



Heterogeneity in climate change risk perception amongst dairy farmers: A latent class clustering analysis



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ABSTRACT

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Livestock production has been criticized for its effect on greenhouse gas emissions and policy makers are now supporting actions to reduce these impact. Voluntary adoption of these actions will be precluded by the farmer perception of the risks from a changing climate. We employ a latent class clustering approach to understand the heterogeneity within a sample of dairy farmers, based on 8 statements related to climate change risk.

The majority of farmers are found to be 'confused moderates' who have no strong opinion towards the possible future impacts of climate change. Two further classes emerged, namely 'deniers' and 'risk perceivers'. We find that higher education levels have an influence on increasing risk perception, as does the intention to pass the farm onto another family member. Membership of agri-environmental schemes does not preclude awareness or acceptance of climate change risk, principally due to the lack of emphasis on greenhouse gas emissions within these schemes. In addition, use of social networks seems to be a significant factor in raising the profile of risk perception within farmer decision-making.

We conclude that advisors and those engaging with the farming community must accommodate climate messages in their communication strategies. Furthermore, emphasis on the greenhouse gas benefits from adoption of agri-environmental schemes would seem to be an efficient vehicle for raising the risk profile of climate change and influence future uptake of Government and industry supported actions.

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Introduction

Agriculture is growing in prominence within the political agendas of national and international agencies. Debates have centred on the requirement to feed a growing global population under increasing constraints of resource scarcity and climatic variability (Foley et al., 2011; Godfray et al., 2010; Royal Society, 2009). This emerges from projections of increased global warming which will lead to pressures on resources used within food production. Globally, livestock production requires significant inputs from manufactured feeds, chemical fertilisers and water resources. In addition, the creation of pastureland for grazing at the cost of other land uses is of significant concern to policy makers (Ingram, 2011; Thornton, van de Steeg, Notenbaert, & Herrero, 2009; WRI, 2011).

Variability caused by climate change is a growing component of production risk within farming (Balzer & Hess, 2009). Studies suggest that there will be a wider variance in susceptibility to livestock diseases, which will lead to income uncertainties and disrupt global food systems (Dercon, 2004; Hansona, Dismukes, Chambers, Greene, & Kremena, 2004; IFAD, 2009; Thornton et al., 2002). The greenhouse gas burden from livestock production within large, developed agricultural systems requires investigation to inform policy frameworks for adaptation and mitigation. The principal issue is therefore how to encourage farmer engagement within climate change agendas and a clear entry point for this is to address their perceptions of risk.

A number of studies have explored farmer perceptions towards risk, finding that farmers tend to be risk averse with respect to income (Bauer, 1995; Binswanger, 1980; Hardaker, 2006; Hardaker, Huirne, Anderson, & Lien, 2004; Pannell, Malcolm, Ross, & Kingwell, 2000; Smit, Harvey, & Smithers, 2000). The adoption of agri-environmental schemes has also been explored in terms of income-related risk aversion (Franklin, Mduma, Phiri, Thomas, & Zeller, 2006; Groom, Koundouri, Nauges, & Thomas, 2008;

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Vollenweider, Di Falco, & O'Donoghue, 2011). A further tranche of studies have focused on the underlying beliefs, attitudes and cultural influences that affect farmer behaviour. These balance explicit monetary rewards, from participation with agri-environmental schemes, with more intrinsic values (Barnes, Willock, Toma, & Hall, 2011; Burton, Kuczera, & Schwarz, 2008; Dwyer et al., 2007; Jackson, Quaddus, Islam, & Stanton, 2009; Willock et al., 1999; Wilson and Hart, 2000). These studies suggest that differences exist with respect to risk perception and environmental sustainability issues.

Research is now integrating environmental risk taking within the schema of overall farm-level decision-making. These tend towards examinations of climate events (Leppala, Murtonen, & Kauranen, 2012; McCown, 2012; Shahbaz, 2012), alongside price and yield effects (Acs, Berentsen, Huirne, & Van Asseldonk, 2009; Harwood, Heifner, Coble, Perry, & Somwaru, 1999; Meuwissen, Huirne, & Hardaker, 2001). Although useful, these studies do not indicate whether any underlying groups exist amongst farmers with respect to shared attitudes and goals.

Several authors suggest that heterogeneities do exist amongst the general public with respect to climate change perceptions (Bord, Fisher, & O'Connor, 1998; O'Connor et al., 1999; Leiserowitz, 2006; Maibach, Roser-Renouf, & Leiserowitz, 2008; Marx, Weber, Orlove, Leiserowitz, & Krantz, 2007; Rahmstorf, 2004; Sterman, 2008; 2011; Whitmarsh, 2009). Work within the agricultural sector has also found heterogeneities within perceptions to the environment (Davies & Hodge, 2007; Fairweather & Keating, 1990; Sutherland, Barnes, McCrum, Blackstock, & Toma, 2011). However, to date few studies have explored whether such heterogeneity exists in terms of climate change risk perceptions amongst farmers. Most have tended to focus on general responses of farmers to climate change (Gwimbi, 2009; Holloway & Ilbery, 1996; Maddison, 2006; Roncoli, 2006). Accordingly, the aim of this paper is to explore whether farmers can be classified into categories and identify the underlying drivers which shape these perceptions. This heterogeneity is important for designing effective climate related communication strategies and identifying ways in which risk-perceptions can be addressed.

The paper is structured as follows. The next section outlines the data and field of study, with a focus on the particular data collection instrument and specifies the modelling approach. This is then followed by a detailed discussion of the results, and conclusions are drawn, with a particular emphasis on the implications for methods to engage farmers further with the climate change policy agenda.

Data and analysis methods

Data collection

A questionnaire was constructed and administered to dairy farmers within Scotland. Scotland provides an example of a developed country which has multiple targets for agriculture and the policy framework provides some of the most ambitious targets for reducing emissions in the World. These targets aim to reduce Ghg (on 1990 levels) by 42% in 2020 and by 80% in 2050 (Scottish Government, 2009). Specialist dairy farmers are one of the most progressive sectors within Scottish agriculture and illustrate an example of high technology adoption but also have the highest intensities of production compared to other sectors. Therefore these producers are significant contributors to Ghg emissions from the Scottish land use sector (Scottish Government, 2011). Consequently, they offer a key commodity within the agricultural sector of Scotland which could meet its economic goals at a cost of increased emissions from greater production intensity.

A sample was constructed using the June Agricultural Census database (Scottish Government, 2011). The census is administered

every year in Scotland and covers over 50,000 agricultural holdings, of which 1651 were classified as specialist dairy holdings. The majority of these farmers tend to concentrate in the South-West of the country, due to naturally conducive biophysical conditions. Thus, some of the variance from regional and other commodity effects were reduced by focussing on this particular sector. The questionnaire was administered through a telephone survey as a means of maximising response across the sector.

In order to understand the variance in the responses of the farmers, statements were aimed at capturing acceptance of climate change and understanding how impacts may be perceived both generally, i.e. in terms of beneficial effects, and specifically, i.e. in terms of access to credit due to continual uncertainties in production. These are outlined below:

- It is likely that average annual temperatures will increase in the future.
- Climate change will only impact negatively in the long term.
- My standard of living will improve due to climate change.
- Climate change should be seen as beneficial and not detrimental to dairy farming.
- My input costs will increase because of climate change.
- Climate change will lead to increasing productivity losses due to diseases and pests.
- Uncertainty due to climate change seriously affects my ability to invest in my business.
- The threat from climate change forces me to re-assess my business objectives.

Statements were developed in consultation with colleagues at the SRUC Dairy Research Centre in Crichton, South West Scotland and tested with dairy farmers in the same region. To maximise responses and reduce respondent time, all questions were closed and responses to attitude statements were measured across a standard 5-point Likert type scale, ranging from "strongly disagree" to "strongly agree".

The survey was administered in February to March 2009, which led to 550 fully completed questionnaires, a response rate of 33% on the initial sample of 1651 (After data cleaning, 533 responses were kept for analysis). The distribution of responses was compared with the main dairying categories from the census (specialist lowland and LFA) and a chi-square test confirmed that categories were statistically similar (at 95% confidence levels). Average land area of the dairy farms was 135 ha (compared to 122 ha from the June Agricultural Census) and they had an average of 142 dairy cows and heifers either in milk or in calf, compared to 124 animals of the same categories from within the census.

A range of influences have been found to affect climate change perceptions within the public. These include standard socio-economic variables, but also ethnic background and political affiliation (Defra, 2007; Futerra, 2005; Schubert & Soane, 2008; Stedman, 2004). However, very little has been explored in terms of what is influencing farming perceptions towards climate change related risk. Gbetibouo (2009) within the developing country context found that household size, farming experience, wealth, access to credit, access to water, tenure rights, off-farm activities, and access to extension are the main factors that enhance adaptive capacity.

The studies conducted in a developed country context, where a number of these input factors are more accessible, have not explored the influence of drivers on climate change perceptions (Harrington & Lu, 2002; Holloway & Ilbery, 1996; WIDCROP, 2009). Nevertheless, a wider literature exists on perceptions of environmental damage from farming activity and the drivers behind uptake of technologies which mitigate these impacts (Barnes, Willock, Hall, & Toma, 2009; Mathjis, 2003; Morris & Potter, 1995; Potter &

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