Centre for the Study of Agriculture, Food and Environment

New Zealand Pastoral Farmers and the Mitigation of Greenhouse Gases in the Agricultural Sector

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Executive Summary

This report provides an initial assessment of the current state of awareness of and anticipated response to the proposed emissions trading scheme (ETS) and associated afforestation policies among pastoral farmers in New Zealand. The objective of the analysis was to develop a timely "state of the sector" report, relying on established contacts with farmers in the ARGOS project. The report analyses the response of 29 of these farmers as expressed during interviews which introduced them to the conditions of the ETS and estimated liability levels and costs. Due to this focus, the findings in the report provide insight to some of the attitudes and the general level of preparedness in regard to adaptation to climate change among pastoral farmers.

In order to provide a context within which to better interpret the farmers' response, the report includes a review of existing social research on participation in agri-environment schemes in Europe, Canada, Australia and New Zealand. This literature strongly asserts the challenge faced in the implementation of policy that does not conform to the productivist focus of farming in these regions. Thus, any representation of the ETS as a purely economic policy instrument would fail to account for the social and cultural context through which farmers interpret and engage with such policy.

The farmers' response to the ETS and associated policies can be summarised on the basis of the sets of scenarios presented during the interviews:

1. **agricultural component of the ETS**:
   - The farmers generally considered that the inclusion of the agriculture sector in the ETS was unfair, especially if other countries were not doing so.
   - Many farmers believed that credits for land use and management practices should extend beyond afforestation to include, for example, soil carbon and sequestration in grasses.
2. **point-of-obligation**:
   - Farmers expressed a slight preference for an individual (farm-level) point-of-obligation. This was especially true among farmers who indicated the capacity to include trees in areas of their farms.
   - Many farmers also expressed preference for processor-level point-of-obligation, emphasising the reduced transaction costs in such a situation.
3. **afforestation policies**:
   - Just over half (~ 60%) of the farmers interviewed demonstrated a willingness to plant trees on their farms.
   - The forestry component of the ETS was the most commonly preferred policy for encouraging afforestation among sheep/beef farmers. This reflected their preference to maintain greater flexibility of land use and the desire to earn income off all of their land.
   - The PFSI was the most commonly preferred policy among dairy farmers who sought to establish forested conservation (as opposed to production) areas on smaller patches of marginal land on their farms.
   - Despite identifying capital substantial constraints, neither group of farmers expected to utilise the AGS except for isolated areas considered to be unproductive.

4. **price signals**:
    - For those farmers willing to consider afforestation as a strategic response within the ETS, higher carbon prices prompted larger areas of tree planting. This response reflected concerns over increasing liability costs.
    - While most farmers were confident of their ability to adapt to the ETS given a 90% free allocation of credits, they doubted the continued viability of their farms if subject to full liability.

The most consistent feature of the interviews was the general lack of awareness and knowledge of both the relationship between agricultural greenhouse gas emissions and climate change and the nature and operation of the proposed ETS. As a result, a list of farmers' questions and concerns regarding the policy was compiled from the interviews and provided in Appendix 1. The uncertainty surrounding both the science and the policy of the ETS also contributes to the following concerns as identified by the research team

- many farmers see little capacity to change because they are unwilling to critique current farming practice and its focus on productivism. This suggests that farmers may not be as highly adaptive as they are often characterized.
- without credible and consistent information on alternative management and land use strategies, farmers will rely on existing knowledge that may not be accurate or appropriate in the context of climate change.
- farmers have a hard time seeing the logic of the entire regulatory system, from Kyoto through ETS. This lack of legitimacy may make them less likely to engage the ETS/PFSI in an optimal, efficient or informed manner.
- farmers are currently uninformed about (and lack the means of negotiating) the ETS policy and policy proposals leaving them largely unprepared, unequipped and unresponsive to the need for adaptation at a rapid rate.
- farmers see themselves constrained by lack of options, especially given the current economic conditions of the meat and (to a lesser extent) dairy industries. The perceived need to exploit all farm land for productive purposes leaves little unproductive area that can be moved into forestry.
- farmers refer to currently existing uncertainty surrounding both climate change policy and science to justify both their opposition to such policy and their delay in developing strategic response.
- farmers require decision support tools that not only calculate liability and credits, but also inform and instruct them about underlying ecological and economic processes of greenhouse gas production and mitigation at the farm level.
- farmers view many elements of domestic climate change policy (e.g., exclusion of shelterbelts and differentiation between pre-1990 and post-1989 forests) as arbitrary and contradictory conditions imposed by international interests.
- farmers also perceive greenhouse gas regulation as the product of urban interests that rests on a failure to adequately distinguish between industrial and "natural" (agricultural) sources.

Introduction

The implementation of an emissions trading scheme (ETS) as a policy instrument is intended to contribute to the efficient reduction of greenhouse gas (GHG) emissions in New Zealand within the limits agreed to in the Kyoto Protocol. The ETS provides the mechanism through which 'emissions units' equal to the committed level of carbon dioxide equivalents (CO2e) can be allocated among the sectors of the New Zealand economy. By establishing emission units as tradable items, the ETS would create what is essentially a new commodity that demands inclusion in the financial planning strategies of producers of goods and services. In this manner, the ETS is expected to incentivise the incorporation of GHGs within production strategies. The transition to a carbon economy may, however, prove more difficult than the mere extension of accounting procedures to expenditures of GHG emissions and sequestration of carbon. The conceptual process of envisioning carbon equivalents (both emitted and sequestered forms) has been hampered by at least two factors. First, because the New Zealand economy has experienced an intensification of emissions-generating economic production since agreeing to the Kyoto Protocol, compliance with limits on GHG emissions has largely been represented as an additional cost as producers struggle to compensate for liabilities. In addition, commonly recognised alternatives to the purchase of emissions units (including tree planting) often involve a reduction in production intensity that does not conform to existing understandings of good business practice. Such complicating factors operate with similar impact on industrial and agricultural production.

Because carbon (the measurement standard for all GHG emissions and sinks) has hitherto not been a commonly recognised feature or metric of good farming (beyond the occasional reference to the value of soil carbon—especially in conditions of low soil moisture or the dramatic loss of carbon reserves following deforestation), farmers (and more particularly, New Zealand farmers) do not readily include it in their assessments of farming practice. Rather than merely incorporating an additional cost within calculations of management strategies, an ETS—by placing a value on carbon—imposes a novel means of assessing and evaluating farming practice. Furthermore, due the fact that most farmers perceive this to be an externally imposed valuation, they are more likely to challenge it based on their existing understandings of good farming. Carbon credits are viewed as more than merely a cost. They also threaten the pursuit of production that is a well established metric of farming proficiency.[1] As a result of such complicating factors, we argue that understanding farmer response to GHG mitigation policy involves more than simple interpretation of response to economic stimulus and its rationality.

The objective of this report is to provide a preliminary assessment of GHG mitigation policies proposed for the New Zealand agriculture and forestry sectors. In particular, it examines the response of pastoral farmers to the introduction of the ETS and several associated policy scenarios intended to encourage the establishment of carbon sinks by means of afforestation on farms. In order to better understand the context within which farmers are likely to respond to policies targeted at environmental outcomes, the report first compares the New Zealand ETS with agri-environment schemes in the European Union (EU), Australia and Canada that promote environmental outcomes through economic dis/incentives. The reluctance of farmers in the latter countries to participate in the schemes portends a similar hesitation among New Zealand farmers to engage

with and plan for the ETS. We suggest this reaction is affected by the existing "spirit of farming," or the farmers' own positioning within agri-food commodity chains. The report then documents the existing state of preparation for a carbon emphasis in the economy among New Zealand pastoral farmers. This was accomplished through the analysis of semi-structured interviews in which participants were introduced to the concept of emissions trading and the principal features of the ETS and provided with a rough estimate of their potential emissions liabilities given current stocking rates and land-cover attributes. It is noteworthy that the majority of farmers interviewed indicated a general lack of awareness, let alone understanding, of policy proposals or the potential impacts of the emissions trading scheme for their farming operation. Both this situation and the general preference to avoid contemplation of the implications of the ETS suggest that farmers' preparations for the scheme are not well advanced. This should be of little surprise given the challenge posed by the introduction of these new factors of production into considerations of farm management. In order to compensate for the lack of general preparedness, in addition to the general examination of the interviews and the marked farm maps, the report also focuses more specifically on a subset of farmers (two from each sector) who provide case studies of more nuanced differentiation among the introduced scenarios as these might affect land use practices. The conclusion to the report provides both a summary of farmers' response and recommendations for future policy directions and research needs.

The ETS as an agri-environmental policy

Despite the fact that the ETS can be construed primarily as an economic policy instrument, we argue in this report that the likely impact of its implementation in the New Zealand agricultural sector most closely resembles that of agri-environmental schemes in the European Union and elsewhere. We acknowledge that the underlying mechanisms of these policies (that of a market oriented allocation of emissions units compared to direct payments for environmentally beneficial practices) establish theoretically distinct incentives for action and effects on the wider economy. The successful incorporation of each policy type within existing management practices involves, however, a very similar need to value practices that contradict those underlying the productivist attitudes current in the agriculture sector in New Zealand, Europe and most other western economies. In this manner, these policies seek to impose a substantive change in farming identities—that is, adoption of and compliance with such policies involve an alteration of how farmers view themselves and what they consider to be the appropriate and acceptable objectives of farming practice.

The Spirit of Farming

In order to better represent the similar effect of these diverse policies in equally diverse production environments, we introduce the concept of the spirit of farming (as derived from Boltanski and Chiapello's (2005) examination of the spirit of capitalism—see, Rosin 2008). The spirit of farming can best be defined as the assemblage of attitudes, values and identities to which farmers refer in order to justify and rationalise their relatively weakly rewarded position within agricultural production chains. In other words, how do farmers represent the actions of agricultural production (on which the provision of food and fibre are dependent, but which generally realise less than 35% of the value of the final retail product) as sufficiently valued to justify their continued presence in the production chain? Social scientists increasingly identify a shared culture of productivism as the foundation of the existing spirit of farming that is being challenged by growing emphasis on non-productive aspects of land management (see

Burton and Wilson 2006; Dufour, et al. 2007; Evans, et al. 2002). The concept of productivism establishes a means of evaluating agricultural producers based on their capacity to produce a quantity of food or fibre. As a result, the most frequently celebrated feature of a farmer's achievements is her/his level of production. Those farmers who do not realise a level of production that is comparable to the "best" of their peers will readily explain the constraints they face relative to the highest producers in order to uphold their own position as a good farmer. Pertinent to the spirit of farming associated with productivism is the frequent reference to the independence and ingenuity of the individual farmer. For example, in representing themselves as both valued and valuable contributors to a broader society, farmers will celebrate the individual who coaxes the greatest possible (and generally sustainable) production from a farm within the context of its biophysical, social and economic environment. In light of this spirit of farming, policies that essentially impose the external recognition of limiting factors on production (for example, the removal of available land or limitation placed on the application of inputs) are viewed as much as threats to the farmers' identity as they are perceived to provide economic dis/incentives (see Burton, et al. 2008; Siebert, et al. 2006). As such, the spirit of farming directly influences a farmer's propensity to comply with and participate in agri-environment schemes.

The roots of the current spirit of farming are located in the variety of efforts to encourage increased production throughout the 20th Century as noted in influential analyses of global agri-food systems (Friedmann and McMichael 1989; Friedmann 2000; McMichael 2004). In response to the shortages of food and fibre resulting from the upheaval of the two world wars and subsequently from the escalating demand of a rapidly expanding global population, governments of developed economies created incentives to encourage higher agricultural production. The success of such policy initiatives was enhanced by the development of synthetic inputs (fertilisers and pest control agents). In this political-economic environment, farmers were challenged to demonstrate their capacity to 'farm well' through the adoption of new technologies which facilitated the intensification of production and resulted in rapid gains in production. Thus, *producing more* became a socially necessary and valued trait while any negative consequence associated with more intensive production was considered a necessary evil. In New Zealand, this situation was most evident in the orientation toward commodity production that predominated during the period of privileged access to the British market prior to the 1970s.

This political-economic environment essentially remained intact until the promotion of production in developed regions resulted in surplus supply and falling global commodity prices. As the 'dumping' of surplus product from subsidised production was increasingly associated with deteriorating market conditions for developing world producers, international efforts began to focus on eliminating incentives of excess production. For agriculture, to a greater extent than many other sectors, the issue of production subsidies has been difficult to resolve as they are linked to the continued viability of farming as a profession. In the European Union this has involved a policy shift toward payments for environmental and social services including the development of numerous agri-environment schemes to encourage specified management practices. Because these schemes attempt to convince farmers to engage in non-productive pursuits (that is, they involve a challenge to the existing spirit of farming), they have become the focus of a large body of social research. The schemes, as a closer analogue to the conditions of the ETS, also provide greater insight to the likely response of New

Zealand farmers to the implementation of the GHG mitigation efforts than past response to regulation in New Zealand. This claimed similarity is subject to the important caveat that, in contrast to the New Zealand case, the agri-environment schemes are generally undertaken by the respective governments, which provide either a direct (EU and USA) or indirect (Australia) stimulus to encourage participation. Since the 1980s, New Zealand farmers have faced a variety of market-based pressures to change practice. The adoption of integrated management protocols in the kiwifruit industry (KiwiGreen) is perhaps the most obvious incidence of market derived pressures for environmental outcomes—albeit with significant economic incentives as well (Campbell et al. 2006). Similarly, the loss of unlimited access to the British market in the 1970s has been the impetus for quality and animal welfare improvements in sheep meat production (Le Heron, et al. 2001). In both of these cases, however, the impetus for change emerged from within the industry as a response to unfavourable market conditions.

Agri-environment schemes and post-productivism

Initially, researchers examining the response to the agri-environmental schemes and the adoption of related management practices found evidence of a shift among farmers in the United Kingdom to a post-productivist mindset. This shift involved an alteration in their spirit of farming that acknowledged and valued some non-productive aspects of farming practice—including biodiversity enhancement, landscape creation and conservation, soil maintenance, etc. Ward, et al. (1998) provide among the strongest arguments for such a change in their examination of farmers evolving attitudes toward the regulation of pollution. Similarly, Morris and Potter (1995: 51) identify 'new conservationists' among farmers participating in the schemes while emphasising the need to develop enhanced means to legitimise conservation as an appropriate and viable use of rural land. The presence of farmers willing to accept the constraints on production and farmer agency imposed by the schemes suggests that they are able to rationalise another form of production. The interest in following the development of a more sustainable form of farm management led to the explication of an irreversible transition from productivism to post-productivism defined as farming with multiple objectives including such non-productive aspects as environmental services, aesthetic enhancement of the landscape and rural tourism. The concept was further formalised in EU policy which employed the concept of *multifunctional agriculture* in its efforts to justify the continued payment of subsidies to the agriculture sector.

More recently, further evidence of emerging non-productivist approaches to land management have been noted in other European countries. For example, Kristensen (2003) notes that 57% of farmers in Jutland, Denmark had employed some form of conservation practice on their farms. In a review of literature from several countries, Elands and Praestholm (2008) identify an increased willingness among both small- and large-scale farmers to include trees as elements of their farmed landscapes. These latter studies are, however, less optimistic about the pace or uniform directionality of the proposed transition toward non-productivist practices among farmers. These authors note that most farmers employing non-productivist practices also devote other parts of their farms to intensive production. This apparent diversion from a post-productivist transition has attracted extensive attention in the literature.

Among the explanations of a failing (or, in the extreme, failed) transition to post-productivism, deficiencies in existing agri-environmental policy instruments form one common theme. Such assessments often focus on the extent to which land managers

who enrol in a scheme either neglect to actively care for the areas subject to the scheme's criteria or to limit their productivist emphasis on areas remaining outside of the scheme. In other cases, the large numbers of non-participants are the focus of researchers' attention. For example, in an analysis of four agri-environment schemes in the United Kingdom, Brotherton (1991) argues that small payments and scheme constraints have discouraged farmer participation. Examining the Australian situation, King et al. (2000) argue that current policy has disassociated land managers from the process of defining and valuing environmental outcomes. Their study examines the emergence of a 'sustainability indicator industry' that fails to incorporate farmers' conceptions and understandings of sustainability. This process leads to the devaluing of existing and valid assessment of sustainable practice within the farming community. In a comparative analysis of farmers across the European Union, Gorton, et al. (2008) note that the farmers maintain strong support for productivist policies (subsidies and import protection), but are more ambivalent about agri-environmental ones. In the latter case, the common preference is for policy instruments that retain the flexibility of farmers' management strategies, thereby facilitating continued hybrid productivist/post-productivist approaches on individual farms. Franks and McGloin (2007), by contrast, propose alternative policy frameworks based on farmer-led Environmental Cooperatives that have shown successful results in the Netherlands. Robinson (2006) reports on similar experiences with active farmer participation in scheme development in Canada. In a similar vein, Morris (2006) highlights the need to incorporate farmer understandings in policy development to avoid alienation and devaluing of valid alternative perspectives. All three of these studies suggest that greater farmer ownership of schemes through the negotiation of criteria and constraints can result in greater participation and improved compliance. In addition, because negotiation occurs in terms that are familiar and relevant to the land managers, there is greater possibility to attain distinctive outcomes not dominated by productivism and multifunctionalism. Both Morris and Read (2007, for England) and Prager and Nagel (2008, for Germany) argue that the limitations of existing policy also lie in the accepted means of evaluation. They suggest that outcomes of agri-environment schemes should involve more than issues of efficiency, calculability, predictability, control (through technology) to include factors more relevant to prevalent farming attitudes. As a whole, these studies suggest that the non-productive nature of the practices promoted by agri-environment schemes necessitate the formation of policy that both provides opportunity to realign the underlying productivist focus of the current spirit of farming (what Halfacree (2007) describes as the need for a radical reinterpretation of the rural) and remains open to the contributions of those who the policy expects to influence.

Other authors suggest that it is the nature of the targeted environmental outcomes that detracts from the ability of land managers to incorporate them within their management strategies. According to this reasoning, the limited ability of land managers to recognise either the impact of climate change or the contribution of their individual actions to GHG levels in the atmosphere interferes with their capacity to incorporate associated policies within their management strategies. Carolan (2007) addresses this basic level of perception by arguing for policy that enables the creation of 'tactile space', that is experiences which increase awareness of and sensitivity to environmental and social impacts. He similarly argues that the benefits of sustainable agriculture—such as soil loss—are less 'visible' than those of conventional agriculture—including production (Carolan 2006). Another aspect of this position asserts that the scale at which environmental impacts occur is such that any cause-effect relationships with

management are not immediately perceived. Land managers are more likely to comply with policy based on local environmental conditions and the concerns of the local community. In her explanation of the response of Finnish farmers to agri-environment schemes, Kaljonen (2006) argues that farmer participation in the schemes reflects their local relationships to the environment and experiences with state governance. As such, their response may take little account of justifications of policy based on larger scale environmental impacts.

More recently, social researchers have emphasised the role of multiple actors in the pursuit of environmentally more responsible farming practice. In particular, these studies note the influence of the consumption end of the commodity chain including both retailers and consumers. Morris (2004), for example, uses Actor Network Theory as framework for examining the broader interactions among a range of actors that affect agri-environment scheme participation in the United Kingdom. Assessments of the impact of best practice auditing driven by European retailers in the New Zealand kiwifruit industry show that these can promote practices with an environmental orientation (Campbell 2005; Campbell et al. 2006). Selfa et al. (2008) caution against the reliance on such market pressures, however, arguing that consumers often hold excessively narrow understandings of what contributes to agricultural sustainability. In a study of governance structures for indigenous forests on the West Coast of New Zealand's South Island, Memon (2007) identifies further difficulties in allowing for balanced acknowledgement of diverse interest groups in regard to conservation objectives. The variety of interests and vectors of influence on the environmental impact of agricultural production identified in these studies provides further evidence of the socio-political context that affects the implementation of agri-environmental policy.

Productivist farming and environmental policy

Further explanation of the limited progress toward post-productivism promoted by the agri-environmental schemes involves characteristics of the farmers as targets of such policies. Such research usually involves statistical analyses of correlation between attitudes or characteristics and levels of participation. For example, Ondersteijn, et al. (2003) employ Linear Structural Equation Analysis to assess the correlation between farmer characteristics derived from a survey and nutrient balance conditions in the Netherlands. Seabrook, et al. (2008) identify variety of farmer characteristics which might affect retention of trees in farmed landscapes. Other authors have examined farmers' values and motivations as factors underlying their management actions. Schoon and te Grotenhuis (1999) identify two distinct bases for motivation among Dutch farmers that include both the desire to uphold convictions of being a good farmer as well as more practical or superficial rationales. In some studies, researchers emphasise the diversity of response indicators that overwhelms any attempt to provide generalised recommendations for policy development. For example, in a review of farmer participation in schemes to encourage biodiversity throughout Europe, Siebert et al. (2006) conclude that—individually—neither attitudes, values in regard to nature or authority nor economic factors provide sufficient explanation of behaviour.

A related and extensive body of research associates the limited participation in agri-environment schemes with an unaltered farming identity or spirit of farming founded in productivism. In this literature, the shared argument is that, beyond a change in policy, true compliance with agri-environmental policy requires a substantial change in farmers as individuals. Barr and Gilg (2007: 377, emphasis added) summarise this perspective

in the conclusion to their assessment of the adoption of environmentally friendly behaviour among the public in general, stating: "changes in attitudes, structures *and* values may be needed … to fundamentally change behavioural commitments to the environment". Lockie (2006) makes the further claim that farming identities may outweigh the impact of social networks on agri-environmental group membership based on research conducted in Australia. Retter, et al. (2002, cited in Siebert, et al. 2006) note that the farmers' identity also establishes a situation of conflict with outside assessments of environmental practice:

> "Farmers perceive themselves as being in a defensive position, both because of their negative public image (a fact that makes them fear for their survival) and because of nature-conservation policies usually being linked to restrictions, bans and limitations being placed on the agency." (331-2)

Thus, continued commitment to the productivist ideal among farmers establishes social and personal barriers to the incorporation of environmentally oriented practice in farm management strategies.

The role of farming identity in the adoption of non-productivist practice has also been approached through the examination of difference among various types of farmers who are thought to employ distinct approaches to management. The most frequently employed comparison in this regard is that between organic and conventional farmers with the intent of assessing whether organic practice represents an initial movement toward acceptance of a non-productivist orientation. Verhoog, et al. (2002) make a strong claim for recognising the unique status and understanding of 'natural' within organic farming. The distinct character of the concept among organic farmers contributes to what the researchers define as a holocentric ethics that would underlie a greater willingness to recognise the value of environmental outcomes. In an analysis of New Zealand data, Sandhu et al. (2007) similarly suggest that organic farmers are different in their recognition of environmental services. They qualify this claim, however, by acknowledging that some ecosystem services are equally appreciated by all types of farmers. The presence of the intention to pursue more sustainable environmental practice among conventional farmers in New Zealand has also been documented (Fairweather and Campbell 2003). Lockie and Halpin (2005) further challenge the distinction between organic and conventional farmers arguing that, on the basis of survey data from Australia, there are not significant differences in environmental attitudes between the two types. Taking a different tack, Beedell and Rehman (2000) use a structural social psychology model to demonstrate that members of the Farming and Wildlife Advisory Group maintain a weaker productivist orientation than other farmers in Bedfordshire, England. These studies suggest that, while recognised types of farmers may not be a sufficient basis for predicting environmental actions, it is possible to identify groups of farmers who are less inhibited by productivist attitudes in their response to agri-environmental policy.

Finally, more theoretically nuanced explanations of farmer behaviour in the context of increasing demands for environmentally responsible practice have focused on the social performance of farm management. These explanations are frequently based in 'theories of practice' in which practice is defined as the everyday means through which action conforms to social expectations. In this manner, the practice of farming is examined as the repeated and habitualised actions of farmers who are subject to the judgemental gaze of other farmers and society more generally. For example, Burton et al. (2008) use

Bourdieu's concept of a variety of capitals (including cultural and social as well as economic) to explain the limited potential for practices associated with agri-environment schemes in Scotland and Germany to be recognised as good and skilful practice among farming peers. In an assessment of agri-environment schemes and the promotion of multifunctionality in France, Dufour et al. (2007: 335-6) use a 'sociology of action' and conclude that the adoption of management orientations that move beyond a narrow productivist focus in agriculture involves a process of acculturation in order to incorporate previously unrecognised factors into understandings of farming as a profession. Rosin (2008) develops a similar explanation of the extent to which the existing spirits of farming in the New Zealand kiwifruit and dairy sectors either promote or inhibit the adoption of environmentally oriented best practice. These analyses provide a further indication of both the challenges involved in the promotion of non-productivist practice among farmers and the need to encourage a shift in the underlying spirit of farming in New Zealand.

The review of the existing literature that assesses the response of land managers to agri-environment schemes suggests that the incorporation of GHG emissions as an element of land management strategies will require a substantial shift in the farming identity among New Zealand's pastoral farmers. The implementation of the ETS arguably provides a means to quantify emissions liabilities and credits in terms that are compatible with the productivist orientation of the dominant spirit of farming. It is questionable, however, whether this valuation of carbon provides the requisite conditions to enable viable land management strategies in light of the complex social-ecological interactions related to GHG mitigation on farms. Past experience with policy instruments intended to promote environmental outcomes through economic incentives demonstrates the extent to which farmers have difficulty accommodating valuations of non-productive activities within their management strategies. Frequently, the introduction of such policies leads to farmers' resentment at the introduction of outside regulation by poorly informed bureaucrats. Furthermore, because farming practice has never accounted for GHG emissions, land managers will have poor understandings of the ecological processes that affect the levels of emissions or sequestration. New Zealand pastoral farmers are, thus, likely to respond with hesitancy to (if not outright dismissal of) the introduction of the ETS in the agricultural sector.

Data

The objective of this report is to provide an initial assessment of the current state of awareness and understanding around emissions trading as a means to reduce the net level of GHG emissions. In order to develop rapid insight into farmer understandings and perception, we utilised established contacts with farmers participating in the ARGOS project.[2] A subset of these farmers (12 dairy from the North Island and 17 sheep/beef from the South Island) representing a feasible number of participants within the time constraints of the project were interviewed during April-May 2008. This selection process admittedly does not provide sufficient coverage of the variety of New Zealand pastoral farmers to enable the extension of general conclusions to the sector as a whole. This group of farmers is, however, sufficiently representative to provide insight to both the potential response to emissions trading and the extent to which pastoral farmers are prepared to engage such policies.

The interviews with farmers included three distinct aspects: a) the provision of information regarding existing policy and expected scenarios; b) an opportunity for

participants to query the interviewer and provide feedback; and c) a mapping exercise in which potential on-farm responses to scenarios were indicated. During the introductory section of the interviews (generally consisting of at least one-third of the interview length), the interviewers provided an overview of emissions trading, the recognised sources of liabilities for pastoral farming, and various means of reducing the potential liabilities on farms. The interview participants were also introduced to the current features of the New Zealand Emissions Trading Scheme (ETS) and to further afforestation policy initiatives—the Permanent Forest Sink Initiative (PFSI) and the Afforestation Grant Scheme (AGS). At this point, a rough estimate of an individual's carbon liabilities in the proposed ETS (based on current stocking rates less a 90% allocation of free credits) was calculated. This calculation was used to facilitate an examination of plausible strategies (from the individual farmer's perspective) of engaging with ETS conditions. Generally, throughout the explanation of the conditions of Kyoto Protocol obligations, emissions trading, and potential liabilities and sinks, the participants posed questions of clarification as well as challenges to underlying assumptions of the policy arena. These discussions were recorded to facilitate analysis of feedback regarding the ETS and associated policy initiatives. This section of the interview concluded with the introduction of further scenarios involving the point of obligation for carbon liabilities (industry vs. individual) and different carbon prices ($25 and $50 per tonne). Once the full suite of scenarios was presented, each participant was asked to indicate the potential locations for afforestation on their farms. This information was recorded by means of marking on farm maps and, where farmers were able to differentiate, included distinct areas for any of the scenarios noted above.

Analysis of the farmer interviews involved the coding of responses to scenarios and the grouping and assessment of these codes. This process was accomplished by assigning codes to temporally defined segments of the interview audio. These segments then become elements in a database that can be searched by code to allow all similar segments from the complete body of interviews to be scrutinised as a group. In this manner, similarities and differences in response and positioning relative to scenario conditions were examined. Variation in response was also compared to farmer and farm characteristics to develop initial hypotheses regarding the effect of such factors as age, farm size, and geographical location on response tendencies. Finally, the coding process facilitated the identification of quotations from the interviews that provided a good illustration of the attitudes and intentions expressed by the interview participants.

A separate analysis of the mapping activity was accomplished by means of an ArcGIS database. All of the farm maps were already included in the spatial database for the ARGOS project. The areas marked as potential sites for afforestation on each map were digitised and amended to existing map data. This involved some interpretation of the markings by the research team. For example, in cases where a farmer referred to a whole paddock, the paddock fence line was used to calculate area rather than the marked line. Similarly, strips of trees were digitised to conform to a 30 metre minimum width. Based on the digitised information, estimated areas of afforestation were calculated for each farm and each relevant scenario on that farm. The discussion of the mapped data (both in general and for the case studies) is presented to give some insight to the decision-making process as farmers respond to the ETS and the emphasis on CO2e in the economy. The limited sample of farmers and the conditions of their response limits, however, the capacity to draw more generalised conclusions relevant to the pastoral sector as a whole.

Farmer awareness of and response to policies

This section reviews the interview results with respect to the farmers' response to and potential engagement with various policy scenarios. Farmers were presented with the effect of a variety of scenarios on their farm and given the opportunity to comment on the potential implications for each. The scenarios presented allowed the farmers to reflect on the agricultural component of the Emissions Trading Scheme, the potential points-of-obligation for agriculture in the ETS, the forestry component of the ETS, the Permanent Forest Sink Initiative and the effect of prices of $25 and $50/tonne CO2e in the ETS and PFSI, and the Afforestation Grant Scheme.

The farms participating in this study (12 North Island dairy and 17 South Island sheep/beef) display broad ranges of total land area, stock composition, and stock density. On the whole, these farms tend to be smaller, have fewer stock units and lower emissions liabilities than the MAF model farms described in the report *Projected Impacts of the New Zealand Emissions Trading Scheme at the Farm Level* (MAF, 2008). Several participating sheep/beef farms also mix grazing and arable production resulting in lower stock units per hectare than typical for the pastoral sector. Tables 1 and 2 provide summary statistics for participating dairy and sheep/beef farms.

Table 1. Summary statistics for participating dairy farms

	ha	t CO2e/yr	full liability @ $25/t
Minimum	70.5	337.5	$8,437.50
Median	98.8	687.5	$17,187.50
Maximum	175.0	1575.0	$39,375.00
Mean	113.0	718.1	$17,953.13
Std Deviation	37.1	350.2	$8,755.24

Table 2. Summary statistics for participating sheep/beef farms

	ha	t CO2e/yr	full liability @ $25/t
Minimum	141.0	343.6	$8,590.00
Median	425.1	1213.5	$30,336.25
Maximum	1650.6	3160.0	$79,000.00
Mean	564.9	1263.7	$31,591.72
Std Deviation	433.0	759.4	$18,985.16

*values in **ha** and **t CO2e/yr** columns are independent

The agricultural component of the ETS

In each interview, farmers were provided with information on the proposed design of the ETS and the involvement of the agricultural sector, the significance of agriculture in the national emissions profile, and indicative emissions factors for each category of ruminant stock. Farmers were also invited to ask questions and offer feedback at any point in the exercise. In general, farmers initially professed little knowledge of the scientific basis of climate change, a lack of awareness regarding the institutional framework of either international or domestic GHG governance and only vague understandings of the potential implications of the New Zealand ETS for their farm operations. Despite their unfamiliarity with the state of the science and policy around GHGs, farmers were able to make quick assessments as to their role in the agricultural component of the ETS. When evaluating the outcomes of these interviews, it is

important to consider that these reactions are based on what—in many cases—was a farmer's initial consideration of the ETS and its implications for their farm. Most participants framed their engagement with the ETS primarily in terms of its costs for their farm. Participants expressed almost universal opposition to the ETS in light of these financial liabilities. This opposition reflected their concerns relating to the effect of the ETS on levels of individual farm profitability, likely trade-offs between emissions liabilities and competing uses of farm capital, the effects of the ETS on the international competitiveness of the sectors, and the potential depreciation of land and stock prices arising from the reduced returns on investment in pastoral production. Additionally, while they acknowledged the market-like basis of emissions trading and its economic rationale, many farmers referred to the ETS and their emissions liabilities as a "tax" or purchasing emissions units as "paying the government". The creation of the ETS and the establishment of a price on GHGs were perceived not primarily as an efficient means for reducing emissions, but as unjustified government interference in farming with few tangible benefits.

In response to the description of the recognized sources and sinks for GHGs within the ETS, many farmers expressed concern about the method for calculating stock-generated emissions based on the indicative emissions factors used in the interviews. Of these farmers, comments were evenly divided between those who favoured the simplicity of applying a single-factor approach against those who felt that the calculation of liabilities required consideration of farm attributes beyond the number of stock units. These additional attributes included the breed of stock, the characteristics of pasture and supplemental feeds and the use of organic inputs. The farmers who raised this issue expected (with various degrees of certainty) that their farm management practice was likely to generate less emissions than the standard indicative factor. A majority of the farmers interviewed also raised the issue of soil carbon and pasture grass sequestration in their reaction to the sector's liabilities within the ETS. In almost all cases, farmers referred to these issues as potential means to reduce individual and sectoral emissions liabilities; the remainder of the farmers who mentioned soil carbon and pasture grass sequestration considered the omission to be arbitrary and indicative of what they viewed as inevitable limitations of climate policy.

Based on the calculation of potential emissions liabilities from indicative emissions factors and stocking rates conducted as part of the interview, farmers were asked to evaluate the potential consequences of GHG liabilities for their farm post-2013. Most, but not all, farmers considered their exposure to emissions liabilities post-2013 with 90% free allocation and an emissions unit price of either $25 or $50/tonne CO2e as a manageable expense. Farmers universally claimed that full exposure to emissions liabilities at $25/tonne CO2e (based on the removal of all free allocation of emission units) would move their operation into negative profitability. Many interview participants indicated that they would be forced to sell their farm if their costs for ETS compliance approached these levels.

While many of the farmers expressed similar sentiments on their general impression of the ETS and its effects for their farms, the interviews revealed some differences between how the dairy and sheep/beef sectors might respond to new emissions liabilities. Dairy farmers viewed their emissions liabilities at 90% free allocation as generally affordable and several subjects indicated that this cost (at $25/tonne) was approximately equal to their recent increase in payouts. Most diary farmers indicated

that at 90% free allocation, the cost of emissions units (at both $25 and $50/tonne) would have no significant effects on farm management. A few farmers did note that than exposure to emissions liabilities ranging from $2000-$8000 per year would encourage a closer examination of farm management practice in order to improve on-farm efficiencies to recover these costs. Some dairy farmers indicated that as the free allocation of emissions units was reduced, they might attempt to intensify per-animal production in order to improve their cost per unit ratios. As mentioned above, none of the participating dairy farmers indicated that their farm would remain viable if they were exposed to their full emissions liability at a price of $25/tonne or above.

Although most sheep/beef farmers indicated their ability to manage the cost associated with emissions liabilities under 90% free allocation at $25/tonne, some farmers indicated that even this amount (and amounts at 90% free allocation at $50/tonne) would have a significant effect on current profitability given current prices. While some farmers would be shielded from their initial emissions liabilities based on existing forestry credits, in most cases such credits (for both pre-1990 and post-1989 forests) provided only a minimal cushion from emissions liabilities. The sheep/beef farmers characterized the potential range of changes in farm management to counter costs of agricultural emissions from the ETS more narrowly than did the dairy farmers. Among the constraints noted by sheep/beef farmers were relatively high levels of existing stocking density, the high costs of inputs that would enable further intensification, low levels of available capital for investment, and high interest rates that discouraged further borrowing. Some of the sheep/beef farmers expressed the likelihood of reducing the number of stock (particularly of sheep) and increasing the proportion of farm production dedicated to cropping. Other farmers noted the infeasibility of more extensive cropping given existing diesel and fertilizer prices. Two farmers mentioned the possibility of shifting production away from sheep to deer in order to improve or recover profitability based on a better meat price to emissions liability ratio, although the feasibility of such changes were considered uncertain. Finally, a few sheep/beef farmers considered the distribution of emissions liabilities and free allocation of emissions units between sectors as favoring dairy production at the expense of the sheep/beef sector. These farmers suggested that in order to avoid a downturn in both sheep/beef production and the viability of sheep/beef farms, exposure to liabilities should correspond to the ability of sectors (or perhaps individual farms) to reconcile these liabiities within the capacities of existing farm management practice.

Potential points-of-obligation in the ETS

Farmers were asked to indicate their preference for the point-of-obligation in the agriculture component of the Emissions Trading Scheme. The point-of-obligation was described to farmers as the agent responsible for calculating and reporting emissions from agricultural production and obtaining and holding the necessary units to cover the level of emissions. Dairy farmers' preferences were split relatively evenly between that of farm-level or processor-level point-of-obligation. Among the justifications given for farm-level obligation were increased capacity for adaptation and flexibility, a preference for using their own time and labour as compared to having processors include cost-recovery charges and a desire for transparency in the exact costs of compliance. Farmers who indicated a preference for processors as the point-of-obligation noted a desire to avoid additional paperwork and the ability of Fonterra to easily calculate each farm's liability based on existing records. In many cases farmers expressed a weak preference and noted potential benefits associated with both of the alternatives. A few

farmers suggested that they would prefer the flexibility that a farm-level point-of-obligation could provide, but were concerned about the potential for non-compliance from other farmers and the negative attention such could bring to the sector. Another farmer expressed support for a processor-level point-of-obligation by default but with the option of opting for self-reporting if they were unsatisfied with the processor's governance strategy.

Sheep/beef farms were also divided between the two options, although more respondents indicated a preference for a farm-level obligation. Sheep/beef farmers also cited a desire for management flexibility, avoiding compliance charges passed on by processors, and a desire for transparency as justification for their preference. Interest in a farm-level point-of-obligation was strongest among sheep/beef farmers who could claim existing emissions credits from forestry and those who expected to participate in ETS forestry to off-set stock-generated emissions. It was weakest, by comparison, among sheep/beef farmers who were not interested in afforestation. This contrast may indicate that, under a processor-level point-of-obligation, any incentives for adopting alternative farm management strategies may not translate from processor to farmer alongside the cost of compliance. Citing their concern for minimizing the costs of ETS participation a few sheep/beef farmers suggested that, if processors were the point-of-obligation, the factors for stock-generated emissions be made public as to assist farmers in differentiating between actual emissions liabilities and cost-recovery by processors. Other farmers, however, commented that processors would likely be able to generate efficiencies of cost management and compliance that would lower the overall cost of compliance to farmers compared to individual farm reporting and auditing. Finally, a few sheep/beef farmers expressed concern about how reporting of emissions from stock units at the farm-level could be made compatible with flexible, between farm stock sharing programmes and how stock unit-based calculation of emissions factors would affect the price of live sales. Table 3 summarizes farmer preferences for the point-of-obligation between sectors.

Table 3. Farmer preference for point-of-obligation in ETS agriculture

	Dairy	**Sheep/beef**
Farm/Individual-level	6	10
Processor/Industry-level	4	5
No preference/Unsure	2	2

The forestry component of the ETS

After discussing their farm's expected liabilities for agricultural GHG emissions, many farmers recognized afforestation as a potential strategy to reduce their net liability and the cost of compliance with the ETS. Almost all farmers perceived afforestation as a direct trade-off with grazing productivity and pastoral production. When describing their general interest in establishing new qualifying forest blocks to generate emissions credits, farmers frequently characterized their farm landscape as "useful" and "valuable" in contrast to land suitable for forestry that was characterized as "not useful." This description reflects farmers' willingness to prioritize certain land uses that may contribute to efficient management of mixed production landscapes. However, many farmers who initially described their entire farm as "productive" could, when pressed, identify areas of pasture that made little or no contribution to profitability. This included both smaller pockets (still of at least 1 hectare) of less productive grass or

entire paddocks that were either difficult to work or infrequently grazed. In a majority of cases where afforstation was considered, farmers initially expressed a preference for planting indigenous species. However, after the calculation of sequestration capability for native species and the land available for afforestation, almost all farmers indicated that exotic species (most often *pinus radiata* or *pseudotsuga menziesii*) with higher rates of sequestration would be preferred. While many farmers were interested in off-setting some of their farm's emissions liabilities, there were wide disparities in the ability of farmers to identify areas for afforestation that would make a substantial difference in the cost of compliance. In general, sheep/beef farmers were able to identify larger land areas suitable for afforestation than were dairy farmers, but only one farmer was able envision afforestation sufficient to off-set more than half of the emissions liabilities generated by their current stocking rates (calculated with fifteen year *p. radiata*). No farmer expressed interest in afforestation beyond the level that would offset livestock generated emissions liabilities. In a few cases farmers noted the possibility of purchasing low-cost, low-productivity land in order to establish forestry for off-set credits at a location away from the home farm. This consideration was generally vague and farmers were reluctant to pursue more detailed discussions as to their perception of the financial feasibility of this option.

The farms included in the interviews exhibited a broad range of existing forest cover with the potential to claim emissions credits. Only one of the twelve dairy farms had existing eligible post-1989 forest that covered ETS liabilities for current stock units at 90% free allocation. Many of the participating sheep/beef farms, by contrast, had pre-1990 exotic forests of sufficient size to raise their interest in participating in the forestry component of the ETS. Only one farmer with pre-1990 exotic forest (of less than 50ha) indicated they would opt-out of participating in the forestry component of the ETS. Farmers with pre-1990 exotic forest indicated interest in using the one-time allocation to off-set agricultural GHG liabilities post-2013. While some sheep/beef farmers had post-1989 forests of sufficient size to off-set agricultural liabilities at the initial 90% free allocation, only two of the participating sheep/beef farms expected credits from post-1989 forest to cover more than 25% of total agricultural emissions. In many (but not all) cases, farmers who expected to earn credits from existing forest were more likely to consider further off-set oriented afforestation and regarded the delayed exposure to a negative balance of emissions units as beneficial in their efforts to identify future options for changes in farm management practice.

The proclivity to plant new areas of forest within ETS forestry also varied substantially among the participating farmers. Those who demonstrated interest in establishing new forests within ETS forestry did so primarily as a means to off-set future liabilities generated by grazing animals. Preference for participation in ETS forestry, as opposed to the PFSI, was based on both a desire to earn equivalent emissions units as those charged for stock (rather than Kyoto Assigned Amount Units), and a perception that the ETS offered greater flexibility for future land use. Most farmers, including those who could identify potential sites for conversion of pasture to forest, perceived afforestation as an uncertain investment. The uncertainties identified by farmers as affecting any decision to participate included the large up-front cost of establishing new forests, an inability to forecast carbon prices, concern about the accuracy of sequestration tables for financial planning, potentially drastic changes in the political or policy environment, the long period required for a return on investment from timber harvesting, low expectations for future log prices, and concerns about compliance costs and paperwork

associated with resource consents and participation in ETS forestry. Except when provided with concrete information during the interviews, farmers generally lacked sufficient knowledge about the cost of establishing and maintaining forest blocks. Farmers reluctant to engage in ETS forestry often claimed little knowledge of silvicultural practices and wished to avoid reliance upon consultants and other advisors if they were to participate in afforestation. Several farmers noted that, by the time future liabilities for agricultural emissions were large enough to justify undertaking new forest plantings, the area needed for significant off-sets would exceed the ability of the farm to remain profitable. Farmers who lacked existing forestry credits and expressed interest in afforestation also considered the low rate of carbon sequestration in newly established forests as a significant disincentive to early adoption since these forests would not significantly off-set agricultural liabilities for at least ten years.

The interviews also highlighted significant differences between sectors in farmers' descriptions of their reactions to and potential engagements with ETS forestry. In general, dairy farmers expressed relatively little interest in participating in ETS forestry in comparison to sheep/beef farmers. Many dairy farmers characterized their farms as having little land available for forestry. Furthermore, few saw any economic advantage to forestry as, even at a price above $50/t CO2e, it appeared to provide less income than dairy production. Among those dairy farmers who identified some land with afforestation potential, there was little interest in harvesting the planted forests (these farmers were more likely to prefer participating in the PFSI). Although sheep/beef farmers were more likely to express interest in ETS forestry, they also expressed significant concerns that reflect the sector's diminished or constrained ability to engage these policies. Many sheep/beef farmers with some interest in afforestation indicated that they are currently constrained by levels of low profitability, little cash-on-hand for investment, and high interest rates. Such constraints work against the ability of the sector to engage policies aiming to reduce net emissions levels and delay the conversion of land to forestry. Several of the participating sheep/beef farms are involved in arable production that provides a major source of farm income. These farmers often explained the unsuitability of ETS forestry for their farm in terms land prices, soil quality, and the need to maintain open areas for irrigators. Several farmers perceived their farm as unsuitable for forestry based on local climatic conditions including frost and draught. Other farmers indicated that they had previously established forest blocks; but, due to disappointing outcomes, they were unlikely to attempt afforestation even with the potential to earn carbon credits. Moreover, for sheep/beef farmers who were interested and willing to engage the forestry component of the ETS, there were difficulties identifying the appropriate conditions on their farms. Most of the participating sheep/beef farmers had difficulty envisioning afforestation beyond 25% of their agricultural liability due to the perceived effects on stocking densities. Although there is significant interest among farmers in establishing new forests that would earn emissions credits, the ability of farmers to move land into forestry is very limited based on substantial social, spatial, and financial barriers.

The Permanent Forest Sink Initiative

Many of the same concerns that were expressed about ETS forestry apply equally to the potential participation of farmers in the PFSI. Among the most prominent limitations are an unwillingness to convert productive grazing land to forestry, the lack of significant areas of unproductive land available for conversion and the uncertain return on investment from forests established for carbon sequestration. In most cases

participation in the PFSI was perceived as a means to off-set liabilities for agricultural GHGs. A few farmers did, however, express interest in moving small areas of land into permanent forest sinks even if not exposed to any emissions liabilities. Dairy farmers expressed more interest in the PFSI than did sheep/beef farmers, due mostly to the former group's lack of interest in harvesting for timber. Sheep/beef farmers also associated greater constraints on future land use options with the PFSI conditions and criteria.

The Afforestation Grant Scheme

Interest in the Afforestation Grant Scheme was limited among both dairy and sheep/beef farmers. Several dairy farmers cited a lack of sufficient land available for meeting the five hectare minimum application size required for tenders within the AGS. Other dairy farmers indicated a preference for maintaining maximum flexibility in land use decisions that was incompatible with the ten year grant agreement contract. Sheep/beef farmers who did not expect to participate in the AGS tended to explain their decisions with reference to a desire to earn income from all available land area on the farm. Among those sheep/beef farmers who expressed interest in afforestation of unproductive pasture, many preferred the option of earning credits through ETS forestry or the PFSI to that of the AGS. Of the interview subjects who expressed interest in tendering for an afforestation grant, most expressed a preference for native species and sought to establish new forests contiguous to sites currently regenerating to native bush.

Price scenarios and price signals

Most farmers expressed uncertainty about the nature of prices for emissions units, although a higher price scenario did prompt more extensive areas of tree planting among those who would consider afforestation. Despite the apparent capacity among some farmers to describe carbon in terms of the familiar notion of commodity prices, many also questioned the extent to which future changes in domestic or international GHG emissions policies might have dramatic influence upon liabilities and opportunities for forestry-generated emissions credits. When faced with potential changes to farm operations that require capital investments and generate sunk costs, farmers tended to characterize their current financial outlook as sternly risk averse. In the face of long-term price uncertainty for both agricultural products and carbon, some farmers favoured a reliance on potential technological solutions or political shifts. Other farmers questioned whether a long-term increase in the price of emissions units might actually prove to be a disincentive for afforestation. They reasoned that, if new forests were planted at a relatively low carbon price in order to off-set existing emissions from their livestock, harvesting or future deforestation of these forests might become a significant future liability depending on the price of carbon in thirty years. Similarly, concern was expressed that extensive afforestation on productive pasture might lower the value of that land given the cost of deforestation liabilities if these blocks were returned to pasture at a later date.

During interviews, farmers frequently described the potential to preserve or increase farm profitability as the principal criteria for decision making in regard to GHG emission liabilities and credits. When characterising why particular alternative farm management scenarios might be pursued, farmers frequently justified their decisions in purely economic terms. As such, most farmers expressed agreement with the idea that the price for emissions units could reach a level at which significant shifts in farm operations from pastoral production to forestry would be financially beneficial.

However, when asked to describe the conditions under which this shift might occur, farmers often struggled to identify the range of factors and price signals within which alterative decisions would be made. This situation is unsurprising given that the farmers are being exposed to new price signals and new institutional contexts while lacking the requisite information and experience with these contexts to identify optimal economic outcomes. Even if farmers, as economic actors, were able to apprehend the range of considerations and uncertainties associated with carbon prices, the extended time-scale dependency of altering farm management may preclude the construction of concrete financial forecasts.

Spatial differentiation of policy impacts

The final activity in the interview process involved asking participating farmers to mark areas of possible land use change on farm maps. The process of mapping was expected to be informative both for the participants (providing a degree of spatial visualisation present neither in descriptions of policy nor spreadsheet formats) and for research (providing some insight to the locational decisions of farmers and an estimate of potential area converted to afforestation). In practice, however, the exercise posed several challenges for both the farmers and the interviewers. First, there was substantial uncertainty around potential land use change on the part of farmers due in part to their limited awareness of policies and the continued negotiation of the terms and conditions of the ETS. As a result, few farmers were able to distinguish on their maps among competing potential scenarios and often treated the decision as purely a cost/benefit analysis in which whole paddocks were shifted to new forest plantings. (As noted above, the two selected farms from each sector are used to establish case studies of likely response in a more informed and stabilised decision environment.) Second, those farmers who lack experience in establishing forest blocks had little insight to the appropriate location and conditions for plantations that might provide associated benefits for soil erosion control, shelter or enhanced biodiversity. This factor also contributed to the tendency to select whole paddocks for conversion to trees. Finally, several of the participants were reluctant to engage in an activity that gave some implication of commitment or permanence. In other words, they refrained from mapping to avoid establishing the expectation that they were committed to the markings on the maps. This group of farmers also included those who viewed their refusal to do the mapping as a political action intended to indicate their opposition to the ETS more generally. With these caveats in mind, the following summary of the farmers' spatial differentiation of policy and carbon price scenarios is based on maps completed by the participating farmers.

Mapped afforestation for all farms

Overall, approximately 62% of the farmers interviewed identified areas of their farms where they would consider planting trees in response to any of the scenarios. This group of farmers included ten (of 17) sheep/beef and eight (of 12) dairy farmers. The size of areas planted varied from as little as 1.1 to 102.4 hectares with an average size of 17.5 hectares (in the $50/t CO2e scenario) on the farms where potential plantings were indicated. Many of the farmers who did mark areas of afforestation on their maps indicated that they would consider increasing the area (except in the case of the AGS) with an increase in the price of carbon. None of the farmers differentiated the areas on the maps in response to the point-of-obligation scenarios. As noted in the interview analysis, the availability of what an individual considered to be marginal land was one of the primary factors contributing to a positive response to afforestation policy. This

factor is also a likely explanation for the high variation (standard deviation of 24.1 across all the farms) in the area designated for tree planting.

The summary data for the mapped areas is shown in Table 4. The starkest contrast evident in the mapped areas of afforestation is that between to the two sectors. The sheep/beef farmers generally committed larger areas to afforestation than the dairy farmers. This situation likely reflects the larger total areas of their farms and the more common presence of areas of more marginal productive potential (hills, gullies, etc.). Most of the seven sheep/beef farmers who did not mark areas of afforestation on their maps were located in relatively flat regions and depended to a significant extent on crop production. The sheep and beef farmers showed a strong preference for the ETS as a policy incentive for afforestation with seven farmers seeking to claim carbon credits at the $25/t and ten at the $50/t price. The ETS also encouraged the largest area of tree planting. On the other hand, the AGS had some appeal for the sheep/beef farmers, four of whom would consider the grant scheme (although this did not increase with the price of carbon).

Table 4: Potential area of afforestation in response to policy scenarios (in ha)

	Dairy	S&B	All Farms
AGS	5.6	71.6	77.2
ETS			
$25	11.0	107.7	118.7
$50	17.0	162.2	179.2
PFSI			
$25	25.9	0.0	25.9
$50	35.7	46.4	82.1
Total ($25)	42.5	179.3	221.8
Per interview	3.5	10.5	7.6
Total ($50)	58.3	280.2	338.5
Per interview	4.9	16.5	11.7

The dairy farmers, by comparison, committed generally smaller areas of their farms to afforestation and were more likely to divide this area among several plantings. (It is noteworthy that, among the farms that marked areas of afforestation on their maps, these areas represented 5% of total farm area for both sectors.) For the dairy farms, the number of plantings marked on an individual farm map ranged from one to ten (mean = 3) as compared to a range of one to six (mean = 2.3) for sheep/beef farms. The resulting average patch size for tree planting at the $50/t price level is 1.9 hectares for dairy and 12.2 hectares for sheep/beef farms. This suggests that the dairy farmers had to be more selective of areas for planting trees due to the potential impact on the production capacity of their smaller farms and more intensive operations. The relatively smaller increase in forested area in response to higher carbon prices across all policy instruments (afforestation on dairy farms increased by 37% compared to 56% for sheep/ beef farms) offers a further indication of the limited areas on the dairy farms that are not considered indispensable as productive grazing area. Finally, the dairy farmers demonstrated a distinct preference for the PFSI, which accounted for approximately 60% of afforestation marked on the maps. Based on the interview comments, this largely reflects the desire to plant for conservation as opposed to harvesting purposes.

Mapped afforestation for selected case study farms

Dairy Case Study Farm 1:

The first case study farm is a Waikato dairy operation of 128.9 hectares with 330 dairy cattle. The calculated liability for this farm was 825 tonnes CO2e with a cost of $2,062.50 at 90% free allocation and $25/tonne. The farmer's reaction to this initial liability, and a $50/tonne liability of $4125.00 was, "It's not going to break the bank...as a comparison I would spend more than that a year maintaining my tractors...in dollar terms it's an annoyance, rather than tipping you over." The preferred point-of-obligation in the ETS was industry level. The farmer called this the "easy option" and said, "If it was a scheme that cost us 3 cents/milk solid, by the second year we wouldn't even blink...it'd be forgotten about." The farmer claimed that he "has been hoping that this whole carbon emissions thing will just go away."

This farmer saw little capacity for changes in farm management that could lower emissions levels or improve emissions efficiencies and would consider participating in ETS forestry or the PFSI to earn emissions credits. A total of five sites of potential afforestation were identified in the mapping exercise. Four of these sites, with a combined size of five hectares, would be considered at a price of $25/tonne CO2e. An additional site of 6.7 hectares was identified as an option at $50/tonne. The farmer's preference for the ETS and PFSI (instead of the AGS) was primarily driven by an interest in maintaining flexibility and control over land use, although there was also an interest in earning emissions credits. Sites indicated for potential afforestation were characterised as low performing or steep land that is currently grazed. The farmer expressed a desire for a mix of native and exotic species across blocks. The large section indicated at $50/tonne was selected for its location at the back of the farm in areas adjoining a small waterway.

Dairy Case Study Farm 2:

The second case study is a 112.8 hectare Waikato dairy farm. The operation consists of 300 dairy cattle generating an estimated 750 tonnes of CO2e. At a price of $25/tonne and 90% free allocation, this farm faces a liability of $1875.00. Neither this figure, nor a doubling of this figure, was considered as imposing a significant impact on farm management. The farmer responded to these figures by saying, "I don't think it would change farming a lot...it's not a big enough, scary enough number to be perfectly honest. You could tweak your farming operation to offset most of that cost I would say." This farmer preferred a processor point-of-obligation in order to minimize paperwork and labour involved in reporting emissions, but expressed concern with how Fonterra might administer and manage liabilities across different types of dairy operations.

While this farmer expressed some interest in the ETS/PFSI in order to earn credits on unproductive land, he indicated relatively small potential blocks of afforestation and described the financial incentives provided from sequestration as being of minimal impact. The AGS was viewed as potentially more appealing than ETS/PFSI afforestation based on the lack of risk of financial loss to the farmer. The same two blocks were identified for participation in each of the three programmes. These blocks were of 2.3 and 3.3 hectares and were selected based on their low grazing productivity and their location along the farm boundary and adjacent to a stream. Establishing forest cover in this area was expected to, "have no effects on our farm revenue." The farmer described the farm as lacking large parcels of land that could be put into forest either permanently or for as little as ten years.

Sheep/Beef Case Study Farm 1:
This 758 hectare mid-north Canterbury sheep/beef farm currently stocks 3000 sheep and 200 beef cattle. In some years stocking may reach 4000 to 4500 sheep. The calculated liability for this farm was 1340 tonnes/CO2e with a cost of $3,350.00 at 90% free allocation at $25/tonne. Existing pre-1990 forest covers only 2-3 hectares and provides little cushion against agricultural liabilities from 2013. While this farmer claimed that the liability could be serviced out of anticipated farm income, additional price levels or reduced free allocation could prove more challenging. The current operating environment and low lamb prices was seen as already encouraging a reduction in inputs (the establishment of offset forestry was also characterized as an input). While the farmer mentioned the use of supplemental feeds as a means to increase animal weight to improve emissions efficiencies, the cost effectiveness of such actions were seen as uncertain. The farmer noted his concerns on the long term implications of the ETS and its potential for "increasing the cost of agricultural production by $40,000 a year."

This farmer expressed a reluctance to bear the cost of emissions liabilities and would consider participating in the forestry component of the ETS in order to offset liabilities from stock. This farmer conveyed that he would love to participate in the AGS and had envisioned active afforestation of native bush "if I had cash in hand." When faced with emissions liabilities though, this farmer indicated that these areas would instead be used for establishing exotic forest blocks to earn emissions credits. Two sites were selected for potential planting. Both areas were described as steep slopes with low grass production; removing these areas from grazing was still expected to reduce stocking capacity though. An area of 33.8 hectares was identified for planting at $25/tonne and another area of 21.3 hectares would be considered at $50/tonne. The farmer indicated that planting of high sequestration pines at staggered age classes would be preferred. The farmer estimated that he would need to establish more than 80 hectares of high sequestration forest species in order to fully balance his stock emissions and expressed significant doubt that this extent of afforestation would allow for sufficient stocking levels to maintain profitability.

Sheep/Beef Case Study Farm 2:
This south Canterbury sheep/beef farm typically stocks 3640 sheep and 105 cattle. The emissions for this farm were calculated to 1379 tonnes/CO2e. At 90% free allocation and $25/tonne, this farm's liability was estimated to be $3447.50. The farmer expressed concern that future reduction of free allocation would be problematic saying, "If they come out and say you're liable for the full amount, then you're not going to make any money on the farm." Approximately four existing hectares of post-1989 douglas fir are expected to provide credits.

The farmer identified 24.5 hectares of possible afforestation during the mapping exercise. Of these, 18.5 hectares were included at $25/tonne and the remaining six hectares at $50/tonne. The location of blocks was based on several criteria. Two small blocks could be located alongside existing areas of woody vegetation; two other sites were chosen for their potential as shelter or windbreaks; a final larger block could potentially be located in a low lying area across several paddocks. While the farmer expressed a willingness to "work out what trees were the best for where on the farm and what was going to give you the best [sequestration] rate," he also noted that,

> "It's not easy to establish trees down here. The climate's very extreme and you get cold springs and frosts which young seedlings, even young pines, would get nailed here ate times. Then you get dry summers. You only have to look at some of the older trees when they're cut down, you see from the ring growth on them where they've had good years and not so good."

In general, this farmer perceived few options for engaging emissions policies based on limited profitability and environmental suitability from afforestation.

As a whole, these case study farms indicate the extent to which, even for farmers more predisposed to offsetting liabilities with afforestation, the proposed policies act as much as a hindrance as an incentive. In particular, the different sequestration rates between native and non-native species contradicted existing perceptions of which actions would be more environmentally appropriate. The constraints on size, shape and future land use also affected these farmers engagement with the policies. These latter conditions of participation (in association with price signals) also influenced the area and location of planting. Finally, the response of these case study farmers indicates that extent to which putting a price on GHG emissions associated with animal production are perceived as penalties on producers rather than a means for efficiently allocating emissions credits among competing industries.

Conclusion

Prior to presenting conclusions from the above analysis, we strongly caution against the extension of these findings to more general assumptions about the agriculture sector in New Zealand. A more appropriate and accurate interpretation of this data would be to recognise the attitudes and positions assumed by the farmers in this report as indicative of at least some of the (very real) perspectives that are current in the agricultural community. As a whole, the interview data examined for this report suggests that it would be extremely premature to develop national-level quantitative approximations of the impact of the policy scenarios examined. The farmers generally expressed a lack of awareness, let alone an understanding, of the structures and conditions of the ETS. As a result, they were very appreciative of the information and explanations provided by the interviewers and raised further questions about the scheme as noted in Appendix 1 below. Because of the limited knowledge of the ETS and uncertainties surrounding its implementation, it was also difficult for most of the farmers to distinguish among the variety of scenarios introduced. Thus, an assessment of their response is largely limited to their consideration of a single afforestation policy including the effect of different prices for carbon and reflection on the point-of-obligation. The four case study farms are arguably more indicative of a more *nuanced* response to the ETS (remaining aware, of course, of the potential for the social and ecological context of a particular farm to influence that response). Until that point at which the conditions of compliance in the ETS are fixed and New Zealand's pastoral farmers gain an understanding of the processes underlying carbon liabilities and credits, it will be difficult to provide a more general assessment of the impact of policy alternatives for GHG mitigation.

The feature of the proposed ETS that elicited the most considered discussion was that of scheme governance, or more specifically the preference for the individual farm or industry as the point-of-obligation for carbon liabilities and credits. Individual point-of-obligation was of particular interest to those farmers who had a greater capacity to plant areas of trees on their farms. These farmers anticipated greater returns from a process

that rewarded them for achieving higher than average sequestration rates. Farmers in both sectors, by contrast, also perceived benefits in a processor-level point-of-obligation that translated the vagaries of GHG mitigation into a more readily understood price effect. Many in this latter group anticipated that the transaction costs of individual monitoring would outweigh any potential financial benefits of more individualised measurements. In regard to this element of the scheme, it is possible to distinguish between farmers' responses based on the industry with which there is the greatest interaction. Overall, the sheep/beef farmers expressed a stronger preference for an individual point-of-obligation, likely reflecting a more competitive element in their interactions with a variety of processing firms.

The farmers also demonstrated the ability to differentiate between carbon prices. The higher liability costs when calculated at $50/tonne CO2e increased the likelihood that the farmers would alter management (i.e., reducing stocking rates or use of nitrogenous inhibitors) or land use (i.e, afforestation) in some way. Similarly, those who identified potential areas of tree plantings often indicated they would consider planting larger areas at a higher price for carbon. The liability costs at the higher price were considered sufficient, however, to force several of the sheep/beef farmers to sell their farms. While the great majority believed themselves capable of adapting to the economic conditions of the ETS at certain price points and allocation levels, many also expressed concerns about the continued viability of the sector with the dissolution of the free allocation of credits.

Policy recommendations

The most consistent feature of the interviews was the general lack of awareness and knowledge of both the relationship between agricultural GHG emissions and climate change and the nature and operation of the proposed ETS. A list of farmers' questions and concerns regarding the policy and policy scenarios was compiled from the interviews and is provided in Appendix 1. The uncertainty surrounding both the science of GHG mitigation and monitoring and the policy of the ETS also contributed to several concerns within the research team regarding the continued development of that policy. These concerns are the basis for a series of policy recommendations related to farmer participation in the negotiation of policy terms and the establishment of a more appropriate social and economic context to facilitate informed and appropriate response from farmers. It is expected that addressing these concerns can contribute to a less contentious response to future policy related to climate change.

In order to promote a greater sense of ownership of policy instruments among farmers, there is need for greater means of farmer participation in the negotiation of its terms and conditions. Achieving this form of engagement is hampered by several issues of uncertainty. First, farmers have difficulty understanding the logic of the entire system, from Kyoto through to the ETS. The subsequent lack of legitimacy may make them less likely to engage the ETS/PFSI in an optimal, efficient or informed manner. Farmers are currently uninformed about existing ETS policy and policy proposals leaving them largely unprepared, unequipped and unresponsive to the need for adaptation at a rapid rate. As a result, they often refer to this uncertainty to justify both their opposition to climate change policy and their delay in developing strategic response. Second, farmers often view climate change policy as the product of external interest groups who use their social or political power to impose unfair conditions on the agriculture sector. For example, farmers view many elements of domestic climate

change policy (e.g., exclusion of shelterbelts and differentiation between pre-1990 and post-1989 forests) as arbitrary and contradictory conditions imposed by international interests. They also perceive GHG regulation as the product of urban interests that rests on a failure to adequately distinguish between industrial and "natural" (agricultural) sources.

Farmers are further impeded in the capacity to construct appropriate response strategies for GHG mitigation by current social and economic conditions. Some of these barriers lie in their identity as farmers. Many farmers perceive little capacity to change because they are unwilling to critique current farming practice and its focus on productivism. This suggests that farmers may not be as highly adaptive as they are often characterized. Furthermore, without credible and consistent information on alternative management and land use strategies, farmers will rely on existing knowledge that may not be accurate or appropriate in the context of climate change. Farmers also see themselves as constrained by a lack of options, especially given the current economic conditions of the meat and (to a lesser extent) dairy industries. The perceived need to exploit all farm land for productive purposes in order to ensure viability leaves little unproductive area that can be moved into forestry. There is also a general lack of knowledge and awareness in regard to the role of GHGs on farm management. Farmers, thus, require decision support tools that not only calculate liability and credits, but also inform and instruct them about underlying ecological and economic processes of greenhouse gas production and mitigation at the farm level.

Future research directions

Finally, the results of the research conducted to produce this report provide several insights to the need for further research to facilitate a more comprehensive assessment of the potential impact of the ETS in the agriculture and forestry sector. First, the current state of familiarity with the ETS among farmers and other land managers requires a participatory research framework. In other words, the research should extend beyond a simple focus on the collection and assessment of response and include both the provision of information and the opportunity to negotiate the evolving terms of compliance. Both the existing literature on agri-environment schemes and the comments of the interview participants indicate that land managers must be able to assume more active ownership of GHG mitigation policy if it is to become readily incorporated within their management strategies. Second, there is urgent need for more comprehensive information on the current state of land managers' understanding of GHG emissions and emissions trading and the effect these new influences will have on farm livelihoods. In order to draw stronger conclusions in regard to the generality of these positions, a more extensive study would be required which allowed for broader sampling including more geographical regions and a greater diversity of farmer characteristics. The lack of attention to farm-level implications of emissions policy is further evident in the emphasis on technological fixes for emissions mitigation among industry and research organisations to the almost complete exclusion of improving the management capabilities of the land managers. Third, because mitigation of GHG emissions in farming practice necessarily involves complex interactions of social and ecological processes, further assessment of policy to direct and/or regulate emissions requires a similarly transdisciplinary approach. A more comprehensive understanding of GHG mitigation requires concerted efforts to assess the social, environmental and economic factors at the farm and sector level as well as the collaboration among often isolated disciplines to examine and explain the interactions among these aspects of

climate change in New Zealand agriculture. This argument for the recognition of the value and potential of research that crosses disciplinary boundaries and remains aware of the diverse factors that affect and influence human interactions with the environment echoes that included in the MRST *Roadmaps for Science—Environmental Research* as the most appropriate means to achieve systems understanding and integration.

Endnotes

[1] This should not be taken to say that all farmers are seeking to push productivity to the greatest extreme possible on their farms; but farmers will generally rationalise their current production relative to recognised highest producers and subject to various biophysical, structural or self-imposed constraints.

[2] ARGOS (Agricultural Research Group on Sustainability, see www.argos.org.nz) is a FRST funded research project examining the social, environmental and economic conditions of sustainable production in the New Zealand agricultural sector. It consists of a diverse team including farm management consultants, ecologists, zoologists, economists, sociologists and geographers organised into five research objectives (farm management, He whenua whakatipu, economic, environmental and social). The ARGOS team employs a transdisciplinary approach in the comparative assessment of agricultural sustainability on over 120 farmers in the Dairy, Kiwifruit and Sheep/Beef sectors. In each sector farms have been selected as clusters, all of which include a representative of each of the management systems studied in the sector.

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Appendix 1: Farmer Questions and Concerns Regarding the ETS

- Farmers expressed widespread interest in the potential for soil carbon and pasture grass sequestration to offset emissions liabilities from stock. This was predominantly characterised as a "common sense" recognition of GHG exchanges that are not currently included in the ETS.

- Many farmers expressed an interest in afforestation/regeneration using native species, but the relatively smaller credit earning potential of these trees in the ETS and PFSI were considered insufficient to balance establishment costs and potential reduction in grazing area. By comparison, many farmers expressed a favourable opinion of the AGS in regard to its ability to support native afforestation, but had difficulty reconciling land use changes that would not increase farm profitability.

- Several farmers expressed concern that the ETS would incentivise the clearing of regenerative native bush to establish eligible exotic forest plantings. Many farmers described their farm landscape with reference to "unproductive" areas (including regenerating native scrub) that would be the most likely sites for afforestation in the ETS or PFSI.

- Some farmers potentially interested in the AGS found the description of the tender process given in the Afforestation Grant Scheme Guidelines unclear on the extent of actions required in order to constitute "assisted natural reversion".

- A few sheep/beef farmers questioned the equivalence given to agricultural sectors within the ETS. They suggested each sector be exposed to emissions liabilities in accordance with the growth of each sector's emissions levels under the assumption that dairy farmers had engaged in greater intensification.

- Farmers are concerned about what they consider to be significant uncertainty around the effects of the ETS on land prices. If profitability decreases on less than premium productivity land, these farmers fear that periodic downturns in product prices will constitute greater threats to continued financial solvency in their sectors.

- Farmers often suggested that, given a stable regulatory environment, small changes in farm management practice could be used to effect marginal changes in emissions levels. These changes frequently involved practices beyond stocking rates such as feed composition, the use of organic inputs and stock ages.

- Farmers noted that decisions to undertake significant and long-term changes in farm management were difficult to justify given their perception of political instability surrounding both the ETS and international agreements for 2013 and beyond.