40
Figure 6.2 Net profit per ha, Scotland, 2005-2008, mean and 95% confidence intervals, Scotland 40
Figure 6.3 Distribution of net profit per hectare, England, 2005 to 2008 average 42
Figure 6.4 Net Farm Income by top and bottom 10% of LFA Sheep Producers, £ and ratio between top and bottom 10% 49
Figure 6.5 Net Profits by top and bottom 10% of LFA Sheep Producers, £ and difference .. 50
Figure 6.6 Net Farm Income by top and bottom 10% of LFA C&S Producers, £ and difference 50
Figure 6.7 Net Profits by top and bottom 10% of LFA C&S Producers, £ and difference 50
Figure 6.8 Net Farm Incomes for Non-economic Lowland Cattle and Sheep farms, £ mean and ratio of top to bottom 52
Figure 6.9 Net Profits for Non-economic Lowland Cattle and Sheep farms, £ mean and ratioof top to bottom 52
Figure 6.10 Net Farm Income for Non-economic LFA Cattle and Sheep farms, £ mean and ratio of top to bottom 52
Figure 6.11 Net Profits for Non-economic LFA Cattle and Sheep farms, £ mean and ratio of top to bottom 53
Figure 6.12 Holding wide payment under various stocking densities, for sheep and cattle and sheep farms, Scotland. 54
Figure 6.13 Holding wide payment under various stocking densities, for non-economic cattle and sheep farms, England 54

1 Introduction

A number of farming sectors are generally populated by low income groups, subject to seasonal fluctuations in yield and fragmentation towards peripheral areas. These factors have tended to provide the rationale for public support both at the British and the EU levels, and continue with the latest Commission proposals for CAP support beyond 2013. The growing agenda towards the environmental and social benefits of maintaining farming production in disadvantaged areas has led to increasing interest in how these systems can be maintained. Non-economic farming systems tend to be extensive systems, managing larger proportions of land under rough and common grazing and, as a result are generally low income or non-economic operations but are generally species rich given the large tracts of land under less intensive management.

There is some debate regarding how non-economic farming systems can be defined. Arguably most hill farms and small holdings can be classified as non-economic, but other systems, such as upland cattle and beef farms also inhabit a spectrum which includes non-economic farming types. The variability of incomes, due to fluctuating prices, scale of operation and seasonality effects, makes identification of these systems difficult and presents policy makers with a complex problem for providing targeted CAP and Rural Development Regulation support.

Consequently, additional measures for providing support to farmers to encourage the delivery of multiple benefits from a wider range of ecosystems services were developed. Chief amongst these are measures within the European Agricultural Fund for Rural Development, particularly the Less Favoured Area (LFA) and Agri-Environmental (AE) measures as well as measures to support woodland management. The mid-term review of the CAP in 2003, and the 2008 CAP Health Check have led to widespread decoupling of payments from production and the introduction of the direct support payments through the Single Payment Scheme (SPS). The SPS was implemented using differing implementation models in different Member States, with variations in the degree to which Member States have maintained partially coupled payments in some sectors, e.g. particularly France and Spain as illustrated in Table 1.1. However, as a result of the 2008 CAP Health Check all coupled payments will be phased out by 2013, except for those in the suckler cow, sheep and goat sectors. Within the UK only Scotland maintained some link with production under the Scottish Beef Calf Scheme, under Article 68. Farmers are funded mainly on the basis of historic payments and there is growing opposition to this approach from both farming and environmental groups, predominantly because the largest proportion of payments goes to the most productive farmers that are those least in need of support.

Table 1.1 SPS implementation model and degree of decoupling

	Historic	Static Hybrid	Dynamic Hybrid
Max Coupling	France,Spain		
Partial decoupling	Austria, Belgium, Italy, Greece, Netherlands, Portugal, *Scotland*	Denmark, Sweden	Finland
Full decoupling	Ireland, *Wales*	Luxembourg, *Northern Ireland*	Germany, *England*

Source: SAC (2010b)

The 2013 CAP Reform provides an opportunity to alter this system in terms of encouraging and supporting farms which are truly non-economic but which nevertheless provide an above proportionate contribution to ecosystems goods and services. To this end the

European Commission's Communication on The CAP Towards 2020 (COM(2010)672/5) suggests that future support payments for farmers in disadvantaged areas will be maintained, measures to ensure more public good benefits are gained for these payments will be introduced, there will be a simplification of payments to small holdings, and redistribution of support from the largest holdings (capping) to smaller holdings whilst making payments more equitable across Europe, particularly in the New Member States.

A key issue of specific pillar 2 environmental schemes is that they are constrained by the current requirements of the Rural Development Regulation (RDR) based primarily on income foregone and additional costs. This means that scheme payments should be income neutral (the income forgone element includes a component of normal 'profit'). However, for farming systems that exhibit very low levels of profitability this means that agri-environment payments simply perpetuate these low levels of profitability (although the fixed nature of the payments over a given period may act as a buffer against fluctuating agricultural margins). For systems that are not profitable, income forgone becomes redundant and other approaches are needed to support such farming systems, where there is a public benefit from doing so.

This report centres on the role of non-economic farming and the support for public goods through the available schemes and aims to assess the impact of these schemes and whether changes in payment mechanisms can both support non-economic farming systems and enhance the provision of public goods to society. There is, however, a difficulty in defining non-economic farming systems and hence the work involved developing a workable definition to apply to predominantly UK based farming types. The variability of incomes, due to fluctuating prices and seasonality effects, makes identification of these systems difficult and presents policy makers with a complex problem for assigning subsidy support schemes. Consequently, the first task is to present a robust and workable definition of non-economic farming, that can be applied to systems across the UK and suggest how this can be extended towards other peripheral farming systems within Europe.

1.1 Aims and Objectives

The aim of this project is to examine the rationale for supporting non-economic farming systems and compare the possible impacts of a change in payment mechanism on these farms in terms of both the economic and ecological impacts. This covers five key objectives, namely to;

- Establish the context, and describe the scale of the problems faced by low or non profitable farming systems.
- Review the context for agri-environment scheme payments under the EAFRD rules[5].
- Explore alternative payment approaches for non-economic farming systems delivering public goods.
- Test alternative payment approaches through an economic analysis.
- Make recommendations on what technical scope there is to develop formulas that more effectively support such systems.

[5]Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

2 Environmental Context

This and the following chapter aim to provide context setting for the study of systems which are both non-economic and provide a higher level of environmental value. Hence it provides the basis for defining the particular farming systems which operate under these conditions. This chapter focuses on providing a robust workable definition for identifying and classifying non-economic farming systems

In defining non-economic farming systems there are clear difficulties with data availability and generalisation of a definition which can encompass a variety of farming systems currently operating within Europe. Therefore we firstly reduced the quantitative scope to UK based farming systems and, within the final stage of this project explored the application of results qualitatively across other EU farming systems. Secondly, we recognised that this definition must encompass those non-economic farming systems which have a high probability of providing public goods. An example, which we used to illustrate the provision of ecosystem services and which has been studied in some depth, is the High Nature Value farming concept (HNV) which is explored below

2.1 HNV concept

The HNV farming concept recognises that many European habitats and landscapes considered to be of high nature conservation value are intimately associated with the continuation of specific low-intensity farming systems (Beaufoy *et al.* 1994; Bignal & McCracken, 1996, 2000). Long before the Common Agricultural Policy (CAP), it was the policy of many European countries in the 20th century to encourage the technological development of agriculture in the drive for greater production. The CAP reinforced this approach, encouraging the amalgamation of small farms, an accelerated loss of agricultural biodiversity and the homogenisation of rural landscapes. World Trade Organisation negotiations still focus exclusively on intensive agriculture and on an increasing desire to reduce production-oriented payments to farmers. They also determine the conditions for financial support that can be offered to farmers via European rural development policies (such as Less Favoured Areas and agri-environment programmes).

Hence HNV farming systems are not getting large agri-environment payments but also in many cases their pillar 1 payments are low, i.e. the collective amount of public support going to these systems is low and will have low profitability. However, although the public support may be lower in monetary terms, such farming systems are more reliant on public support since it makes up a larger proportion of their overall income (EEA 2009). Within the EU, CAP measures therefore still favour intensive systems on more productive land (Boccacio *et al* 2009; EEA, 2009). Combined with commercial competition and technological change, these policies create an operating environment in which HNV farming systems face a choice between intensification (e.g. higher stocking rates, switch to fast maturing commercial breeds) or abandonment. The underlying principles behind the development of the HNV farming concept were, and remain, that:

- Market, agricultural policy and social pressures are increasingly making such HNV farming systems economically unviable
- Any resulting intensification or abandonment of such farming systems would adversely impact on the associated HNV
- There is therefore a justifiable case to be made for directing additional financial support to these farming systems to help maintain the HNV

Across Europe, HNV farming systems are characterised by either (1) low intensity of land use and a high proportion of semi-natural vegetation forming the forage or fodder resource or (2) low-intensity of land-use sitting with a diverse landscape mosaic of natural and semi-natural habitats (Beaufoy, 2008). However, there is no universally applicable dividing line between HNV and non-HNV farming systems any more than between low-intensity and intensive farming. The biological diversity of farmland ranges along a gradient between the lowest and the highest values. But for a given situation, a judgement can be made of what types of farming should be considered as HNV, on the basis of available knowledge about the land cover, the farming systems in question and their inherent value for biodiversity. Ideally a clear differentiation between HNV and other farmland can be made; but realistically, Member States will have to choose between criteria likely to *include* as much HNV farmland as possible and those which *exclude* as much farmland of lower interest as possible. Based on this judgement, indicators can be designed.

Although some HNV farming systems occur in association with traditional cropping systems (such as extensive olive production in the Mediterranean or non-irrigated crop production in northern Spain), a large number of Europe's remaining HNV farming systems are now largely associated with livestock grazing systems on semi-natural habitats in the mountains and other remote areas of Europe (Bignal & McCracken, 2009). Ensuring the maintenance of the farmland biodiversity value associated with such areas therefore depends on ensuring the continuation of appropriate farming systems in those areas. This requires an understanding not only of how the different elements of HNV farming systems interact to maintain the HNV but also of how HNV farming systems can be identified. The identification of whether the system practised at a farm level is HNV or not is important, since ultimately it is at the farm level that any public funded support is directed.

The key broad ecological and production characteristics of such systems are known (e.g. Beaufoy 2008) and over the years these have been used to try to identify surrogates from agricultural statistics which could be used to develop broad HNV farming system typologies (e.g. Andersen *et al*., 2004; Cooper *et al*., 2007) or inform the focus of work assessing the potential for undesirable land abandonment which could result from further CAP reform or trade liberalisation (Renwick et al., 2010)

The range of farming systems across Europe is large and hence the definitions at a national and regional level have the potential to be many and varied. For the purposes of this LUPG study, it is suggested that a simple, tight definition be used that would be expected to capture a large proportion of the HNV systems occurring in the UK. To this end, the 'simple' definition of HNV that SAC is using in its involvement with the Scottish Government High Nature Value Farming and Forestry Indicator Technical Working Group has been used here as well.

2.2 Generation of public goods in non-economic farming systems

Agricultural land covers over 70% of the United Kingdom's total land surface area of 24,413,900 ha, with c. 2% of the civilian working population employed in the agriculture, forestry, hunting and fishing sector. Of the total agricultural area in the UK, just under 50% is designated as Less favoured Area (LFA), although there is a large difference between England (with only c. 15% of its agricultural area classed as LFA) and Scotland, Wales and Northern Ireland (with c. 90%, 80% and 70% respectively).

The various government departments with agricultural responsibility in the four constituent countries of the UK (England, Northern Ireland, Scotland and Wales) all distinguish between different land quality using a set of physical criteria such as height, slope, climate, soil and drainage, and the extent to which these factors constrain agricultural use. Although the number of grades recognised by these departments differ from country to country, it is possible to combine some grades to make the figures for each country comparable with

those calculated by what was formerly known as the Ministry of Agriculture Fisheries and Food (MAFF) for England and Wales.

Using the MAFF system, Grade 1 is land with very minor or no physical limitations to agricultural use. Grade 2 has some minor limitations, particularly in soil texture, depth or drainage. Both these grades represent high-potential land, which can grow a wide range of farm and horticultural products. Grade 3 land has moderate limitations due to soil, relief or climate - it has no potential for horticulture but can produce 'good' crops of cereals, roots and grass. Grade 4 has severe limitations, and in spite of some potential for fodder crops is basically used for pasture. Grade 5 is of little agricultural value, with severe limitations - it is rough grazing with scope for improved pasture on limited areas.

From Table 2.1 it can be seen that in Wales and Scotland over 75% of agricultural land is in the two poorest grades, with little potential beyond sheep and cattle rearing, while in England the figure is only 26%. By contrast, Northern Ireland is similar to England, with quite a high proportion of land within the first three grades and therefore suitable for tillage. It must be stressed, however, that this classification only gives a broad indication of agricultural potential. It does not reflect the differing agricultural outputs and, as shall be seen later, there are marked regional differences within each country.

Table 2.1 Percentage of agricultural land by MAFF agricultural land classification grade in each of the 4 constituent countries of the United Kingdom. UK figures are 1977 MAFF estimates reported in Burrell et al. (1990).

	Grade				
	1	2	3	4	5
Scotland	0.3	2.4	13.6	10.2	73.5
England	3.3	16.6	54.4	15.7	10.3
Wales	0.2	2.3	17.5	44.2	35.8
NorthernIreland	-	3.3	42.0	49.0	5.7
United Kingdom	1.8	9.8	36.4	18.2	33.7

On account of climate and soil conditions, the lowlands of the United Kingdom can be regarded as being similar in having predominately livestock-based production (dairying, beef cattle and/or sheep) on grasslands concentrated in the west of each country and arable-based production (cereals and vegetable production)in the drier and more fertile east.

2.2.1 Underlying ecological principles

Within any agricultural landscape, biodiversity is generally greater within areas that (a) contain a wide range of niches (e.g., different habitats, different vegetation structures), (b) are subject to medium levels of disturbance (e.g. through climatic or management factors), (c) occur at a large enough scale to allow enough individuals to survive and maintain viable populations and (d) provide a sufficient amount of similar habitats (though with varied environmental conditions) within close proximity to each other to allow the individuals of each species sufficient choice of potentially suitable habitats at any one time. Many European farming systems are of high biodiversity value because:

- They continue to utilise and maintain a high proportion of semi-natural vegetation managed at relatively low levels of intensity. This may be largely by default in that climatic and topographic constraints limit the intensification of vegetation management and agricultural practices that can be applied to these areas. However, the outcome is a greater range of ecological niches over much of the area utilised within the farming system.
- These climatic and topographic constraints also generally mean that not all of the land in an area is available for utilisation by all the different land use components of the system (e.g. grazing by domestic animals, growth of crops). Hence, crops, more intensively managed pastures and semi-natural vegetation are generally found within

a mix of more natural habitats (not only woodlands but also other landscape elements such as hedgerows and wetlands).

- The constraints imposed on the vegetation by climate and topography control not only the type but, just as importantly, the timing of the management that is applied to the vegetation. Hence, the farm management practices are generally synchronised with the annual natural growth cycle of the vegetation and so are not imposed at a time when it would be detrimental to a wide range of the plant species involved. In addition, soil type and nutrient limitations place limitations on the type of crops which can be grown or the number of years they can be grown in succession. There is therefore also more of a need to include a greater variety of crops in the crop rotation (including periods of fallow in which to build nutrients to a level at which the subsequent crop can be supported).
- For most of the year, the nutritional value of much of the semi-natural vegetation is generally low which places limits on the number of animals and the duration of grazing intervals in a given area. It also leads to a need for larger areas to be utilised. Hence, grazing pressure on any one area is generally either low or (in closely shepherded flocks) only high for a very short period, which leads to a greater heterogeneity of vegetation structures.
- The need to produce fodder to carry livestock through the winter and the constraints on the amount of fodder which can be grown mean that (a) there is a limit to the total number of animals that can be supported and (b) there is a need to move animals to other areas during the period of growth and harvesting of winter fodder in the summer. Both these factors markedly reduce grazing pressure on any one area of land over the course of the year. In addition, not only do the fodder crops introduce further heterogeneity into the landscape, but many of these are also of extremely high biodiversity value in their own right.
- The habitats of many wildlife species are naturally unstable and it is common for populations to disappear from one area and for new ones to appear when a suitable niche becomes available elsewhere. These farming systems and associated farming practices are maintained at a scale and intensity which ensures sufficient area of potentially suitable habitat is available within relatively (in terms of the distance that the species can move) close proximity to each other and thereby allows scope for these cycles of colonisation and re-colonisation to take place.
- By the same token, these systems are much more favourable to a wider range of wildlife species (especially the larger vertebrates) because they are practised over a wider scale and therefore (a) the conditions required at any one time of year (especially by more mobile species) can be found at a wide variety of locations and (b) the different requirements by these species at different times of year are catered for, i.e. through changes in the mix of structures and habitats in any one area through the year.

The high biodiversity value of many European farming systems therefore relates both to the spatial and temporal diversity that they introduce. In a spatial context, they produce a patchwork of habitats - meadows, grass pastures, crops, fallows, woodland, hedgerows, natural pastures (including alpine grassland, heath, moorland, saltmarsh, marshland, bog, woodland-pasture) as well as more intensively managed land around settlements and farmsteads. In a temporal context, not all land is managed in the same way at the same time; so neighbouring farms with essentially the same production systems may sow and harvest crops at different times. This produces a patchwork of the same crop at different stages of development. In a similar fashion, adjacent pasture under different ownership will be grazed in different ways (e.g., with different animals and at different stock densities) and at different times of the year. This diversity provides much more favourable conditions for

plants and animals (especially invertebrates) to find areas with suitable conditions for the completion of their lifecycles (Bignal & McCracken 2000).

2.2.2 Ecological relationships with farming systems

Over much of the drier and more fertile lowlands of the south and east of each country in the UK, the increased concentration on arable cropping over the past 50 years has resulted in the intensification and simplification of agricultural practices (e.g. increased use of chemical fertilisers, herbicides and pesticides and a marked decrease in mixed farming systems).

There has been a significant loss of large areas of semi-natural habitats (e.g. dry grasslands, wet grasslands). As a result, much of the biodiversity value of these agricultural areas has declined greatly and is now largely associated with remaining boundary habitats (such as hedgerows or woodlands) or proximity to relict areas of semi-natural vegetation (such as lowland raised bogs and wetlands). However, as outlined above, there are exceptions. The issue in many cases is whether the limits which semi-natural vegetation places on an agricultural system are still manifest, or whether they have been masked or overcome (either by intensive practices or merely by the farm being dominated by a more significant area of intensively-managed land).

In both upland and lowland situations in both UK, there seems to be one common factor in all systems with even the smallest Nature Value - grazing by livestock. In the lowlands it is a vital component of mixed systems, which have a higher diversity of man-made habitats and have at least the potential for the integrated and biodiversity-friendly management of both nutrients and any small remaining areas of semi-natural vegetation. Livestock give a rationale to more diverse rotations and to the retention of boundary features such as hedges, walls and drinking areas.

In areas of semi-natural vegetation stock have a crucial impact. They prevent tree and shrub regeneration and, together with appropriate burning regimes, maintaining a diverse mosaic of Ericaceous moorland, grassy heaths and acid and neutral grasslands that make up the core biodiversity resource. However, intensification of farming practices have also occurred in many of these areas (e.g. a direct loss of semi-natural vegetation as land is enclosed and fertilised; increase in number of livestock on the farms) leading to changes in the grazing and management regimes on the heaths and moorlands.

This change in management leads to a simplification of the habitat mosaic (through the creation of uniform areas of species-poor acidic grassland) and further exacerbates the effects of high grazing intensity. This has particularly severe effects on areas of high conservation value but low grazing resistance such as scrub and bogs, and also has detrimental effects on breeding birds such as Red Grouse *Lagopus lagopus*, Golden Plover, *Pluvialis apricaria*, and Hen Harrier, *Circus cyaneus*, through the loss of breeding and feeding habitat.

On the better land in the uplands, increases in soil fertility and modifications to the vegetation as a result of improvement schemes, have resulted in the decline of botanical diversity in meadows and pastures and the loss of wet flushes and unimproved grassland which are essential to the breeding success of many species of wader (e.g. Snipe, *Gallinago gallinago*, and Redshank, *Tringa totanus*). The change from hay production to more intensive silage production (with the associated increased use of fertilisers and earlier cutting), means that the floristic richness of meadows decreases because many plants do not have time to flower and set seeds before mowing. Silage management also effects ground nesting birds, e.g. the earlier and denser growth of lush vegetation makes it difficult for species such as the Lapwing, *Vanellus vanellus*, to nest or feed their chicks on silage fields.

Further discussion of these concepts is provided in Annex 4

2.3 A simplified definition of HNV systems

Using Scotland as an initial example, Table 2.2 below highlights the major broad farming systems expected to occur within Scotland and which formed the focus of considering the likely HNV potential. These are listed in descending order of their potential to be HNV (based on the characteristics of the majority of farms practising each system). The first column highlights the farming system name used in this exercise, while columns 2 and 3 indicates the equivalent RERAD Farm Accounts system typology and new EU Farm Account Data (FADN) farming system typology, respectively. Given the uniqueness, and potential HNV importance, of crofting in Scotland, a separate category has been created for this, even though there is no direct FADN or RERAD Farm Accounts equivalent.

Table 2.2 Major broad farming systems considered to occur in Scotland

Broad Scottish farming system	Equivalent RERAD Farm Account farming system	Equivalent New FADN farming system
1) Crofting	No equivalent	No equivalent
2) Sheep system	Specialist sheep (LFA)	Specialist sheep
3) Beef cattle system	Specialist beef (LFA)	Specialist cattle rearing & fattening
4) Combined sheep & cattle system	Cattle & sheep (LFA) Lowground cattle & sheep	Sheep & cattle combined
5) Mixed livestock & arable system	Mixed (part)	Mixed crops & livestock
6) Arable system	Cereals General cropping	Specialist cereal, oilseed & protein crops General field crops
7) Dairy system	Dairy	Specialist dairying
8) Mixed arable and horticulture system	Mixed (part)	Mixed horticulture & cropping
9) Horticulture system	No equivalent	Specialist horticulture
10) Pig system	No equivalent	Specialist pigs
11) Poultry system	No equivalent	Specialist poultry

A number of systems occurring in the UK, (i.e. arable systems, dairy systems, mixed arable & horticulture systems, horticulture systems, pig systems, poultry systems) are very specialised and the vast majority are managed very intensively. Hence the majority of farms practising such systems cannot be considered to be of HNV (in terms of any strong positive link between the system characteristics and farmland biodiversity value). Some semi-natural landscape features (such as hedges, ponds, wetlands and small uncultivated patches), can still occur around such intensively managed farmland that otherwise is of limited nature value, and such features are certainly important for conserving vestiges of biodiversity. However, the presence of these features do not qualify such farming systems to be classified as HNV systems, rather they simply indicate that such productive farming systems can (depending on the landscape context in which they sit) contain some features of HNV interest.

The other farming systems occurring in the rest of the UK, (i.e. sheep systems, beef cattle systems, combined sheep & cattle systems, mixed livestock and arable systems) have more of a potential to be HNV, but this is very dependent on the range of habitats occurring at a farm level (especially those utilised as forage and fodder resources) and the intensity at which these are managed. Datasets of detailed farm-level ecological and farm management characteristics do not exist, but there is the potential to use some of the farm-level structure

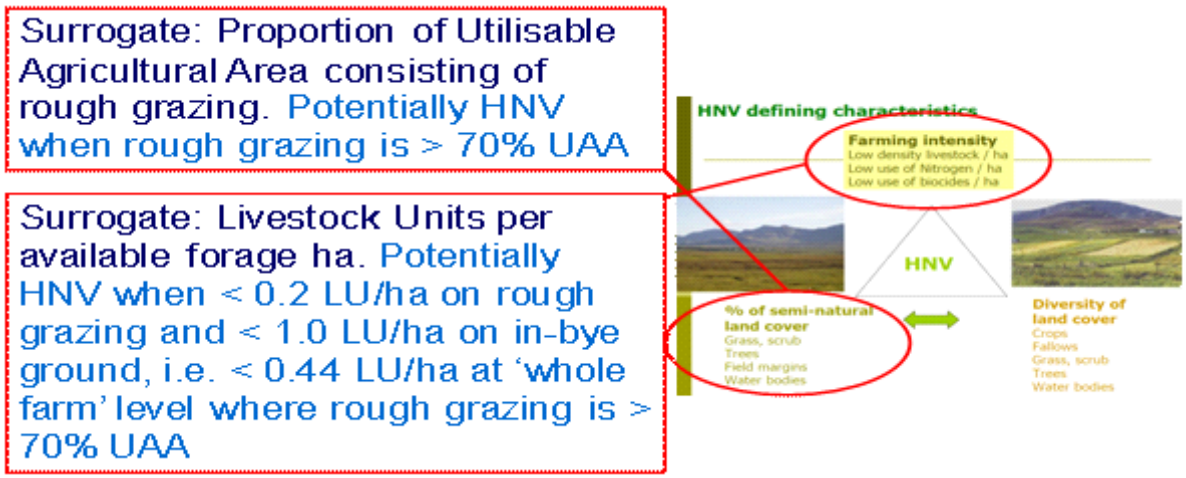
variables as surrogates as to what may be happening on the ground (in terms of the type of habitats, and hence associated farmland biodiversity, present and the intensity at which these are being managed). However, the data which are available to use as surrogates are much more relevant to use on livestock dominated farming systems (see Figure 2.1) and hence, the approach being taken in Scotland will not be able to identify many HNV mixed livestock and arable systems (if indeed any exist), especially any which do not contain a large proportion of rough grazing as part of the Utilised Agricultural Area.

Whilst a number of indicators could be used, the approach applied here focuses on considering the livestock-dominated farming systems occurring in the UK (i.e. sheep systems, beef cattle systems, combined sheep & cattle systems) and attempting to identify the number and extent of these with potential HNV characteristics, using the proportion of rough grazing on the farm as a surrogate for the amount of semi-natural habitat which may form the forage and fodder resource and a broad calculation of livestock densities as a surrogate for the intensity at which forage resources across the farm are utilised. For the purposes of this exercise, livestock-dominated systems in Scotland considered to be of potential HNV are taken to be those:

> ***where rough grazing[6] (used as a surrogate for semi-natural occurrence) makes up more than 70% of the UAA and where livestock units per available forage ha (as a surrogate of farming intensity) are less than 0.44 LU/ha at the whole farm level.***

These thresholds have been set based on previous work and on the basis that if there is more than 70% of the UAA on a farm consists of rough grazing then this puts a constraint on the ability of the farm to try to increase its profitability by increasing the intensity of management on the in-bye ground. Obviously it is feasible to try to increase profitability in those situations by increasing livestock numbers, hence the reason for the use of the stocking density threshold.

Figure 2.1The surrogates being used to identify the amount of potential HNV grazing systems in Scotland



Agricultural land use in the UK
Drawing on information contained in Jones & McCracken (2003)

[6] We use rough grazing as it is easily available from collected data sets, however over indicators may also be worth exploring. For example, in section 6.1 of this report we utilise grazing density and the proportion of permanent to temporary grass as part of an approach to distinguish HNV farms in situations in England where rough grazing is less than 70% of the UAA on the farm (this could go on the main text after Figure 2.1).

3 Economic Context

This chapter provides the economic context under which these systems operate. A series of major changes to upland farming in Great Britain have been well reported, which relate to the most recent CAP reform package commencing in 2005 (e.g. SAC, 2008; RSE, 2008), and it is evident that changes are continuing apace, both at the individual farm level and at regional and national levels. Reducing numbers of sheep is the 'headline' issue, varying across localities and regions. At the farm level these range from small to large overall reductions in sheep numbers, to complete abandonment of sections of farms, often due to practical difficulties of managing and gathering sheep (SAC, 2008; Morris et al., 2005). These issues are not necessarily new (e.g. Hill Task Force 2001, English Nature 2001), but the reform of CAP that came into effect in 2005 has been a particular issue that has enabled or accentuated changes.

The losses incurred by hill farming and the subsequent impact that abandonment would have on the countryside have been recently discussed at the UK policy level, with a view to examining future support strategies under the CAP (House of Commons, 2011). In addition, CRC (2010) argued for regionalised understanding of management, e.g. stocking levels, to develop payments and also to encourage the development of wider markets for upland ecosystems goods and services, such as carbon and water markets (CRC, 2010). Further McCracken et al. (2011) review the losses in ecological value to Scotland after examining declining stocking levels of cattle and sheep production.

Lewis (2010) showed that for six case study farms, margins varied greatly from a net margin of £27,000 pa to £-27,000 per annum and for the moorland sector of these farms (which have better land and farming systems, including dairying in the valley bottoms) margins were still poor. All farmers, when questioned, considered that the end to the current approach of Single Farm payments in 2013 would end grazing on the moorland.

Economic pressures were further highlighted by Turner et al (2008) for hill farms in south-west England. They pointed to significant future pressure as a result of the continuing changes in policy support measures in England as part of the 2005 reforms; given England has a changing profile of SPS (moving from historic to area based payments through a dynamic hybrid implementation model). In their analysis, the more peripheral farms were the greatest source of concern. The future viability of English hill farms, with poor performance, heavy dependence and high influence of support payments, was also emphasised by most recent economic reports for England (Harvey and Scott, 2009).

For Scotland, SAC (2010b) noted that the trend of stock reduction has continued since decoupling, with weak cross-compliance of active farm management, and continued poor financial support. In some case studies it was evident that there were very many different patterns and triggers for change at the farm level. Very similar issues and changes are occurring in Wales. Turner et al. (2008) also considered though that in terms of structural changes, many extreme hill farmers would continue to farm, despite poor income and long hours, perhaps in hope of better future returns (as predicted by much of the literature on decoupled[7]) . In time though, and with fewer young people entering, farms will disappear and their land will be shared between neighbours.

[7]For an overview of theoretical and empirical literature regarding decoupled agricultural support see SAC (2010) A Review of Literature on the Value of Public Goods from Agriculture and the Production Impacts of the Single Farm Payment Scheme. Report Prepared for the Scottish Government's Rural and Environment Research and Analysis Directorate.

In a recent study for Scotland (SAC 2010), the continued decline in livestock numbers in the hill areas and three case study areas (south Skye, Ettrick Valley in Scottish Borders and Lairg in Invernesshire), that there were intimate linkages between livestock management, natural heritage interests and social and economic issues. Both local farming and conservation interests viewed the social issues, which underpinned the capacity of the areas to continuing farming, and thus achieve environmental goals, was most important. Underlying social issues were the poor economic performance of hill upland systems and poor recruitment of young people into livestock farming and crofting activity.

So whilst the overall pattern during the period of the recent reform to datehas been of declining sheep numbers and a trend towards partial or complete abandonment, it is much more complex than this, especially at the farm level. Some commentators have suggested that intensification and enlargement of units in the uplands may be a way forward for some, given recent high prices for lamb and breeding sheep, and overall limited improvements in Farm Business Incomes (FBI) seen in the most recent cycle of reporting (Scottish Government, 2010b, Defra 2010a).

Whilst much interest has been upon the future of the farming business, the finer scale management practices are the building blocks of these systems, and often the detail that affects environmental goods and services. Agri-environment schemes likewise target particular activities and management regimes and objectives. Within these hill and upland farming systems, marginal economic assessments are frequently undertaken by the land managers involved. Many of these activities are the ones that are under threat, particularly where the availability of appropriately skilled labour is scarce (SAC, 2008, SAC 2011).

Defra (2009) have produced a number of reports from the Agricultural Change and Environment Observatory with respect of the uplands and these highlight the changing patterns of land management, uptake of agri-environmental schemes within the English uplands. The changed patterns of labour availability in relation to common grazings is further noted (Defra 2010), which mirrors issues noted above. Stott *et al.,* (2005) modelled hill farming systems in the UK, and considered a range of input based scenarios, where profit and animal welfare were the goals. They found little economic benefit from measures that improved both livestock performance and welfare, because of increased costs associated with the inputs. Labour costs and scarcity were noted in the participative research that underpinned this work. There have been few studies of these issues in relation to agri-environmental activities. Gardner et al., (2010) modelled a range of livestock grazing scenarios, linked to vegetation cover change and found that high costs of labour were again a restricting issue.

The recent study by SAC for SNH (SNH, 2010) also notes considerable issues over labour in three study areas. Lack of labour contributed towards stock no longer being grazed in further removed common grazings and more difficulty in organising sheep gathering from hill grazing. As noted by Morgan-Davies and Waterhouse (2010), abandonment, or partial abandonment on one farm was a major influence upon the workload of gathering on neighbour farms, which ultimately affected their decision making.

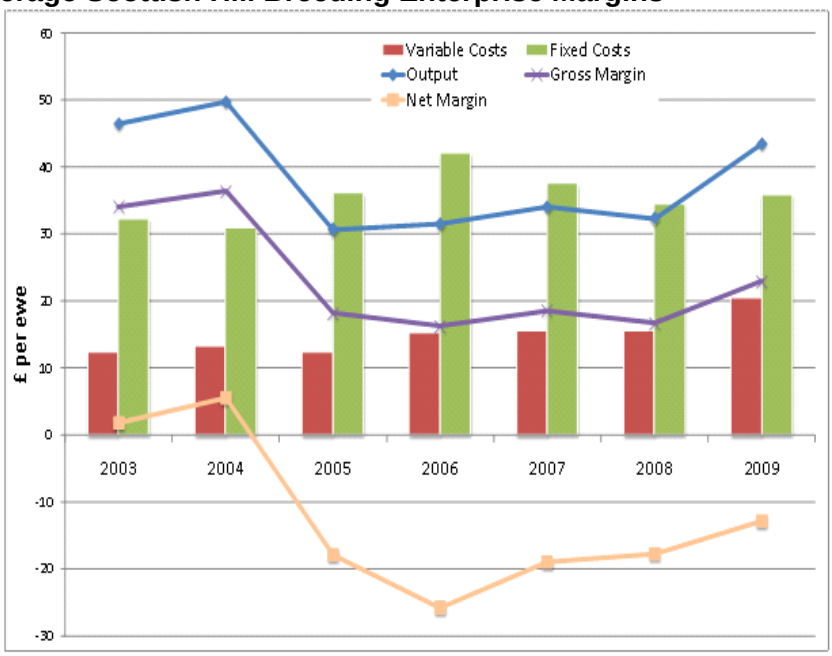
3.1 Economic Context for these systems

The main categories of data in the Farm Business Survey of each of the UK countries, is somewhat different and because it is whole farm rather than enterprise, farm outputs often mix different enterprises. More significantly, differences between enterprises may be hidden within the data. In particular, the English Grazing Livestock (LFA) farms cover both hill flocks (hefted purebred self-replacing ewes) and upland flocks (crossbred ewes typically selling all progeny as finished lambs).

The most recent Quality Meat Scotland farm costing data (QMS, 2009), showed that upland ewe enterprises achieved an average gross margin of £47 per ewe within a range of (-) £1 to £69 per ewe. LFA hill sheep enterprises by contrast averaged a gross margin of £17 per ewe

within a range of (-) £13 to £44 per ewe. Figure 3.1 show the outputs, costs and margins per ewe over the period 2003 – 2009, highlighting the non-economic nature of this system of agriculture, particularly post 2004 and the era of decoupled support (these figures do not take into account direct CAP support payments such as LFASS and SFP). What is noteworthy is that the market revenue obtained from sheep was insufficient to make any contribution to the farm's fixed costs in the period 2005-2008, leading to farmers reducing stock numbers in order to minimise losses from their continued production of sheep. Despite returning lower gross and net margins per ewe than their upland counterparts, LFA hill sheep enterprises showed the benefits of efficiency with higher prolificacy and heavier lambs contributing significantly to the £20 improvement in gross margin per ewe between the average and the top third.

Figure 3.1 Average Scottish Hill Breeding Enterprise Margins



Source: Adapted from QMS Cattle and Sheep Enterprise Profitability in Scotland (various years)

Lowground breeding ewe enterprises surveyed achieved an average gross margin of £52 per ewe within a range of £27 to £95 per ewe(QMS, 2009). When fixed costs were included in the financial performance, the average net margin for all those enterprises surveyed was £26 per ewe, was significantly lower, and negative, for hill ewe flocks, between £(-)39.15 and £(-)1.00 per ewe for bottom and top third producers. By contrast the upland flocks range from £(-)7.79 and £14.86. The contrast is even greater between the better hill farming areas (such as the Borders, Ayrshire, and Angus glens) and the West Highlands and Northwest coast, wheretypical costing margin data shows poorer gross and net returns for the latter locations (SAC, Farm Management Handbook).

These differences are similarly seen when comparing the outputs and margins from poorer hill farming areas in England (e.g. Lewis 2010), with the standard Farm Business Survey data for SDA Hill farms sub-set in the FBS data. They show for North York Moors farm that net farm income per hectare were only £12.80 for the NY moors flocks, compared to £167 for the FBS hill farm sample. Similar levels of subsidy were paid, the key difference was that sheep income from the NY moors farms was only £139.80, compared to £279 for the FBS sample. Comparing per ewe and with gross margins, the NY moors farms had a gross margin/ewe of £5.50 compared to £29.60. EBLEX data from their costed flocks does not differentiate between hill and upland flocks, but demonstrates big differences between bottom and top third producers in their LFA sample – with £-45.08 and £-11.03 net margins based around lambing productivity of 132 and 141 lambs weaned per ewe for bottom and top third producers respectively.

Welsh data (Aberystwyth University, 2010) highlights the dependence upon livestock within this country as there are only six types of farm, all livestock, but with the divisions between hill (LFA), upland (SDA) and lowland spread across all farm types including dairy. Table 3.1 shows that profits for average and top third producers (by FBI) varied by these main types.

Table 3.1 Farm Business Incomes for the 6 livestock farming types within Wales

	Hill Sheep	Hill cattle & sheep	Upland cattle & sheep	Lowland Cattle & sheep	Hill & Upland Dairy	Lowland Dairy
Profit before unpaid rent/ farm (£)	25,942	26,130	32,318	26,234	56,058	73,190
Average Per ha	177	201	299	289	582	674
Top third per ha	370	413	534	553	1189	1396

The hill sheep sector in Wales is worthy of closer scrutiny because it is differentiated into different size units, based upon standard farm size units (European Size Unit - ESU) and this is illustrated in Table 3.2 below.

Table 3.2 Farm Business Survey Data for Wales 2008/9. Hill Sheep Farms, differentiated by business size

		Small (< 28ESU)	Medium (28-60 ESU)	Large (>60 ESU)
Livestock (hd)	Cows	8	19	36
	Other cattle	16	37	84
	Breeding ewes	504	1,020	2,288
	Other Sheep	310	566	1,198
Land (ha)	Crops	0.3	0.9	3.3
	Hay	2.3	2.2	4.7
	Silage	10.3	18.2	35.7
	Other grassland	50.1	101	207
	Rough Grazing	40	63	208
	Other Common Land (share)	16	21	48
Income (£/farm)	Single Farm Payment	£16,943	£31,920	£70,902
	Tyr Mynydd	£8,876	£11,933	£29,181
	Other	£2,493	£3,175	£8,457
Farm Business Income (£/farm)		£14,094	£26,475	£53,037
Subsidy as % of FBI		186%	166%	189%

Size of farm says much about the scale of the business in terms of economic costs and incomes. The above table shows a range of welsh hill sheep farms covering the range from an average of 500 breeding ewes kept on barely 100 hectares to large farms averaging 2300 breeding ewes and 36 cows had a proportionately similar profit, a similar high dependence upon subsidy payments almost double the farm business income. Land area per head is also similar, with both farms broadly equal proportions of semi-natural rough grazing and improved grasslands with a small amount of cropping. There is no indication that 'small' has any clear farming characteristics, though the labour force in these two extremes is quite different, providing scope for much greater personal drawings in farms in the larger farm samples. These data also illustrate that as in beef cattle and sheep systems, some LFA dairy farms even with their extra Tyr Mynydd (LFA) payments, have a more difficult time reaching profitable output. The larger farms though are proportionately similar in Farm Business Income per cow, and here again the larger farm has a greater farm business income and greater scope to support the labour force necessary to run a dairy farm. As the

Farm Business Income for the smaller hill and upland dairy farms shown here is an average, it implies that many make relatively low farm profits. It is unsurprising that dairy farm numbers throughout the UK are in decline.

These data demonstrate great variation between core system, such as hill versus upland, between upland and lowland and between bottom and top producers as defined by costings collectors (QMS, Eblex). Geographical and bio-physical issues also provide a strong basis for differences between systems and differences in input and output variables and costs. There are also considerable cultural and historic background to many of the systems and land tenure issues further create issues of difference.

4 Agri-environment and other axis 2 payments

A number of schemes can be grouped under the general banner of payments for ecosystem services. This section reviews the rationale for payments for ecosystem services and payment mechanics of the main axis 2 payments including agri-environment payments, LFA payments and forestry payments. A literature review on payment calculations in axis 2 measures in Scotland, UK and the EU has been carried out to synthesise existing payment calculation approaches and to discuss the constraints and opportunities to develop alternative approaches for non-economic farming systems. Particular attention has been paid to the implications of WTO requirements (e.g. Matzdorf et al., 2010, Hepburn and Bellemann, 2009, Blandford, 2005, Blandford and Josling 2007, Blandford and Hill, 2008, Schwarz et al., 2008) and the different payment calculation approaches used across EU Member States and regions. Payment calculation data have been obtained from official documentations of national and regional rural development programmes in EU Member States and from a survey of paying agencies and ministries in selected Member States carried out and analysed in the EC project AGRIGRID (e.g. Hrabalova et al., 2007, Schwarz et al., 2007 and Vlahos and Tsakalou, 2007).

4.1 Rationale for payment for eco-system services

Recent CAP reform has set an agenda that is heavily influenced by the desire to link public support to environmental (public good) outcomes and rural development. Public procurement of positive externalities (or public goods) from private land owners is not a new challenge, although given the prominence of an Ecosystem Approach there is currently more scrutiny of the value of these outputs relative to investment costs of their delivery. Alongside this use of public funds there is also government interest in other models of (ecosystem) service delivery using market-based approaches, where the government does not have to play any role except perhaps facilitation[8] through the provision of information to sellers and potential buyers of ecosystem services. This is the essence of the so-called Payments for Ecosystem Services (PES) Agenda[9].

The PES agenda seeks to further the reach of markets into environmental management by identifying and facilitating the conditions for trades between the supplier of ecosystem goods and services and a prospective demand. PES have been most commonly applied for watershed services, biodiversity, climate change, and landscape beauty. PES schemes are commonly classified by five criteria: (1) a voluntary transaction, with (2) a well-defined ecosystem services that is being bought by (3) an environmental service buyer from (4) an environmental service provider (5) given the service is continuously delivered only when payments are made (Wunder 2005; Wunder *et al*. 2005).

The demand side for PES transactions comes from three broad sources (outlined in Table 4.1). Each category has the potential to be supplied by farmers. However, the output of these types of services will obviously vary by farm type.

Climate change mitigation by reducing Carbon emissions:

- Polluters under regulation (for low cost offsets)
- Voluntary buyers (anticipation of regulation)

[8] Lowering so-called transaction costs.
[9] Defra (2010) Payments for Ecosystem Services: A Short Introduction
http://www.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf

Watershed benefits:

- Hydroelectric facilities (to reduce operating costs e.g. moderating abstraction for livestock watering)
- Municipal water facilities (reduce operating costs by removal of pollutants at source, e.g. through reduced stocking densities near water bodies)

Biodiversity conservation:

- Transformation of existing market product types - consumers of eco-labelled products or labels for animal welfare (environment; food safety concerns)

The interesting element of the PES agenda is the extent to which trades can involve private sector stakeholders. Logically the attraction of PES is that market arrangements obviate state involvement in transacting for environmental gains. Yet a review of 70 global water-related PES programmes (47 cases in developing countries and 23 cases in developed countries), suggest that schemes are still largely dependent on government intervention (or funding)as a service purchaser or in some intermediary role. While attractive, too few PES deals are of the purely private nature.

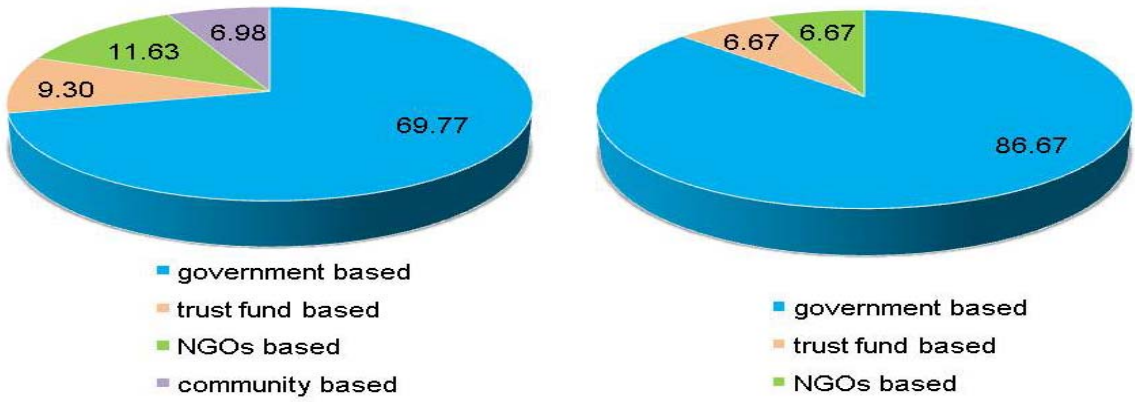


Table 4.1 Types of intermediary-based transaction in developing countries (left) and developed countries (right) (%) (reference).

The reasons for limited private participation are mainly dominated by conditions in developing countries; e.g. insecure land tenure, lack of title, small farm holdings (thus high transactions costs). These reasons and a frequent lack of access to credit also help explain why there is limited participation by the poor in a PES programs. Much further discussion of these concepts can be found in Baldock et al., (2011[10])

4.2 Agri-environmental schemes and WTO requirements

The WTO agreement on agriculture provides boundaries for domestic payment schemes. That is, inclusion of any policy instrument in the Green Box is conditional on it having no, or at least, minimal distorting effect on trade patterns. This means that it should not influence the level of commodity production. However, several commentators underline that this is to

[10]Baldock, D., Hart, K. and Scheele, M. (2011). Public Good and Public Intervention in Agriculture. EU: Brussels. http://www.ieep.eu/assets/740/Public_Goods_Brochure_231118_-_FINAL.pdf

be understood as the spirit underlying the agreement, rather than a particular condition to be explicitly complied with. So in the case of environmental instruments such as agri-environmental payments, the Agreement on Agriculture (AoA) outlines in paragraph 12 two particular conditions to be incorporated in design of support measures, one being compliance with a specific government environmental programmes, and the second requiring that payments can only be made on the basis of additional cost and income foregone. (See textbox 5.1 for AoA text)

The payment criteria in 12(b) have been criticized for being too narrow and not being flexible enough (Latacz-Lohmann and Hodge, 2003, Glebe, 2007). The criteria make it easy to compensate farmers for reverting from damaging practice but not for maintaining positive management. Blandford (2005) argues that agri-environmental payments may need to cover the opportunity costs faced by farmers (their potential earnings in non-agricultural activities or from use of the land for alternative purposes), rather than simply covering the additional costs that environmental programmes may impose due to their impact on specific agricultural practices. However, Schwarz et al. (2008) conclude that the domestic scope for altering the basis of payment calculations is limited without a more flexible interpretation of the WTO requirements. The perceived rigidity may come rather from lack of effort hitherto in developing a suitable, green box compliant payment measure. On the face of it the criteria do seem to make room for a calculation formula based on costs incurred by continuation of farming as compared with no costs in abandoning the farms. Taking this view, the problem may simply be that such a formula has not yet been explored, and in theory may well be defendable, provided it is transparent, clearly defined, and based strictly on calculation of costs, not on incentives.

The preamble to the AoA implicitly acknowledges the legitimacy of domestic policies to address environmental market failures as non-trade concerns, and agri-environment schemes could thus be viewed as trade correcting or at least as less trade distorting than previous policies – a stance already adopted by other WTO panels when considering policy changes. Although some commentators have concluded that this would require high-level negotiations and an ability to demonstrate the limited impact of public good provision on commodity trade (Latacz-Lohmann and Hodge, 2001; Blandford and Josling, 2007; Blandford and Hill, 2008), there is another possible interpretation of the evidence. If it is accepted that domestic policy legitimately addressing environmental market failures is a non-trade concern, then all that is required is to justify the two conditions set out in paragraph 12, especially the '*payments ….as part of a clearly-defined government environmental or conservation programme*' requirement. It also important to point out that there has not been any legal challenges or dispute concerning agri-environmental measures in relation to paragraph 12.

The current EAFRD Regulation specifies a payment formula which is clearly targeted at fulfilling the AoA paragraph12(b) requirements (Articles 37(1), 38(1) and 39(4) of Council Regulation (EC) No 1698/2005). In addition further specification of procedures for payment calculations is made, to ensure that these comply with the intent of the WTO text in the context of its objectives and purpose. Moreover, to ensure that any costs compensated are really 'additional', and to satisfy the 'Polluter Pays Principle', the baseline or reference level against which costs of agri-environmental commitments are calculated has to comply with all existing mandatory requirements (EC Reg 1698/2005, Art.39(3)). Mandatory baseline requirements include regulatory requirements (in regional, national or EU law) that apply to the farm whether it is in an agri-environment contract or not, minimum requirements for fertiliser and plant protection products defined in the RDP, and GAEC standards defined at Member State or region level.

Calculations of payments are made on the basis of income foregone and additional costs of implementation, and in the case of agri-environmental payments (but not LFA or Natura/WFD payments) there is also an option to cover transaction costs. The use of standardised values for the determination of payment levels is explicitly endorsed in the EU

regulation, and standard cost approaches to payment calculations have been widely used by MemberStates and regions in the 2007-2013 rural development programmes. Although the use of auctions as an alternative to standard cost approaches is attracting increasing interest in the literature and is also mentioned explicitly within the current EAFRD Regulation (Eggers et al., 2007), this approach has only been applied in a few case studies in the EU. Higher administration costs and the long term effectiveness are the main concerns about the application of auctions (Latacz-Lohmann and Schilizzi, 2007).

While EU Member States generally use a standard cost approach to calculate payments, large variations exist for similar and comparable measures in applied eligibility criteria and commitments, payment differentiations, definitions and applications of baseline requirements and consideration of cost and income foregone components. Because of some differences in how Member States transpose EU environmental legislation into national laws which are integrated in the baseline requirements, and the differences in how they define applicable GAECs, some management requirements can be paid for as part of an agri-environment contract in one Member State, while these are part of the reference level elsewhere in the EU, and farmers have to bear the cost of the action (or the opportunity cost (IEEP, 2010).

There may be very good reasons for varying transposition of a particular directive across the EU, e.g. the action programmes under the Nitrates Directive must be designed to address the particular environmental *and* agronomic conditions in the particular region designed as NVZ. Similarly the management plans for Natura 2000 sites on agricultural land will reflect both environmental priorities and agricultural management. However, the variations in payment formulas are not only a result of differences in environmental and climatic conditions, bio-physical characteristics of the agricultural land, different structures of the agricultural sectors and variations in the defined calculation boundaries, but are also caused by differences in the availability of suitable and reliable data for cost components and the use of different data sources and reference periods. In addition, payment levels are not only determined by the applied calculation method, but also influenced by external factors [i.e. factors not being included in the actual calculation of payment levels, but impacting on payment levels in an ad-hoc manner] such as European and national policy objectives, budget priorities, stakeholder influences and payment levels from previous RDPs ("path dependency"). As a result, the transparency of quantifying payment levels varies considerably (Hrabalova et al., 2007). The following paragraphs provide a brief review and synthesis of payment formulas in agri-environment, LFA and forestry measures in Scotland and the EU.

4.3 Agri-environmental payments

Income forgone as a result of the participation in agri-environment measures is, in many cases, estimated through gross margin changes of specific crop and livestock systems or average gross margin changes across several systems, e.g. management of grass margins and beetlebanks in arable fields (Scottish Government, 2010a). In other cases, yield differences as a result of the implementation of the agri-environment commitments are explicitly estimated and multiplied by the market price. Examples include the establishment of water side strips in North Rhine-Westphalia, Germany (Hecht et al., 2007) and maintenance of permanent meadows, pastures and meadow-pastures in the Veneto Region, Italy (Regione del Veneto, 2009). In very few cases, losses of the single farm payments and LFA payments are also included in the calculation of income foregone in agri-environment measures (e.g. payments for the creation of buffer zones in Poland (MARD, 2007).

Additional cost components are considered in the payment calculation formula in relation to the various scheme commitments and land or farm management changes such as the development of environmental plans, supervision tasks, monitoring, weed control, ploughing, sowing, drying, worming and haulage, etc.. Common cost components considered in the calculation are labour costs (including additional labour requirements for management,

supervision and planning tasks and wages paid for contractors), machinery costs and material costs (Hrablova et al., 2007, IEEP, 2010). In addition, transportation costs and paid rent are included in payment calculation formulas of a range of different agri-environment measures, e.g. options for moorland management and management of heath in Scotland (Scottish Government, 2010a), the HLS option seasonal livestock exclusion supplement in England (DEFRA, 2004) and the livestock extensification scheme in Greece (Vlahos and Tsakalou, 2007). Some Member States (e.g. Scotland and Lithuania) also include interest charges and depreciation in the payment calculations. On the other hand, payment calculation formulas also consider cost savings due to fewer (or no) applications of fertilizer and plant protection products, e.g. the options unharvested crops and introduction or retention of extensive cropping in Scotland (Scottish Government, 2010a), the HLS option maintenance/restoration of rough grazing for birds in England (DEFRA, 2004) and organic farming support payments in most Member States.

An important issue for the consideration of full cost approaches is the consideration of fixed costs in the calculation formula. The need for considering the full cost of land management in payment calculations is highlighted in a number of studies (e.g. Espinosa-Goded et al., 2009, Hrabalova et al., 2007, and Edwards and Fraser, 2001). Currently, however, although the current EAFRD Regulation has not specifically mentioned the possibility of including fixed costs in payment calculations, nevertheless a few examples exist where the EC accepted the consideration of fixed costs in payment calculations in agri-environment measures, e.g. in the support payments for organic livestock in the Pais Vasco region in Spain (Departamento de Agricultura, Pesca yAlimentacion, 2009). It could be argued that a future Regulation, should include a new or adapted measure with a more liberal interpretation of fixed costs, where the baseline for calculating payments would in fact be the absence of land management and calculations could thus consider as “additional costs” the full range of (opportunity) costs incurred by a farmer who makes a voluntary effort to continue farming and management of agricultural land, or/and the full costs of managing the land for a specific environmental objective. This approach was already adopted in the regulatory framework of the previous programming period, where Art. 18 of Reg. 445/2002 explicitly stated that the economic consequences of abandoning land or ceasing certain farming practices may be taken into account in payment calculations when justified by the agronomic or environmental circumstances (European Commission, 2002). But the consideration of potential land abandonment in payment calculations was not mentioned in Reg. 1974/2006 of the current programming period (European Commission, 2006).

In Scotland, transaction costs are not includedin the payment calculations for agri-environment measures. In those Member States where transaction costs are explicitly considered in the payment calculation formula, the quantification varies between simple reference values per ha and detailed calculations of different transaction cost components. However, Hrabalova et al. (2007) emphasise that Member States apply different definitions of what they consider as additional cost component and the transaction cost component. For example, while in Finland seeking information and advice is included in transaction costs, in Scotland additional management efforts such as time for information and experience gathering, planning and executing the organic farming process, marketing, sales management and administration are considered to be additional costs in the calculation of organic support payments (Scottish Government, 2010a).

Calculated payment levels are restricted by maximum payment levels defined by the EU Regulation 1698/2005. Maximum agri-environment payments per ha are set at 600 Euro for annual crops, 900 Euro for perennial crops and 450 Euro for other land uses. Livestock payments for local breeds in danger of being lost to farming are limited to 200 Euro / LU. Additional limitations and payment ceilings are implemented on the basis of maximum area for support, maximum amount per holding or in terms of payment modulation, e.g. according to the farm size.

Generic payment calculation formula:

agri-environment payment per ha / LU = (income foregone + additional cost – cost savings + transaction cost) ≤ EAFRD ceiling

Vlahos and Tsakalou (2007) identify three main calculation approaches in agri-environmental measures. For agri-environmental measures which affect whole farm systems gross margin comparisons of participating and non-participating farms are used. In some cases, e.g. organic farming support payments, this entails a comparison of gross margins based on the calculation of all income and cost elements of a sample of participating farms and another sample of comparable non-participating farms. But in the majority of cases, a (typical or average) sample of non-participating farms is used as a basis to which changes (either proportional or absolute) to gross margins or specific income and cost components known to be affected by the measure are implemented. Examples include the pastures management schemes in the CzechRepublic and the promotion of catch crops cultivation in Germany. The second approach applies to agri-environmental measures which "only" incluce additional costs for specific farm/land management practices. Examples include the grassland management options for corncrake *Crex crex* and the heath management options in Scotland. In many agri-environmental measures, however, a third approach is required which combines the calculation of gross margin changes with the calculation of additional costs for specific commitments. This approach can, for example, be found in many agri-environment options in Scotland. In addition to these two main approaches, an ad-hoc calculation approach is applied in cases where more detailed calculation data are not available. The payment is calculated based on aggregated and generic cost components and values are often based on expert consultations.

4.4 Natural handicap payments

In all cases, application of the LFA measure follows a compensatory approach. The logic is that by paying compensation to farmers to reflect the impact on incomes of the handicaps faced, land can be kept in agricultural production, with benefits for the countryside and rural communities. MemberStates have some flexibility in setting levels of payment, within specified limits, and different approaches are used to differentiate and calculate natural handicap payments across the EU. In most cases the calculation of natural handicap payments is based on a comparison of income and cost elements of farms based in less favoured areas (LFAs) with farms outside LFAs (Miettinen and Aakkula, 2008, IEEP, 2006). This kind of approach is based on the assumption that the disadvantages of farming in LFAs can be identified in lower gross outputs from livestock and crop enterprises as a result of poorer productive performances as well as potentially lower market prices (for example, due to distance from processing and consumption centres) and in higher input costs due to the lack of home-grown feedstuffs and also due to additional transport costs in peripheral areas (especially true for island regions). However, the comparability of samples of LFA and non-LFA farms is limited due to different farm structures and systems in LFA and non-LFA areas and, in some cases (e.g. Scotland and Finland) a lack of representative non-LFA farm data (Miettinen and Aakkula, 2008, Schwarz et al., 2006).

In addition to economic farm data comparisons, payment calculation formulas for natural handicap payments also consider bio-physical data (e.g. soil quality), remoteness and fragility of the area and other socio-economic data such as unemployment rate and net-migration. However, in some cases the available information explaining how these additional elements in the calculation formula have been quantified is limited (Miettinen and Aakkula, 2008 and Hrabalova et al., 2007). Selected examples from Scotland, Germany, Spain and Sweden are outlined below to highlight some payment calculation approaches in more detail.

The calculation of the area based entitlements in Scotland depends on eligible forage hectares, livestock units and grazing categories, fragility categories of areas, and an enterprise mix multiplier which rewards environmental and socio-economic benefits of keeping cattle in LFAs. In addition to the above procedure, the calculation of GM losses from a comparison of LFA and non-LFA farming systems has been added to the calculation process to justify the payment rates (Scottish Government, 2010a), although no direct linkage between the calculation of the GM losses and the proposed payments exists.

In North Rhine-Westphalia compensatory allowance calculations are based on the replacement value of grassland yield reductions. The soil has been classified into four soil quality groups by an LVZ indicator (agricultural comparison indicator), which relates to yield potentials based on soil indices with some corrections for location and climate. It is assumed that in the most disadvantaged group (LVZ ≤ 15) grassland yields are 25% lower compared with average yields. In the best soil quality group in which LVZ lies between 25 and 30, yield losses amount to 10%. For LVZ > 30 no allowances are granted. Farmers' net yield losses within each soil quality group are stated in terms of feed energy (MJ). In replacement costs calculations, purchases of wheat at 115 Euro/t have been assumed, which results in the cost of 0.153 Euro / 10 MJ. Farmers' income losses (i.e. calculated payment levels) in each group are calculated by multiplying feed energy losses with this cost factor. The system is flexible so that the actual payment levels can be modified according to budgetary conditions. Current payment rates per ha vary, depending on the soil quality group, between 35 Euro and 115 Euro (Hecht et al., 2007, Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz, 2009).

In the Spanish regions Galicia and Navarra the base payment rate is 94 Euro/ha in mountain areas, 57 Euro/ha in depopulated areas and 120 Euro/ha in areas affected by specific handicaps. However, no information on the calculation of the base payments was available. When calculating the annual payment per holding five different coefficients are taken into account in four steps. In the first step, two coefficients are used to calculate the eligible area for payment, while the second, third and fourth step adjusts the base payment rate depending on the size of the holding, farm income and the location of the holding (Ministerio de Medio Ambiente yMedio Rural yMarino, 2009, Departamento de Desarrollo Rural y Medio Ambiente, 2009).

1. Determination of the eligible area differentiated between forage area and crop area:
    a. forage area: multiplication of the different types of forage area with the coefficient C_i, which has the following values: 1.0 per hectare of permanent pasture, 0.5 per hectare of pasture grazed between 2 and 6 months and 0.15 per hectare of grazed stubble and fallow
    b. crop area: multiplication of the different types of crop area with the coefficient C_j, which has the following values: 1.00 per hectare of irrigation, 0.50 per hectare of extensive dry land crops and 0.30 per hectare of woodland and scrubland
2. Adjustment of the base payment according to the size of the holding using coefficient C1 with following values: first 5 ha = 1.0, from 5 to 25 ha = 0.75, from 25 to 50 ha = 0.5, from 50 to 100 ha = 25 Euro/ha and over 100 ha = 0.0 (i.e. land above the first 100 ha is excluded),
3. Adjustment of the base payment according to the farm income using coefficient C2: if the farm income is less than 50% of the reference income, the base payment is multiplied by 1.20. In 2007, the reference income was set at 22,732 Euro/holding.
4. Adjustment of the base payment according to a holding coefficient C3, which increases the base payment depending on multiple factors affecting the holding (altitude, slope, depopulation, and other socio-economic indicators defined in the regional rural development strategy).

Similarly to Germany, Ireland, Greece, France, Italy, Austria, Portugal, payments in Spain are skewed towards small and medium farms through payment modulation (IEEP, 2006). The minimum annual payment per holding is at least 300 Euro. The final amount of payment is calculated utilising the formula:

$$Payment = [\sum forage\ area_i \times C_i + \sum crop\ area_j \times C_j] \times [base\ payment\ rate \times C1 \times C2 \times C3]$$

In Sweden payments are based on economic inequalities due to natural handicaps, andthis is in contrast to Scotland, which has higher payments for more severely disadvantaged regions. Payments are mainly targeted at agricultural areas used for ley on arable land and pasture. The economic inequalities in terms of lower income and higher cost are calculated using a weighted average for different branches of production in a reference area in central Sweden and correspond to the average value for each of the less favoured areas. In addition, payments for grain and potato production are provided for LFA regions in Northern Sweden, based on an estimate of higher production cost in comparison to non-LFAs (Swedish Ministry of Agriculture, 2008).

However, none of the reviewed regions and Member States considers the opportunity costs of continuing farming in LFAs. Despite increasing attention in policy discussions, opportunity costs in terms of alternative income options outside farming are not yet included in payment calculation formulas for natural handicap payments.

4.5 Forestry measures

Forestry measures are relevant to non-economic farms for several reasons. Hill and upland farms in the UK often have associated areas of woodland, perhaps still used as wood pasture, where both the environmental benefits and potential productivity may both be declining as a result of lack of appropriate management. On non-economic farms there may also be opportunities for environmental afforestation, and/or the development of new agro-forestry systems which combine extensive agriculture and extensive forestry. In other parts of Europe woodland ownership and management may be even more closely integrated with farming, for example in the low intensity dehesa and montando systems of Spain and Portugal. The forestry measures available to Member States were significantly extended by the EAFRD Regulation, and now include several ‘cross-over’ measures applicable on land owned and managed by farmers, although some of these measures have not yet been widely applied. This may be partly due to a problem in defining the baseline reference level. Farmers taking up afforestation, Natura 2000 and forest-environment payments do have to observe SMR/GAEC cross-compliance on whole farm, but for the forestry elements of the measures, the baseline cannot reflect EU policy objectives because there is not a legal framework for forestry at the EU level. So the forestry baseline elements have to be linked partly to a more general commitment by Member States to sustainable forestry under the Ministerial Conference on the Protection of Forests in Europe MCPFE process, and partly to national forest standards. Depending on how detailed national forest plans are, these could act as a baseline for certain forest-environment measures.

There is a high degree of variation in the extent to which forestry measures are implemented as part of the EAFRD policy in the different Member States. In addition, some Member States have chosen to support forestry measures under state aid programmes, either fully, or as a complementary tool to their EAFRD policy. The range of Member States using EAFRD forestry support varies, from countries such as Greece where all measures are implemented, to Finland where no forestry measures are implemented. In Scotland, afforestation measures and forest environment payments are implemented in the Scottish Rural Development Programme, but agro-forestry measures were not implemented until 2010 when a woodland pasture Rural Priority option was introduced (Scottish Government, 2010a). Overall, in EU-27 the three most frequently implemented forestry measures in the current 2007-13 RDPs are the afforestation of agricultural land, restoring forestry potential, and non-productive investments, with the first two also accounting for the highest levels of

expenditure. The measure for restoring forestry potential and introducing prevention action is rather different in design and implementation from other forestry measures under the EAFRD policy. Instead of per hectare payments based on a standard cost approach, real costs are reimbursed under this measure on a project by project basis. Consequently, this review focuses on the payment calculation formulas in afforestation and forest environment measures.

Cost components considered in the calculation of the establishment payments in the afforestation measures include the preparation of the afforestation (or project) plan and establishment costs as such, either as an aggregated component or disaggregated into various specific components. Farmers taking up the afforestation measure are also allowed to retain their entitlement to pillar 1 SPS payments for the land afforested.

Substantial differences exist between the Member States in the level of detail provided in the calculation of the different components of establishment costs. Greece, for example, only includes an aggregated figure of establishment costs in the payment calculation, while other countries, e.g. Lithuania and Poland, differentiate between a range of different establishment cost components such as site preparation, cost of seedlings, labour costs for planting, replacing seedlings and protection of seedlings (including fencing costs) (MARD, 2007, Ministry of the Environment of the Republic of Lithuania, 2003, Schwarz et al., 2007).

Similarly, the level of detail provided in the calculations of maintenance payments varies significantly. Scotland only differentiates between costs for protection and other maintenance costs and provides maintenance cost payments only for agricultural land (Forestry Commission, 2007, Scottish Government, 2010a). In other Member States cost components for weed control, pruning, replacements of plants and other work such as irrigation are explicitly quantified. A particular case is Greece, where a percentage of eligible costs is reimbursed instead of standardised maintenance payments, which partly explains the more detailed consideration of different (eligible) cost components (Schwarz et al., 2007).

The calculation of agricultural income foregone only applies for the afforestation of agricultural land. The main component in the calculation of the payments for agricultural income foregone is the gross margin loss of agricultural activities. In addition, loss of direct payments (e.g. in Poland and Finland) and gross margin gains of productive forestry plantations (e.g. Greece) are considered in the calculations in some Member States. While Member States have generally based their calculation of income foregone on agricultural gross margin losses, income foregone calculations are often differentiated by land types and type of beneficiaries (e.g. Scotland, Czech Republic, Greece and Spain) (Schwarz et al., 2007 and Departamento de Desarrollo Rural y Medio Ambiente, 2009).

Figure 4.1 Logic representation of existing payment calculations in the measures 221, 222 and 223 (Schwarz et al.,2007)

The top of the Figure 4.1 shows different types or groups of parameters which affect the calculation of the three main payment (cost) elements. In other words, the calculations of establishment costs are differentiated by the type of trees, purpose of woodland or/and topography of the land. Maintenance cost calculations are differentiated by the type of trees and/or topography, while the calculations of agricultural income foregone depend on the type of land, area designation and/or type of beneficiaries.

Payments for woodland establishment then have to take into account the EAFRD payment rates, either applying a uniform payment rate across the country or different rates differentiated by three regions (outermost regions, Natura 2000, LFA and WFD areas, and other areas). It is important to note that the application of EAFRD payment rates also depends on the type of beneficiaries as these rates only apply to farmers, other natural persons and private law bodies. Payments for maintenance costs do not need to apply the EAFRD payment rates, but in some cases, e.g. Scotland (see below), the EAFRD payment

rates are applied and support for maintenance costs reduced accordingly. On the other hand, agricultural income foregone payments have to conform to the given EAFRD maximum payment hectare. Finally, the sum of all three payment elements is the overall amount of financial support provided in this measure.

A range of different approaches is applied to quantify the different components of the payment calculation formulas in afforestation measures. The applied approaches include national evaluation guidelines and expert studies and stakeholder evaluations, which, for example, have also been used in Scotland to quantify the standard costs for a wide range of different forestry activities in the past and now "only" provide the basis for the forestry models in the new tariff payments. A simplified tariff payment system based on seven forestry models has replaced the use of detailed standard cost list for applicants in Scotland (Forestry Commission, 2006, Scottish Government, 2010a, Schwarz et al., 2007). Modelling exercises are conducted developing a set of different forestry (planting) models which are differentiated by tree species and composition. Such modelling exercises are also conducted in other Member States, e.g. CzechRepublic, Poland and Germany. These planting models include assumptions on topography, stocking density, species composition, and the amount of material and labour required for the different maintenance activities. However, a general observation is that fewer details are available for the calculation of maintenance cost than for establishment cost. The quantification of gross margin losses in the agricultural income foregone calculation is either done through a detailed calculation of changes in revenue and variable cost, gross margin figures from farm account surveys and databases or standardised gross margin figures from expert studies (e.g. SAC's Farm Management Handbook (SAC, Various Years)) (Hrabalova et al., 2007, Schwarz et al., 2007).

In addition to the standard cost based afforestation payments in the woodland creation option in the Rural Priorities Scheme in Scotland, tenders can also be submitted by land managers to bid for woodland creation meeting specific priorities, currently, in relation to the Scottish Government's climate change programme (Scottish Government, 2010a).

4.6 Forest environment payments

In comparison to afforestation payments fewer details are available on the payment calculation formulas in forest environment payments. The payment calculation is on the same basis as agri-environment but there is no possibility of including transaction costs. Forest environment payments are implemented in a smaller number of Member States and the justifications of the payment calculations in forest environment payments often only refer to aggregated payment calculation formulas and lack details on the actual approach used to calculate income foregone and cost components, reflecting the difficulties many Member States have to define a clear calculation baseline (Schwarz et al., 2007). This probably reflects the difficulty many Member States have with defining the baseline sufficiently clearly.

As a consequence, the review could only find a limited amount of available information regarding the actual calculation process. In Scotland, beneficiaries are required to provide a costed action plan which needs to exceed the minimum permissible under the EAFRD of 40 Euro/ha/year in order to be eligible for support. The maximum rate of support differentiates between areas where native woodlands or areas of LISS overlap with a high level of public access and other areas. In addition, a top-up is provided for agricultural income foregone due to the removal of domestic livestock. Higher payments apply for areas undergoing restructuring felling (Scottish Government, 2010a). However, no further details on the calculation of the payment rates per hectare are provided. Hrabalova et al. (2007) and Schwarz et al. (2007) refer to available examples of more detailed payment calculations in the CzechRepublic and Mecklenburg West-Pomerania (Germany). They explain that the payment calculation of the payment for improving the species composition of forest stands in the Czech Republic is based on the assumption of lower income due to a lower average felling increment (AFI) in forests with a higher proportion of ameliorative and reinforcing wood species (ARWS). The different calculation steps are as follows:

1. Calculation of AFI for stands with minimal rate of ARWS per rotation
2. Calculation of AFI for stands with increased share of ARWS per rotation
3. Calculation of AFI difference for whole rotation (multiply by rotation of stands with minimal ARWS)
4. Total income foregone divided by payment duration of 20 years

The first four steps are carried out for each of the defined six forest type models before the final payment is calculated in a fifth step as a weighted average across all six forest model types.

The second example is the forest environment measure to maintain and develop ecological valuable forest biotopes in Mecklenburg West-Pomerania (Germany). The main components considered in the calculation process below are foregone income due to renunciation of harvest, the value loss due to non-usage of trees over a period of 20 years and an incentive element of 10%. (Ministry for Agriculture, Environment, Consumer Protection of Mecklenburg West-Pomerania, 2009). The calculation consists of the following four main steps:

1. Implementing assumptions on interest rate, percentage value loss per year, fixed yield, net revenue and present value without exploitation costs
2. Multiplying the sum of the interest and value losses by the period of 20 years and discounting to the beginning of the period
3. Calculating a yearly annuity which gives the annual payment per tree.
4. Determining the final payment per hectare by calculating the maximum number of (supported) trees per hectare, taking into account the EAFRD maximum payment limit of 200 Euro / ha.

From the available information three main cost components can be identified in the payment calculation formula of the forest environment payments. These include the preparation of a forest plan, which outlines the detailed management activities and commitments, the loss of income due to reduced or delayed forest exploitation, and additional forest management cost resulting from the uptake of this measure. While forest plans are considered in some Member States (e.g. Spain, Greece, Lithuania and Scotland), the general basis for the payment calculation formulas is the loss of income from forest exploitation with additional forest management costs being explicitly included in the payment calculations in most cases. Additional management costs include, for example, specific protection measures such as preservation of ecological corridors and timber marking (Schwarz et al., 2007).

4.7 Synthesis

Hrabalova et al. (2007) and Cesaro et al. (2008) derived two basic methodologies applied in current payment calculations in area-based rural development measures: a balance sheet approach and practices approach. The balance sheet approach is applied at farm level and consists of a direct comparison, in a proper accounting exercise, of two samples of farms: one sample of farms participating in a rural development measure and one sample of non-participating farms similar in terms of farming system and local conditions. Once the balance sheet items that are influenced by the implementation of a RD measure are identified, the differences between the two samples in all identified income and cost components (i.e. the difference in gross margin) are calculated and determine the cost of participation in the scheme. Evidently, the available data sources and the nature of the samples influence the level of detail that can be reached in the payment calculation approach. A possible variation of the balance sheet approach is a partial budgeting approach. This simplification of the main approach consists in the identification of an appropriate sample of non-participants and the assessment of income and cost elements which are known to be influenced by a RD measure; then, variations due to the implementation of a measure are estimated in the form

of either a proportional or absolute value change. This variation of the balance sheet approach is the main calculation approach used in agri-environmental measures.

The second approach is the practice approach, where additional costs are quantified for specific commitments and resulting changes in agricultural practices (i.e. farm and/or land management changes). Once the relevant practices which are influenced by the implementation of a RD measure are identified, the cost of the practices are either directly assessed, e.g., through expert opinion or through a quantification of the specific and implicit cost components that can be attributed to the implementation of the practice. Examples include the calculation of establishment and maintenance cost in afforestation schemes, where costs are calculated for different practices such planting, protection and weed control (Schwarz et al., 2007). However, the practice approach mainly applies to payment calculations which only consider additional costs. The complexity of many area-based rural development measures requires a combination of the two approaches combining the calculation of income changes, e.g. gross margin changes, at farm level with the calculation of additional costs for specific commitments and practices. This combined approach can, for example, be found in many agri-environment options in Scotland (Hrabalova et al., 2007, Cesaro et al., 2008).

In summary, payment calculation formulas in axis 2 rural development measures clearly reflect the requirements defined in the EU Regulations and by WTO. Despite large differences in calculation details, general calculation formulas of the different rural development measures are similar in the different MemberStates based only on income foregone and additional (variable) costs due to scheme-related farm and land management requirements beyond baseline requirements or due to natural and socio-economic handicaps. Natural handicap payments follow a compensatory approach and are generally calculated based on the assumption of lower agricultural income and higher production cost in comparison to non-LFA farms. Opportunity costs of farming are not considered or full costs of land management are not considered.

A more flexible interpretation of the requirements defined in the EAFRD, including baseline definitions, is required to develop a suitable policy framework for non-economic farming systems. EAFRD requirements might have been expected, in 2005, to reflect the shift from reducing negative externalities (income foregone) to actively supporting the provision of ecosystem services and public goods through non-economic or HNV farming systems. Instead, the scope for alternative payment formulas seemed to have decreased from Reg. 445/2002 to Reg. 1974/2006, as no reference to land abandonment as a baseline for payment calculation is included anymore. Allowing for land abandonment to be considered as a baseline for payment calculations would justify considering the full costs of managing the land for specific environmental objectives in payment calculations. It could also be argued that payments for non-economic farming systems that deliver beneficial environmental outcomes with a high risk of land abandonment must consider opportunity cost of farm (family) labour and capital because farm families will only actively manage land when the farming activity is able to give a better return than alternative uses outside farming. However, in order to satisfy WTO rules, any changes to the framework for payment calculations in agri-environmental and other area-based rural development measures would need to demonstrate only limited production and trade effects. But this might be less of a problem for non-economic farming systems with generally rather little market impact, if the environmental objectives of these farming systems are clearly defined and linked to government policy. The potential design and acceptance of alternative payment formulas will be discussed in detail in the next chapter.

5 Alternative payment approaches for non-economic farming systems delivering public goods.

This section identifies theoretical alternative payment approaches which are compliant with the WTO Green Box rules[11] and with EAFRD requirements and effectively support low and non-economic farming systems/practices providing a high level of environmental public goods. It is particularly important that any proposed payment approaches are realistic within the framework of the 2014-20 programming period and other pressures on the CAP, and are applicable within the UK and other EU Member States where non-economic farming systems are important providers of environmental public goods.

The following assumptions were made in designing the alternative approaches:

- the WTO Green Box rules, as set out in Annex 2 of Agreement on Agriculture (AoA), are non-negotiable for the period considered;
- the existing suite of pillar 2 measures continues to be available in more or less the current form (with the understanding that certain modifications of implementing rules on payment calculations may be necessary);
- the environmental rationale for LFA-type support within Axis 2 will be similar to the (as yet unimplemented) requirements in 1698/2005, and will not revert to the broader definitions used until 2005;
- the basic structure of SMR/GAEC cross-compliance will remain, but the GAEC requirements, and hence the reference level may change;
- the time horizon for scenarios is 2020;
- the focus is on payment mechanisms; related budgetary questions (size, allocation between pillars and Member States, co-financing etc) are not considered.

The limits of flexibility within the current WTO Green Box rules is explored first, then three alternative payment approaches are developed:

1. Payments based on full cost of management (**FCM payments**): an agri-environment type, site-specific environmental public goods payment calculation based on the full cost of management, including fixed costs, under paragraph 12 of the AoA.
2. A holding-wide (**HW payments**) approach to payments based on assistance for disadvantaged regions where farming systems provide environmental public goods, exploring the scope to develop holding level payments based on whole farm agri-environment requirements under paragraph 13 of the AoA (or possibly paragraph 12).
3. Payments based on opportunity cost (**OC payments**): a similar holding level approach to that in 2, but with the payment calculation based on opportunity cost of

[11]The Green Box WTO rules are understood to be the rules governing measures specified by the Agreement on Agriculture (AoA), in force as from 1995, as those that have no direct effect on production, in contrast to support measures that stimulate production directly. Within the range of measures which AoA considers as not affecting production directly, the particular focus in this paper is on both the general and measure-specific rules that govern payments under environmental programmes and under regional assistance programmes (Art 12 and 13 of Annex 2 of AoA, for details see Box 5.1).

farming rather than on the income foregone + additional costs under paragraph 13 of the AoA.

In all the calculations the costs of labour (own labour and any hired labour) are included in the variable or fixed cost calculations, as appropriate.

In developing these approaches consideration has been given to the role of mixed faming and forestry systems (including traditional wood pasture, new agro-forestry), the issue of part-time farming and the effect of the reference level on payment calculations..

Figure 5.1 Methodological framework for the development of alternative payment approaches

Following the definition of the required dimensions for payment differentiation (e.g. in relation to land characteristics and type of beneficiaries), suitable reference levels for the payment approaches are reviewed and suggested. In the third step, the different components of the payment formulas such as crop specific costs, fixed costs of land management and opportunity costs of labour, land and capital are identified. The feasibility of including environmental outcome components will also be explored. This is followed by identification of data requirements including, for example, environmental and biophysical data, farm and land management related data and regional socio-economic data, in particular for the opportunity cost approach. Based on the assessment of existing data sources, data gaps will be highlighted, for example in relation to agro-forestry systems and small farms, In the final step, methodological key issues for the testing of the different approaches are discussed.

5.1 The scope of the WTO framework for pillar 2 payments

The previous section described the scope of current payment calculations and showed that, despite large difference in the detail of current calculations, most follow some combination of a balance sheet or partial budgeting approach with a cost of practices approach.

A cautious interpretation of the WTO and EAFRD regulations, with attention to the flexibility existing in the present regulatory framework, is required to develop a suitable policy framework for non-economic farming systems. EAFRD requirements might have been expected, in 2005, to reflect the shift from reducing negative externalities (income foregone) to actively supporting the provision of ecosystem services and public goods through non-economic or HNV farming systems. Instead, the scope for alternative payment formulas seemed to have decreased from Reg. 445/2002 to Reg. 1974/2006, as no reference to land abandonment as a baseline for payment calculation is included anymore. However, allowing for cessation of land management, involving complete land abandonment, in non-economic systems, seems to be a realistic assumption to be fully considered as a baseline for payment calculations, given the recent trends in these farming systems. Such an assumption can be justified as reflecting the real counterfactual situation, i.e. that without adequate support for the provision of ecosystem services and public goods through land management in the non-economic farming systems, complete cessation of land management, involving land abandonment, is likely to take place in these systems [see Section 3].If evidence for this new counterfactual situation is established and recognised at the policy design level, and the need for payments for land management to ensure delivery of specific environmental objectives from non-economic farming systems is justified as a priority (through the political process) then the assumption above has to be taken seriously as a baseline for payment calculations. In other words, a conservative estimate of ‘costs incurred’ and/or ‘income forgone’ involved in such land management will have to consider the *costs involved in continuation of farming in these systems, as opposed to complete cessation of land*

management. It would then justify considering the full costs of managing the land for specific environmental objectives in payment calculations.

One obvious observation to be made in this context is that the counterfactual assumption based on the threat of cessation of land management involving complete land abandonment as proposed above, differs partly from the logic underpinning the current EAFRD rules for the agri-environment and the natural handicap measures. Under the existing EAFRD Regulations, *continuation of agricultural activity* is implicitly assumed to be part of the counterfactual baseline, i.e. part of the hypothetical situation of what would happen in the absence of public support. In this logic, the costs considered as incurred and income forgone in the relevant payment formulas under EAFRD are understood to be only those going above the counterfactual baseline, i.e. above 'normal' agricultural management that would take place without support. Following this logic, payment formulas under the current EAFRD measures aim to provide either a premium for farming practices which deliver environmental benefits going beyond the reference level and hence carry higher opportunity costs (measure 214), or compensation for a natural handicap of land management in certain areas (measure 212). However, recent trends in non-economic farming systems show that this may not fully reflect, firstly, the recent changes in the counterfactual situation in these systems, i.e. that without adequate support, complete cessation of land management involving complete land abandonment is likely to take place. Secondly, it may not fully reflect the changing public demand for the provision of ecosystem services and public goods, which requires the continuation of agricultural land management for this purpose in these areas.

Most important in the Green Box WTO context, however, is that Annex 2 of AoA does not specify any particular technical parameters for the definition of the 'extra costs' or 'loss of income' in the payment formulas of the compliant policy measures. As long as the measures satisfy the measure-specific and generic requirements set out below (Box **5.1**), and as long as justification is clear, accurate and transparent, Annex 2 of AoA leaves the way clear for policy-makers to justify the realistic costs involved in supporting land management for environmental or regional assistance objectives linked to government policy.

It could then be argued that payments for non-economic farming systems that deliver beneficial environmental outcomes where there is a high risk of cessation of land management involving complete land abandonment, must consider the opportunity costs of farm (family) labour and capital because farm families will only actively manage land when the farming activity is able to give a better return than alternative uses outside farming. To satisfy the main generic requirement of the Green Box WTO rules, any changes to the framework for payment calculations in agri-environmental and other area-based rural development measures would need to be justified as having only limited production and trade effects. This is less of a problem for non-economic farming systems with generally rather little market impact particularly if the environmental objectives of land management within these farming systems are clearly defined and linked to government policy.

The relevant sections of the WTO Agreement on Agriculture are the rules of Annex 2, under paragraphs 12 and 13, as quoted in Box 5.2[12].The key differences between the two AoA provisions are in the implied purpose, the legally defined justification for the payments and the focus for the calculation of costs incurred and income foregone. Paragraph 12 covers payments (for specific actions, which may include land management) linked to *'a clearly defined government environmental or conservation programme'.* Paragraph 13 is focused primarily on regional assistance and hence is much broader with respect to defining the kind of land management involved, linking instead the payments to *'undertaking agricultural*

[12] Source: Agreement on Agriculture, 1994, *Annex 2: Domestic Support – The Basis for Exemption from The Reduction Commitments.*

production' in a defined geographical area *'considered as disadvantaged on the basis of neutral and objective criteria'.*

.

Box 5.1 Extract from Green Box WTO rules (Agreement on Agriculture)

"12. Payments under environmental programmes
(a) Eligibility for such payments shall be determined as part of a clearly-defined government environmental or conservation programme and be dependent on the fulfilment of specific conditions under the government programme, including conditions related to production methods or inputs.
(b) The amount of payment shall be limited to the extra costs or loss of income involved in complying with the government programme.

13. Payments under regional assistance programmes
(a) Eligibility for such payments shall be limited to producers in disadvantaged regions. Each such region must be a clearly designated contiguous geographical area with a definable economic and administrative identity, considered as disadvantaged on the basis of neutral and objective criteria clearly spelt out in law or regulation and indicating that the region's difficulties arise out of more than temporary circumstances.
(b) The amount of such payments in any given year shall not be related to, or based on, the type or volume of production (including livestock units) undertaken by the producer in any year after the base period other than to reduce that production.
(c) The amount of such payments in any given year shall not be related to, or based on, the prices, domestic or international, applying to any production undertaken in any year after the base period.
(d) Payments shall be available only to producers in eligible regions, but generally available to all producers within such regions.
(e) Where related to production factors, payments shall be made at a degressive rate above a threshold level of the factor concerned.
(f) The payments shall be limited to the extra costs or loss of income involved in undertaking agricultural production in the prescribed area."

At present, the agri-environment measure under Reg 1698/2005 has been notified for the Green Box WTO compliance under paragraph 12 of AoA[13]. The justification provided in the notification focuses on the link between payments and voluntary agri-environmental commitments and on environmental objectives of the scheme. This has been fully accepted.[14] The current LFA payments are notified under the rule relating to regional assistance, paragraph 13 of AoA, which involves the definition of eligible areas as a key requirement, but requires no environmental justification. It is important to note that after 2014 the new, environmental criteria proposed by the Commission for non-mountain LFA areas (based on climate, soil and terrain) are likely to be the basis used to define these 'natural handicap areas' in the EU. With regard to paragraph 13 of AoA, eligible regions will be defined in a much stricter way, but the purpose of the existing notification, i.e. providing payments for land management in eligible regions, is unchanged. Unlike the current usage

13 Domestic support: European Union. Notification under Article 18:3 of the Agreement: New or modified domestic support measures exempt from reduction.
14 Within the generic justification provided in the notification, for example grazing is to be seen as activity introduced under the specific government programme for habitat management, rather than an activity with impact on trade.

of the LFA definition, it may well exclude areas where the natural handicap has been overcome[15].

5.2 Payment Calculations

5.2.1 Full cost of management (FCM) payments

The FCM approach takes into account the full cost of the continuation (or introduction) of specific farming activities on identified areas of land, in situations where the required management is not economically justified as part of the farm business, and the land is therefore at risk of abandonment (or has recently been abandoned[16]). The agri-environment requirements could be low-level (topped up by higher level agri-environment payments) or they could be higher level, but in either case it is envisaged that the FCM payment calculation would normally be used for non-economic but environmentally important parcels of land within a farm. In exceptional cases it could also be applied to the whole farm (for example, non-economic mixed HNV farming systems on Natura 2000 land where the management of different parcels of land are closely interdependent, but to make the farm economically viable the farming system would have to be substantially changed, with significant loss of environmental public goods). The FCM approach could be used as an alternative payment calculation approach or in addition to existing standard cost based agri-environmental payment rates.

FCM payments would be related to specific, defined management actions on a delineated area of land. These payments would comply with paragraph 12 of the Green Box WTO rules and would:

- be above the reference level (SMR + GAEC + applicable national or regional regulations);
- have clearly defined environmental objectives/justification which would be spelled out in the EU regulatory basis governing the FCM support programme.

The FCM payment calculation is based on the income foregone plus costs incurred, but because the assumed counterfactual is an absence of agricultural management, and any current agricultural activity is operating at a loss, there is no income to forego, and the payment is entirely costs incurred. This bears some resemblance to a few existing UK agri-environment payments, for example the re-introduction of grazing to coastal heaths, but the key difference is that FCM includes not just the variable costs attributable to the environmental management of the land concerned, but also a proportionate share of the fixed costs of the farm of which it is part. The logic of this is that the farmer is being paid to farm some land which would otherwise be abandoned or converted to non-agricultural uses, and to ignore the fixed costs attributable to this land would mean that the profitable enterprises on the farm would effectively be subsidising the agri-environment management. In exceptional situations where it is environmentally justified to include the whole farm, all the fixed costs would be covered. This might be the case, for example in some parts of the EU-12 Member States, where HNV farming is characterised by large numbers of small mixed farms, with fragmented holdings, which collectively deliver high levels of multiple public goods. Whether the FCM payment applies to selected land or to the whole farm, the

[15] See http://ec.europa.eu/agriculture/rurdev/lfa/comm/index_en.htm.

[16] The FCM payment could also apply to land that has been abandoned for a longer period, but in such cases additional non-productive investment payments would be required to bring the land back into a state where the agri-environment management could be implemented – for example clearing naturally regenerated tree and scrub growth that had developed following abandonment. These one-off costs are not covered by the FCM payment, but it is assumed they would be eligible for other Axis 2 type support.

incentive for the farmer to apply for the FCM scheme will be that the full costs of the required management are covered, including the labour costs (these will effectively be the element of the payment that is retained by the farm family).

One of the key issues for the calculation is the allocation of the appropriate share of fixed cost components to the grazing system on the relevant land. In standard accounting approaches fixed costs are usually allocated between different enterprises on the farm according to their proportionate contribution to total gross margin or total output.This does not seem to be a suitable approach to allocating fixed costs to non-economic enterprises on the farm, where these may be operating at a loss and thus make no contribution to total gross margin. The calculation proposed here is a simple allocation of fixed costs based on *the proportion of the area of the farm* which is occupied by the livestock and cropping systems subject to agri-environment requirements.

The FCM payment calculation is set out in detail in Annex 5 but the calculation may be summarised as [the sum of: the variable costs per ha of the specified management system, and the proportionate share of the fixed costs of the whole farm]. Where more than one type of farming system applies on the land concerned (e.g. both livestock and cropping) the calculation is repeated for each system. Using readily available farm management data, the payment rate per ha for the area of the farm to which the agri-environment management applies is:

variable cost per LU of specified agri-environment livestock management x required stocking rate in LU/ha

PLUS

variable cost per ha of specified agri-environment crop management

PLUS

share of fixed costs per ha (total fixed costs of farm X percentage of farm area in agri-environment management / ha in agri-environment management)

In this and the other payment calculations FADN terminology has been used, as a way of achieving some form of standardisation in the terminology across EU Member States. However, the standardisation is only suggested in terms of using the FADN terminology but not FADN data. FADN data can be used in many cases for calculating payments, but a mandatory application of FADN data would cause problems in relation to small farms and in some cases a lack of representative samples for regionally important farm types and production systems in some EU Member States. Generally, the formulas for all three approaches provide sufficient flexibility to deal with large differences in data availability. In cases where more detailed data and information are lacking, aggregated figures, e.g. based on expert consultation, could be used for the various cost components. Ideally, however, cost components such as 'purchased feeding stuff' are calculated based on required labour, material and/or machinery cost. The explicit calculation of the various cost components would also allow the testing of how different amounts of labour would affect the payment level.

The calculation could be refined or modified in several ways. For example, the agri-environment requirements could be low-level, or they could cover all management from the reference level to a higher level, but in either case are likely to apply to a defined area of the farm where a particular stocking or cropping system is specified; the inventory of cost components and differentiation categories are largely based on the AGRIGRID project; an alternative way of allocating fixed costs would be to use other options such as simple averages per ha or per Livestock Unit (LU).

5.2.2 Holding-wide (HW) payments

In contrast to the site-specific, agri-environment management defined FCM approach, the holding-wide (HW) approach is aimed at securing the continuation, across a geographically defined area, of a type of farming in which the necessity of adapting to natural handicaps limits the agricultural income but at the same time delivers environmental public goods. Considering these farming systems at both a landscape scale and a farm scale the greater the proportion of land that is managed in a way closely adapted to the natural conditions, the more public goods are likely to be delivered. The payment calculation is structured to recognise both the relative lack of profitability of these farming systems and the potential 'benefits of scale' in the delivery of public goods. This approach *does not consider fixed costs* in relation to maintaining the farm – the assumption is that once the financial disadvantage due to the natural handicap is paid, the farm should be economically viable.

The HW payments would comply with paragraph 13 of the Green Box WTO rules and would

- require baseline management at the reference level (SMR + GAEC + applicable national or regional regulations)
- apply to all land on the farm falling within the relevant national/regional definition of 'natural handicap'
- reflect the income foregone as a result of both the natural handicapand the need for long-term sustainable management of land delivering multiple public goods;
- normally be available to all farmers within a geographically delineated area, but with the opportunity of differentiating payments to reflect natural handicaps and the delivery of public goods

The HW payment calculation is set out in detail in Annex 5 , and is based on two parameters - the agricultural disadvantage due to natural handicaps, expressed as a difference in gross margins; and the relative environmental benefits (in terms of the range and quality of public goods) that the farming system delivers, at a field scale and a landscape scale. The calculation is a three stage process; the first stage is a series of separate calculations of a payment rate per hectare for each of the different livestock and crop systems on the farm based on the difference in gross margin (GM) per hectare between that production system on land with a natural handicap and a similar system on land without the handicap. This is then multiplied (if appropriate) by an HNV coefficient for that particular system, to reflect its level of delivery of environmental public goods. The second stage is to take these individual calculations and apply the proportions of the farm (by area) used by each system to calculate an overall payment per hectare for the whole farm; at the third stage this whole farm payment/ha can be multiplied by an AE co-efficient (if appropriate) to reflect the landscape scale delivery of environmental public goods by the particular mix or proportion of farming systems on that farm as a whole. The use of these coefficients is discussed below but the calculation can be summarised as:

Stage 1 – calculate payment per ha for different systems on farm:
[(GM/LU for non-handicap land x stocking rate in LU/ha) – (GM/LU for handicap land x stocking rate in LU/ha)] x HNV coefficient for that livestock system

AND/OR

[GM/ha for crop on for non-handicap land – GM/ha for crop on non-handicap land] x HNV coefficient for that crop

Stage 2 – calculate whole farm payment per ha:
[(payment per ha for livestock system A x ha used for that system) + (payment per ha for livestock system B x ha used for that system) + (payment per ha for crop system A x ha used for that system)] / total area of farm = payment per ha for whole farm

Stage 3 – apply AE coefficient to whole farm payment:
payment per ha for whole farm x AE coefficient = final payment per ha for the farm

The agricultural calculations are based on readily available data and, although figures are available for GM/ha of different livestock systems, this calculation uses GM/LU multiplied by the stocking rate to allow more scope for scheme administrators to take account of local and regional variations, especially in farming systems that use semi-natural grazing areas. Payment could be differentiated based on land quality or geographic/territorial aspects, which would imply the application of different stocking rates and gross margins for different systems. It also reflects the agricultural loss of income with a long-term environmentally sustainable stocking rate - the payment per ha increases as the stocking rate decreases in response to the greater handicap.

There are several different ways in which an environmental element could be added to this agricultural payment calculation. One possibility is to set a frame for the range of stocking rates eligible, or to specific environmentally desired stocking rate for particular types of grazing land. That would strengthen the agri-environment character of the payment and reduce the compensatory allowance aspect. The use in this calculation of the system-specific HNV coefficient is intended to tie an environmental element of the payment to specific management systems within the farm, reflecting the extent to which the way this land is farmed could continue to deliver multiple public goods at a high level (for example, the coefficient would be higher for wet heath, blanket bog and wood pasture than for improved grassland, where it could be zero).

Although this HNV coefficient could capture the public goods delivery of separate areas of land and reflect this in the payment per farm this does not capture the cumulative effect of the environmental management of all these parcels of land on the *landscape scale delivery* of environmental public goods – for example water quality and flood protection, habitat connectivity, habitat diversity, carbon storage in peatland, fire protection in the Mediterranean zone. This landscape scale benefit is the reason for introducing the whole farm AE coefficient, which could be adjusted in several ways. For example it could be set at farm level (reflecting the environmental benefits of a high proportion of semi-natural grazing land, small average parcel size, mixed farming, agro-forestry) or for all farms within a delimited area (a Natura 2000 site, a water catchment or an area of small, traditional HNV farms).

The HW calculation has been designed as a relatively simple calculation of the agricultural impact of natural handicaps, with the capacity to differentiate the payment to reflect the delivery of environmental public goods. There is clearly a risk of Member States 'stretching' the calculation to use it as a less environmentally targeted income support, as happened with LFA. To counter this, the implementation guidelines would have to require precise and transparent definitions of the agricultural systems used for comparison, of the environmental

eligibility requirements and of the types of land and farming to which the coefficients would apply.

The compliance with the WTO paragraph 13 would also have to be carefully defined, and the possibility could be explored of notifying the additional environmental coefficients under paragraph 12, where they sit more naturally, There is no legal barrier to notification under the two different WTO paragraphs, provided the definitions of the different elements are transparent and clear.

5.2.3 Opportunity cost (OC) payments

The third approach is the Opportunity cost approach which aims to secure farming in disadvantaged areas (based on the opportunity cost of farming). The OC approach would reflect a natural handicap payment, either as a separate payment scheme or as a component of the SFP, based on the opportunity cost of farming in disadvantaged areas.

This approach considers the opportunity costs of farming in relation to other (alternative) uses of labour or land. The main assumptions are that the opportunity cost of farming expressed in alternative income options are higher than the income from farming (or the farm household income) and that the lower income from farming reflects the impact of natural handicaps on farm incomes, in comparison to the average income in the region. The payment would reduce the income gap between farming and other sectors in specific regions and thus reduce the incentive for land managers to abandon agricultural land management activities in order to generate income in other sectors.

The OC payments would comply with paragraph 13 of the Green Box WTO rules and would

- require baseline management at the reference level (SMR + GAEC + applicable national or regional regulations)
- apply to all land on the farm falling within the relevant national/regional definition of 'natural handicap'
- reflect the opportunity cost of farming as a result of the natural handicap expressed in lower incomes than the regional average incomes in other sectors;
- normally be available to all farmers within a geographically delineated area.

The payment calculation formula considers the total amount of labour required to manage the different land management systems on the farm and calculates the payments based on the difference of, e.g. hourly wage rates in the agricultural sector and an average wage rate from non-farming activities. The calculation formula can be summarised as:

Stage 1 – calculate payment per ha for different systems on farm:
[Average wage rate non-farming - average wage rate farming) x (Total labour per ha and year]

Stage 2 – calculate whole farm payment per ha:
[payment per ha for livestock system A + payment per ha for livestock system B + payment per ha for crop system A + payment per ha for crop system B = payment per ha for whole farm

However, there are some data issues associated with the opportunity cost approach. In order to operationalise this approach there is some requirement for data on farmer incomes which is, usually, imputed within FADN data sets and the calculation of cash income; management and investment income and net farm income all have imputed values for unpaid farmer and spouse labour. Net Farm Income imputes (in part) management and labour income for the farmer and spouse. This is divided by the average number of hours worked, namely 2600, to provide an hourly wage rate. A further issue in relation to the practicality of this approach is the comparison withan alternative wage from other non-

farming activities in the area which requires the availability of reliable data on regional average wage rates for non-farming activities. These issues add complexity or suggest the need of using some parameters or quidelines for the practical application of this approach.

6 Identifying Non-Economic Farming Types[17]

This section examines the impact of alternative payment mechanisms on non-economic farming systems. The criteria for screening the data for a non-economic farm are described in Chapter 2, though these are presented for illustrative purposes to indicate how such an approach can be applied in practice. This has taken a UK perspective and examples are drawn from standard account datasets. The application to a wider EU perspective is discussed in the next chapter.

Whilst the 2013 CAP reforms have yet to be finalised, it has been Defra's and hence the UK's position to promote the phased removal of direct support (the Single Farm Payment) from 2013 in favour of improved pillar 2 support (Defra, 2011a, 2011b),[18]. Recent research (Vrolijk, et al , 2010) shows that under a scenario of SPS payments abolition many more UK farmers (compared to the EU positions) would be faced with significantly adverse financial positions with 20.0% having "fairly bad" prospects and 14.7 per cent of UK farms having "bad prospects" (although the report did not account for repositioning of CAP support through pillar 2). CCRI and FERA (2010) also reported that 41% of the commercial farmers they interviewed (n=59) in the English uplands would leave farming under a scenario of SPS phased out by 2020 with support focused on agri-environment objectives. Lack of farming viability under SPS removal scenarios is clearly an important issue, particularly in the uplands where there are limited alternatives, and it would bringing many more of the remaining farms into the "non-economic" category.

The first section applies this criteria as a screening tool, and outlines characteristics of the main farming types which operate under the 'non-economic' criteria used in this report. This is then further analysed in terms of long-term trends in key financial indicators. The purpose is to present a range of farms which may be near to or far from the limits of profitable farming. These are then used as the basis for establishing the impact of alternative payment mechanisms on these farming systems.

6.1 Identifying non-economic farming systems

Figure 6.1 shows the variance in net profitability per ha for farms within the Scottish farm accounts data over the period 2005 to 2008. Whilst there are some outliers it's clear that a large amount of variance occurs around the average of £233ha, and a proportion of farms return a negative profit, which make up around 12% of the total sample.

[17] For definitions used in this section please refer to Annex 2 Definition of Financial Terminology
[18] Contrary to the position of the devolved administrations. See the announced their joint news release on the future of CAP at http://www.scotland.gov.uk/News/Releases/2011/01/19115551.

Figure 6.1Distribution of net profit per hectare, Scotland, 2005 to 2008 average

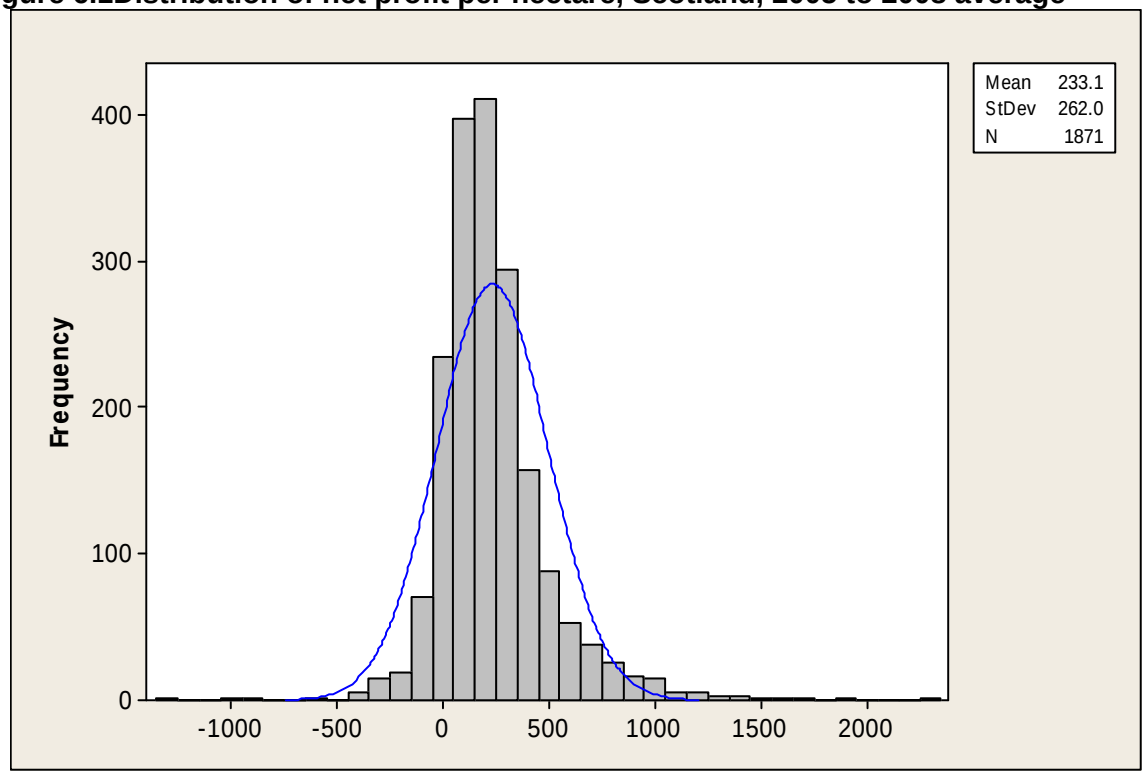
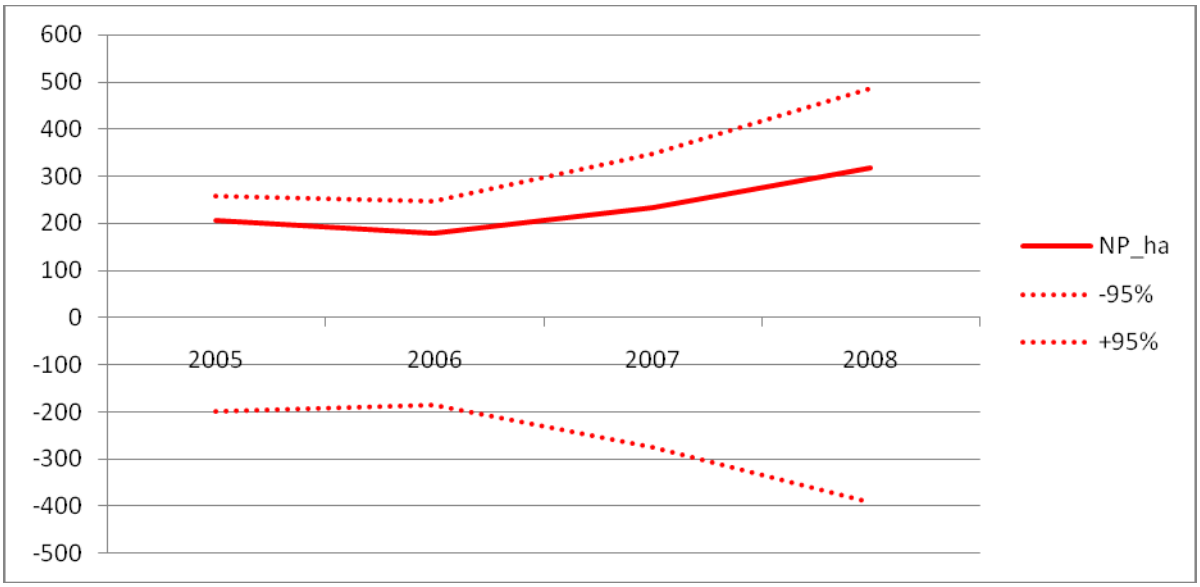


Figure 6.2 shows this variance over time, with the mean and 95% confidence intervals, indicating a wide variance in net profits of these farms. Clearly at the mean profits are positive but at the lower confidence interval these have remained negative. Consequently, this infers the great deal of variance which occurs over time in the profitability of Scottish farms.

Figure 6.2Net profit per ha, Scotland, 2005-2008, mean and 95% confidence intervals, Scotland



Consequently, we take a boundary of £140/ha for net profits (which is 60% below the mean) as the first criteria to define non-economic activity. These were further screened to infer high

public good production by applying the simplified HNV criteria of more than 70% rough grazing to total agricultural area and less than 0.44 grazing livestock units per hectare at the whole farm level. Financial indicators for farms who meet these criteria are given in Figure 6.3.

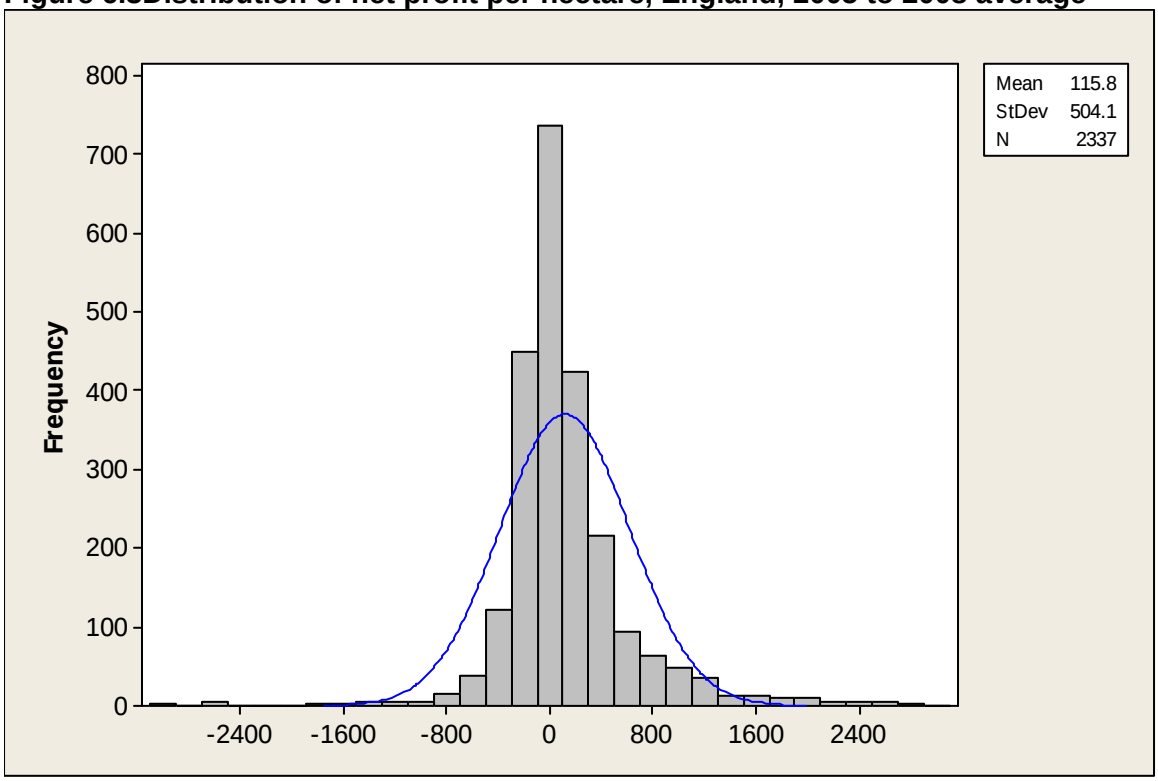
Table 6.1 Financial indicators of farms operating under the above criteria, Scotland

Year	2005	2006	2007	2008
Net Profit per ha				
Mean	66.11	45.68	38.13	37.7
StError of the Mean	*8.49*	*8.77*	*9.07*	*12.3*
Subsidies per ha				
Mean	215.5	204.3	224.4	242.5
StError of the Mean	*15.6*	*16.9*	*15.8*	*18.8*
Net farm Income per ha				
Mean	34.44	5.1	10.7	7.9
StError of the Mean	*9.58*	*10.1*	*10.3*	*13.7*

What is noticeable is that both Net Profit per ha and Net farm Income per ha have fallen over the period whereas subsidies per ha have increased for these farms. Indeed, large drops are recorded between 2005 and 2006 which implies large adjustments over the period of decoupling. Accordingly, the large standard errors indicate that variance still exists with these non-economic farms and the next section shows results at single farm level. Of those farms within the whole sample who met the criteria for non-economic performance (170), 54% were classified as specialist LFA sheep, and 44% were cattle and sheep enterprises.

Figure 6.3 shows the variance in profitability per ha of English farms from within the farm accounts data over the period 2005 to 2008, excluding 166 outliers above £3000/ha or below -£3,000/ ha. It's clear that a large amount of variance occurs around the average of £116 per ha, and a proportion of farms return a negative profit. These farms make up around 43% of the total sample.

Figure 6.3Distribution of net profit per hectare, England, 2005 to 2008 average



The criteria for HNV for farms used is that more than 70% of Utilisable Agricultural Area (UAA) is rough grazing and there are less than 0.5 grazing livestock units per forage hectare. Whilst this is applicable across the UK it is acknowledged that fewer farms in England and Wales (particularly those in the Farm Business Survey) meet the rough grazing criteria. Therefore an additional selection criteria was used to select farms likely to have HNV based on the proportions of permanent grass and grazing density. Thus for grassland HNV farms the criteria used is that:

> **grassland farms in England and Wales are potentially HNV when less than 70% UAA is rough grazing, there is less than 1.0 grazing livestock unit per forage ha, more than 70% of UAA is made up of grass with less than 10% of that grass being temporary grass**.

Using the rough grazing definition 54 farms were selected from the FBS dataset, as shown in Table 6.5, with the vast majority being LFA grazing livestock, as suspected. Using the Grass HNV definition 443 FBS farms were selected with the majority being LFA grazing livestock and Lowland grazing livestock farms. A non-economic criteria was also added if profits from agricultural activities were negative. This resulted in a total of 453 non-economic HNV farms, of which the 312 LFA Grazing Livestock and 66 Lowland Grazing Livestock farms were selected for further analysis.

6.2 Financial performance of non-economic farms

6.2.1 Scotland

Using the selection criteria as described above (farms that fall under 60 percent of the average net profit per hectare, rough grazing accounting for more than 70% of total area with less than 0.44 grazing livestock units per hectare) resulted in 93 LFA sheep farms and 75 LFA Cattle and Sheep farms in Scotland over the period 2005 to 2008. To provide a baseline for the analysis average physical and financial data was extracted for the top and bottom 10 per cent of farm types to provide exemplars at the extremities within these groupings (i.e. the most non-economic and those marginally non-economic). Table 6.3

reveals the physical difference between the most and marginally non-economic farms. Here it can be seen that the most non-economic farms tend to be economically and physically smaller (quite considerably in the case of LFA Cattle and Sheep), have lower numbers of livestock, have lower number of livestock per labour unit (less efficient use of labour) and have lower amounts of in-bye land (crops and grass area). Whilst the rough grazing proportions are similar across the farm types, the higher Adjusted Utilisable Agricultural Area (AUAA) on the most non-economic LFA sheep farms entails that they ironically are located on better quality grazing. LFA Cattle and Sheep farms have an AUAA commensurate to the amount of in-bye and rough grazing land available. Grazing densities (per AUAA) are considerably higher on the marginally non-economic farms (Top 10%) compared to the most non-economic, whilst the converse is true on the LFA Cattle and Beef farms.

Table 6.2 Physical Data from Non-economic Farms 2005 to 2008, average, Scotland

	LFA Sheep		LFA Cattle and Sheep	
	Top 10%	Bottom 10%	Top 10%	Bottom 10%
Farms in sample	9	9	7	7
Area	1,203 ha	1,009 ha	2,116 ha	783 ha
Area used for agriculture	1,184 ha	942 ha	2,098 ha	778 ha
IACS forage area	1,051 ha	914 ha	2,094 ha	775 ha
Crops and grass area	55 ha	39 ha	96 ha	73 ha
Rough grazing	1,129 ha	902 ha	2,002 ha	705 ha
% Rough grazing	93%	95%	90%	89%
Adjusted UAA	122 ha	210 ha	298 ha	149 ha
Grazing Livestock Units	140	113	221	161
GLU / Ha	0.118	0.120	0.105	0.207
GLU / AUAA Ha	1.155	0.539	0.741	1.086
Total labour units	1.38	1.76	2.23	1.80
GLU/labour unit	101	64	99	90
European size unit	27.33	21.76	46.93	36.87

The financial data extracted from these exemplar groupings is shown in Table 6.3 which shows how the better performing farms have significantly higher output (which includes subsidies) and subsidies and have a significantly better annual cash flow position. The negative cashflow position of the most non-economic farms (Bottom 10%) should be a worrying situation as a continuation of this will erode bank reserves and eat into the businesses Net Worth, which could lead to it becoming financially unviable in the long run.

Whilst the marginally non-economic farms appear to make positive returns using Net Farm Income, Occupiers Income, Family Farm Income or Farm Business Income measures, when adjusted to account for unpaid labour, it is telling that both groupings are non-economical (making negative returns on managerial and investment inputs). It is noteworthy that the better performing farms have higher subsidy payments, on average that suggests that they may either be located on better quality land or had higher stocking densities under to pre-decoupled CAP regime and have structurally adjusted post 2005 and the introduction of the Single Farm Payment.

As a measure of debt, interest payments show that the poorer performing LFA Beef and Sheep farms are faced with significantly higher debts on average. The level of machinery depreciation highlights the relative machinery intensity on each grouping of farms, and it can be seen that the better performing LFA Sheep group have less capital invested in machinery, whilst the converse is true for the LFA cattle and sheep farms where machinery may be helping make beef production more efficient.

Table 6.3 Financial Indicators from Non-economic Farms 2005 to 2008, average, Scotland

	LFA Sheep		LFA Cattle and Sheep	
	Top 10%	Bottom 10%	Top 10%	Bottom 10%
Farms in sample	**9**	**9**	**7**	**7**
Total output	£72,615	£49,086	£127,464	£92,217
Net cash flow	£16,854	-£11,524	£33,682	-£19,080
Cash income	£25,299	-£2,420	£45,835	-£2,179
Grants and subsidies	£38,972	£28,115	£75,312	£38,109
Single Farm Payment	£21,276	£15,349	£41,115	£20,805
LFASS	£7,295	£5,263	£14,097	£7,133
Agri-environmental	£5,201	£3,752	£10,050	£5,085
Net Farm Income	£13,215	-£16,315	£16,137	-£12,244
NFI / AUAA Ha	£109	-£78	£54	-£82
Net Profit	£16,128	-£12,304	£40,411	-£10,522
NP / AUAA Ha	£133	-£59	£136	-£71
Occupiers Net Income	£12,855	-£14,897	£16,143	-£11,598
ONI / AUAA Ha	£106	-£71	£54	-£78
Farm Family Income	£15,001	-£12,865	£36,473	-£11,390
FFI / AUAA Ha	£123	-£61	£122	-£77
Farm Business Income	£13,848	-£14,049	£43,134	-£3,873
FBI / AUAA Ha	£114	-£67	£145	-£26
Management & Investment Income	-£649	-£31,577	-£6,595	-£24,316
MMI / AUAA Ha	-£5	-£150	-£22	-£164
Machinery depreciation	£6,267	£7,015	£11,852	£8,921
Interest paid	£2,764	£2,194	£2,542	£7,658

Table 6.4 provides some financial indicators to assess the relative performance of the farms in the exemplar groupings (and can be used across all farms and farm types). The interest cover shows how many times a farm can meet its interest payments from its returns (i.e. so they do not need to eat into reserves or increase overdraft). It can be seen that the marginally non-economic farms (Top 10%) can readily meet their interest payments from their Net Profits whilst the most non-economic cannot meet them and will need to fund these payments from another source. When unpaid labour is accounted for then the farms in both groupings cannot meet their interest charges.

The gross profit and net profit margins reveal the proportion of output is generated into gross and net profits and it again is abundantly clear how the top 10 per cent of non-economic farms totally outperform the bottom 10 per cent, with the inclusion of unpaid labour (through MII measure) means both groupings have negative net profit margins.

Return on capital shows how both the better performing LFA Sheep and LFA Cattle and Sheep farms have an acceptable return on their assets, although once unpaid family labour is accounted for it does become negative.

The gearing ratio indicates the level of indebtedness of each of the groupings of farms and it is clear that the LFA Sheep farms have similar proportions of outside debt, whilst there is a significant difference in the LFA Cattle and Sheep farms where the poorest performing farms have more a third of their assets funded from outside debt, compared to only a tenth for the better performing farms in the non-economic group.

Table 6.4 Financial Ratios from Non-economic Farms, 2005 to 2008, Scotland

	LFA Sheep		LFA Cattle and Sheep	
	Top 10%	Bottom 10%	Top 10%	Bottom 10%
Farms in sample	**9**	**9**	**7**	**7**
Interest cover (NP/interest payments)	5.8	-5.6	15.9	-1.4
Interest cover (MII/interest payments)	-0.2	-14.4	-2.6	-3.2
Gross Profit Margin	71.6%	68.0%	70.8%	56.2%
Net Profit Margin (NP/output)	22.2%	-25.1%	31.7%	-11.4%
Net Profit Margin (MII/output)	-0.9%	-64.3%	-5.2%	-26.4%
Return on Capital (NP/Total Assets)	4.6%	-2.5%	7.3%	-3.0%
Return on Capital (MII/Total Assets)	-0.2%	-6.5%	-1.2%	-7.0%
Gearing ratio	12.8%	12.7%	10.8%	35.5%

6.2.2 England

To provide a baseline for the analysis in England the average physical and financial data were extracted for the top and bottom 10 per cent of farm types to provide exemplars at the extremities within these two farm types (i.e. the most non-economic and those marginally non-economic). This number of holdings that this exercise yielded by farm type are given in Table 6.5 below.

Table 6.5 English HNV farms by farm type

	HNV Definition		HNV Farms	Non-economic HNV Farms
Farm Type	Grass	Rough Grazing		
Cereals	0	0	0	0
Dairy	13	2	15	13
General cropping	0	0	0	0
Horticulture	7	0	7	7
LFA Grazing Livestock	274	49	323	312
Lowland Grazing Livestock	70	0	70	66
Mixed	25	0	25	23
Pigs	17	2	19	10
Poultry	28	0	28	13
All	**443**	**54**	**497**	**453**

Table 6.6 reveals there is clearly large differences in the total agricultural area of the top and bottom performers across both farming types. The difference is nominally down to the amount of rough grazing, and the bottom LFA cattle and sheep producers have below 70% of total agricultural area dedicated to rough grazing, compared with around 25% for the top performers. The more specialist farm types tend to have minimal areas of rough grazing regardless of performance.

Furthermore, there are clearly differences in labour cost per area and stocking rates. The difference in labour costs across the two non-economic criteria are £79 for lowland cattle and £83 for LFA grazing areas.

Table 6.7 shows total farm output is higher for the bottom performers, though this becomes lower on a per ha basis. Total fixed costs appear substantially higher for the bottom performers though, again, a more mixed picture emerges on a per ha basis. The bottom performers also seem to merit more single payment subsidy in both Lowland and LFA areas.

Table 6.6 Descriptive statistics of non-economic farming types, England

	Lowland Grazing Livestock		LFA Grazing Livestock	
	Top 10% non-economic	Bottom 10% non-economic	Top 10% non-economic	Bottom 10% non-economic
Number of farms in sample	**7**	**7**	**32**	**32**
Total Agricultural Area (UAA)	95 Ha	203 Ha	132 Ha	665 Ha
Total grass area	86 Ha	200 Ha	98 Ha	226 Ha
Grass forage as % total	90.7%	98.6%	74.5%	34.0%
Total rough grazing	4 Ha	3 Ha	43 Ha	458 Ha
Rough grazing as % total area	3.9%	1.4%	32.3%	68.9%
Total AUAA	93 Ha	201 Ha	104 Ha	311 Ha
Total grazing livestock units	68	113	85	237
GLU / Ha	0.72	0.56	0.65	0.36
GLU / AUAA Ha	0.73	0.56	0.82	0.76
Labour Costs per GLU	£39	£118	£41	£124
Labour Costs per AUAA Ha	£29	£66	£33	£95

Table 6.7 Main financial indicators for top and bottom performing farms by lowland and LFA categories, England

	Lowland Grazing Livestock		LFA Grazing Livestock	
	Top 10% of non-economic	Bottom 10% of non-economic	Top 10% of non-economic	Bottom 10% of non-economic
Number of farms in sample	**7**	**7**	**32**	**32**
Farm Output	£71,249	£110,785	£78,723	£202,542
Farm Output / AUAA Ha	£764	£553	£757	£652
Farm Output / GLU	£1,043	£982	£923	£854
Fixed Costs	£38,464	£77,174	£35,310	£124,740
Fixed Costs / AUAA Ha	£413	£385	£339	£401
Fixed Costs /GLU	£563	£684	£414	£526
SPS	£16,140	£41,152	£32,987	£86,577
Agri-Environmental	£11,870	£22,626	£4,874	£29,849
Hill Farm Allowance	£0	£0	£3,271	£10,189
Diversification Output	237	5,770	2,589	4,271
Net Farm Income	£22,396	£15,017	£27,717	£21,409
Net Farm Income / AUAA Ha	£240	£75	£266	£69
Farm Gross Margin	£30,288	-£48,543	£27,775	-£89,074
Gross Margin / AUAA Ha	£325	-£242	£267	-£287
Net Margin	£8,703	-£26,409	£7,953	-£59,800
Net Margin / AUAA Ha	£93	-£132	£76	-£192
Agricultural Profit	-£4,835	-£48,543	-£9,890	-£89,074
Agricultural Profit / AUAA Ha	-£52	-£242	-£95	-£287
Management and Investment Income	£8,180	-£6,339	£11,712	£4,186
MII / AUAA Ha	£88	-£32	£113	£13

Nevertheless, despite these higher rates of subsidy, Table 6.8 shows how the bottom performers in both groups tend to have a substantially lower levels of net profit per ha and management and investment income per ha (which includes imputed levels of farmer and family labour).

Table 6.8 Main robust indicators for top and bottom performing farms by lowland and LFA categories, England

	Lowland Grazing Livestock		LFA Grazing Livestock	
	Top 10% non-economic	Bottom 10% non-economic	Top 10% non-economic	Bottom 10% non-economic
Number of farms in sample	**7**	**7**	**32**	**32**
Gross Profit Margin	42.5%	20.4%	35.3%	14.7%
Net Profit Margin (NP/Output)	12.2%	-23.8%	10.1%	-29.5%
Net Profit Margin (MII/Output)	11.5%	-5.7%	14.9%	2.1%
Return on Capital (NP/Total Assets)	1.0%	-1.4%	1.3%	-5.1%
Return on Capital (MII/Total Assets)	1.0%	-0.3%	1.9%	0.4%
Gearing Ratio (debt / assets)	0.9%	6.4%	2.0%	12.4%
Current Ratio (CA /CL)	5.04	1.12	9.31	0.97

Other indicators show the level of debt to assets (gearing) is much higher in the bottom level, indicating higher levels of debt or low levels of asset value. Other indicators, such as the current ratio, the balance of current assets to current liabilities) are much lower for the bottom performing farms, though from a solvency perspective these still operate at around the 1 to 1 level. Return on capital employed is negative for the lower performers, reflecting the loss through negative profits relative to the farm's asset base.

6.3 The impact of a change in activity on public goods provisions

The characterisation above helps to understand the possible impacts on these indicators of a change due to alternative payment systems. Hence, whilst these are stylized farm types, representing the parameters of profitability under the non-economic criteria, they provide a basis for some understanding of the impact of the three funding options proposed in Chapter 5. Hence, the situation outlined above can provide the basis for a baseline scenario compared with the alternative funding provided under a range of payment criteria and these are outlined below.

6.3.1 Full Cost of Management

This formula is based on Axis 2 with site specific environmental public goods. Payments are based on the full cost of management (FCM) which includes fixed costs and normal profits. The FCM calculation compares the payment (on a per ha basis) of an alternative practice on the same piece of land. As such it requires information on a farm variable and fixed costs which are obtainable from the FADN. In this case we compare different levels of rough grazing under various levels of management. Hence the base level practice is the costs related to managing livestock on this land, principally labour, treatment and feeding costs on cattle and sheep farms. This is compared with an alternative practice which engenders the same ecological benefit, i.e. control of vegetation through crop protection and labour. The fixed cost element requires allocation of fixed costs on a per ha basis to the treated area. To do this we simply take total fixed cost expenditure multiplied by the share of treated land and then divided by the area of treated land to get a per ha value. Whilst simple to implement the weakness is an assumption that fixed costs are equally spread across the farm and more

sophisticated weights could be examined in the future. The final calculation multiplies the sum of the livestock practice by the activity level (stocking density on this land) plus the alternative practice by the share of land to be treated, plus the fixed cost components on this share of land. This gives a per ha payment value which can be aggregated over the area of land to be managed.

Table 6.9 shows the results of this exercise in terms of the Scottish sample as an illustration of the impact of applying this formula on a per ha basis. To give a range of impacts these show various degrees of rough grazing entering under management, ranging from a quarter of the rough grazing area on these farms up to the whole of rough grazing. The baseline represents the present situation with present agri-environmental payments.

Table 6.9 Agri-environmental payments under various land management scenarios using the full costs of management formula, Scotland £ mean

Farm type	LFA Sheep top 10%	LFA Sheep bottom 10%	LFA C&S top 10%	LFA C&S bottom 10%
AE Payments (baseline)	9,400	7,293	13,794	7,891
FC(25% RG)	22,789	27,209	42,384	35,373
FC(50% RG)	41,122	48,037	74,646	61,995
FC (All RG)	77,800	89,694	139,171	115,240

Clearly under this payment scenario all non-economic farms benefit from higher subsidy payments. With 25% of rough grazing under management in this calculation then the payments increase by £13 thousand up to £28 thousand pounds. This differential increases substantially to £37 thousand, up to an increase in payments of £67 thousand ifincluding all rough grazing within the estimate. This differential between top and bottom performers is also illustrated in the figures below which shows the impact of these subsides on output value and hence net farm incomes and net profits. Figure 6.4 and Figure 6.5 are applied to the Scottish LFA sector and show the difference in net profits and farming incomes between the top and bottom performing non-economic farms. Clearly, even with 25% of rough grazing entering the calculation there is a distinct reduction in the gap between these performers and incomes equate to around £35,000 per annum. As level of land under management increases then incomes rise, and the distinction between the two ranges of performance decrease to the extent that the bottom performers obtain more income and profit than the top performers. However, this requires an increased burden of public expenditure which is for debate within the Government budgetary process.

Figure 6.4 Net Farm Income by top and bottom 10% of LFA Sheep Producers, £ and ratio between top and bottom 10%

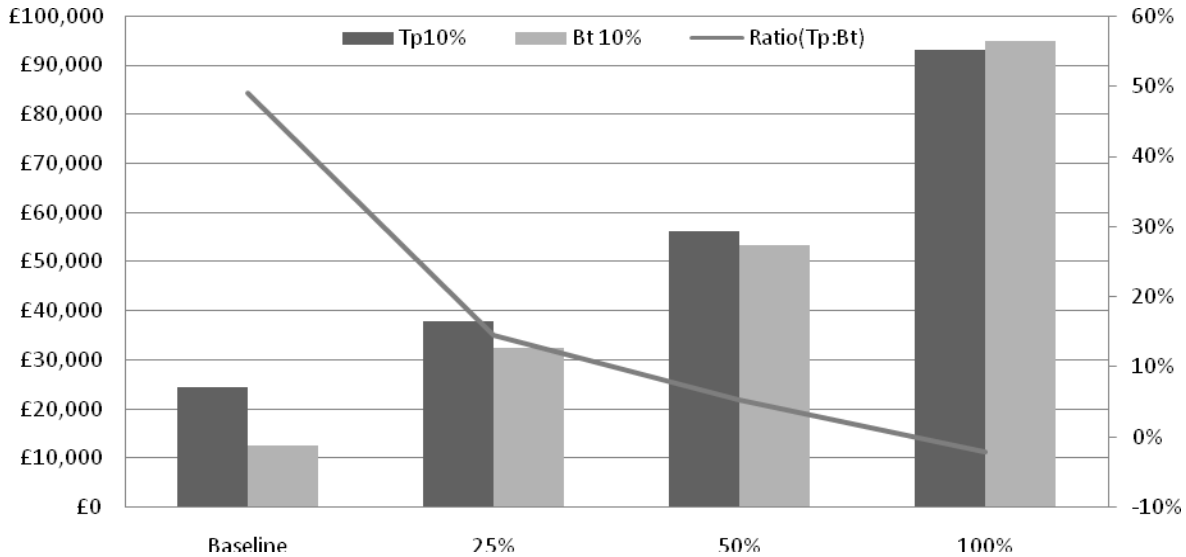


Figure 6.5 Net Profits by top and bottom 10% of LFA Sheep Producers, £ and difference

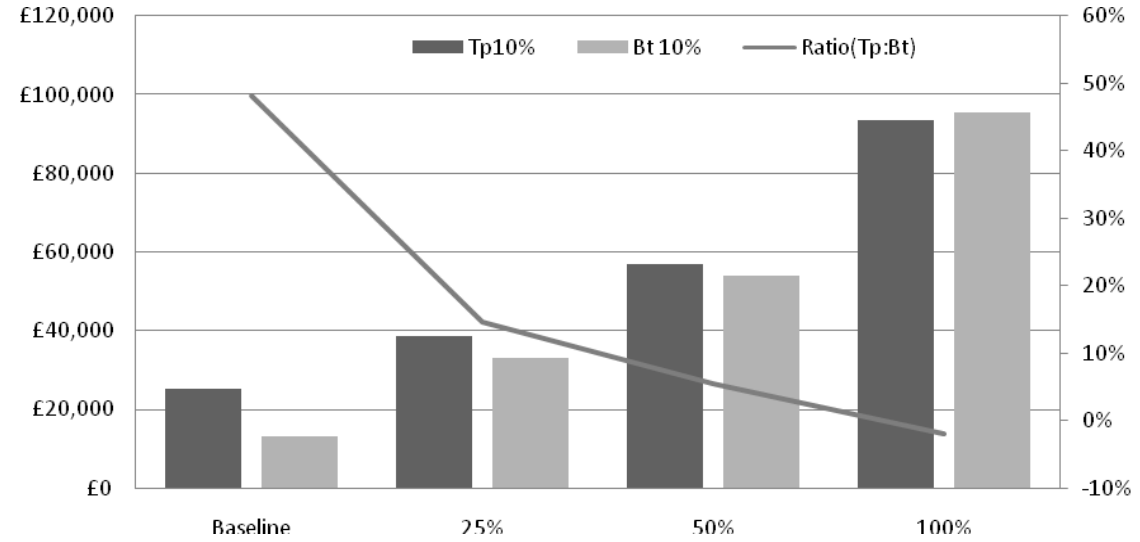


Figure 6.6 and Figure 6.7 show how the cattle and sheep producers in the LFA sector perhaps provide the most explicit example of the change in incomes between top and bottom performers, under the non-economic criteria. The top performers increase their incomes from a nominal level to more sustainable position of around £32,000 under the 25% rough grazing scenario, though bottom performers return to positive profit and incomes, all be it small of around £6,000. Increasing the amount of land under management does not significantly affect the ratio between the top and bottom performers, though there is a slight movement towards equity. Nevertheless, unlike the sheep producers, more land would have to come under management to make the bottom performers return a sustainable level of profit and income, again this must be considered against the larger public payments required to engender this growth.

Figure 6.6 Net Farm Income by top and bottom 10% of LFA C&S Producers, £ and difference

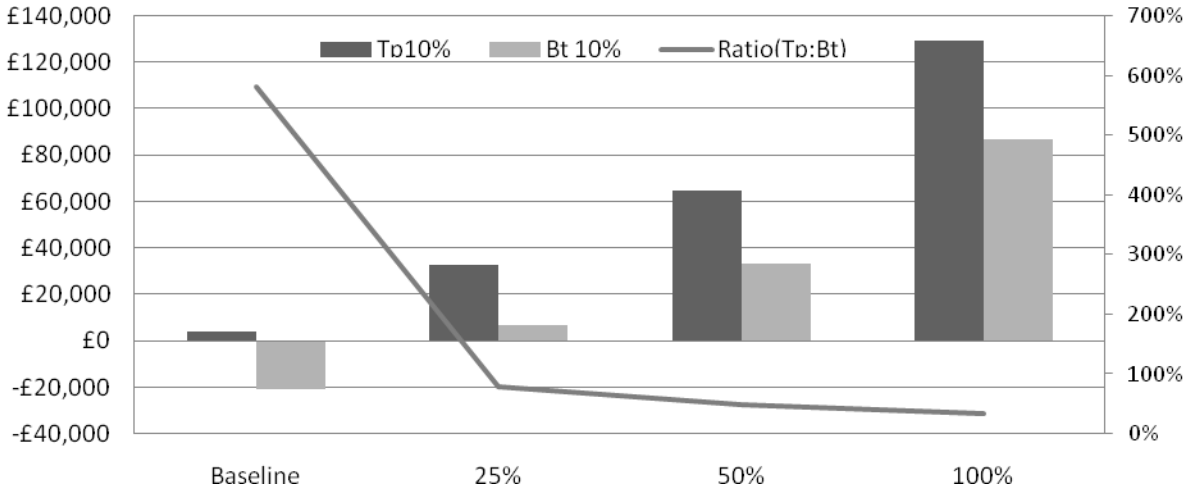
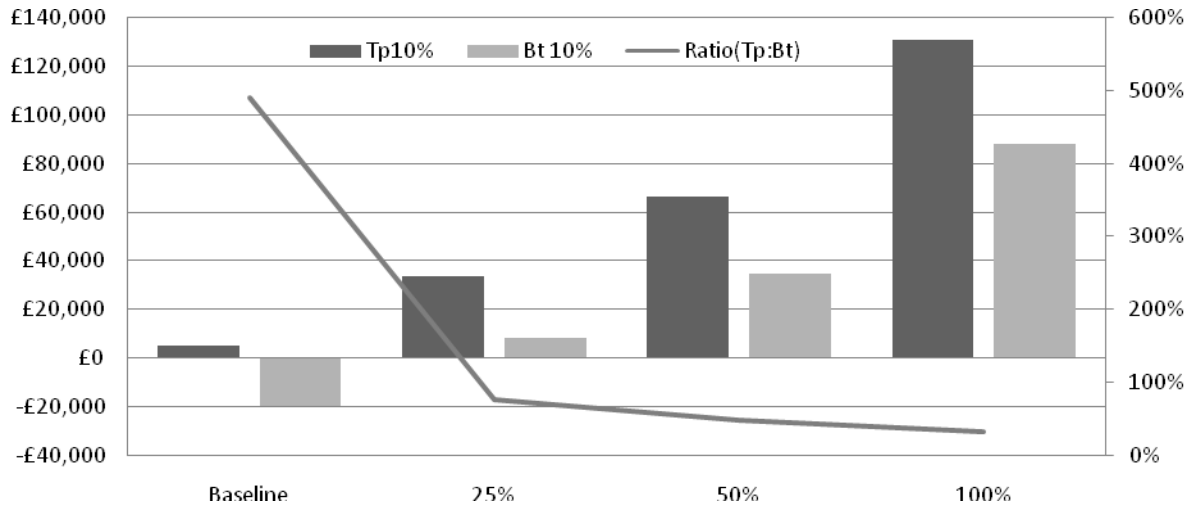


Figure 6.7 Net Profits by top and bottom 10% of LFA C&S Producers, £ and difference



The English farms operating under the non-economic criteria have different mixes of rough grazing compared to Scotland and therefore provide a useful comparator to illustrate how payments change when different mixes of land use comes under management. Table 6.10 shows the distribution of payments in England using the same formula as above.

Table 6.10 Distribution of payments (£) by non-economic farms under the FC formula in England

	Lowland		LFA C&S	
	Top 10%	Bottom 10%	Top 10%	Bottom 10%
Baseline	**11,870**	**22,626**	**8,752**	**41,241**
FC(25%)	456	360	4,083	44,495
FC(50%)	907	718	7,815	75,203
FC(100%)	1,811	1,433	15,279	136,620

It seems that within the non-economic types the English farms have much higher fixed costs which increases the payment per ha. The Scottish farms had fixed costs per ha of an average of £28 per ha, the English equivalents tends to have fixed costs at £104 per ha. Comparing both against benchmarking data, derived across the whole sample by farming type, fixed costs per ha are between £400 and £500 per ha. This may be a combination of sampling bias, through low numbers of farms within the non-economic criteria plus indicates low levels of investment in aspects such as labour, machinery and land improvements. Notably, using these higher values within the calculation generates much higher levels of payment per ha and subsequent environmental subsidy and presents an issue for setting eligibility criteria based on levels of fixed costs per ha.

Against the baseline, under this formula most farms tend to have a large decrease in payment. A prominent reason for this is the use of rough grazing, which is a simple indicator of public good provision and an aggregator of benefits across the farm. Thus, for lowland English farms which meet the non-economic criteria only an average of 4ha is rough grazing. For LFA cattle and sheep farms the top 10% have 43 ha, whereas the bottom performers have an average of 453 ha. This, coupled with the higher fixed costs per hectare, tend to increase the payments to extremely large values for these bottom performing types. Consequently, whilst rough grazing seems a simple indicator to apply across EU countries it seems that payments will vary substantially given variances in these farm indicators. Figure 6.8 and Figure 6.9 show the impacts of these measures against the baseline payments on farm income and profitability.

Under this formula non-economic lowland cattle and sheep producers experience a fall in incomes and profits from the baseline, due to the loss in agri-environmental payment. Given the low level of rough grazing on these farms there is very little difference across the three scenarios of land under management. Clearly, this indicates that if this were applied at the

EU level some criteria will need to be modified for inclusion of lowland livestock farmers and this may focus around identifying practical criteria for inclusion of species-rich and diverse land under management.

Figure 6.8 Net Farm Incomes for Non-economic Lowland Cattle and Sheep farms, £ mean and ratio of top to bottom

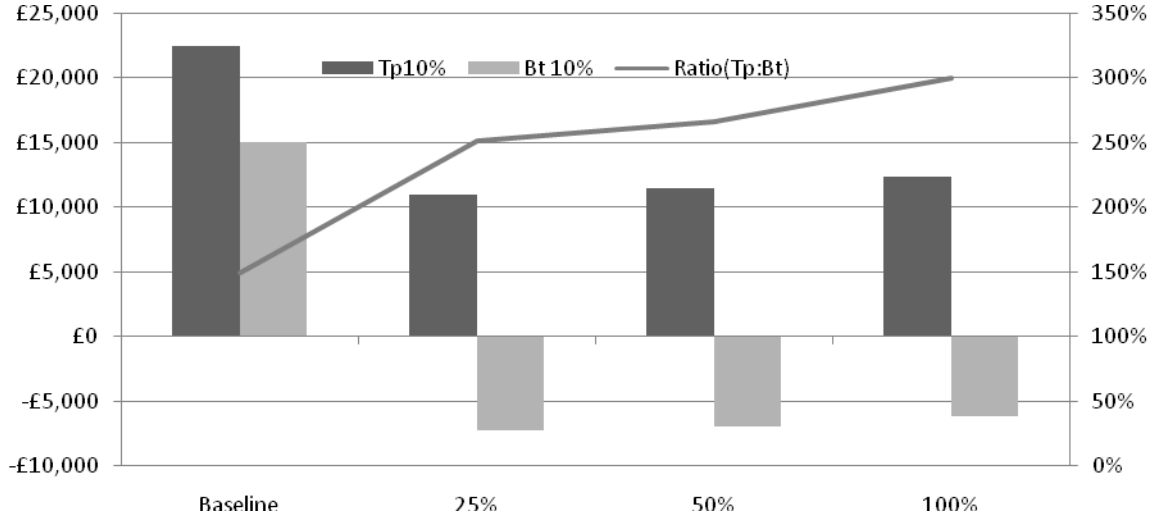


Figure 6.9 Net Profits for Non-economic Lowland Cattle and Sheep farms, £ mean and ratioof top to bottom

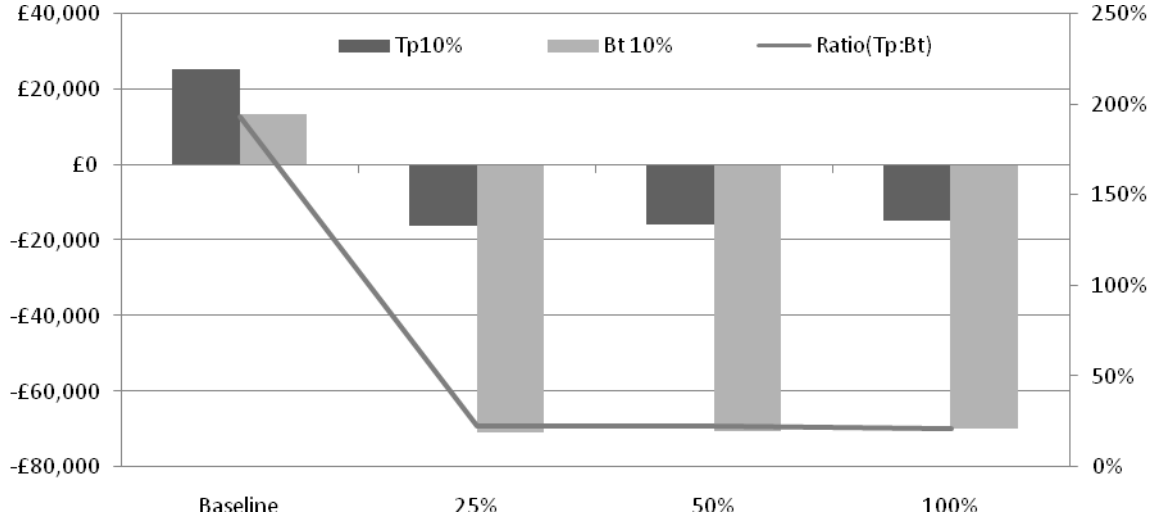


Figure 6.10 and Figure 6.11 show the results of applying this formula to non-economic LFA cattle and sheep farms. Due to the use of rough grazing as an indicator of land under management the bottom performers do benefit quite substantially from this approach, indeed with 25% of rough grazing under management this mechanism gives higher income levels than the top performers. In addition, net losses decrease for these farms, however only with the option of including all rough grazing do both farms return a profit, though for the top performers this is minimal (at £515), and for the bottom performers this becomes £17,697.

Figure 6.10 Net Farm Income for Non-economic LFA Cattle and Sheep farms, £ mean and ratio of top to bottom

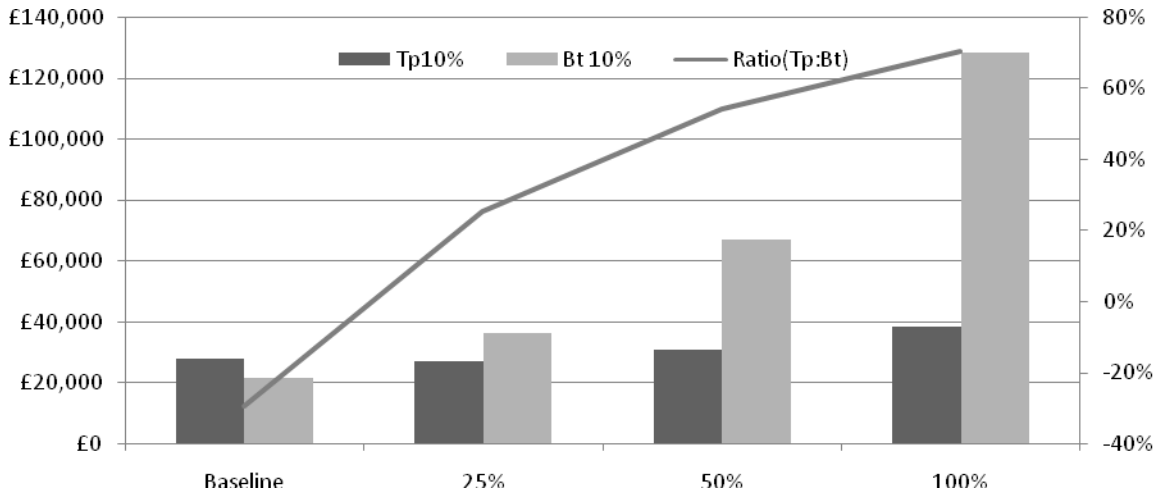
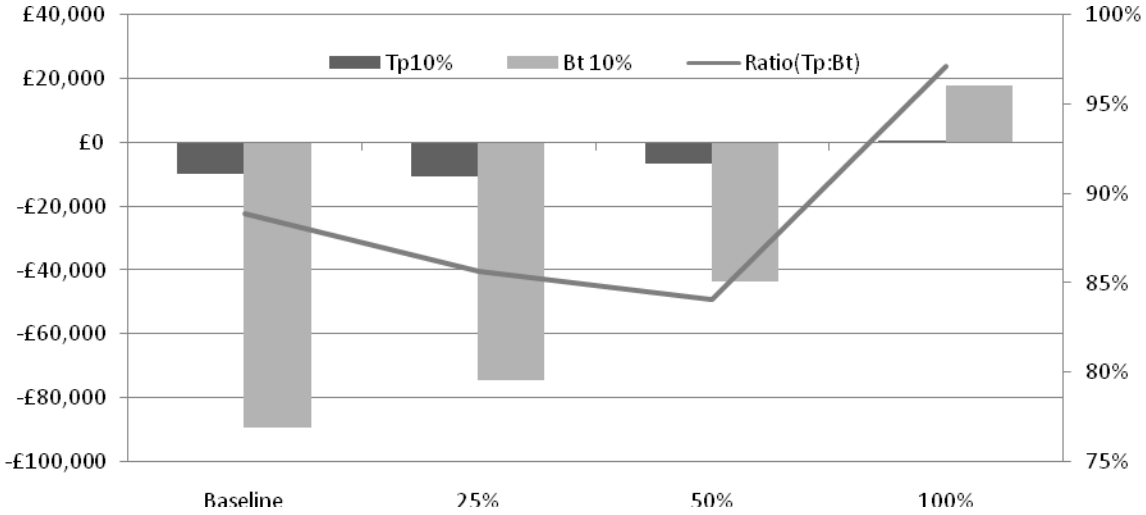


Figure 6.11 Net Profits for Non-economic LFA Cattle and Sheep farms, £ mean and ratio of top to bottom



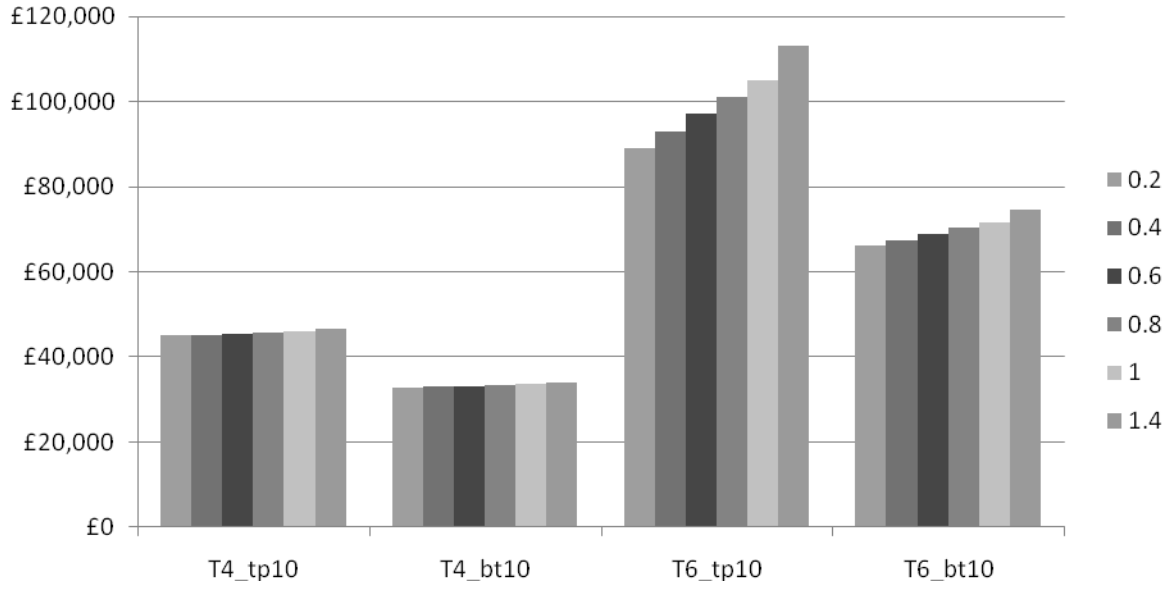
6.3.2 Holding-wide payments

This is an axis 2 approach to payments based on assistance for disadvantaged regions where farming systems provide environmental (and social) public goods and explores the scope for developing holding level payments based on whole farm agri-environment requirements. This calculation is based on agricultural disadvantage due to natural handicaps (expressed as the difference in gross margins for this and the non-disadvantaged areas), and environmental coefficients which adjust the payment based on different defined environmental qualities. In order to apply this, some division between naturally disadvantaged areas is needed. This approach does not consider fixed costs in relation to maintaining the farm and the assumption is that once the financial disadvantage due to the natural handicap is paid, the farm should be economically viable.

The approach requires information to be collected on stocking densities per ha and some distinction criteria to be made on the share of naturally disadvantaged areas (NDA) on the farm compared to non-NDA areas. Similarly it requires some derivation of environmental coefficients which could be simply calculated as the ratio of rough grazing to total agricultural area. However further simplified rules could be applied to test this approach.

Figure 6.13 we assume a small environmental coefficient of 0.05, which infers some impact of the managed land of environmental benefits, though this represents a scale between 0 and 1 of some environmental impact to be agreed upon. Similarly, a whole farm coefficient is applied, which can represent such factors as interconnectivity within the landscape for example, or the mixture of habitats. For the specialist sheep producers we take a coefficient of 0.1 and a value of 0.2 for cattle and sheep farms, representing, perhaps more environmental benefit from mixed livestock activities. Secondly, some criteria are needed for defining the share of NDA land on the farm, for this example we take the share of rough grazing to total area. In Figure 6.12 below the baseline represents the level of return from the NDA land, under various stocking densities by the four farm types.

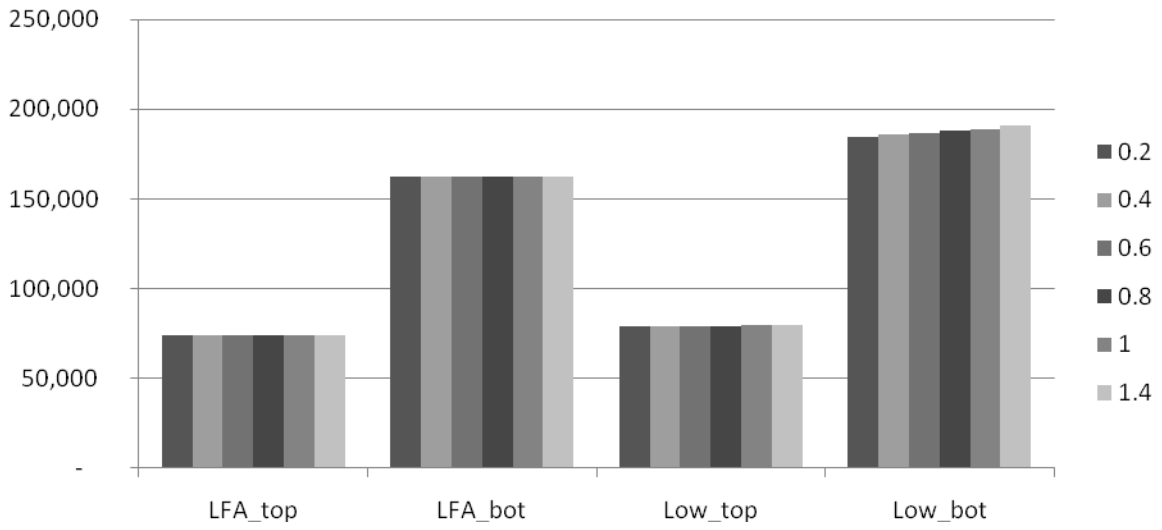
Figure 6.12 Holding wide payment under various stocking densities, for sheep and cattle and sheep farms, Scotland.



Key: T4: Specialist Sheep; T6: LFA Cattle and Sheep
tp10: Top 10%; bt10: Bottom 10%

Effectively under various low stocking densities for both countries (Figure 6.12 and 6.13) it seems that this payment does not change. However, some agreement would have to be made regarding the parameters for applying stocking densities to retain this payments.

Figure 6.13 Holding wide payment under various stocking densities, for non-economic cattle and sheep farms, England



6.3.3 Opportunity Cost of Management

Opportunity costs of management are based on the costs foregone of managing a disadvantaged area compared to alternative used for labour or land. The assumption of this approach is that the natural disadvantage is reflected in the lower incomes compared to other sectors within the same region. This is a whole farm approach, though another approach could relate to the income returned from management of environmental land compared to management of land for agricultural production. However, there is little, if any data available on this aspect which is further complicated by separating and defining environmental and agricultural activities at the farm level. Hence, in order to operationalise this method there is some requirement for data on farmer incomes which is, usually, imputed within FADN data sets and the calculation of cash income, management and investment income and net farm income all have imputed values for unpaid farmer and spouse labour. In short, this is one aspect that is complex or where further parameters or guidelines to delimit the use of the approach would be required.

We take as an exemplar Net Farm Income which according to Defra '…represents the return to the farmer and spouse alone for their manual and managerial labour and on the tenant-type capital invested in the farm business.' (Defra,[19] 2008). Consequently, it is an overestimate as it includes a return on capital invested[20]. This is divided by the average number of hours worked, namely 2600, to provide an hourly wage rate. A further issue in presenting practicality of the application is comparing the alternative wage from other non-farming activities in the area. Thus, an average could be taken of a rural regional income level as the comparator, such as forestry, game management or, from the annual survey of earning and hours worked (ASHE) the median gross hourly pay for *'botanical and zoological gardens and nature reserve activities*', which may reflect a parity of ecological benefit. However, this clearly needs some investigation in terms of setting the occupation in which to compare a disadvantaged farmer against, for example Defra use an average of local market rates for manual agricultural work to impute unpaid labour. However, this does not include a component for management. These rates are not easily accessed but whichever method is used it relies on the difference between the two and, for a positive payment to farmers, that the farming income is lower than these comparative rates.

Further assumptions have to be made on the level of hours required to farm particular activities. For this exercise we take the standard labour requirements provided in the SAC

[19] http://www.defra.gov.uk/evidence/statistics/foodfarm/farmmanage/fbs/published-data/farmaccounts/2008/Appendix2.pdf

[20] NB: Though this does not include return to land and buildings.

Farm Management Handbook for on-farm work. Hence for purposes of illustration we assume the LFA sheep farms have an average of 700 sheep and 20 cattle and LFA Cattle and Sheep have 300 sheep to 100 cattle. Though the calculation is not very sensitive to change in livestock numbers.

However, the calculation is most sensitive to the differential of the comparative activity, and, as described above, is the weakness of this approach in terms of adequately defining and agreeing an alternative activity. Table 6.11 shows the impact of changing the difference between non-farm and farm wage rates on environmental payment per ha.

Table 6.11 Impact of an increase in the difference between farming and non-farming income on payments per ha, top and bottom performing Scottish livestock farms

	£0.50	£1.00	£1.50	£2.00
Sheep_Top10	£91.29	£182.59	£273.88	£365.18
Sheep_Bt10	£61.63	£123.26	£184.89	£246.52
Cattle & SheepTp10	£172.57	£345.15	£517.72	£690.30
Cattle & Sheep_Bt10	£127.56	£255.13	£382.69	£510.25

6.4 Summary of Impacts

The mechanisms outlined above support farms and reward the effort required to maintain and encourage ecosystem services. Indications are that all three methods will provide a substantial upward shift in support for these non-economic farming systems. In most cases, the entry of only small areas of land will increase incomes to sustainable levels, or at least to parity across similar more profitable types. Table 6.12 takes the average payment per ha under various flavours of the above formulas (using rough grazing area as a proxy for environmental maintenance and protection).

Table 6.12 Average payment per ha under the various formulas for Scottish and English grazing farm types, £[$]

	Scotland		England	
	Cattle and Sheep (LFA)	Specialist Sheep (LFA)	Cattle and Sheep (LFA)	Cattle and Sheep (Lowland)
Full Costs (25% rough grazing)	£35.16	£26.82	£163.01	£1.02
Full Costs (100% rough grazing	£75.75	£87.76	£509.72	£4.07
Holding Wide	£76.68	£27.24	£894.76	£296.69
Oppourtunity Cost (10% rough grazing)	£101.11	£49.87	£750.23	£181.34

[$] taken at the mean of bottom and top performers

Measuring against the present total payments for agri-environmental payments for these farms (extracted from the farm accounts data), most farm types experience a rise in payment, aside from Cattle and Sheep (Lowland) in the full costs approach. However, these farms meet the higher nature value criteria and therefore provide some benefit to the environment by providing significant ecosystems services. Hence, the loss of these farms and the habitats they maintain would incur a cost to society under a payment for ecosystem services scheme. These costs are difficult to estimate but the aggregation of payments needed to enable the three formulas should be viewed with respect to these social costs.

7 Conclusions

A number of farming systems across the EU are under threat and extensively farmed land is being abandoned as systems fail to maintain a sustainable level of income to survive. The loss of these farms will have an impact on the management of potentially valuable public goods. A key driver is the low financial returnsfrom farming practice on these systems due to long-term structural, biophysical and financial factors. The level of ecosystem service provided on these maintained habitats may also be threatened by the need to focus on agricultural output production in order to obtain sustainable incomes. This report has provided and tested a methodology for identifying farms which require further consideration within the policy arena based on their deliveryof higher levels of nature value and the fragility of their financial position.

Subsidies for the production of public goods are available under rural development schemes, and the income provided through the single payment scheme requires some level of cross-compliance. Nevertheless, these schemes tend to ignore the labour element required and therefore potentially are operated at a financial (or opportunity) cost for the farmer. The 'income foregone, or 'additional costs' formula becomes much more useful in the policy context for change if it is recognised that in some cases existing farms are operating at a loss. There is therefore no income to forego and the economically realistic alternative is abandonment. Therefore the full cost of farming that land is an 'additional cost'in itself.

Under the existing EAFRD Regulations, *continuation of agricultural activity* is implicitly assumed to be part of the counterfactual baseline. In this logic, cost incurred and income forgone in the relevant payment formulas under EAFRD are understood to be only those going above the counterfactual baseline. Following this logic, payment formulas under the current EAFRD measures aim to provide either a premium for farming practices which deliver environmental benefits going beyond the reference level and hence carry higher opportunity costs (measure 214), or compensation for a natural handicap of land management in certain areas (measure 212). However, recent trends in non-economic farming systems show that this may not fully reflect, firstly, the recent changes in the counterfactual situation in these systems. Secondly, it may not fully reflect the changing public demand for the provision of ecosystem services and public goods, which requires the continuation of agricultural land management for this purpose in these areas.

There are difficulties with the coverage of data sets. The data sets which could be used for developing payments would be the FADN data, which is collected by each member state. Principallyin this study wefocus on using FADN data to identify non-economic systems and this is useful as it also gives estimates of rough grazing and livestock grazing units in order to apply the simplified HNV criteria. More importantly, the FADN data set gives indicators of cost which can provide a basis for applying the formulas outlined in this report. However, whilst the FADN provides indications of costs these are not apportioned across enterprise, thus practical application requires some thought on developing linking coefficients between specific labour and management of land under environmental protection in the proposed funding schemes.

The FADN lacks coverage in terms of the relatively low numbers of the agricultural population within the sample and also there is EU limiting criteria on size units and activity which are imposed. Thus, potentially valuable sources of ecosystem services from part-time and very small scale farming systems are not included as these are not covered by the FADN. This is a fundamental issues as when applying these formula at an EU level, part-

time farming is the norm on marginal land in many parts of Europe. The FADN data approach could be augmented by both IACS and EU Land Use Cover area frame Statistical survey LUCAS data sets. These sets provide detailed land cover indicators and have been used for detailing spatial impacts on ecosystem services. However, our experience with UK farm account data is that these cannot be matched with IACS identifiers and leaves open the potential for some modelling requirement to develop payment levels for farms.

A clear example of this is the oppourtunity cost approach, which aims to directly compensate for labour time expended on farming activities. The main issue is the comparator value to compare, which has to be feasible for a farm manager and within the same region. Thus we simply resort to examining sensitivities of this differential in order to examine the impact on payment. The EU farm structure survey is conducted four times a decade and consists of land cover information but also can detail labour and capital inputs into the production systems which may be explored to further refine the oppourtunity costs approach. However, these are all methods which try to match data sources and the key failing is the ability to match separate databases, e.g. Farm Account Databases with June Agricultural Census data. An even larger issue is how these databases can match others, such as the BTO farmland birds database for example, which would indicate ecosystem performance over time, if payments were considered on outputs rather than management inputs. Accordingly the availability and suitability of consistent EU-wide data is a real problem, which needs to be solved whether or not new payment calculations are introduced. This is also true for environmental data, particularly uptodate electronic data not just on land cover and land use but also on intensity of management. Within the approaches outlined above we provide some coefficients for estimating environmental activity and further work could focus on refining these estimates.

Using costs directly from these farms for Scotland and England tends to generate high levels of payment and much higher than the present agri-environmental and LFA type support presently expended on this farm type. However, this should not be a disincentive to explore these mechanisms as it is recognised, within this report, that the farms here are a special case for protection, provide a higher level of ecosystem service and therefore a merit a higher value to society.

The formulas could be refined in terms of agreement on the appropriate values for comparison and then checked on a number of actual farming systems to understand the changes to incomes that these approaches could bring. Payments on a per hectare basis on these farms is simple to apply, as is payment at a farm level for the LFA-type options, but as even small amounts of land under management will increase Government expenditure, other methods and restrictions may be imposed. These could explore payments by stocking density or by land classification type under management. Similarly, we could explore a stepped approach in which a fixed payment for a certain quality of land is paid, and which is reduced as more land is entered into the calculation. In the HW payments formula this could be reflected in using different values for environmental benefit. In the OC formula, this could be interpreted as on-farm oppourtunity cost, related to the labour and management time required for environmental activities compared to production of agricultural products. However, this would require the introduction of a special survey to allocate costs to these activities and set up a reference value set, which may prove difficult.

We find no need to wait for a new WTO agreement. There is sufficient scope within the existing WTO agreement if Member States and the EU really tried to use it to its full potential. Most importantly, with the Green Box WTO context, is that Annex 2 of the agreement on agriculture does not specify any particular technical parameters for the definition of the ‘extra costs’ or ‘loss of income’ in the payment formulas of the compliant

policy measures. As long as the measures satisfy the measure-specific and generic requirements (set out in Box **5.1**, pp.34), and as long as justification is clear, accurate and transparent, Annex 2 of the Agreement on Agriculture leaves the way clear for policy-makers to justify the realistic costs involved in supporting land management for environmental or regional assistance objectives linked to government policy.

In conclusion it seems that focusing on the non-economic farming element reduces the restriction related to incurring a trade distortion or production effect, as these farms have a rather limited market impact. Similarly, if the environmental objectives of these farming systems are clearly defined and linked to government policy then these formulas are justifiable under the WTO agreement.

Payment for these farms increase incomes up to sustainable levels under all three formulas. There is therefore an eligibility issue which needs to be explored further under the three payment options as some formulas have a redistribution effect. We base our calculation on rough grazing and stocking densities and these could provide a more sophisticated basis for developing a payment, or ensuring a phased in approach by offering quite restrictive criteria for the most disadvantaged and higher nature valued farms. Another issues with the payments increase is that eligibility will change over time and whilst we use farm business income as the main parameter for indicating 'non-economic' farming, other criteria could be tested. For example, in Chapter 6 we discuss a number of financial indicators. Hence, a more sophisticated measure could be developed which accounts for long-term trends in performance and also for the role of off-farm and non-farm incomes. A key point however is that if the Single Farm Payment were removed or reduced, as some have proposed, in the mid-to longer term, then a much larger number of farming systems could become non-economic by our definition. This scenario, would have the impact of widening the farming types which would enter this category. This in turn would require further development of an indicator which captures the public good element of various cropping based systems to help target the most valuable public goods being produced.

8 References

AberystwythUniversity (2010) Welsh Farm Income Booklets http://www.aber.ac.uk/en/ibers/enterprise-kt/fbs/fbs-database/

Anderson, E, Baldock, D., Bennett, H., Beaufoy, G., Bignal. E., Brouwer, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D.I., Nieuwenhuizen, W., van Eupen, M., Hennekens, S. & Zerva, G. (2004) *Developing a high nature value farmland indicator*. Report for the European Environment Agency, Copenhagen. 75 pp + appendices

Barrantes, O., Ferrer, C., Reiné, R., Broca, A. (2009) Categorization of grazing systems to aid the development of land use policy in Aragon, Spain. Grass and Forage Science, 64. 26-41.

Beaufoy, G. (2008) *HNV farming: explaining the concept and interpreting EU and national policy commitments*. Stratford-upon-Avon: European Forum on Nature Conservation & Pastoralism. 15 pp. Available at http://www.efncp.org/download/EFNCP-HNV-farming-concept.pdf

Beaufoy, G., Baldock, D., and Clark, J. (1994). *The nature of farming: low-intensity farming systems in nine European countries*. Institute for European Environmental Policy, London.

Bignal, E.M. & McCracken, D.I. 1996. Low-intensity farming systems in the conservation of the countryside. *Journal of Applied Ecology* 33 413-424.

Bignal, E. & McCracken, D.I. 2000. The nature conservation value of European traditional farming systems. *Environmental Reviews* 8 149-171.

Bignal, E. & McCracken, D. (2009) Herbivores in space; extensive grazing systems in Europe. *British Wildlife* 20 (5 Special Supplement: *Naturalistic grazing and rewilding in Britain: perspectives from the past and future directions*), pp. 44-49.

Blandford, D. (2005) Disciplines on Domestic Support in the Doha Round. Trade Policy Issues Paper #1 - 2005

Blandford, D. and Hill, B. (2008) Guest Editorial: Directions in Rural Development Policy – Lessons from Both Sides of the Atlantic, *Eurochoices*, Spring 2008, 6-12.

Blandford, D. and Josling, T. (2007) Should the Green Box be Modified? IPC Discussion Paper, International Food & Agricultural Trade Policy Council http://www.agritrade.org/Publications/DiscussionPapers/Green_Box.pdf

Brodt, S., Klonsky, K. and Tourte, L. (2006) Farmer goals and management styles: Implications for advancing biologically based agriculture. Agricultural Systems, 89. 90-105.

Burrell A., Hill B. & Medland J. (1990) *Agrifacts: A Handbook of UK and EEC Agricultural and Food Statistics*. Harvester Wheatsheaf, London

Caballero, R. (2001) Policy schemes and targeted technologies in an extensive cereal-sheep farming system. Agriculture and Human Values, 19. 63-74.

Caskie, P., Davis, J., Wallace, M. (2001) Targeting disadvantage in agriculture. Journal of Rural Studies, 17. 471-479.

Cesaro, L., Chiozziotto, F. and Tarasconi, L. (2008) Methodologcal grid development in EU rural development measures. Report to the European Commission. In AGRIGRID.

Methodological grids for payment calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

Chatellier, V., Delattre, F. (2005) Les soutiens directs et le découplage dans les exploitations agricoles de montagne. Economie Rurale, 288. 40-56.

Conington, J.,Bishop, S.C., Waterhouse, A., and Simm, G., (2004). A bio-economic approach to derive economic values for pasture-based sheep genetic improvement programmes, *J. Anim Sci*, **82**, 1290-1304

Cooper, M.McG., Thomas, R.J., (1991) Profitable sheep farming. Farming Press Books, UK,198 pages.

Cooper, R.A. (2003). Sheep and goats. In: Primrose McConnell's The Agricultural Notebook, 20th Edition, Soffe. R.J. (ed). Pp 500-521. Oxford: Blackwell Science Ltd. 744pp.

Cooper, T., Arblaster, K., Baldock, D., Farmer, M., Beaufoy, G., Jones, G., Poux. X., McCracken, D., Bignal, E., Elbersen, B., Wascher, D., Angelstam, P., Roberge J-M., Pointereau, P., Seffer, J. & Galvanek, D. 2007. *HNVIndicators for Evaluation: Final report for DG Agriculture. Contract notice 2006-G4-04*. Institute for European Environmental Policy

Countryside and Community Research Institute and Food and Environment Research Agency (2010). Economic and environmental impacts of changes in support measures for the English uplands – an in-depth forward look from the farmer's perspective. Report for Defra. http://www.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/research/documents/uplands-indepth.pdf

Cumulus (2005) Assessment of the Impact of CAP Reform and Other Key Policies on Upland Farms and Land Use Implications in Both Severely Disadavantaged and Disadvantaged Areas of England. Report to Defra, London. http://statistics.defra.gov.uk/esg/reports/cap%20uplandfarms%20report.pdf

Cunningham, J.M.M., Groves, C.R., (1985) The hills and uplands of the UK. In 'Hill and Upland Livestock Production' eds Maxwell, T.J., Gunn, R.G., BSAP Occ Publ. No 10; 1-8

Defra (2004) England Rural Development Plan,HLS payment calculations, Annex VIII

Defra (2009) The farm practices Survey 2009. Uplands and other LFA's survey report. Report by Defra Agricultural Change and Environment Observatory Report No 16. http://www.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/research/documents/UplandsFPS_report09.pdf

Defra (2009) Farm Incomes in England 2008/9. http://www.defra.gov.uk/evidence/statistics/foodfarm/farmmanage/fbs/published-data/farmaccounts/2009/FAE.pdf

Defra (2010a) Farm Business Income, Net Farm Income and Cash Income by types of farm in England, http://www.defra.gov.uk/evidence/statistics/foodfarm/farmmanage/fbs/published-data/fbsincomes/documents/Oct10statsrel.pdf

Defra (2010b) Farming in the English uplands. Report by Defra Agricultural Change and Environment Observatory Report No 20 http://www.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/research/documents/uplands2010.pdf

Defra (2010c) Definitions of Terms used in Farm Business Management. http://www.defra.gov.uk/foodfarm/farmmanage/advice/documents/def-of-terms.pdf

Defra (2011a). Environment Secretary Caroline Spelman's speech at the Oxford Farming Conference 2011. [Online]. Available at: http://ww2.defra.gov.uk/news/2011/01/05/spelman-speech/

Defra (2011b) UK response to the Commission communication and consultation "The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future". http://www.defra.gov.uk/foodfarm/policy/capreform/documents/110128-uk-cap-response.pdf

Departamento de Desarrollo Rural y Medio Ambiente (2009) Programa Desarrollo Rural de la Comunidad Foral di Navarra. Pamplona, October 2009.

Departamento di Agricultura, Pesca Y Alimentacion (2009) Programe de Desarrollo Rural del Pais Vasco 2007 – 2013. Version December 2009.

Dewar-Durie, A., 2000. The Scottish sheep industry: a way forward. Scottish Executive, Edinburgh, website publication. http://www.scotland.gov.uk/Publications/2007/06/06110400/0

Dolman, P.M. & Sutherland, W.J. (1992) The ecological changes of Breckland grass heaths and the consequences of management. *Journal of Applied Ecology* 29 402-413

Eadie, J., (1985) The future contribution of the hills and uplands to agricultural output. In 'Hill and Upland Livestock Production' eds Maxwell, T.J., Gunn, R.G., BSAP Occ Publ. No 10; 123-130.

EBLEX (2010) Business Pointers 2010. http://www.eblex.org.uk/returns/-businesspointers.aspx

Edwards, G., and Fraser, I. (2001) Reconsidering Agri-Environmental Policy Permitted by the Uruguay Round Agreement." *Ecological Econonomics* 37, 313–26.

Eggers, J., Mettepenningen, E. and Beckmann, V. (2007) *Assessing the Efficiency of Local Action Groups and Auctions for Designing and Implementing Agri-environmental Measures in the EU - Results From An Expert Survey* Paper prepared for presentation at the 47th annual conference of the GEWISOLA (German Association of Agricultural Economists) and the 17th annual conference of the ÖGA (Austrian Association of Agricultural Economists),'Changing Agricultural and Food sector', Freising/Weihenstephan, Germany, September 26-28, 2007. http://ageconsearch.umn.edu/handle/7584

English Nature (2001) *State of Nature: The Upland Challenge*. English Nature, Peterborough. http://naturalengland.etraderstores.com/naturalenglandshop/product.aspx?ProductID=f426155b-fe6f-4c31-a50e-d6abf44ebd75

Espinosa-Goded, M., Dupraz, P. and Barreiro-Hurle, J. (2009) Fixed costs involved in crop pattern changes and agri-environmental schemes. Working Paper SMART – LERECO N°09-15.

European Commission (2002) COMMISSION REGULATION (EC) No 445/2002 of 26 February 2002 laying down detailed rules for the application of Council Regulation (EC) No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF). Official Journal of the European Communities: 15.03.2002.

European Commission (2005) COUNCIL REGULATION (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD). Official Journal of the European Communities: 21.10.2005.

European Commission (2006) COMMISSION REGULATION (EC) No 1974/2006 of 15 December 2006 laying down detailed rules for the application of Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD). Official Journal of the European Communities: 23.12.2006.

Fairweather, J.R. and Keating, N.C. (1994) Goals and Management Styles of New Zealand Farmers. Agricultural Systems, 44. 181-200.

Farm Animal Welfare Council, (1994) Report on the welfare of sheep. F A W C, Surbiton.

Farm Business Survey (current) web-site at http://www.farmbusinesssurvey.co.uk/index.html

Forestry Commission (2006) Proposed Grant Rates for Woodland Creation under LMC Tier 3, based on models & SFGS Standard Costs. Forestry Commission March 2006.

Gardner, S.N., Waterhouse A. and Critchley, C.N.R. (2009) Moorland management with livestock - the effect of policy change on upland grazing, vegetation and farm economics In Bonn, A., Allott, T., Hubacek, K., and Stewart, J., Drivers of environmental change in uplands, p. 186-208. Abingdon: Routledge Taylor and Francis Group.

Gaspar, P., Escribano, M., Mesías, F.J., Rodrigues de Ledesma, A.and Pulido, F. (2008) Sheep farms in the Spanish rangelands (dehesas): Typologies according to livestock management and economic indicators. Small Ruminant Research, 74. 52-63.

Gelan, A., Schwarz, G. (2008) The effect of single farm payments on less favoured areas agriculture in Scotland: a CGE analysis. Agriculture and Food Science, 17. 3-17.

Girard, N., Duru, M., Hazard, L. and Magda, D. (2008). Categorising farming practices to design sustainable land-use management in mountain areas. Agronomy for Sustainable Development, 28. 333-343.

Glebe, T.W. (2007) The Environmental Impact of European Farming: How Legitimate Are Agri-Environmental Payments? *Review of Agricultural Economics* 29, 87-102

Gorton, M., Douarin, E., Davidova, S., Latruffe, L. (2008) Attitudes to agricultural policy and farming futures in the context of the 2003 CAP reform: A comparison of farmers in selected established and new Member States. Journal of Rural Studies, 24. 322-336.

Hecht, J., Nieberg, H. And Offermann, F. (2007) Review of payment calculations in agri-environmental measures in Germany. In AGRIGRID. Methodological grids for payment calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

Hepburn, J. and Bellemann, C. (2009), "Doha Round negotiations on the green box and beyond." Agricultural Subsidies in the WTO Green Box.ICTSD*, Information Note* No. 16, September 2009

House of Commons,Food, Environmental and Rural Affairs Committee (2011). Farming in the Uplands; third report of session 2010-11. London, HMSO.

CRC (2010). High Ground, High Potential: a future for England's upland communties. Commission for the Rural Communities, Gloucester.

Hill Task Force (2001) *Task Force for the Hills.* http://www.hillfarming.org.uk/

Hrabalova, A., Wollmuthova, P., Kapler, P., Schwarz, G., Morrice, J. Messager, P. et al (2007) *Review of payment calculations in rural development measures in the EU.* Report to the European Commission. In AGRIGRID. Methodological grids for payment calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

IEEP (2006): An evaluation of the less-favoured area measure in the 25 Member States of the European Union. http://ec.europa.eu/agriculture/eval/reports/lfa/index_en.htm

IEEP (2010) Agri-environmental policies in the EU. Report to Gakushuin Women's College, Tokyo. IEEP: February 2010.

Jansson T., Britz W., Renwick A. and Verburg P.:(2010). Modelling CAP reform and land abandonment in the European Union with a focus on Germany. Presentation at the Agricultural Economics Society Conference 2010, 30th and 31st of March 2010, Edinburgh, UK

Jones, G. & McCracken, D. 2003. *Unpublished National Report on United Kingdom and Ireland*. 41 pp. Conducted as part of *Developing a high nature value farmland indicator Project*. Report for European Environment Agency (Contract 3223/B2002.EEA51351), DanishForest and Landscape Research Institute, Denmark.

Jones, G. 2006. *Unpublished Farming Systems Regional Case Study on The Highlands & Islands, Scotland*. 23 pp. Conducted as part of *HNV indicators for evaluation Project*. Report for DG Agriculture (Contract 2006 G4-04), Institute for European Environmental Policy, London.

Latacz-Lohmann, U. & Hodge, I. (2001). 'Multifunctionality' and 'Free Trade': Conflict of Harmony? *EuroChoices* Spring 2001, 42-47.

Latacz-Lohmann, U. and Schilizzi, S. (2007) Quantifying the Benefits of Conservation Auctions, *Eurochoices*, 6/3, 32-29

Latacz-Lohmann, U., and Hodge, I. (2003) European agri-environmental policy for the 21st century. *Australian Journal of Agricultural and Resource Economics* 47, 123-140.

Lewis, M. (2010) North York Moors Hill Sheep Economic Study 2009.Askham BryanCollege

Lukesch, R. & Schuh, B. (eds) 2010. *Working paper on approaches for assessing the impacts of the Rural Development Programmes in the context of multiple intervening factors.*Findings of a Thematic Working Group established and coordinated by The European Evaluation Network for Rural Development

Matzdorf, B, Müller, K., Kersebaum, K.C., Kiesel, J. and Kaiser, T. (2010) Improving agri-environmental benefits within the CAP. In: Goetz, S.J. and Brouwer, F. (Eds.) (2010) New perspectives on agri-environmental policies. London and New York: Routledge Taylor & Francis Group, ISBN: 0-415-77702-Xnati

Maxwell T.J., (1994). Future of animal production in hill and upland areas. In "Livestock Production and Land Use in Hills and Uplands" Occ. Publ. No. 18 eds Lawrence T.L.J., Porter D.S., Rowlinson P. 75-84.

McClelland T.H., Armstrong R.H., Thompson J.R., Powell T.L., (1985) Sheep Production Systems in the Uplands. In "Hill and Upland Livestock Production" eds Maxwell T.J. and Gunn R.G., BSAP Occ. Publ. No. 10, pp 85-94.

McCracken, D.I. (1994) *Extensive farming systems in Europe: an initial assessment of the situation in the United Kingdom and the Republic of Ireland*. Report to the Institute for European Environmental Policy.

McCracken, D.I. (Drafting in progress). *Describing and characterising HNV farming systems in Scotland*. For Scottish Government High Nature Value Farmland and Forestry Indicator in SRDP Technical Working Group

McCracken D., Waterhouse, A. & Thomson S. 2011 Identifying and supporting High Nature Value farming systems. In: Pakeman, R.J., ed., *Biodiversity and Farming: a summary of research outputs from the Scottish Government's "Environment – Land Use and Rural Stewardship" research programme*, 6-7. Macaulay Land Use Research Institute, Aberdeenhttp://www.macaulay.ac.uk/biodiversity/biodiversity-farming.pdf

Miettinen, A. and Aakkula, J. (2008) *Methodological grids for natural handicap payments.* Report to the European Commission. In AGRIGRID. Methodological grids for payment

calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

Milán, M.J., Arnalte, E., and Caja, G. (2003) Economic profitability and typology of Riposella breed sheep arms in Spain. Small Ruminant Research, 49. 97-105.

Milán, M.J., Bartolomé, J., Quintanilla, R., García-Cachán, M.D., Espejo, M., Herráiz, P.L., Sánchez-Recio, J.M. and Piedrafita, J. (2006) Structural characterisation and typology of beef cattle farms of Spanish wooded rangelands (dehesas). Livestock Science, 99. 197-209.

Ministerio de Medio Ambiente Y Medio Rural Y Marino (2009) Programa de Desarrollo Rural de Galicia 2007-2013. Version 2009.

Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz (2009) NRW Programm Laendlicher Raum 2007 – 2013. Version April 2010. http://www.umwelt.nrw.de/landwirtschaft/pdf/laendlicher_raum2.pdf

Ministry for Agriculture, Environment, Consumer Protection of Mecklenburg West-Pomerania (2009) Entwicklungsprogramm fuer den laendlichen Raum Mecklenburg-Vorpommern 2007 bis 2013. Version December 2009. http://www.europa-mv.de/docs/download/10095/EPLR-Programm_2007-2013.pdf

Ministry of Agriculture and Rural Development (MARD) (2007) Rural Development Programme 2007 – 2013. Warsaw.

Ministry of the Environment of the Republic of Lithuania (2003) Methodology for accounting and evaluation of sprouts, planting and afforestation works No. 659; Vilnius: 18/12/2003

Morris, J., Audsley, E., Wright, I.A., McLeod, J., Pearn, K., Angus, A. & Rickard, S. (2005) Agricultural futures and implications for the environment. Defra Research Project IS0209, CranfieldUniversity

National Sheep Association (1995) Sheep UK, our natural hidden asset. NSA, Malvern.

QMS (2009) Cattle and Sheep Enterprise Profitability in Scotland: 2009 Edition Farming in Scotland. Report for SNH: Contract No. 29028

Rapey, H., Lifran, R. and Valadier, A. (2001) Identifying social, economic and technical determinants of silvopastoral practices in temperate uplands: results of a survey in the Massif Central region of France. Agricultural Systems, 69. 119-135.

Regione del Veneto (2009) Piano di Sviluppo Rurale per il Veneto 2007-2013. http://www.unipd.it/fundraising/PSR_documento.pdf

Rehman, T., Garforth, C., McKemey, K., Yates, C. and Rama, R. (2008) Farmers' behavioural inclinations and their influence on the anticipated response to the reform of the Common Agricultural Policy in England. Journal of Farm Management, 13. 281-308.

Riedel, J.L., Casasús, I. and Bernués, A. (2007) Sheep farming intensification and utilization of natural resources in a Mediterranean pastoral agro-ecosystem. Livestock Science, 111. 153-163.

Royal Society of Edinburgh (2008) Committee of Inquiry into the Future of Scotland's Hills and Islands. http://www.rse.org.uk/enquiries/hill_and_island_areas/full_report.pdf

Russel, A. J. F. and White, I. R., (1984) The determination of foetal number in pregnant ewe, In: HFRO Bi-annual Report 1982-83, pp 141-144.

SAC (Various Years). Farm Management Handbook. SAC, Edinburgh

SAC (2008) Farming's Retreat from the Hills. Edinburgh: SAC Rural Policy Centre. http://www.sac.ac.uk/mainrep/pdfs/retreatreport.pdf

SAC (2010a) A Review of Literature on the Value of Public Goods from Agriculture and the Production Impacts of the Single Farm Payment Scheme. An SAC Rural Policy Centre report prepared for the Scottish Government's Rural and Environment Research and Analysis Directorate for the Inquiry into the future of support for agriculture in Scotland. http://www.scotland.gov.uk/Resource/Doc/278281/0093368.pdf

SAC (2010b). Rural Scotland in Focus. Edinburgh. http://www.sac.ac.uk/ruralpolicycentre/publs/researchreports/rsif/

SAC (2011 forthcoming). SNH An Analysis of the Impact on the Natural Heritage of the Decline in Hill Farming. SNH, Edinburgh.

Morgan-Davies, C. & Waterhouse, A. 2010. Future of the Hills of Scotland: Stakeholders' preferences for policy priorities. Land Use Policy, 27 (2), 387-398

Schwarz G., Morrice, J., Messager, P., Buchan, K., Matthews, K. and Gelan, A. (2007) *Review of payment calculations in forestry measures*. In AGRIGRID. Methodological grids for payment calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

Schwarz, G., Wilson, R.M., Swales, V., Burton, R., Wright, I.A., Gilbert, A. and McLeod, J. (2006) *Less Favoured Area Support Scheme in Scotland: Review of the evidence and appraisal of options for the scheme post 2010*. Report for the Scottish Executive, 207pp. October 2006.

Schwarz, G.,Moxey, A., McCracken, D., Huband, S. and Cummins, R. (2009) An analysis of the potential effectiveness of a payment-by-results approach to the delivery of environmental public goods and services supplied by agri-environment schemes. Report to LUPG UK. http://www.lupg.org.uk/pdf/LUPG_Payment_by_Results_Feb09.pdf

Scottish Government (2010a) Scotland Rural Development Programme 2007 – 2013. Scottish Executive: May 2010. http://www.scotland.gov.uk/Publications/2010/05/05134234/0

Scottish Government (2010b) Economic Report on Scottish Agriculture: 2010 Edition. http://www.scotland.gov.uk/Resource/Doc/315020/0100103.pdf

Stott, A.W., Milne, C.E., Goddard, P.J. & Waterhouse, A. (2005) Projected effect of alternative management strategies on profit and animal welfare in extensive sheep production systems in Great Britain, Livestock Production Science,Volume 97, Issues 2-3 , November 2005, Pages 161-171

Swales, V. & Moxey, A.. 2008. *Targeting CAP support at High Nature Value farming and crofting systems*. 93 pp. Royal Society for the Protection of Birds, Edinburgh.

Swedish Ministry of Agriculture (2008) Rural Development Programme for Sweden. Stockholm: 2008.

Tubbs, C.R. (1997) The ecology of pastoralism in the New Forest. *British Wildlife* 9 7-16

Turner, M., Robbins, K. & Silcock, P. (2008) Hill farming in south-west England: economic viability and delivery of public goods. Report to the Duchy of Cornwall and Dartmoor and ExmoorNational Park.

Vipond J.E.,Gun R.G., (1985) The management and performance of sheep in the hills and uplands. In 'Hill and Upland Livestock Production' eds Maxwell, T.J., Gunn, R.G., BSAP Occ Publ. No 10; 49-54.

Vlahos, G. & Tsakalou, E (2007) *Summary review of payment calculations for agri-environmental measures. Measures under article 39 of Reg. EC/1698/05, code 214 of Reg. EC/1974/06*. In AGRIGRID. Methodological grids for payment calculation in rural development measures in the EU. Sixth Framework Programme, Specific Targeted Research Project No. SSPE-CT-2006-044403

Vrolijk, H.C.J., de Bont, C.J.A.M., Blokland, P. W. and Soboh, R.A.M.E. (2010) Farm viability in the European Union; Assessment of the impact of changes in farm payments. The Hague, LEI, 2010, Report 2010-011 for Defra. http://www.lei.dlo.nl/publicaties/PDF/2010/2010-011.pdf

Waterhouse, A., (1996) Animal welfare and sustainability of production under extensive conditions - a European perspective. Applied Animal Behaviour Science , 49, 29-40.

Waterhouse A. and Marsh S.P., (1999) Effect of supplementation method on grazing behaviour of hill ewes. Proceedings of British Society of Animal Science 1999, BSAS, Edinburgh.

Waterhouse A. and McClelland T.H., (1987) Supplementation of Scottish Blackface gimmess during mating and mid-pregnancy. Animal Production 44 471 (abstr).

Waterhouse A., (1994) Extensification, implications for animal performance, health and welfare., "Livestock Production and Land Use in Hills and Uplands" eds Lawrence T.L.J., Parker D.S. and Rowlinson P.,BSAP Occ. Publ. No. 18, 43-50.

Waterhouse, A. (2006) Economic solutions for hill sheep farms. Proceedings of Sheep Veterinary Society, ed M Clarkson volume 6 pages 87-89 Paper presented at Sheep Veterinary Society Annual Conference Inverness, October 2006

Waterhouse, A. and Ashworth S.W. (1998) Choices for animal care and management in extensive systems and implications for animal productivity and welfare. In '*Implications of Extensification for health and welfare of beef cattle and sheep*' P.J Goddard (ed) Occasional Publication No 5, MLURI, Aberdeen, pp 51-58

Waterhouse, A. and Ashworth, S.W., (1996) Extensification of Hill Sheep Systems. In Book of Abstracts of the 47th Annual Meeting of the European Association of Animal Production, eds van Arendonk J.A.M., p 216.

Waterhouse, A. and Morgan-Davies, C. (2008) CAP Reform and new agrienvironment schemes – impacts on welfare. IN " " *Proceedings of a Workshop Held at Macaulay Institut*e (ed. P. Goddard). Aberdeen. Add hyperlink

Waterhouse, A., Gardner, S.M., Pearce-Higgins, J. and Grant, M.C. (2006) How might CAP reform influence land management, moorland vegetation, birds, economy and employment. Biodiversity Science and Management, 2(3), 235-237

Waterhouse, A., Morgan-Davies, C. and Holland J.P. (2008) Impacts of different policy-driven land uses for the Scottish hills on retention of farming, the environment and local economy Aspects of Biology, 85, 115-120 in 'Shaping a vision for the uplands', Ed Stockdale, E., AAB

Waterhouse, A; Pattinson, S E; Ashworth, S W (1996). Extensification of hill sheep systems. *Invited paper for the 47th meeting of the European Association of Animal Production*. Lillihammer, Norway. (Van Arendonk, J A M ,ed) 2, p216

Wildlife Trusts. (1996) Crisis in the hills: overgrazing in the uplands. The Wildlife Trusts, Cheltenham, UK. 21 pages.

Wunder, S. (2005) Payments for environmental services: Some nuts and bolts. CIFOR Occasional Paper No. 42 Center for International Forestry Research. http://www.cifor.cgiar.org/publications/pdf_files/OccPapers/OP-42.pdf

Wunder, S., Bui Dung The, & Ibarra, E. 2005. Payment is good, control is better: why payments for forest environmental services in Vietnam have so far remained incipient. Bogor, Indonesia: CIFOR. 61 pp.

Annex 1 Articles of EC Regulations cited in the report

Council Regulation (EC) No 1698/2005

Article 37(1)

Natural handicap payments in mountain areas and payments in other areas with handicaps

1. Payments provided for in Article 36(a)(i) and (ii) shall be granted annually per hectare of utilised agricultural area (hereinafter UAA) within the meaning of Commission Decision 2000/115/EC of 24 November 1999 relating to the definitions of the characteristics, the list of agricultural products, the exceptions to the definitions and the regions and districts regarding the surveys on the structure of agricultural holdings (1). Payments should compensate for farmers' additional costs and income forgone related to the handicap for agricultural production in the area concerned.

Article 38(1)

Natura 2000 payments and payments linked to Directive 2000/60/EC

1. Support provided for in Article 36(a)(iii), shall be granted annually and per hectare of UAA to farmers in order to compensate for costs incurred and income foregone resulting from disadvantages in the areas concerned related to the implementation of Directives 79/409/EEC, 92/43/EEC and 2000/60/EC.

Article 39(3) and (4)

Agri-environment payments

3. Agri-environment payments cover only those commitments going beyond the relevant mandatory standards established pursuant to Articles 4 and 5 of and Annexes III and IV to Regulation (EC) No 1782/2003 as well as minimum requirements for fertiliser and plant protection product use and other relevant mandatory requirements established by national legislation and identified in the programme. These commitments shall be undertaken as a general rule for a period between five and seven years. Where necessary and justified, a longer period shall be determined according to the procedure referred to in Article 90(2) for particular types of commitments.

4. The payments shall be granted annually and shall cover additional costs and income foregone resulting from the commitment made. Where necessary, they may cover also transaction cost. Where appropriate, the beneficiaries may be selected on the basis of calls for tender, applying criteria of economic and environmental efficiency. Support shall be limited to the maximum amount laid down in the Annex.

Council Regulation (EC) No 445/2002

Article 18

1. The reference level for calculating income forgone and additional costs resulting from the commitments given shall be the usual good farming practice in the area where the measure is applied.

The economic consequences of abandoning land or ceasing certain farming practices may be taken into account where this is justified by the agronomic or environmental circumstances.

2. Payments may not be made per unit of production, except in the case of support for rearing farm animals of breeds which are in danger of being lost, which may be paid per

livestock unit or per animal reared. Where commitments are normally expressed in units other than area, Member States may calculate payments on the basis of those units.

3. In the specific cases referred to in paragraph 2, Member States shall ensure that the maximum amounts per year eligible for Community support as set out in the Annex to Regulation (EC) No 1257/1999 are complied with.

To this end the MemberState may:

(a) set a limit on the number of units per hectare of the farm to which the agri-environment commitments applies; or

(b) determine the overall maximum amount for each participating farm and ensure that the payments for each farm are compatible with this limit.

4. Payments may be based on limitations on the use of fertilisers, plant protection products or other inputs only if such limitations are technically and economically measurable.

Annex 2 Definition of Financial Terminology

Adjusted Utilisable Agricultural Area (AUAA) is UAA reduced by the conversion of rough grazing into the equivalent area of average quality grassland.

Cash income is the difference between total revenue and total expenditure (adjusted for debtors and creditors) representing that return those with an entrepreneurial interest in the business (farmers and spouses, non-principal partners and directors and their spouses and family workers) for their manual and managerial labour and on their investment in the business.

European size unit (ESU) is a measure of the economic size of a farm business based on the gross margin imputed from standard coefficients for each commodity on the farm. 1 ESU is roughly corresponds to either 1.3 hectares of cereals or 1 dairy cow or 25 ewes (or combinations therein).

Farm Business Income (FBI) represents the return to all unpaid labour (farmers and spouses, non-principal partners and directors and their spouses and family workers) and on their capital invested in the farm business, including land and buildings. FBI is derived from management accounting principles rather than financial accounting principals.

Farm Family Income (FFI) represents the return to all unpaid labour (farmers and spouses, non-principal partners and their spouses and family workers), and on all their capital invested in the farm business, including land and buildings.

Gearing ratio provides a measure of indebtedness that the farm has, measuring the level of external debt against the net worth (owners' equity) of the business. Highly geared business are at more risk in times of economic downturn as they still have to service their debt.

Grazing Livestock Units (GLU) are based on estimated energy requirements and standard ratios are used for converting animals of different species and ages into Livestock Units with one unit usually representing a mature 'black and white' dairy cow.

Gross profit It is calculated by subtracting variable costs (e.g. feed, seeds, fertiliser, etc) from sales revenues plus grants and subsidies plus sundry revenue plus single payment. This gives a figure from which all overhead costs must be paid.

Gross Profit Margin expresses the proportion of sales that is converted into gross profit.

Interest cover shows the farms' ability to meet interest payments on its debts from profits generated. The lower the ratio the greater the risk of profit being insufficient to cover debt interest.

Management & Investment Income (MII) is total farm enterprise output less total inputs (including the value of the labour input of the farmer and spouse). It represents the reward of the farmer's (and spouse's) management and interest on the tenant's capital employed on the farm.

Net Farm Income (NFI) represents the return to the farmer and spouse for their manual and managerial labour and on the tenant-type capital (livestock, crops and machinery – excludes buildings) in the farm business

Net Profit is gross profit less overheads less deprecation plus profit (or loss) on sale of assets

Net Profit Margin expresses the proportion of sales that is converted into net profit.

Occupier's Net Income (ONI) represents the return to the farmer and spouse alone and is Net Farm Income minus interest payments, occupiers' expenses (depreciation and improvements) and imputed rent.

Return on Capital provides a measure of return the farmers is getting from the capital invested in the business (similar to the rate of interest you may earn from investing money in a bank)

Total output is the sum of crop output, livestock output, miscellaneous output and other grants, subsidy and payments.

Utilisable Agricultural Area (UAA) comprises the area of crops, grass and rough grazing, fallow and any uncropped land that could be returned to agricultural production.

For an overview of farm financial management terms refer to Defra (2010c)

Annex 3 Context for sheep systems in the UK

Systems of sheep production differ dramatically between regions; mainly determined by topography, soils and altitude. A broad classification of British sheep systems is shown in Table A3.1

Table A3.1 Summary of British sheep farming systems

	System	Characteristics	Main Products
	Hill ewes producing pure-bred lambs	Bound acclimatised stock on a high proportion semi-natural pasture producing pure-bred lambs	Store lambs Pure-bred fat lambs (14-18 kg) Pure-bred fat lamb (8-12 kg) for export Draft ewes
Hill Systems (LFA land)	Hill ewes producing some crossbred lambs	Bound stock, possibly partially dehefted from hill. Usually a higher proportion of inbye (improved) land.	As above but draft ewe sales reduced and crossbred male and female lambs sold
	Crofting	Small scale producer but often with larger sheep 'farmers' using bulk of land	Mainly store lambs as value of draft ewes is low
Upland (LFA Land)	Draft hill ewes producing crossbred lambs - 'classic' middle tier ewe in Figure 4	Unbound flock brought onto unit - grazing mainly sown pastures and fenced hill areas LFA land	Crossbred ewe lambs for breeding and slaughter Crossbred male lambs for slaughter
	Crossbred ewe mated to terminal sire (lowest tier ewe in Figure 4)	Unbound flock brought onto unit - grazing only sown pastures and fenced hill areas	3 way cross lambs for slaughter usually of a terminal sire breed (Suffolk/Texel/Charollais dominate) (17-21 kg)
Lowland	Crossbred ewe mated to terminal sire	- Grassland farm - Mixed farm - Arable unit	3 way cross lambs for slaughter usually terminal sire breed (Suffolk/Texel/Charollais dominate) (17-21 kg)

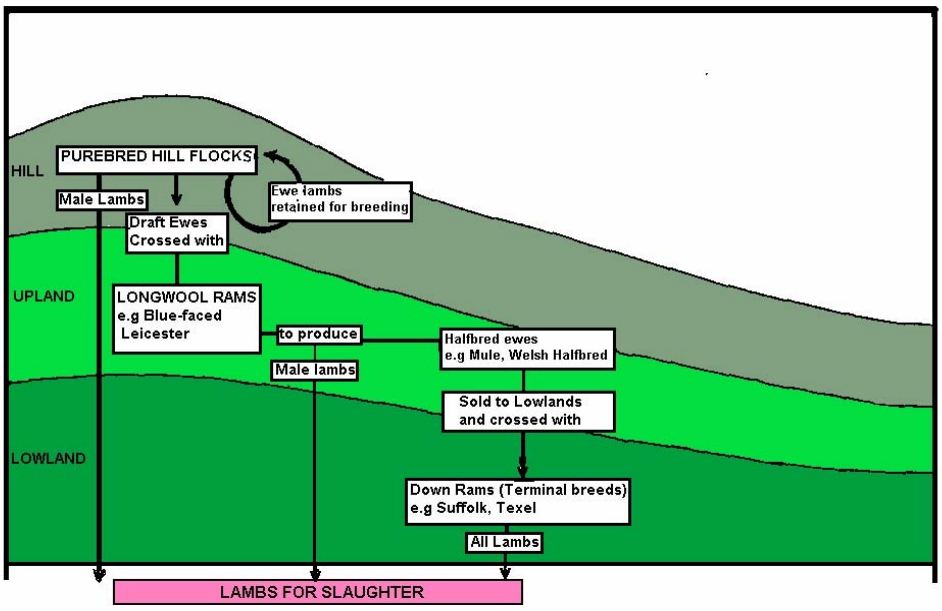
Some seasonal movement of stock occurs in Great Britain, with the commonplace movement of flock replacements, often over hundreds of miles, from hill and mountain regions to lowland pastures for the winter. This is a different form of migration to that found in the Mediterranean regions as people do not move with the livestock, instead the responsibilities for the stock are, usually, temporarily transferred to the farmer on whose

farm the seasonal grazings are taken. This is the core of the stratified production system, with upland and lowland farmers taking livestock from the hills (Dewar-Durie, 2000; Cooper, 2003).

Although transhumance is found in many parts of Europe, stratification is common only in Great Britain and Ireland. Stratification is the development of a highly structured sheep industry based on the natural resources of different areas of the country and the sale and movement of livestock between these different areas. Typically, sheep flow from the most naturally disadvantaged areas, the hills and mountains, to the more favoured areas, the lowlands. In the hills and mountains, sheep are bred to produce livestock which are sold to producers in the more favoured areas for use as breeding stock or for further grazing and sale as finished livestock. The classical pattern of stratification of breeding animals and the flow of stock from hill to lowland is described in Figure . This pattern is however, far from a complete model and is changing. Nevertheless, it is a major difference between the sheep systems within the British Isles and those in Europe, allowing use of different categories of land by different systems. The flow of genes for crossbred stock, usually with high health status (because hill farms are typically closed to female stock), from the hills and mountains is a key strength of these mountain systems and of considerable strategic value to the whole sheep industry.

Socio-economic, land use and animal breeding benefits can arise from this industry structure in Britain. The National Sheep Association (NSA, 1995) identified that the stratified system allows large areas of hill and upland to support an economic enterprise. Hardy hill breeds, which are capable of withstanding periods of nutritional stress are maintained and improved through natural selection for maternal performance and vigour. The hill ewes contribute their valuable maternal characteristics to their progeny, while the use of longwool rams contributes enhanced prolificacy and increased body size. Thus, the crossing of hill ewes with longwool rams results in a crossbred ewe of high commercial value, with the capacity to produce and raise an average of two lambs. Further crossing with a terminal sire, bred under conditions where genetic selection can be concentrated on carcass and growth characteristics, allow the production of slaughter lambs which are better able to meet the demands of the consumer.

Figure 3.2. Stratification of sheep farming in Britain (sourced from Cooper and Thomas, 1991)



There is considerable variation amongst hill farms in the British Isles. Cunningham and Groves (1985) differentiated between the size of hill farms found in the countries within the United Kingdom, noting that Welsh hill farms were small and had a much higher proportion of improved (in-bye) pasture than those in England and Wales. Scottish hill farms were at the other extreme with a low proportion of in-bye pasture. Many hill farms in Scotland are many thousand hectares, with typical flock sizes over 1,000 ewes. In the FADN sample most Specialist sheep farms are classified as large and have an average sheep flock size of 1,400. Eadie (1985) and Maxwell (1994) further differentiated between hill farming types, with at least three types identified; intensive, semi-intensive and extensive.

Extensive, mountain and moorland sheep systems all use extensive areas of semi-natural vegetation and small areas of improved pasture. They rely on pure-bred lamb production to sustain flock replacements. The primary output is store livestock sold to lower altitude farms for breeding or for further grazing and slaughter. The breeding ewes tend to remain on the open hill and moorland throughout the year with little daily contact with shepherds. Hill ewes generally maintain themselves within an adopted home range grazing singly or in small groups (Hunter and Milner 1963, Hunter 1962). Many hill farms have unfenced boundaries and some farms remove some ewes but typically only a small proportion of them are brought onto improved pasture for mating and lambing. In some regions (e.g. Angus Glens of Scotland, Welsh mountains) ewes were traditionally removed from the hill during all or part of the winter. Lambing dates are locally fixed, typically late April and May, with little flexibility due to the time of the onset of spring grass growth.

A particularly important aspect of hill systems in Great Britain is the “bound” nature of the breeding flock to the land. British hill breeds all possess a pattern of grazing and social behaviour in which they graze a block of land as their home range, known as a ‘heft’. The heft is maintained by retaining only flock replacements born on each individual block of land on the farm and by policing and dealing with ewes that stray beyond the boundaries. As a result, many hill farms have several self-contained flocks, each with their own home range, maintained partly by sheep behaviour and partly by shepherding. These self-contained hefted flocks have become known as the bound stock of the holding. Because of this, when hill sheep farms are sold or there is a change of tenant, the bound flock is sold to the new farmer. The transfer and valuation methods are laid down by Act of Parliament (Hill Farming Act 1946). In the case of tenanted farms, the number of bound stock to be transferred is often set out in the terms of the tenancy. These traditions provide both stability and lack of flexibility in making breed and stocking rate changes on hill farms.

It is commonplace for hill farms to be tenanted. On many tenanted farms, the landlord holds the shooting rights for wild game and places demands on how the moorland is managed for grouse shooting or deer stalking. It is also typical in some regions for the hill land or moorland to be grazed in common with other farmers whose farmhouses, buildings and better land (in-bye, intake) border the common grazings. In this respect, some of the problems of common grazing are shared with European counterparts. There is difficulty in making decisions on overall stocking ranges, difficulty in applying different management to the individual flocks. Many stock management tasks require considerable co-operation and these may break down. Thus stocking rate changes may be quite large, made simultaneously by individual commoners.

Crofting is a particular type of hill farming occurring only in the north western fringe of Scotland. It typically involves small areas of improved pasture land (c. 5ha) and access to common (semi-natural) hill grazing. The right to keep a small number of sheep (10-50 ewes) and cows (1-4) are called “soumings”. This system became fully established during the period 1870-1905. There is a strong recent trend for cattle numbers to decrease and for the sheep to be kept in larger flocks by only a few of the crofters in any one of the townships (villages). Problems created by the small scale of enterprise, difficult farming conditions and

of access to common land have all contributed to these changes. Because of the location, the habitats used and the characteristics of production systems, this system of hill farming has particular environmental importance, with considerable bird and botanical interests. The use of the hill grazings is usually in common and these are examples of both high increases in stocking and abandonment.

Considerable adaptation to the extensive hill and mountain environment includes:

- Hardy breeds with physical (e.g. wool) physiological (e.g. cold tolerance) and behavioural adaptation (e.g. grazing behaviour).
- Co-operation between neighbouring farmers and common land users to allow unfenced and unshepherded systems to be viable.
- Management to enable sustainability of systems
- Sale of lambs and stores
- Off-wintering of flock replacements, and first lambing of them at 2 or 3 years of age
- Castration of males and purchase of stock rams from specialist breeder
- Selection based on survival of ewes and 'type' of replacement females and stock rams.

Levels of supplementary feed given to hill ewes have generally increased in the last three decades but still range from zero (although emergency feeding of hay in difficult weather conditions may be carried out) to considerable inputs of concentrate feed and fodder such as big bale silage.

The reasons for change in supplementary feeding practices are complex but include:

- the technology to transport the feed to the flocks on the hills has made feeding easier (all terrain vehicles, feedblocks and big bale silage are relatively recent innovations);
- a greater understanding of the value of better nutrition in the achievement of the breeding potential of the ewe;
- a greater understanding of the importance of supplementary feeding to the achievement of acceptable animal welfare; and
- the increased value of output tending to encourage and finance improvements in breeding potential and welfare through increase inputs.

Levels of output still tend to be low. Numbers of lambs weaned per ewe are often less than 0.8 (Vipond & Gunn 1985). Nevertheless, with improved health care, higher levels of supplementation, improved nutrition and management at mating and lambing increased outputs of lambs are possible on many of the better farms (McClelland *et al*., 1985). A proportion of ewes may be mated to rams of other breeds, either to produce lambs for slaughter (via the use of for example, a Suffolk or Texel ram) or for breeding females (via the use of a Longwool breed ram such as the Blue Faced Leicester). All these changes have potential to change resource use and encourage land improvement. These changes can lead to localised environmental damage from changed management practices; e.g. increased supplementary feeding, changes to the species mix in the semi-natural grassland and, in some cases direct loss of moorland and heath.

Other recent changes to management practices have involved more hill farmers retaining and finishing their own pure-bred male lambs on those brassica crops (e.g. forage rape, stubble turnips) which are associated with land improvement programmes. This has reduced the sale of immature store animals to lower altitude farms. Even more recently, large numbers of lambs (in many regions up to 50% of the lambs available for sale) are now sold direct for export to the Mediterranean countries, where the carcass size (8-13 kg) and level of fatness suits local market demands at a time of year when Mediterranean production is at its lowest level. Traditionally, these lambs were sold as stores to lowland farms and

finished at carcass weights of over 14 kg for the British and North European market. Thus the classical pattern of stratification as described in Figure 4 has broken down to some degree, with many hill farms also fulfilling the traditional roles of the upland farm in producing crossbred breeding stock and producing slaughter lambs.

The sale of draft ewes, after they have produced four to five lamb crops, from harsh hill farms to lower altitude farms is still a very important part of the British hill sheep system. These ewes may be retained for breeding for a further 1-3 years on the lower altitude farm. It is a well disciplined and very selective market with considerable variation in prices between years and between lots of different perceived quality. However, many old females fail to go in to this market because they are unsuitable for future breeding as a result of failures of udders, teeth or lack of demand for particular breeds. For example, the demand for Cheviots has dropped in the last decade whilst demand for Scottish Blackfaces has increased because of perceived differences in the value of these genotypes in the breeding ewe market. Instead they are sold for mutton. High health status, in relation to absence of ovine enzootic abortion (chlamydia) infection, is also highly valued for breeding stock.

Upland systems rely to a greater degree upon sown pastures, some of significant age, with fertiliser and lime inputs within fenced, field boundaries, with limited access to semi-natural extensive pasture. There are two core systems typically on different farms. Firstly, buyers of draft, or cast, breeding stock from hill breeds, produce lambs – some direct for the meat market, but classically for producing crossbred ewe replacements for other farms. These are the core engine for the next lower tier in the upland system. This second farm usually buys in these crossbred young female sheep and commits all of its effort to breeding lamb for the retail butcher market. A range of Mule type ewes, as thee crossbreds are referred to, originating from Scottish, north of England or Welsh hill-bred ewes and longwool rams on the first farm feed the second type of farm. Lambs are available for slaughter from early summer onwards, though with lower altitude and better weather, capacity to house and feed ewes through the winter, there is significant flexibility in lambing season.

Production levels are high, due to a combination of the genetics of the breeding flock, a valuable contribution from the crossbred nature of the stock and the high quality nutrition available on these farms. Multiple births are the norm and expectations of lambs weaned from hill ewes taken from hill farms to these better farms is at least 20% higher than the hill farms, and for the Mule type ewe, weaned lamb numbers per ewe range from 1.4 to over 2. There is a range in intensity of production within these farms, but the main industry promotion bodies (QMS, Eblex, HCC) promote greater technical efficiency in terms of lambs per ewe and ewes per hectare. Home produced winter fodder is an important feature of these farms, with silage being the key component on many of the more intensive farms, though hay can be important in many regions, linked to agri-environment schemes. Intensive grassland management and well-grazed pasture is seen as a key technical target of these farmers.

Lowland systems traditionally a crossbred might feature on these farming systems, with bigger ewes such as Cheviot x Longwool breeds to produce so-called half-breds. More recently, though crosses which include terminal sire breed genotypes; Suffolk and Texel have become more common. These aim to still achieve high levels of output, but greater carcass quality. The dividing line in description in terms between an upland sheep farm and a lowland farm though is often a matter of where the farm is, relative to LFA. Across both groups, there have been increasing tendencies to close the flock from external purchases or transfers of female replacements. This is both to reduce the very significant disease risk (particularly from enzootic abortion, but many other diseases) but also to control genetic improvement within both purebred flocks and crossbred flocks. A number of British (e.g Lleyns) and New Zealand (e.g Rissington) breeds are now often bred pure on these farm systems. The sheep industry is also typified by large number of rams that transfer between

farms, and there are very large numbers of breeds and flocks producing small numbers of purebred breeding stock, often associated with a larger sheep or cattle enterprise.

Beef farms in the uplands, typically with a sheep flock, and sometimes with a dairy herd, would graze extensively on hill pastures and produce a single calf in the spring, weaned in the autumn, that was typically moved away to better pasture farms in the autumn. Weaned calf sales would see these calves flow from the hills to the lowlands. In reverse, beef cow replacements would often arise by either pure-breeding within the hills or by purchase of heifers from crossing of traditional dairy cattle (short-horns, Friesians) and a beef bull (Hereford, Aberdeen Angus). There was even large specialist production of hardy, but productive, hills cows from crossbreeding of a hill breed female with dairy breed bulls (Galloway cow and dairy shorthorn bull to produce the 'Blue-Gray' cow). Much of these traditional systems have now collapsed. For example, Limousin, and in particular Limousin crossbreds, are the most common beef cattle in Britain according to British Cattle Movement Service data, with Aberdeen Angus fourth, and the Limousin cross is accepted to be the most common suckler cow genotype in the UK.

Nevertheless, some characteristics of typical beef systems can be identified. The location of these systems varies. Upland LFA farms dominate the view of a typical beef producing farm, but there are many farms in the lowlands of the UK, where either a beef breeding herd, or a beef rearing enterprise is the biggest enterprise. These may use marginal land areas, traditionally not suited for dairying, or more recently in the last three decades or so, where former dairy farms (and farmers) have been retired. A varying mix of beef cattle and sheep may occur. These grassland farms dominate much of the land in the UK less suitable for cropping, but not defined at Less Favoured Area. Some of this land may have important landscape and natural heritage features as described above, and may be relatively less intensively managed than the dairy farmland it once was.

Table A3.2. Summary of British cattle farming systems

	System	Characteristics	Main Products
Suckler beef systems	Suckler cows producing weaned store calves for sale	Typically spring born, naturally mated – pregnant cows typically housed in autumn and winter, though a proportion are out-wintered. The bull would be of a recognised terminal sire breed, unless priority breeding females.	Male, castrated bullock calves sold at autumn sales – at 200-280Kg liveweight – for finishing on lowland farms Female calves sold into same market, or sold, or retained for breeding. Those sold would be from recognised purebred or crossbred types.

	Suckler cows producing and finishing their own cattle	Typically spring born, naturally mated – pregnant cows typically housed in autumn and winter, though a proportion are out-wintered. Some systems can produce calves in other season (autumn/early summer). Again terminal sire breeds predominate (Limousin, Charolais, Simmental)	Finished cattle, principally, bullocks (though a few producers have reared bulls) and heifers not for breeding. These may be finished early (14-18 months) on intensive diets, or slower (18-24months) with a grazing phase often preceding a housed period.
Beef finishing systems	Grass and forage based systems	Purchase of weaned suckled calves in autumn and onto silage based systems – most likely kept on steady growth rates in winter and then grazed in the next summer, with a proportion housed and finished in a second winter	Finished cattle of 550-750 kg.
	By product and cereal based systems	Heavily dependent upon price and availability of feed sources – on lowland farms with some grassland, but dependent upon straw, cereal and by-product feeds. Tend to be intensively fed. Bulls are favoured and may take crossbred bulls from dairy herd.	Finished cattle at 550-700kg
Beef from the dairy herd	As above	Crossbred males and female calves from dairy herds, where the Belgian Blue is favoured beef type, or they may rear female crossbred calves for sale as breeding females for the suckler herds.	16-20 month old cattle – running off one grazing season and one-two winter housed season.

Annex 4:Regional Variations in Biodiversity Potential in the UK

There are strong regional variations to the biodiversity potential of livestock farming systems in the UK, and some examples (two each from largely upland and largely lowland areas) are provided below to illustrate this.

Examples of systems of largely upland character

(1) *Northern England*(from McCracken 1994)*:* Farming in the Pennines is predominately based on rearing sheep and beef cattle and dairying. In the north Pennines, the richer valley bottoms are used to produce hay (or more generally silage), whilst the moorlands are grazed by sheep and cattle. The valley sides, known locally as allotments, contain wet meadows and permanent pastures grassland and rush. Sheep graze here in the autumn, before going to the ram, and again in the spring, when they are lambing. After a period of rest some pastures are used in conjunction with the moorlands for summer grazing, while hay is being produced on the better land. Most farms run across the valleys and include valley bottom, allotment and moorland. The patchwork of habitats that this system produces sustains a wide range of wildlife.

On the moorlands of both the north and south Pennines large areas of blanket bog are dominated by cotton grass, *Eriophorum* spp., and extensive tracts of Heather, *Calluna vulgaris*, with Crowberry, *Empetrum nigrum*, Bilberry, *Vaccinium myrtillus*, and Cloudberry, *Rubus chamaemorus* occurring more locally. The grasslands are dominated by Purple Moor Grass, *Molinia caerulea*, Mat Grass, *Nardus stricta*, and Wavy Hair Grass, *Deschampsia flexuosa*. In the valleys, the remaining hay meadows are floristically rich, with such species as Devil's-bit Scabious, *Succisa pratensis*, Wood Crane's-bill, *Geranium sylvaticum*, Marsh Marigold, *Caltha palustris*, and Bugle, *Ajuga reptans*, present across a range of vegetation types.

The allotments are nationally and internationally important for breeding waders such as Redshank, Lapwing, Snipe and Curlew, *Nurmenius arquata*. On the moorlands, Red Grouse and Hen Harrier are associated with the Heather areas, Golden Plover with the *Eriophorum* bogs, and Whinchat, *Saxicola rubetra*, Curlew and Lapwing with the acid grasslands.

(2) *Inner Hebrides of Scotland* (from McCracken 1994)*:* Farms on these islands vary in size from small crofts to large dairy farms, but the majority are involved in the production of lambs and cattle to be sold for fattening. Cereals, mostly barley but also some oats, and silage are grown for use as winter feed. Livestock normally graze the permanent grass pastures and moorland during the summer, when crops are grown on the better land. Sheep and many of the cattle are not housed in the winter, and are fed silage on rough pastures, especially on sandy soils in coastal areas which are not so prone to waterlogging. The wildlife associated with Hebridean agriculture, particularly crofting, is internationally recognised.

Some of the most restricted habitats in Europe occur commonly in these islands. The sand dune and machair systems are internationally important and the survival of their floristic interest is intimately linked with agricultural practice. The moorland, bog and wet heath communities are characterised by many plants with very restricted western European distributions - Lesser Twayblade, *Listera cordata*, Pale Butterwort, *Pinguicula lusitanica*, Bog Asphodel, *Narthecium ossifragum*, Great Sundew, *Drosera anglica*, and many species of

Sphagnum bog moss - although dominated by what is often regarded as common plants - Heather, Cross-leaved Heath, *Erica tetralix*, Deer Grass, *Scirpus caespitosum*, Cotton Grass and Purple Moor Grass.

A wide range of birds utilise the Hebridean farmlands and rough grazings, and the area is recognised as important not only for rarities but also for the richness of species once more common and more widely distributed in lowland Britain. For example, Meadow Pipit, *Anthus pratensis*, Skylark, *Alauda arvensis*, Wheatear, *Oenanthe oenanthe*, Stonechat, *Saxicola torquata*, Dunlin, *Caladris alpina*, and Oystercatcher, *Haematopus ostralegus*, are all typical breeding birds. Less common are Golden Eagle, *Aquila chrysaetos*, Peregrine, *Falco peregrinus*, Raven, *Corvus corax*, Twite, *Carduelis flavirostris*, Corncrake, *Crex crex*, , and Chough, *Pyrrhocorax pyrrhocorax*. The addition of winter visitors such as Barnacle Goose, *Branta leucopsis*, and Greenland White-fronted Goose, *Anser albifrons*, makes these areas of cropped fields, grass pastures, moorland and coast internationally significant for nature conservation.

Examples of systems of largely lowland character

(3) *The New Forest* (from Tubbs 1997): The New Forest in southern England is a remarkable survival of medieval England in both historical and biological senses. Nowhere else in the lowlands has a pastoral economy based on the exercise of common rights of a large tract of common land survived. The area includes nearly 20,000 ha of unenclosed common land, including c. 15,000 ha of lowland heath and c. 4,500 ha of ancient woodland, mostly of Oak, *Quercus*, Beech, *Fagus sylvatica*, Holly, *Ilex aquifolium*, Ash, *Fraxinus excelsior*, and Alder, *Alnus glutinosa*. The Forest lies on acid sands and clays and the soils are mostly acidic, nutrient-poor and poorly drained. There is a dense network of small streams and abundant bogs, springs and other small wetlands, many of them ephemeral. Neutral grasslands follow many watercourses and occur on the margins of settlements and elsewhere where large numbers of livestock concentrate.

Most of the enclosed lands in and around the Forest posses various rights of common exercisable over the common lands within it. Between 1988-1995, a mean of 380 commoners depastured means of c. 3,500 ponies, 2,000 cattle (excluding calves) and c. 80 donkeys on the Forest in the summer. Winter numbers were lower. In addition, c. 450 pigs were turned out on the autumn seed harvest, many of which were owned by non-commoners since the pigs are seen as valuable in eating potentially poisonous acorns. However, few commoners now depend on farming and the exercise of common rights as their primary source of income. The practice survives because it provides a useful subsidiary income and is a pivotal element in the social structure of a local community which is still closely knit.

The pastoral history of the New Forest, in which periodically the density of animals has been very high, has diversified the vegetation by suppressing the potentially dominant Purple Moor-grass, Molinia, heathers (*Calluna vulgaris* and *Erica* spp.) and some trees and shrubs (especially gorse, *Ulex*), thereby allowing a great variety of small herbs, sedges and grasses to invade and form a diverse array of plant communities. The neutral grasslands, and the wet flushes and ponds which commonly occur there, support a rich flora, including an array of species for which the New Forest is now the main centre of the population in Britain. They include Small Fleabane, *Pulicaria vulgaris*, Pennyroyal, *Mentha pulegium*, Coral-necklace, *Illecebrum verticallatum*, Hampshire-purslane, *Ludwigia palustris*, and Slender Marsh-bedstraw, *Galium constrictum*. The muddy, empemeral polls, made eutrophic by dunging, are the habitat of the rare Fairy Shrimp, *Chirocephalus diaphanus* and the tadpole shrimp, *Triops cancriformis*, whose only known British locality is in an empemeral, heavily poached Forest pond. Most of these plant and invertebrate species have vanished elsewhere in lowland England because the commons are no longer grazed, poached and dunged by

commoner's animals. The grazing of the Forest also enhances the habitat for many heathland passerine birds (such as the Woodlark, *Lullula arborea*), bog-breeding waders (such as Curlew, Lapwing, Redshank and Snipe) and for a considerable array of invertebrates (including dragonflies, grasshoppers and bush crickets).

(4) *Breckland of East Anglia* (from Dolman & Sutherland 1992): Breckland is a region of eastern England covering approximately 940 km2 of south-west Norfolk, north-west Suffolk and part of Cambridgeshire. It is characterised by sandy soils and a semi-continental climate, with lower rainfall than most of Britain. Historically, Breckland has been dominated by lowland heathland, which was created by the clearance of woodland for agriculture and the grazing of livestock by Neolithic farmers (c. 5000 BP). The heaths have been disturbed and regenerated by shifting short-term cultivation. Indeed the name Breckland comes from the word 'breck' describing an area of land which has been cropped and then left for many years before being cropped again. Mixed farming continued throughout the Bronze Age (c. 3600 BP) and high densities of sheep grazed the heathlands from c. 2000 BP. Although sheep density declined from the seventeenth century and less hardy breeds were introduced from the early nineteenth century, sheep grazing was a major influence on the heathlands until the early part of the twentieth century. Since that time, the extent of heathland has declined as a result of loss to agricultural land and especially plantation of conifer forests.

Current arable farming consists of a mixture of cereals, field crops (especially sugar beet) and vegetable crops (which were introduced during the Second World War on land that had never been cultivated before). The majority of crops grown in the area are irrigated and the soil fertility is such that there is a high proportion of spring crops in the rotation. The main biodiversity interest on the arable area is, however, limited to the Stone Curlew, which occurs in small numbers and is more prevalent on arable fields than on the heathlands. The area was once a main wintering area for sheep (which came from as far away as Northumberland) which grazed on a combination of heathlands and arable stubbles. In recent years, wintering from other areas has declined and the majority of sheep in the area are now owned by local farmers.

The Breckland heaths are unusual amongst British lowland heathlands. In addition to areas dominated by Heather, much of their area is dominated by calcareous and acidic grass heath communities occurring in close proximity to each other. These communities not only contain species characteristic of lowland heaths but also contain elements of coastal sand dune, continental heathland, steppe and Mediterranean communities. The heaths support many rare plants, birds and insects, including a number not found elsewhere in Britain. Many rare Breckland specialities such as Perennial Knawel, *Sclerasnthus perennis* ssp. *prostratus*, and Field Wormwood, *Artemesia campestris*, as well as other characteristic species such as the Woodlark, *Lullula arborea*, rely on characteristic lichen-rich and emphemeral-rich habitats which were once widespread on the heavily grazed and disturbed heaths. Remaining endangered species include: Starry Breck lichen *Buellia asterella*, Scaly Breck lichen *Squamarina lentigera*, Spiked Speedwell *Veronica spicata*, Spring Speedwell *Veronica verna*, Fingered Speedwell *Veronica tiyphyllos*, Spotted Cats-Ear *Hypochaeris maculata*, Small Alison *Alyssum alyssoides*, Tower Mustard *Arabis glabra*, Breckland Thyme *Thymusserpyllum*, Blue Fescue *Festuca caesia*, Military Orchid *Orchis militaris*, Spanish Catchfly *Silene otitis*, Stone Curlew, Tawny Wave moth *Scopula rubiginata*, Scarce Emerald damselfly *Lestes dryas* and Barbastelle bat *Barbastella barbastellus*. These specialised Brecks plants and animals depends on sensitive management of their habitats. Many now survive in the region only where grazing by sheep (and rabbits) is sustained.

Annex 5:Payment Formula

Full Cost of Management Formula

Calculation equations for the different practices and fixed cost

Practice 1: Maintaining grazing activities

t Component	Component	Component 2	Component	Component 4	Component 5	Factor/Assum	Equation
Differentiatio	Purchased feeding stuff (€/LU)	Feeding stuff produced on the farm (€/LU)	Bedding cost (€/LU)	Treatment cost (€/LU)	Livestock management cost (€/LU)	LU/ha	
Cattle							**= (C6 + D6 + E6 + F6 + G6) * H6**
Sheep							**= (C7 + D7 + E7 + F7 + G7) * H7**

Practice 2: Controlling of vegetation outcome

Cost Component	Component	Factor/Assump	Component	Factor/Assum	Equation
Differentiatio	Crop protection products (€/ha)	Share	Other crop specific costs (€/ha)	Share	
Cattle					**= (C13 * D13) + (E13 * F13)**
Sheep					**= (C13 * D13) + (E13 * F13)**

Fixed cost (overheads)

Cost Component	Component	Factor/Assump	Component	Factor/Assum	Component 3	Factor/Assum	Component 4	Factor/Assumption	Component	Factor/Assum	Equation
Differentiatio	Upkeep of machinery and equipment	Share	Upkeep of land improveme nts and buildings	Share	Electricity, lubricants and fuels	Share	Water	Share	Other farming overheads	Share	
Cattle											**= (C21 * D21) + (E21 * F21) + (G21 * H21) + (I21 * J21) + (K21 * L21)**
Sheep											**= (C22 * D22) + (E22 * F22) + (G22 * H22) + (I22 * J22) + (K22 * L22)**

Holding Wide Approach

Option 2A:

	Cattle system						Sheep system						Grassland system (without livestock)				Arable system			
	Non-NDA cattle system	Transformation to ha value	NDA cattle system	Transformation to ha value	Area	HNV coefficient	Non-NDA sheep system	Transformation to ha value	NDA sheep system	Transformation to ha value	Area	HNV coefficient	Non-NDA grassland system	NDA grassland system	Area	HNV coefficient	Non-NDA arable system	NDA arable system	Area	HNV coefficient
Formula	Gross margin (€/LU)	Number of LU per hectare (LU/ha)	Gross margin (€/LU)	Number of LU per hectare (LU/ha)	Number of hectare (ha)	α_c	Gross margin (€/LU)	Number of LU per hectare (LU/ha)	Gross margin (€/LU)	Number of LU per hectare (LU/ha)	Number of hectare (ha)	α_s	Gross margin (€/ha)	Gross margin (€/ha)	Number of hectare (ha)	α_g	Gross margin (€/ha)	Gross margin (€/ha)	Number of hectare (ha)	α_a
Equation	**= ((C5 * D5 - E5 * F5) * G5 * (1+H5)) + ((I5 * J5 - K5 * L5) * M5 * (1+N5)) + ((O5 - P5) * Q5 * (1+R5)) + ((S5 - T5) * U5 * (1+V6)) * (1+W5)**																			

Oppourtunity Costs Approach

Differentiation on regional/geographic basis and by farm type			Cattle system	Sheep system	Grassland (without livestoc	Arable systems
	Average wage per hour or day, non-farming	Average wage per hour or day, farming	Total labour per ha and year (in hours or days)	Total labour per ha and year (in hours or days)	Total labour per ha and year (in hours or days)	Total labour per ha and year (in hours or days)
Equation	**=(C28-D28) * E28 + (C28-D28) * F28 + (C28-D28) * G28 + (C28-D28) * H28**					