Hugh McDonald and Suzi Kerr

Why Do New Zealanders Care About Agricultural Emissions?

'… under the current emissions trading scheme … Federated Farmers struggles to see a future for food production in New Zealand and therefore strongly argues for the exclusion of biological agricultural emissions from food production from the ETS.'

(Federated Farmers of New Zealand, 2011)

'By lobbying to be let off the hook, Fonterra and the rest of the agriculture sector want to perpetuate … the subsidy other sectors and taxpayers are making to cover farming's ETS liabilities. It's time for agriculture to enthusiastically take up its responsibilities in the ETS.'

(Rod Oram, 2011)

Hugh McDonald is a Research Analyst at Motu Economic and Public Policy Research.
Dr Suzi Kerr is a Senior Fellow at Motu Economic and Public Policy Research.

Agricultural emissions account for more than 46.5% of New Zealand's total greenhouse gas (GHG) emissions (Ministry for the Environment, 2011) and 13.5% of global GHG emissions (IPCC, 2007c). Excluding agriculture from global mitigation commitments has been shown to increase the cost of containing warming to 2°C by as much as 15–50% (Reisinger and Stroombergen, 2012).[1] Clearly, the question of what response will effectively address these emissions is critically important to New Zealand and the world. However, as the above quotations illustrate, current views on what shape that response should take are polarised. This polarisation may have been exacerbated by the government's initial framing of the emissions trading scheme as a response to a specific international obligation under Kyoto, a motivation that seems less salient since the Durban conference. Designing agricultural emissions policy will require balancing these views, and the views of all other New Zealanders, whose aims for agricultural emissions policy may bring in further dimensions. Implicitly, this involves optimising a social welfare function that considers the aims and motivations

of all New Zealanders. This article contributes to the agricultural emissions policy discussion by stepping back and considering these underlying motivations: why do individuals, communities, companies and government in New Zealand care about how agricultural emissions are addressed?

We argue that New Zealanders' diverse individual motivations can be grouped under three headings: (1) concern about the direct impacts of climate change on New Zealand and the world; (2) pressure from others based on their concern about climate change, be that from international countries and organisations or from climate-conscious consumers; and (3) concern about complementary environmental or social goals that are positively affected by addressing emissions. This framework is useful in setting out how our underlying motivations should shape our responses, and highlights the importance of choosing responses that will be robust in the face of future uncertainties.

Understanding stakeholder aims and concerns is critical for a second reason. Implementing complex policy with a large number of actors and involving difficult and expensive monitoring, such as agricultural emissions policy, requires a high degree of voluntary compliance. Stakeholders, such as farmers and rural communities, are more likely to voluntarily comply when policy responses address, at least in part, their concerns and motivations (OECD, 2000). Explicitly considering the underlying motivations of all New Zealanders will assist in ensuring that policy responses appeal to a wide range of constituents, and will make implementation simpler and far more effective at achieving the many aims New Zealanders hold for addressing agricultural emissions.

Motivations for addressing agricultural emissions

Different New Zealanders will be motivated to address the issue of agricultural emissions for different reasons and to differing degrees; indeed, some will not be interested in addressing it at all. This article does not attempt to present a consensus view of why New Zealanders should address agricultural emissions, or aim to present any specific group's or individual's motivations. Instead, it aims to set out all of the possible motivations to act that well-informed and rational New Zealanders might hold, and investigate how these different motivations should shape the sort of responses we make. Understanding these underlying motivations is essential for the design of effective policy: we need to understand what it is we want to achieve before we can consider what will achieve it.

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Motivation one: climate change is likely to cause serious damage and reducing agricultural emissions will help to reduce the risk

Climate change could affect New Zealanders either directly (through physical changes brought about by global temperature rises) or indirectly (through flow-on effects from physical changes in other countries that are then transmitted to New Zealanders – for example, through trade). We might also be concerned about the negative impacts that climate change will have on others in the world. This motivation is predicated on the accepted likelihood that, globally, climate change will cause damage and that reducing agricultural emissions will help reduce this damage (IPCC, 2007a and 2007b).

Direct impacts on New Zealanders

In a recent summary of science assessing the likely direct physical impacts of climate change on New Zealand, the authors find that the physical effects on New Zealand over the next half century are expected to be mild, particularly when compared with other countries (Ministry for the Environment, 2008). Average temperatures across New Zealand are expected to increase by approximately 1°C by 2040 and 2°C by 2090 (relative to average temperatures in 1990). Rainfall is expected to decrease in the north and east of the country and increase in the south, although there is large variability across specific locations and seasons in these estimates. On the positive side, New Zealand would face significantly fewer days with frosts, and improved pastoral productivity over much of the country. However, research suggests that extreme events (droughts and floods) will become more common and more serious (McMillan et al., 2010).

Indirect international impacts on New Zealanders

New Zealanders could also be affected by global climate change through international effects that are transmitted to New Zealand from overseas. These indirect effects would result from physical climate change effects on other countries, their responses to these effects, and the flow-on effects on the goods and services that New Zealand imports and exports. A recent paper by Stroombergen (2010) looks at one possible path: international agricultural prices. He finds that, by 2070, global climate impacts on agriculture will have led to reduced international agricultural production and higher prices for New Zealand exports, and that New Zealanders will benefit economically from these indirect effects.[2] These benefits could be somewhat muted if agriculture production worldwide increases due to increased carbon fertilisation. Stroombergen also finds that these indirect effects are likely to significantly outweigh any direct

economic impacts of climate change on New Zealand agriculture.

Climate change may also lead to economic and political instability, and is likely to affect migration flows. These could all have large indirect effects for New Zealanders, although the size of these impacts is impossible to assess accurately (Burson, 2010).

Direct and indirect international impacts

Current research shows that the negative effects of global climate change outside New Zealand are likely to be widespread and serious (IPCC, 2007b). We may be motivated by altruism and a sense of justice to minimise these effects.

Motivation two: pressure from others based on their concern about climate change

Another possible motivation for addressing agricultural GHG emissions is that we face pressure from others outside New Zealand who are concerned about climate change. This international pressure could come from two distinct sources: from national governments or international organisations such as the UN; additionally or alternatively, we might be motivated to act because of pressure or opportunities coming from climate-concerned international consumers or markets.

Pressure from other national governments or international organisations

New Zealanders are likely to face the cost of agricultural emissions whether or not we have a domestic policy that accounts for them. New Zealand is a signatory to the Kyoto Protocol and is committed to taking responsibility for any emissions above 1990 levels over the period 2008–2012.[3] While future Kyoto commitment periods are not certain, it is highly likely that there will continue to be an international carbon price and carbon market of some form (Emissions Trading Scheme Review Panel, 2011). Also, regardless of the state of these international agreements, the New Zealand government has made commitments to take responsibility for New Zealand's emissions going forward. This includes a commitment to making a 10–20% cut in emissions relative to 1990 emissions by 2020,[4] and a 50% emissions cut by 2050 (Smith, 2011). New Zealand will face international pressure to meet these commitments regardless of whether a formal global agreement is reached.

Alongside these formal external pressures to 'pull our weight', New Zealanders may be motivated to address agricultural emissions because we individually desire New Zealand to be viewed in a good light by the rest of the world. A favourable international image also has benefits for New Zealand at the macro level, including increased tourism and economic opportunities (Ministry for the Environment, 2001) and co-operative relations with other countries in trade, investment, security and bio-security. Credibility on climate issues also increases New Zealand's ability to influence the design of future international climate agreements (such as, for example, international carbon accounting rules).

There is a risk that if we do not adequately address agricultural emissions, we may be closed out of international markets or lose our position as a favoured supplier to large buyers.

Pressure from international consumers and markets

New Zealanders may be motivated to act due to pressure and opportunities from climate-concerned international markets and consumers. There is a risk that if we do not adequately address agricultural emissions, we may be closed out of international markets or lose our position as a favoured supplier to large buyers. Consumer demand for New Zealand products may also fall if we are seen as emissions-intensive producers (Saunders and Barber, 2008). However, climate-conscious consumers also offer opportunities. If New Zealand producers can meet the concerns of these consumers they may be able to access higher-value markets. Saunders et al. (2011) argue that New Zealand producers could receive substantial price premiums if our agricultural output is perceived internationally as of low emissions intensity.

Efficiency motivations

If New Zealanders want to decrease countrywide GHG emissions, we may want to address agricultural emissions because it is an efficient way to achieve our targets. New Zealand's Emissions Trading Scheme Review Panel (2011) concluded that agricultural emissions abatement opportunities exist, and that as a result agricultural emissions should be addressed within the emissions trading scheme for efficiency reasons. Reisinger and Stroombergen (2012) model the costs of meeting global GHG targets under different policy settings. They find that excluding agricultural emissions from international climate mitigation results in significantly higher costs of meeting GHG targets, both internationally and for New Zealand. Agricultural emissions make up almost half of New Zealand's gross emissions. Under our current commitments, and at a conservative carbon price of $NZ25, by 2020 New Zealand agricultural emissions will have an annual opportunity cost of $1 billion.[5] If New Zealanders could costlessly reduce emissions from agriculture even by 10% we would benefit annually by $100 million.[6]

Additionally, omitting agriculture from efforts to reduce greenhouse gas emissions would create inconsistencies and distortions. We might want to avoid these inconsistencies based on equity grounds: if the New Zealand government regulates to internalise the cost of other industries' emissions (as is New Zealand's current approach through the emissions trading scheme), then it seems reasonable that agriculture industries also should bear the cost of their emissions. We might also wish to be consistent across industries to avoid distorting investment incentives.

If agricultural producers do not face the external costs of their emissions as other industries do, the incentive to shift resources away from emissions-intensive industries such as agriculture will be distorted; agricultural production will in effect be subsidised.[7] Incentives to invest in technologies to reduce agricultural emissions would also decrease.

Interest in complementary goals

A final motivation for addressing agricultural GHG emissions may be that the same actions we implement to address agricultural emissions will also advance other goals we have. Complementary goals could consist of complementary environmental outcomes, such as improved water quality, increased biodiversity, or decreased soil erosion. They could also include rurally-focused aims such as long-term rural sustainability, resilience of rural communities, or increased farm profitability (through improved on-farm efficiency). While it is unlikely that we would choose to address agricultural emissions solely to achieve a complementary goal, recognising that some New Zealanders are motivated by complementary goals could alter the way we choose to respond to agricultural emissions, and increase the constituency of New Zealanders who will support actions that address them.

Actions we take to address agricultural emissions that also contribute towards complementary goals should be enhanced to take into account their additional benefits. Likewise, any actions that are aimed at affecting some other outcome, but that also have positive agricultural emissions impacts, should be strengthened.

Relationships among the different motivations

These different motivations are related to and interlinked with each other. The relationship between motivations one (a desire to avoid climate change) and two (international and commercial pressure to reduce emissions) is of particular interest, as this relationship is liable to change as (or if) international agreements (or informal commitments) to limit GHG emissions become more stringent. This interplay has implications for the responses we should make.

In the short term, acting optimally to influence long-run climate mitigation, acting to meet short-term international obligations, and acting to take advantage of commercial opportunities lead to somewhat different actions. For example, any actions that decrease emissions are useful for mitigating climate change, but appealing to climate-conscious consumers requires mitigation that is visible and marketable: effort needs to be expended on marketing and not just on the mitigation.

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However, as international agreements become more stringent over time, the two motivations can be addressed with similar responses. This becomes clearer when we consider the impact of international agreements: their aim is to assign the external cost of GHGs produced to the country that produced them. Governments of countries then decide whether and how to pass the costs of emissions on to their own citizens and businesses. These global agreements are not currently stringent enough to limit GHG production to a globally optimal level. As a response, some consumers and markets are willing to pay a premium or offer preferred access to producers whose products are less emissions intensive. These consumers and markets are implicitly pricing the emissions mitigation carried out by these producers that is not currently internalised by global emissions agreements. As the stringency of agreements increases, the previously external cost of emissions will be internalised to the country of origin: consumers and markets will be less willing to pay a premium for low emissions production. The motivations to reduce emissions to meet our international commitments and avert global warming will align and increase and the motivation to reduce emissions due to consumer pressure will decrease, and in the long run may be wholly captured by the international agreements. Consequently, when we make long-run investments or decisions with long-run implications, we should make them in accordance with the need to avoid global climate change and to meet our international emissions commitments (motivations one and two), and not to meet international consumer pressure.

The relationship between motivations one and two illustrates the underlying, and potentially conflicting, goals inherent in any decision to address agricultural emissions: maximising environmental outcomes and maximising economic outcomes. In the short term these two goals are often substitutes, and maximising one goal comes at the expense of the other. For example, decreasing the GHG production of New Zealand's farms involves costly mitigation. In the short run, requiring this will maximise environmental outcomes at the expense of economic outcomes. However, as described above, in the long term New Zealand's economic and environmental outcomes are inextricably intertwined. While the short term may invite different responses for each goal, in the long run the ideal response for each is similar. New Zealand's future economic outcomes depend heavily on the future environment: significant global warming will restrict future economic outcomes, and in the long run the emissions content of production is likely to be internalised and faced by the country of origin, if not by the producer. Consequently, maximising long-run environmental outcomes is crucial for both environmental and economic reasons.

Factors influencing the intensity of response

The intensity with which we should address agricultural emissions depends on the number of motivations to act that we hold, and how strongly we hold each motivation. Other factors include how effective we expect our response will be at addressing our motivations, the opportunity cost of acting, and the potential for counter-productive outcomes, such as emissions leakage or decreased food security. The timing of our response is also of importance: when should we act?

New Zealanders' possible impact on climate change

Any GHG emission reductions that we carry out in New Zealand will have a very small direct effect on global emissions because of New Zealand's size. This of course is true of any small country's or region's actions. Our reduction efforts could still be important for controlling global emissions for two reasons: technology and policy transfer; and building global co-operation.

Technology and policy learning and transfer

If New Zealand can learn how to design policy to effectively and efficiently control agricultural emissions without excessive social cost, and we are able to communicate this to other countries, we will potentially be able to reduce the cost of emissions reductions in other countries. This could lower other countries' emissions by reducing their resistance to policies that control agricultural emissions, and ensuring that they adopt already-proven policies. While this could be achieved through research alone, demonstration of technologies and policies that observably reduce emissions without unacceptable human or financial costs will be more compelling. We are also likely to learn by doing in ways that we cannot through research alone.

Building global co-operation

Achieving global co-operation on an issue that affects all sectors and individuals, involves considerable uncertainty, and is likely to be costly presents a particularly recalcitrant problem. The core challenge is that every individual, sector and country has an incentive to 'free-ride', as no one has a large individual impact on the problem, and people face significant direct costs of action for an infinitesimal decrease in their own risk of facing climate change costs. While rational, purely self-interested humans would achieve little co-operation, the work of Elinor Ostrom and others has shown that most humans are not purely self-interested, and that in an indefinitely repeated game, when leaders display co-operative behaviour and the cost of co-operating is reduced, high levels of co-operation can occur (Ostrom, 1990). New Zealand has disproportionate visibility in the climate sphere. Our efforts will likewise have disproportionate impact on others' willingness to act by both building trust and demonstrating that reductions can be achieved without undue social cost.

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Risks from action

The cost of reducing emissions will limit the extent to which New Zealanders will want to respond to these motivations to do so. One factor will be the expense of decreasing emissions: the cost of contributing may be perceived as high relative to the gains that would result. The opportunity cost may also limit action: New Zealanders may want to spend their money addressing other issues. Others may believe that our best response is to focus only on adaptation rather than on emissions control. Along with these, there are two interrelated reasons why acting may be counter-productive: emissions leakage and food security. These may result in New Zealanders choosing not to act on agricultural emissions even if we are concerned about climate change.

Emissions leakage

One potential concern is that reducing emissions in New Zealand will be ineffective because of 'emissions leakage'. When agricultural emissions are reduced, the resulting increase in agricultural production costs may mean that some exported products are no longer competitive, or that products imported from countries with less stringent climate policies are substituted for domestic products. This could lead to some agricultural production relocating to countries without climate policies. This leakage would lead to job losses in New Zealand but no change in global GHG emissions. If international production is more emissions intensive than the New Zealand production, then leakage could even increase global emissions.

While leakage is a potential result of addressing agricultural emissions, Kerr and Zhang's (2009) survey of existing empirical evidence on the responsiveness of livestock production in New Zealand to changes in profit finds that, although there would be significant hardship for farmers, there is unlikely to be significant leakage at carbon prices of around $25 per tonne of CO_2. Given the proposed policy of output-based free allocation of allowances to agricultural producers, leakage is likely to be even lower than Kerr and Zhang's estimates (Greenhalgh et al., 2007).

Food security

Another potential concern is that decreasing agricultural emissions will reduce food production and food security and may mean that more people go hungry. However, this would occur only if the only response to agricultural emissions policy is a reduction in food production (e.g. stock numbers are decreased to reduce emissions) and this food is not replaced elsewhere (either as dairy/meat or something else of equal nutritional value), and richer people who have more than adequate food are not the only ones affected. Even in

Table 1: Choosing appropriate responses given our motivations

	Responses		
	Visible/verifiable	Technology change	International communication and co-operation
Motivation one: avoid climate change	Needs to be visible and/or verifiable to the farmer. Needs to be verifiable and visible to New Zealand regulators if national policy. Effort needs to be visible internationally to encourage others.	Mitigation technologies. Some measurement and monitoring technologies.	Co-operate on mitigation development. Share technologies and knowledge we develop. Actively disseminate knowledge.
Motivation two: meet international pressure			
– from countries or international organisations	Must be verifiable by international organisations.	Verifiable mitigation methods.	Demonstrate to international parties that we are meeting commitments.
– from international consumers/markets	Must be visible to consumers.	Visible mitigation methods. Marketing technologies.	Show effort that is convincing to international consumers.
Motivation three: achieve complementary goals	Effect on complementary goals needs to be visible to communities of interest.	Technologies that positively affect our complementary goals.	None unless community of interest is international, such as biodiversity.

this situation, any decreases in food production as described above could be compensated for in three ways. The first is through rises in the price of food that New Zealand previously provided (e.g. dairy, lamb or beef), which induces an increase in production elsewhere. The second is if investment capital that would have been deployed for food production in New Zealand moves to a food sector in another country. The third is if land that was used for food production is converted to forestry in New Zealand, and the resulting increase in timber supply lowers global timber prices and hence reduces demand for land for plantation forestry elsewhere, thus freeing up agricultural land internationally. Obviously, all these effects will be extremely small for any New Zealand policy, but we can expect them to be larger if we set a precedent for efforts by much larger countries.

There are clear contradictions between food security and emissions leakage fears. If food production decreases in New Zealand are directly replaced internationally with the same type of food (e.g. dairy or meat), then leakage will have occurred, but there will be no decline in food security. If, instead, decreases in New Zealand food production are not replaced overseas then there may be some decrease in food security, but no emissions leakage will have occurred. If leakage is a serious problem, then food security is not. Kerr and Zhang (2009) conclude that it is unlikely that significant levels of emissions leakage or food insecurity will result from the introduction of New Zealand's emissions trading scheme with a carbon price of around $25.

Timing of response

Regardless of our motivation, we may be able to decrease future costs (or take full advantage of future opportunities) if we begin to transition our economy to lower emissions now. This is true if we are personally motivated by currently-held concerns about climate change, or expect to be motivated by them in the future: GHGs emitted now stay in the atmosphere and contribute to global warming long into the future. While the most prominent agricultural greenhouse gas, methane, has a relatively short lifespan in the atmosphere (approximately 12 years), nitrous oxide has a lifetime of more than 100 years (IPCC, 2007a). Nitrous oxide makes up approximately a third of New Zealand's agricultural emissions, equivalent to 17% of New Zealand's total emissions (Ministry for the Environment, 2009). This may lead us to focus more on reducing nitrous oxide, as its effects are long lasting, and only focusing on mitigating methane emissions to meet short-term goals or to avoid climate tipping points. We might also be motivated to begin time-consuming processes immediately. Research, learning and adoption all take time to produce useful outputs; if we want to enjoy their benefits in the future we need to start these processes now.

Immediate action is also justified if we are motivated by pressure from other national governments or international organisations. The commitments made by the New Zealand government need to be met in the short term (Kyoto obligations), medium term (2020 targets) and longer term (2050 targets), and will require short-term action.

What are the implications of these motivations for our responses?

Discussion up to this point has considered why New Zealanders want to address agricultural emissions, and, implicitly, what it is we want to achieve. In this section we consider the characteristics of responses that will address these different motivations. When thinking about the best way for New Zealanders to address agricultural emissions we need to consider which one (or combination) of the motivations outlined above is behind our actions. Effective policy will address the underlying motivation New Zealanders have for responding. Depending on our motivation, we will require our responses to achieve different levels of verifiability or visibility, will have different priorities for technological change, and will focus more or less on co-operating and communicating with actors outside New Zealand. These dimensions are summarised in Table 1.[8]

If we are motivated by concern about climate change (motivation one), then any actions that decrease emissions will be valuable. Our response will need to be visible to those carrying out the mitigation (so that they know they are making a difference), and will need to be verifiable and visible in ways that encourage others to also decrease their emissions. This motivation will require technological progress focused on developing new and improved agricultural emissions mitigation methods, and the communication of these findings to New Zealand farmers. We will also want to co-operate internationally on mitigation development and actively share new technologies and knowledge. New Zealand's participation in the Global Research Alliance on agricultural GHGs is an example of a response which addresses this first motivation.[9]

Addressing international climate-conscious consumer pressure will require that our actions and efforts are highly visible internationally. Developing effective ways to market our mitigation efforts to international consumers will be important. Our response will need to focus on mitigation methods that are visible and verifiable over those which have real but less verifiable environmental effects.

If instead our concern is assuaging international pressure from other countries or international organisations, such as the UN, we will require a response with a focus on mitigation that meets internationally agreed-upon standards of verification.[10] In the short run, we may be able to assuage international pressure through clever marketing and negotiation of favourable rules, but in the long run we will need to respond with integrity. Demonstrating integrity will require technological progress that results in improved abilities to measure, monitor and verify mitigation. A strong response will require new or improved mitigation methods. Demonstrating the rigour of these mitigation methods will require significant international communication.

Responses to address complementary goals (motivation three) need not be as verifiable, but instead will have to have real impact on complementary goals. Technological development will need to focus on mitigation methods that have positive impacts on GHG emissions and on complementary goals: for example, if our complementary goal is improving water quality, we will need to focus on mitigation methods that have positive effects on GHG emissions and also on water quality, such as nitrogen inhibitors.

If, as is likely, we are motivated to address agricultural emissions by some combination of these motivations, then our response should balance these different elements. Considering our response in terms of addressing our motivations in this way will be a useful way to consider appropriate policies.

Robustness

While we can control or influence many of the factors that will affect the success of our agricultural emissions response, some factors are beyond our control. These uncontrollable factors can be grouped under two headings: climate factors and international factors. Climate factors include the seriousness of the climate problem in the future, the existence and stringency of any binding global agreement, and the development of technologies for cheap and effective mitigation. International factors out of our control include world population growth, the global economy and agricultural prices (both partly driven by climate change itself), and the existence of trade barriers. Different possible outcomes (and combinations of outcomes) of these factors will affect the success of our response; we need to consider their robustness to these factors when designing responses.

Robust responses will be those that are flexible, scalable and cost-effective. The need for flexibility is clear: we need to avoid locking ourselves into any set approach to addressing agricultural emissions, and to be able to alter our approach as new mitigation options arise or opportunity costs of responding are faced. Our response will also need to be easily up- or downscaled: we need to be able to alter the intensity of our response in reaction to the seriousness of climate change and to other countries' responses. Our response will also need to be high value: that is, effective at addressing our motivations and low-cost.

Discussion

Designing effective agricultural GHG emissions policy first requires an understanding of the well-informed concerns and motivations of New Zealanders because we are trying to maximise the welfare of all New Zealanders, and because we need voluntary compliance to make implementation possible and to encourage strong behavioural change. New Zealanders also need to be mindful of the many uncontrollable factors that will influence the success of any response we make. We should attempt to ensure that our response is robust in likely future scenarios by building in flexibility, scalability and cost-effectiveness.

If we believe that New Zealand is likely to face a price on carbon emissions in the future, explicit or otherwise, then when making decisions with long-term consequences New Zealanders should focus on responses that will sustainably decrease global agricultural GHG emissions, rather than attempting to appeal to international consumers or regulators. These responses will be characterised by integrity, significant international engagement and co-operation, and a focus on policy and mitigation technology development.

Finally, there is an opportunity to broaden the consensus for addressing agricultural emissions by focusing on outcomes other than climate change. New Zealanders are motivated to address agricultural emissions for a wide range of reasons, not only because they personally care about helping New Zealand meet international emissions commitments or reducing the risk of climate change. Focusing on responses that have positive complementary impacts on GHG emissions and also on issues that potentially resistant New Zealanders care about, such as water quality or on-farm efficiency, may promote action on agricultural emissions.

1 Additionally, higher costs of achieving climate targets will inherently make reaching agreement on co-operative global climate action more difficult.

2 Stroombergen's result assumes no change in extreme events such as floods and droughts, or extreme human responses (such as financial crises or war).

3 That is, to either have net emissions that are on average no higher than our gross emissions in 1990, or buy carbon allowances on the international market to make up the difference.

4 This commitment came as part of New Zealand's association with the Copenhagen accord. This commitment is conditional on a number of issues, such as commensurate efforts by other countries, an acceptable global agreement, and effective rules managing land use, land use change and forestry (LULUCF), among others (Smith and Groser, 2010).

5 The Ministry for the Environment projects agricultural emissions in 2020 to be equal to 39,072,000t of CO2 equivalent, an 8% increase on 2010 agricultural emissions (2009).

6 This benefit could come from decreased costs of buying international allowances to cover our emissions, or from increased incomes from the sale of surplus allowances internationally.

7 Because agricultural emissions in other countries are currently unregulated, the appropriate incentives to invest in low-emissions agricultural production are distorted internationally, and the pricing of emissions in New Zealand may lead to leakage. The issue of leakage is discussed below.

8 Note that this section is not concerned with 'selling' policy to different stakeholders with different motivations to act. Instead, it outlines the characteristics of responses that will best meet different motivations.

9 The Global Research Alliance is a voluntary, collaborative international agreement that aims to 'find ways to grow more food without growing GHG emissions'. More information can be found at http://www.globalresearchalliance.org.

10 Our current ETS addresses this motivation. For example, it requires forests to be at least 30m wide to meet international monitoring requirements, ignoring the benefit of riparian plantings, and does not allow pre-1990 forest to be cleared and replaced with new forests that will have identical storage capacity (Karpas and Kerr, 2011).

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