Modelling the impact of land use decisions on agriculture, biodiversity and socio-economic development of the Irish Upland Commons

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Abstract:

The loss of biodiversity is an issue of increasing importance for human welfare, but sustaining this global common good on a local level often leads to conflicts of interest. The design of sustainable agricultural and biodiversity policies in the Irish uplands, where common land has evolved to accommodate various interests, presents considerable challenges. Changes in agricultural policy and market conditions have rendered traditional low-intensity livestock production less profitable, yet the retraction of farming is perceived as having negative impacts on the economic stability, socio-cultural cohesion and ecological integrity of these areas. The multi-faceted nature of the problem requires an integrative approach to account for multiple goals and the high level of complexity emerging at the interface of ecological and economic systems while being of great contemporary relevance regarding the post-productivist future of the European countryside.

The research presented focuses on multiple use issues in the Irish uplands where the majority of land is held in commonage. In the past, co-operation by right-holders through agreeing sustainable stocking levels on common grazing land contributed to shaping and enhancing upland habitats, species and landscapes. In recent decades, however, the functioning of the Irish commonage has changed significantly with declining numbers of active commonage users and the loss of traditional institutions resulting in biodiversity loss and land degradation through under-grazing.

Against this background, the present paper provides an inter-disciplinary discussion of ecological and economic methodologies to support the design of agricultural and biodiversity policies within the context of the newly emerging multifunctional agricultural regime. The approach combines inputs from the non-linear, adaptive ecosystem management approach and the institutional approach focusing on property rights and their distribution in society.

Keywords: *Biodiversity, commonage, traditional livestock production, European uplands, agent-based modelling*

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1. Introduction

Europe's uplands are of high cultural, recreational and nature conservation value. As such, they have been the subject of significant research activity at the interface of ecology, ecological economics and rural sociology in recent years (e.g. Thompson and Brown, 1992; White and Wadsworth, 1994; Thompson *et al*., 1995, Hanley *et al*., 1996; Evans *et al*., 2006).

Traditional practices, mainly in the form of low-intensity grazing by domestic herbivores and controlled burning, are the principal management tools that have helped to shape and refine the diversity of upland habitats over the past millennia (Bignal, 1998) in what Hampicke (2006) describes as a process of co-evolution of species, ecosystems and man. As a result, agricultural biodiversity is now being recognised as just as worthy of conservation as wild biodiversity (Phillips, 1998; Plieninger *et al*., 2006).

Rural Europe, however, is undergoing far-reaching socio-economic transformations (Marsden, 1999). Multiple new demands regarding landscape, conservation, heritage and recreation have emerged, with increasing emphasis being paid to the provision of consumption-related goods and services rather than the traditionally produced goods (Hall *et al*., 2004). This is manifest in the latest series of reforms to the Common Agricultural Policy (CAP) that has fundamentally changed the way in which the European Union (EU) supports its farming sector and, as such, is having a profound impact on land use, biodiversity and rural communities in upland areas.

The term multifunctionality has come to denote a policy to re-direct agriculture towards sustainable development by liberalising the farming sector, with support and preferential tariff arrangements either removed or targeted at environmental and social goals (Moran, 2006). Farms, under this new rationale, are to be more responsive to - and rewarded by - the market, with government intervention increasingly restricted to issues of public good concern.

While the wider impacts of this transition remain to be established, this change in policy direction has the potential to increase the already apparent polarisation in land use with intensification occurring on productive land and less viable holdings rendered increasingly marginal. The latter is a source of concern in upland areas where, due to a combination of unfavourable bio-physical and socio-economic conditions, farms tend to operate at the margins of financial viability.

The decline of traditional farming has been identified as one of the main threats facing European upland areas (e.g. Baudry, 1991; MacDonald *et al*., 2000; Schmitzberger *et al*., 2005; Strijker, 2005; Conti & Fagarazzi, 2006; Gellerich *et al*., 2006; Gellerich & Zimmermann, 2006; Plieninger *et al*., 2006). Owing to concerns about negative impacts on ecosystem resilience as well as undesirable knock-on effects on rural livelihoods, it is now of considerable importance in political discussions where it has quickly become embroiled in the debate on multifunctionality with the problems affecting upland areas having come to epitomise the dilemma surrounding the future European model of agriculture under which farm businesses have to produce within the context of an increasingly competitive international market, provide environmental goods, and reduce output at the same time as supporting prosperous rural communities (Kristensen *et al*., 2004).

Common grazing land is among the oldest forms of land tenure in remote and marginal areas (Berkes & Folke, 1998; Kissling-Naef *et al*., 2002; Short, 2000) where it developed to accommodate a multiplicity of interests. In the Republic of Ireland, common land covers 426,124 ha and involves about 11,837 farmers, most of them located in the uplands along the western seaboard (Bleasdale and Sheehy-Skeffington, 1995). Being a vital component of the marginal farming systems of which it forms a part, its difficult legal status has shielded common land for the most part from afforestation and agricultural improvement that has led to the large-scale disappearance of semi-natural grazing land in more productive areas. As a result, common land now represents one of the last rich reservoirs of biodiversity.

While under the last decades' productivist agricultural policies many upland commons suffered from serious overgrazing – confirming once again Hardin's (1968) acclaimed tragedy of the commons - a combination socio-economic transformations mean that undergrazing and decay of traditional management structures are now emerging as the main new threats to the Irish upland commons.

A large body of literature explores vulnerability of common property resources to over-exploitation (Bromley, 1991; Ostrom, 2000) and the conditions under which commons institutions are successful (Ostrom, 1990, 1998; Di Falco & van Rensburg, 2004), but surprisingly little research effort has been devoted to investigating the implications of this mode of land tenure in the present debate on the decline of traditional farming in upland areas and the role of common property resources in the new multifunctional countryside (Hynes *et al*., 2007). Reporting on empirical findings from ongoing research, this paper is intended to contribute towards filling this gap by addressing this important question.

The remainder of this paper is organised as follows. To begin with, we will provide some background on the European model of agriculture and discuss multifunctionality as an agricultural and rural policy concept under which, paradoxically, the most intrinsically multifunctional farming systems have come under pressure. In the next section, we will describe the study area and provide a backdrop to the current debate over the management of the Irish upland commons, before the survey instrument and methodological approach being used are outlined. This is followed by a presentation of empirical findings showing how the Irish upland commonage has been transformed.

The paper concludes with a contemplation of this evidence against a background of possible policy change and the wider implications for the commons, discussing the need for inter-disciplinary methodological approaches based on the combination of ecological and economic methods to support the design of agricultural and biodiversity policies within the context of the newly emerging multifunctional agricultural regime.

2. Maintaining biodiversity and upland farming in the context of a changing CAP

2.1. The European Model of Agriculture

The European Model of Agriculture (EMA) is a construct of assumptions regarding the character of rural Europe and the key role of agriculture in defining it. Farms, under this interpretation, are viewed as private suppliers of a range of public goods related to food

security, countryside stewardship and viable rural economies. Since many of these goods – including biodiversity, and landscape character - arise as mere side-effects of farming activities, no market mechanisms exists to remunerate producers for their provision. This absence of markets for public goods valued by society, often referred to as the 'missing market phenomenon' (e.g. Nowicki, 2004), legitimises state support to secure the production of goods and services that would otherwise be underprovided.

While originally envisaged to shield European family farms until they had become sufficiently competitive (Coleman, 1998), economic recession in the 1970s and 1980s in conjunction with falling world market prices, the erosion of non-agricultural employment opportunities, and a growing apprehension that family farms were 'the emblematic expression of rural social organisation'[1] gradually led to the establishment of a much more explicit social welfare agenda to ensure the continued existence of marginal producers.

Over the past two decades, however, the EMA has come under pressure. On the external side, the General Agreement on Trade and Tariffs (GATT) as well as other measures under the World Trade Organisation (WTO) are anxious to see any protective, trade distorting, and production-increasing support measures removed (Bignal, 1998). Internally, overproduction and the presence of intervention stores, EU enlargement, budgetary concerns and a commitment to greater integration between environmental and agricultural policies increasingly question the provision of support payments to farmers.

In the face of these pressures, attempts are being made to justify continued state assistance by defining multifunctionality as a key attribute of the EMA. This is backed by the argument that the joint production of agricultural and environmental goods, a characteristic feature of European farming systems, is vulnerable to market liberalisation. Under the 1992 McSharry reform, the first of an ongoing series of reforms to restructure the European farming industry, the European Commission defended their resistance against steep reductions in price support by declaring that 'sufficient numbers of farmers must be kept on the land' if appearance and social structure of the countryside valued by society was to be maintained'.[2]

Potter (2004) identified a set of assumptions underlying this stance. At the outset, it implies that there are farming systems that are consistent with nature conservation and the provision of environmental benefits. Secondly, it suggests that the majority of these systems are economically marginal and in need of protection from trade liberalisation and agricultural restructuring. Lastly, multifunctionality necessitates the retention of a safety net for low-intensity farmers as they are unable to compete under the present market structure where prices do not reflect the negative environmental impacts of most agricultural systems (Luick, 1998).

This interpretation goes hand in hand with a growing apprehension that there are certain farming systems that need to be underwritten if the semi-natural habitats created and managed through traditional, extensive practices are to be sustained in the future (e.g. Beaufoy *et al*., 1994; Baldock *et al*., 1996; Bignal & McCracken, 1996; Bignal, 1998; Baldock *et al*., 2002).

[1] Buller (2001), cited in Potter (2004), p. 16
[2] Cited in Potter (2004), p. 20

In most parts of Europe, these farming systems have long since vanished, but elements have survived in upland and remote areas where physical constraints have protected them from development. While their uniqueness lies in their inherent multifunctionality, they are typically linked to landholding patterns that are economically vulnerable and heavily dependent on agricultural support.

Although some financial measures (mainly in the form of agri-environmental schemes) provide assistance for the maintenance of traditional cultural landscapes, their impact has so far been narrow (Green & Vos, 2001) and concerns are being raised about the negative effects agricultural restructuring may have on high nature value farming in disadvantaged areas, where there will be little economic incentive to produce for farm prices below the production costs (Coordination Paysanne Europeenne, 2003).

2.2. The impacts and drivers of agricultural restructuring

Plieninger *et al*. (2006) describe the key problem of semi-natural landscapes as their instability, rendering them dependent upon a certain degree of human intervention. This dependence arises out of the fact that, as pointed out by Conti & Fagarazzi (2006), an artificially altered system needs continuous flows of energetic inputs in order to be maintained in its desired state. In the absence of these inputs, a period of uncertainty arises which ends when the system crosses a threshold and enters a new state.

Although the reversion of previously managed land to 'natural' habitats may have positive impacts on some species, continuous low-intensity management in Europe has over the centuries contributed to maintaining a high diversity of species and is thus essential to the conservation of local biodiversity and ecosystem services (Bignal & McCracken, 1996) with the result that the areas concerned quickly lose environmental value if those practices cease. The invasion of vegetation onto old field sites and the succession of higher flora-rich areas to scrubs are often perceived as a loss of openness, heterogeneity and mosaic features, or the wholesale loss of a cultural landscape (Beaufoy *et al*., 1994; Baldock *et al*., 1996). Other effects include a reduction in genetic diversity in both wild species and local breeds of livestock which are often well-adapted to semi-natural habitats.

While the impact of temporal and spatial scales of analysis renders detecting changes in biodiversity a complex, it is generally assumed that abandonment of semi-natural areas has negative consequences as vegetation succession leads to species-poor and more homogeneous vegetation types with diversity decreasing during early abandonment when dominant species begin to thrive. Over the medium-term, with increasing scrub cover, biodiversity may be enhanced but then declines again when forest develops (MacDonald *et al*., 2000).

There has been little formal research on the connection between farming decline and local socio-economic impacts. Overall, the concentrated loss of agricultural land weakens the economic base of rural areas with the land losing its production function and traditional agricultural settlements no longer benefiting from production. Impacts involve direct economic losses imposed on land users such as the fall in land value caused by reduced livestock carrying capacity once scrub encroachment has taken place. Other, more indirect, effects include non-market, external effects related to

changed existence or passive values in relation to system integrity and traditional land uses (Correira, 1993; Burel & Baudry, 1995; MacDonald *et al*. 2000).

Given the above, the aim would be to implement management options for land prone to marginalisation that use livestock as a management tool for optimizing the biodiversity and landscape value of upland areas while maintaining viable farming enterprises. This involves striking a careful balance between the perspectives of a large variety of stakeholders, a tremendous challenge in its own right that becomes even more daunting when considering that the pattern of grazing in upland areas has never been static but has always been, as pointed out by Evans *et al*. (2006), an agent of profound ecological change.

Understanding the forces that lead to the marginalisation of mountain areas is an important prerequisite of any attempt at solving the problem. To date, knowledge about the processes and patterns of changing land use intensity is limited. Formal empirical studies are few and exist mainly in the form of small, context-specific case studies with a great diversity of approaches being developed while proven methods of general application remain elusive (Mottet *et al*., 2006).

In what is one of the first comprehensive studies, Baldock *et al*. (1996) looked at different European countries and found areas with physical and socio-economic obstacles to modern agriculture to be most vulnerable. Changing labour markets and declining relative prices for agricultural products were identified by other case studies. This is consistent with the findings of Strijker (2005) and earlier studies by Surber *et al*. (1973) and Walther (1986) who singled out the presence of significant income disparities between agricultural and non-agricultural jobs as well as the inability to modernise land use due to physical constraints of upland areas as the most important drivers of land marginalisation.

In essence, thus, the hypothesis underlying the majority of studies is that land where cultivation costs are not covered by yields seems to be favoured in terms of abandonment (see Gellerich *et al*., 2006; Gellerich & Zimmermann, 2006; Mottet *et al*., 2006) with work undertaken to date remaining mostly anchored in a rational choice theoretical framework.

A recent and very thorough investigation by Grinfelde & Mathijs (2003), however, who conducted an econometric analysis of farmers' choice regarding land abandonment in Latvia, discovered that short and long-term farm management decisions, farm income, land price, social capital, personal characteristics and the physical conditions of the land all have a significant effect on the amount of land abandoned. These findings somewhat refute the above by implying that the low profitability of farming and the low quality of the land, both typically mentioned as the key reasons for land marginalisation, are not the sole explanation. Indeed, as argued by the authors, land abandonment seems to be part of a more complex set of factors related to the management of a farm business which are easily overlooked when employing models based purely on the assumption of utility-maximisation.

The above study being a notable exception, few moves towards combining empirical and modelling approaches have been made that explicitly seek to reveal and evaluate the underlying forces, apart from economic incentives, that cause land use to change (Lamblin *et al*., 2000) with Lobley & Potter (2004) noting that much of our understanding of the pathways through which farmers could be disengaging from agriculture derives

from studies conducted in the early 1990s, a time when many of the present policy and market pressures would have been difficult to anticipate.

In what is to follow, we take a (similarly) critical perspective on the above and argue, based on findings from an Irish case study, that to the extent that we are interested in explaining the causal relationship between individual choices, land use change and the related biodiversity outcomes, more fully articulated ecological economic models are needed than are currently being employed.

3. Presentation of the study area

3.1. The Iveragh peninsula

The Iveragh peninsula is located in the extreme south west of Ireland (fig. 1). Being surrounded on three sides by the Atlantic and primarily mountainous in nature, it is one of the more geographically isolated regions in the Republic of Ireland. The underlying geology of the area is old red sandstone, although carboniferous limestone occurs in a few locations on the eastern edge of the peninsula. Iveragh's climate is strongly influenced by its maritime location which produces high annual levels of precipitation of 1200 mm.

Physical constraints to development and harsh environmental conditions have led to the continued existence of large tracts of traditional hill livestock farming systems and semi-natural habitats. Of particular ecological interest are the peninsula's extensive blanket bog and upland heather moorland habitats, both of which are internationally recognised as key biodiversity habitats and listed as Special Areas of Conservation (SAC) under the European Habitats Directive (92/34/EEC). On shallow soils upland and, to a lesser extent lowland or Atlantic blanket bog, dominated by bryophytes (*Sphagnum spp.*), ling (*Calluna vulgaris*) and cross-leaved heath (*Erica tetralix*), cotton grasses (*Eriophorum spp*.) and black bog rush (*Schoenus nigrans*), form mosaics with wet heath communities. Purple moorgrass (*Molinia caerulea*) may be locally abundant (Fossit, 2000). Approximately 8 % of Iveragh are covered by plantation forestry, chiefly in more marginal areas where land is of low agricultural productivity. The entire peninsula is designated as severely handicapped under the EU's Less Favoured Areas Directive (75/268).

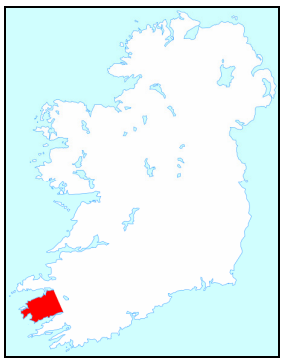
Progressive changes in the farming sector since Ireland's accession to the EEC in 1973 have resulted in transformations of the prevailing farming systems. Past agricultural policies led to a shift from traditional mixed livestock husbandry towards a more simplified management system dominated by sheep. The resulting decline in the number of bovines grazing the hills has contributed to the spread of less desirable vegetation types such as bracken *(Pteridium aquilinum)*, common gorse *(Ulex europaeus)* and hard rush *(Juncus inflexus)* which are more effectively controlled by cattle than sheep.

Traditional farming on Iveragh operates at the margin of financial viability and is heavily dependent on agricultural subsidies. Despite a multifaceted and constantly evolving local context, Iveragh can therefore be considered as a typical example of

many rural locales within and outside Ireland where traditional upland management has come under pressure.

Figure 1

Location map of the Iveragh peninsula



3.2. Commonage

An intrinsic characteristic of Iveragh hill farms is the presence of commonage. The latter denotes extensive areas of common grazing lands that are used jointly by a number of share holders who own farms in the surrounding townlands. While typically consisting of unimproved mountain land of varying quality, Hegarty (2000) points out that 'commonage is not a tangible land use (…) nor is it a discrete landscape; instead it encompasses a range of habitat types', a definition which 'supports a myriad of intricacies in terms of unclear boundaries, absent shareholders and an out of time multi-ownership system, atypical in a country with one of the highest levels of owner-occupancy in the EU (Lafferty *et al*., 1999), all contributing to its complexity. Continuing to be an integral part of many farms to the present day, Kelly (1997) describes the origins of the Irish commonage as dating back before the Anglo-Norman era when most land was held by kinship groups or *fine*.

The earliest evidence of co-operation through informal local institutions regulating the use of commonages is suggested to be the 'rundale', denoting a system of farming under which mountain land was grazed in common by kinship groups who lived together in a clachán with the head of the group dividing land into units of differing quality and assigning them to individual families for cultivation or grazing which would be periodically redistributed, both for the purpose of crop rotation, and in accordance to needs (McCourt, 1950; O'Loughlin, 1987; Whelan, 1997), the aim being to ensure the sustenance of smallholder kingroups (Di Falco & van Rensburg, 2004).

During this time and up until the mid 18th century, commonages were used for cultivation, livestock production and hunting, giving rise to what Aitchison & Gadsden (1992), writing about the English and Welsh Commons, term an inherently complex system of property rights consisting of a combination of private property, multiple right holders and public interest placing them in the position of being arguably the most pronounced example of multifunctional land use (Short, 1998).

Having thus existed for many centuries, most commonages were formalised during the period of land reform between the late 19th Century and the 1980s when the Land Commission was set up to oversee the transfer of freehold land purchased by the Irish government from English landlords to tenants on fair terms, among the aims being the enlargement of uneconomic holdings and the reduction of farm fragmentation (Lafferty *et al.* 1999).

3.3. Commonage management under changing policy agendas

Traditionally, as described by O'Rourke (2008), a farmer's share in an upland commonage was defined with reference to how much low land he owned privately and calculated in terms of a 'collop', a term referring to the grazing equivalent of one cow.[3] The land's carrying capacity was determined by the nutritional value of the land with supplementary feeding being of minor importance. The 'collop' can therefore be seen as a system of 'checks and balances' (Kissling-Naef *et al*., 2002) ensuring that no farmer kept more livestock than his private land could support during the critical months of slow vegetation growth on the mountain.

Disagreement among commonage farmers was and continues to be the order of the day, yet collective action in the form of stock management, protection of the commonage from non-shareholders, enforcement of grazing rules and vegetation management by small scale, controlled burning of heather was common and played a critical role in ensuring the sustained supply of important collective and public goods from by the commonage (Di Falco & van Rensburg, 2004). As such, it can be seen as the 'expression of the strong dependency of a society whose fate is bound up with mountain agriculture, for better or for worse' (Kissling-Naef, 2002).

This bond weakened with Ireland's accession to the EEC and the subsequent introduction of livestock headage payments in 1975 as well as the inclusion of sheep meat in the Common market regime in 1980 after which the total number of sheep in Ireland almost tripled. The dual process of farm modernisation and intensification inspired by CAP subsidies artificially inflated the land's carrying capacity through the import of feedstuff and nutrients, and drove many farmers to rent in improved agricultural land. This, in combination with the onset of the 'Celtic Tiger' phenomenon characterised by high levels of foreign investment and a concurrent boom in the construction industry that brought relative affluence even into marginal areas, started a process of rapid social change and marked the end of existential dependence on traditional commonage institutions which hence ceased to function.

Increased stock numbers and corresponding changes to the traditional farm management system had severe impacts on the ecology of the uplands resulting in widespread damage to heather and bare peat from overgrazing as well as species change and nutrient enrichment from supplementary feeding (Bleasdale, 1995; Bleasdale and Sheehy-Skeffington, 1995). Largely in response to the passing of a series of European directives, including the Birds[4] and Habitats Directive[5] and the Agri-

[3] It is still common among older farmers to describe the size of their land as 'having the grass of (…) cows' rather than the more contemporary acreage.
[4] Directive on the Conservation of Wild Birds (74/409/EEC)
[5] (92/34/EEC)

Environmental Regulation[6], serious efforts were made from the mid-1990s to reduce the problem using two instruments.

A rural environment protection scheme (REPS) was launched in 1994 to encourage farmers to adopt more environmentally-friendly practices in exchange for financial compensation. Since the REPS is a voluntary measure, however, and its initial uptake by farmers was slow, the Irish government introduced Commonage Framework Plans (CFP) in 1998 to address the special problems that were found to be facing commonage areas by quantifying the extent of overgrazing and prescribing de-stocking where necessary in an attempt to 'manage sites, not just designate them' (Bleasdale, 2000). To prevent further damage to upland habitats, a compulsory sheep cull of thirty percent was enforced on all commonages as an interim measure until detailed plans with destocking calculations based on vegetation state, stocking rate and commonage share at individual farm level were drawn up, the aim being to match more closely the sustainable carrying capacity of upland areas.

While Bleasdale (2000) anticipated that, as a result of the commonage framework plans, 'the notion of 'collective responsibility' would once again return to upland stock management', the reality is rather less encouraging. Although some commonages have improved, evidence shows that others are have disimproved[7] or gone from one extreme to the other, i.e. from being overgrazed to being undergrazed, thus validating Ostrom's (2007) suggestion that a high level of government intervention does not necessarily lead to sustainable resource management and that users who have relative autonomy to design their own rules for governing and managing common property resources repeatedly achieve better outcomes than when experts do this for them.

Traditional management and their related institutions involve practices are much more sophisticated than is commonly acknowledged (Dunford & Feehan, 2001). Policy instruments, in contrast, tend to be dominated by reductionist scientific debates on grazing levels (Grant & Armstrong, 1993; White & Wadsworth, 1994; Thompson *et al*., 1995; Hester, 1996). There is increasing evidence that such attempts to deal with upland management may encounter difficulties. The problem, in essence, is that much of the debate on appropriate grazing in the uplands is derived from extrapolations of findings based on 'old' equilibrium notions of ecosystem functioning. Over the past two decades, however, ecology has gone through a major paradigm shift with important implications for ecosystem management, away from the equilibrium concept to one that recognises the dynamic, non-equilibrium nature of ecosystems (Wallington *et al*., 2005).

Unfortunately, as observed by Levin (1999), these developments have not been converted into guidelines of use to land managers and decision-makers with the majority of conservation policies still being based on equilibrium notions. Yet this latter approach to natural resource management, commonly termed 'command and control' (Holling & Meffe, 1996), has been found to result in collapsing resource stocks as well as social and economic welfare loss if applied to complex ecosystems (Sandberg, 2006), thus pointing to the need to examine, in more detail, the changes in upland management arising from transitions in agricultural structure if one is to formulate new options for the common which respond to the specific challenges posed by these abundant areas.

[6] Regulation 2078/92
[7] Personal communication

4. Farming in the Iveragh Uplands Today

4.1. Methodology

In an effort to describe the current farming systems in the study area as well as to explore hill farm responses to changing conditions and the wider impact of these responses, a detailed survey of seventy-two farm households drawn from the three Rural Districts (RD) of the Iveragh peninsula was conducted between September 2007 and February 2008.

Personal interviews were conducted with the farm operator in a field setting, lasting ninety minutes on average and following a standard format that involved a combination of open and closed questions. The questionnaire was developed following a scoping study conducted between March and May 2007 that involved forty-five semi-structured interviews and two stakeholder meetings. Subsequently, the survey was piloted for one month during August 2007 before the final format was adopted.

Each survey supplies a detailed description of upland farms in terms of household composition and labour, the farming system with special emphasis on livestock and grazing management, rules governing commonage use, costs and revenues, attitudes to environmental conservation as well as restructuring in the recent past and near future. In addition, habitat surveys were conducted on each survey respondent's upland grazing area focusing on habitat type and grazing state.

To achieve a good geographical coverage, the sample was drawn from a number of distinct upland areas within each of which a snowballing technique was applied. The resulting sample contained sufficient variation in terms of farm type, size and household structure to be broadly representative of the Iveragh peninsula. At the present stage of research, interview data was analysed using SPSS.

While the survey was not focused exclusively on common land, the fact that 70% of respondents had or still have a share in a commonage renders it a sufficiently common phenomenon as to have an important bearing on how the uplands in the study region are being managed.

4.2. Empirical findings

4.2.1 Farming and upland management today

Mean age of farm operators in the study area was 48.1 (± 12.7) with an average household size of 2.9 (± 1.6) individuals. Only 19.4 % of households were fully dependent on their farms for a living, while in the remaining cases the farm operator, his spouse, or both had an additional income. 6.9 % of respondents were retired (fig.2). Despite the high incidence of off-farm work, 81.9 % of respondents still saw themselves primarily as farmers and would prefer to farm full-time if economic circumstances allowed this.

The survey highlighted the long longstanding tradition of family farming in the area, with respondents reporting that their families had been farming the land for an average of 4.3 (± 1.5) generations. Closely related to this, a total of 70.8% of farmers stated their main personal aims as being the will to maintain and improve the farm while only 20.8 %

described themselves as income maximisers and a mere 8.3 % asserted to hold on to their land due to its asset value and the subsidies connected to it. 98.6% of respondents had learned their farming skills from their parents, own experience or other farmers with only a very small minority feeling that education had had a major bearing on how they farmed. The latter is an issue of importance, both regarding policy-maker's scope for influencing land use and the loss of traditional management knowledge as only 50% of farmers were confident that the farm would remain in the family in the next generation.

Figure 2

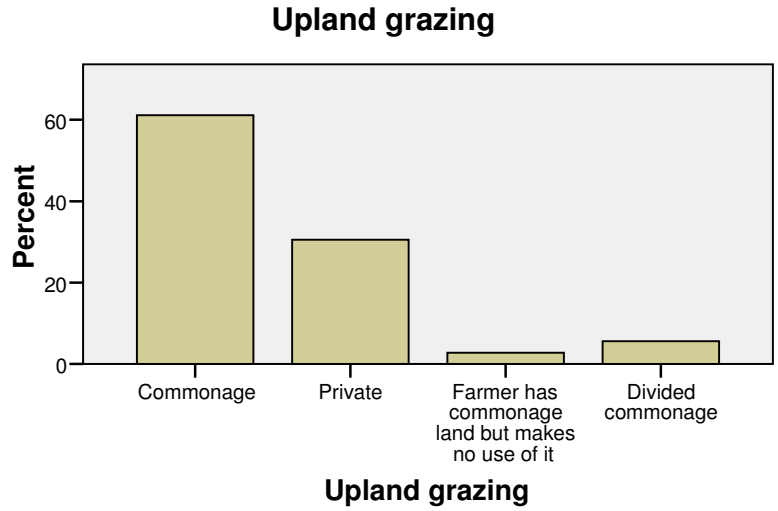
Mean farm size was found to be 138 ha (± 157) of which an average of 91.3 % was owned by the farm operator with the remainder being rented in. Mean upland size was 98.7 ha (± 157.7), thus 58.5% of the total area farmed. For those holdings that had a commonage share, commonage land made up a significant 31.7% of the area farmed, pointing to its important role in the farming system (fig.3).

The average number of shareholders involved in a commonage was stated to be 3.48 (± 3), yet on average only 2 (± 1.2) individuals actively used their share. While on 33.3 % of commonages the number of active right holders had decreased in the last five years, 95.6% of commonage farmers stated a sharp decline in sheep numbers over the same period. 56.5% of commonage farmers stated that they had been affected by de-stocking measures under the commonage framework plans (CFP), mean de-stocking being 19.19% (± 9.7). The remainder had already joined the REPS what rendered further de-stocking unnecessary.

The most common farming system in which 54.2% of all farmers were involved continues to be mixed grazing, consisting of extensive sheep husbandry with small-scale management of suckler cow herds averaging 11 (± 13) animals. This notwithstanding, it must be noted that 36.1% of respondents indicated a change in their enterprise mix in recent years which in the vast majority of cases involved giving up

cattle enterprises[8] or switching from store cattle to spring calving suckler cows, a finding confirmed by Dunford & Feehan (2001) for the Burren region. In contrast, thus, to the traditional custom of out wintering older store cattle on the hills, most calves are now being disposed off as eight month old weanlings (76% of cattle farmers). Many farmers feel that the current undergrazing on the hills is highly correlated to the disappearance of bullocks that effectively controlled tussocky vegetation when spending the winter on the mountain. As the continental breeds of suckler cow that have replaced the hardier Kerry and Shorthorn cows have higher nutritional demands than store cattle, only 19 % of farmers kept a low number of cows on their mountain grazing area for a duration of 4 – 6 weeks after weaning in late summer.

Figure 3



33.3% of farmers in the study area were sheep producers with a mean flock size of 217 (± 185) ewes, characterised by low flock replacement and breeding success rates of 15.9 % (± 9) and 0.86 (± 0.26) respectively (table 1). 76.4% asserted that they had reduced flock size significantly over recent years. While at present 59% of Iveragh sheep flocks still consist of Scotch Blackface Mountain sheep, which are an integral part of the traditional hill farming system and, in a wider sense, of many farmers professional identity, 41% of ewes are crossbred with lowland breeds as lightweight mountain lamb does not conform to current market preferences.

[8] The recently introduced Suckler Cow Welfare Scheme (2008), eighty euro per animal) is expected to revive suckler cow production in marginal areas.

Table 1
Means and standard deviation of the sheep farm livestock yield indicators

Livestock yields	Mean	S.D.
Flock replacement rate (%)	15.93	9.05
Lambs weaned per ewe (%)	0.86	0.26
Ewes per ram	43.31	21.03
Traditional ewes/total ewes (%)	58.06	39.34
Crossbreed ewes/total ewes (%)	41.46	39.35

The intensified production system is beginning to have impacts on the environment as it has led to a reduction of grazing pressure on the mountains, both due to shorter grazing periods and a higher proportion of ewes being housed and supplementary fed. Livestock graze Iveragh's uplands for a mean of 221 (± 88) days per year, a significant reduction when compared to the traditional system that involved year round grazing. All survey respondents stated that they supplementary fed their livestock for at least part of the year. While the production of heavier lambs from crossbred ewes initially increases farmers' profit margin, these benefits tend to be outweighed by the costs of supplementary feeding once a certain threshold is crossed, with many farmers feeling they had fallen into an intensification trap.

Mean annual stocking rates on upland areas were calculated to be 0.29 (± 0.2) livestock units (LU) per hectare (ha), hence lie below the critical threshold of 0.3 LU/ha generally recognized as defining low-input farming systems. This figure, however, masks the fact that, at 0.48 (± 0.39) LU/ha, stocking rates during the grazing season can be significantly higher (table 2).

Table 2
Means and standard deviation for upland management indicators

Upland management indicator	Mean	S.D.
Duration of grazing season (days)	221.32	88.27
Mean annual sheep stocking rate on upland area (sheep LU/ha)	0.28	0.021
Mean annual cattle stocking rate on upland area (cattle LU/ha)	0.02	0.08
Total mean annual stocking rate on upland area (LU/ha)	0.29	0.21
Total stocking rate during the grazing season (LU/ha)	0.48	0.39

It appears that, on its own, the stocking rate is too crude a measure to capture the intricate relationship between herbivores and vegetation. This view is confirmed by Wathern (1992) who argues that it runs the risk to misrepresent actual grazing pressure,

given that the current trend towards larger and younger ewes has strong impacts on dietary preference, foraging behaviour and trampling patterns. Similarly, mean stocking rates provide no information as regards the distribution of grazing over large areas and between different altitudes (see also Fuller, 1996).

The above are aspects of great importance on commonage areas where reduced stock numbers and changed livestock breeds are beginning to have an impact on the traditional 'hefting' system by which flocks maintain a certain home range on the mountain where they were born and raised, provided regular shepherding prevented them from straying. With low stock numbers and gradual disappearance of traditional hefts, stock spread out more what renders vegetation control exercised by grazing less effective and makes sheep harder to control. The resulting inconvenience of collecting widely dispersed sheep is great relative to the benefit of keeping stock on the commonage. 40% of commonage farmers were in favour of converting commonages into private property by dividing and enclosing them to circumvent these problems. This, however, involves the danger of management being intensified by improving and fertilising land, both of which are effectively discouraged by joint ownership as individual right holders are reluctant to incur expenses other commoners would equally benefit from (McKenna *et al*., 2005). Legal intricacies and the topography of the uplands, however, as pointed out by O'Rourke (2008) render the equitable division of commonages a complex undertaking, often with questionable outcomes, particularly in those cases where farmers informally divide land to evade the surveying costs.

In the light of the above, it is thus particularly difficult to establish a coherent picture in relation to ecological change in the uplands. 53% of farmers had noticed a marked increase in scrub and unpalatable grasses over recent years. When asked to describe the current state of their mountain in an attempt to elicit their perceptions, however, only 39.7% said it was undergrazed, while 57.4 % thought their land was sustainably grazed and 2.9 % asserted their mountain was overgrazed (fig.5). In contrast, only 4.4% of respondents believed that their upland grazing area had been undergrazed 5 years ago, while 42.6% and 53% stated it had been sustainably grazed and overgrazed respectively, a marked change to the present situation (fig.6). Vegetation surveys carried out as part of this research mirrored more closely what farmers described as the past state of the grazing area.

The majority of respondents felt that vegetation change was due to reductions in stock numbers, yet climate change and changes in livestock husbandry and vegetation management practices were also deemed as important. The latter relates in particular to the traditional burning of small patches to control scrubby vegetation which used to be a co-operative effort, but is now only carried out by 44% of farmers. There is thus strong evidence of a decline in traditional customs with 35.6% of commonage farmers stating that they no longer co-operate with other commoners in upland management.

Figures 5 and 6

Current (fig.5) and past (fig.6) condition of mountain grazing area as perceived by farmers

Figure 5

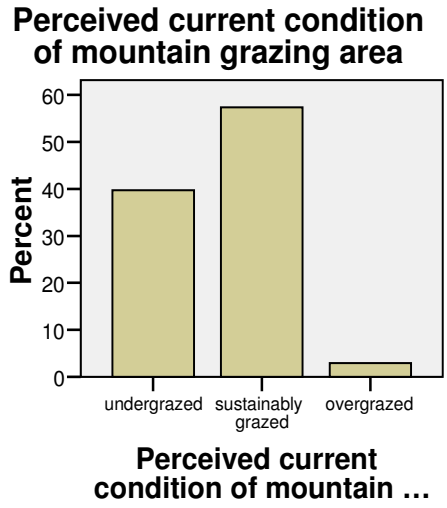
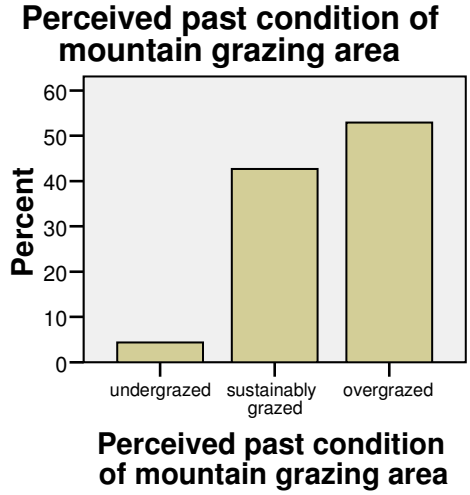


Figure 6



4.2.2. Structural change in agriculture

Looking at the recent past, the picture presenting itself in the study area is one of slow rather agricultural restructuring in term of entries into the sectors and withdrawals from it, combined with significant extensification and changes in how labour is being allocated.

80% of farmers stated that the decoupling of subsidies from production under the single farm payment system (SFP) introduced in 2005 had had an impact on how they ran their farms, with more than half of these saying that the impact had been major. The most common ways in which farmers have adapted was by reducing stock numbers (76.4%), investing in farm machinery (48.6%) and improving facilities (58.3%). The stated purpose of these activities was to fulfil environmental standards under REPS and cross-compliance[9] measures. Equally important, however, was the reduction in labour time afforded by the above changes with many respondents claiming that they wanted to make their farm easier to run.

Increase in farm size to spread fixed costs and render operations more viable, in contrast to findings from other studies (e.g. Lobley & Potter, 2004), has not occurred to a large extent. 52.8% of respondents stated that they would like to expand their operation, yet couldn't afford to do so at current land prices.

Diversification and multifunctionality are, at present, little more than abstract policy concepts that have had a rather low impact on the ground. 33.8% of farmers stated that they were involved in some other farm-based enterprise, yet most of this remains linked to the traditional sectors of agricultural restructuring and construction. Only 16.7% of farmers have diversified into tourism-related businesses with the family income contributed by these activities lying well below 25% of household income in the majority of cases.

Interestingly in the light of widespread hypotheses about the likely future extent of land abandonment in the literature cited in the beginning of this paper, the present survey found little evidence of abandonment either taking place or being likely to happen in the near future. Although only 26.4% of respondents felt that farming alone could provide an acceptable standard of living, 87.5% were confident that they would stay farming. Old age was the only reason cited as compelling farmers to give up in the five years to come. Considering that a relatively high proportion of family income is still derived from the farm and the entitlements that go with it (fig.7), it appears thus unlikely that farming will cease altogether, although the finding that a mean of 67% of farm family incomes is comprised of direct payments indicates a high vulnerability to imminent policy change (table 3).

When being asked as to how they would adapt to drastic reductions in subsidies potentially effected by the next round of CAP reforms in 2013, farmers gave a variety of responses. While 29% said they would change nothing, 31% believed that they would further reduce the size of their operation and 7% thought they would increase off-farm labour time to compensate for the income loss. 4.2% hoped that the land price would drop thus allowing them to increase their operation. In marked contrast to policy debates on multifunctionality, only a small minority of 2.8% saw diversification or the adding of an additional enterprise as an option. 9.7% said they would rent their farms out or pass them on to the younger generation. 15.3% stated that they would give up the farm and exit the sector.

[9] In return for receiving the single farm payment (SFP), European farmers have to keep their land in good agricultural and environmental condition (GAEC). This is called cross-compliance.

Figure 7

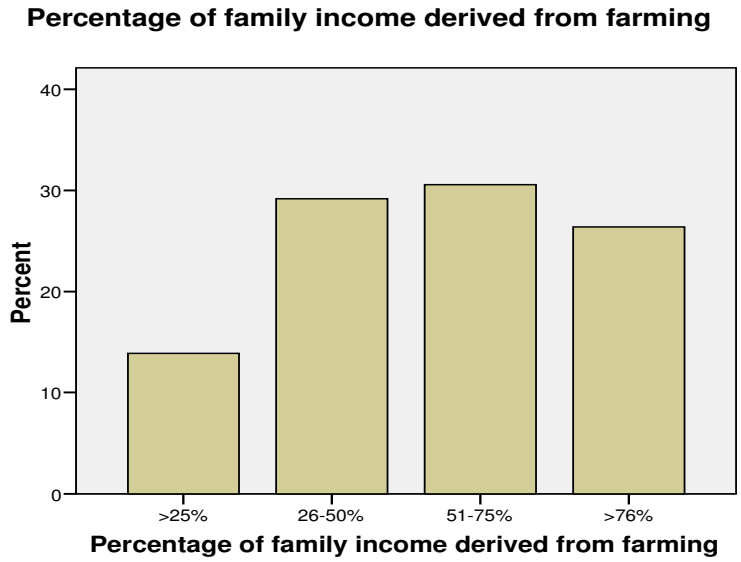


Table 3
Means and standard deviation of the farms production and income indicators

Production and income indicators (€)	**Mean**	**S.D.**
Total gross margin	42,340.28	25,180.65
…of which subsidies for production	18,568.75	9,575.08
…of which REPS	8,600.69	3,896.45
- Direct costs	11,057	9,440.03
= Gross margin	31,282.99	16,864.62
- Overhead costs	9,169.44	5,863.19
= Farm family income (FFI)	22,139.93	12,214.64
…of which single farm payment (SFP) (€)	14,467.36	9,208.811
…of which single payment (SFP) (%)	67.83	34.43
Costs as % of output	46.22	13.36
Index of capital intensification (LU/AWU)	60.66	40.02

5. Implications for research and policy

The fact that a very high proportion of respondents expected to continue farming in one way or another despite downward trends in farm incomes highlights that economic forces are not the only factors impacting on farmers' land use decisions. History, family

tradition, lifestyle, sense of achievement and culture are all essential in keeping upland farmers farming (Burton *et al*., 2005). The restructuring process on Iveragh, while bound to happen, is thus likely to be a slow one brought about more by gradual generational change than by policy reforms.

This argument, however, needs to be differentiated. While there seems to be a high probability that farmers will continue to farm their more fertile and accessible land, the situation presents itself as somewhat different with respect to large commonage areas where simplifications to the existing farming system have already led to what could be termed 'de-facto' abandonment where farmers concentrate their livestock on low ground for much of the year. This problem is likely to become more pronounced in years to come. A very careful distinction, absent in the majority of the published literature, thus needs to be made between outright land abandonment and the cessation of effective land management. Counter-intuitively, as argued by McKenna et al. (2005), commonage management is optimal when all those who have grazing rights exercise those rights with degradation being most likely to occur where traditional controls and customs become moribund through non-exercise of rights. At present, many right holders have little interest in managing their commonage share which has negative socio-economic and ecological impacts and highlights the need for identifying new management structures that respond to the specific challenges posed by these abundant areas in which the economics of livestock production have become questionable (Buckley & van Rensburg, 2006).

While the answer to many of the above concerns was thought to lie in the new agricultural policy framework with its agri-environmental schemes and commonage framework plans, evidence shows a stark mismatch between the concept of agricultural multifunctionality and the approaches used to implement it. Farming, while being a complex and highly adaptive sector, is too often viewed as static with agricultural policy remaining firmly anchored in what Holling and Meffe (1996) call a 'command and control' ethic, based on the old equilibrium assumptions and very much guided by the mistaken but common belief that the public sector can completely manage the landscape through regulation (Bockstael, 1996).

Part of the reason for this is the lack of disciplinary integration in empirical research on upland management. While many of the conditions that have an important bearing on the optimality of grazing strategies are in the realm of social and economic theory, the debate continues to be firmly anchored in the natural science literature with the economics that is done being poorly developed. Tenure type, in particular, barely rates a mention in major studies on land use change in the uplands although it is a powerful determinant of the types of conservation that can occur at any specific location on the landscape (Kindscher & Scott, 1997). Yet even within the tenure factor, random personal variables such as owner age, temperament, education, value system and financial circumstances are very important (McKenna *et al*., 2005).

To the extent, thus, that there is variation in social, economic and ecological systems, a much more flexible approach to conservation is required. To date, emphasis has been largely on biophysical system components with little, uncoordinated action on improving livelihood outcomes for livestock owners or the strengthening of local institutions. Yet this has become imperative in view of the newly emerging multifunctional agricultural regime that is based on a novel relationship between modern agriculture and rural

society within which the new farming context needs no longer be linked to one specific, production-oriented goal but a variety of goals linked to production and consumption (Kristensen *et al*., 2004).

This would certainly be a drastic change of direction away from current agri-environmental policy with its emphasis on physical management and prescribed activities, yet would be a move closer towards the integrated rural development of the Agenda 2000 debate, allowing all the environmental and economic aspects of the uplands to be incorporated into an inclusive governance and management framework (Lowe & Ward, 1998; Potter & Lobley, 1998) within which scientists and policy-makers will have to enter in dialogue with an increasingly diverse set of stakeholders that engage, dis-engage or re-engage with agriculture, among the questions to be asked being: to what extent and in what form should the state intervene to influence structural change for social welfare and environmental reasons (Lobley & Potter, 2004).

This gives rise to two outstanding research priorities. The first is related to the importance of interdisciplinary research on biodiversity in traditional upland farming systems. In order to assess the social impacts of agricultural practices that lead to local extinctions, habitat fragmentation or changes in the relative abundance of species, it is indispensable to gain a deeper understanding of the role of biodiversity in the agricultural landscape, the degree to which its loss affects ecosystem services, and the impact of the latter on the provision of goods and services valued by society.

The second research priority pertains to being aware of the rules governing the system under consideration, such as property rights, the changing role of the state, social transformations, and changing demands on the countryside. Being aware of these rules as well as the contextual factors that lead to their continual evolution and adaptation is vital if we are to formulate policies that enable systems to self-organise in a socially acceptable way.

In a sector where decisions impacting on biodiversity are made by a large number of individual land users, management by centralised 'command and control' means certainly is not a sensible option (Dunford, 2000) as it is the very diversity of independent, uncoordinated management strategies that has contributed to creating a mosaic of agricultural biodiversity.

In response to these challenges, agent-based modelling holds great promise as a tool for complementing empirical methods in inter-disciplinary research. The primary advantage of using the agent-based techniques is that it allows the study of macro-scale emergent behaviour generated by multiple individual actions, thus allowing researchers to study the joint evolution of the physical, ecological and socio-economic components of a system from the bottom up, accounting for heterogeneity among households as well as for system dynamics (Bithell et al., 2006). While describing its application within the context of our work would be beyond the scope of this paper, it is the subject of ongoing research.

6. Conclusions

The aim of this paper is to report work in progress using an original data set on upland management and the decay of common property institutions in the Irish uplands.

Empirical findings question the results of earlier studies employing that employ rational choice theoretical frameworks and predict large-scale land abandonment by marginal farmers no longer able to make a living from traditional farming.

While there is evidence that the structure of farming in the study area is changing, smallholder farmers are have developed a great diversity of adaptation strategies. This emphasizes the need for a much more patterned policy response that differentiates between farm types, social conditions and ownership patterns. If the theory of multifunctionality is to be translated into a working concept, analyses must focus on understanding why land managers in the uplands adopt particular strategies and what constraints prevent them from securing greater returns.

This paper closes with a final observation. Change, as argued by O'Rourke (2005) is 'inevitable and must not be confused with degradation… The way people engage with the landscape depends upon the specific time and place and historical conditions. Evolving landscapes require policies and actions that satisfy the shifting sands of market forces, changing societal demands on the landscape as well as the resilience of the dynamic ecological system in question.'

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