

FARMERS' ATTITUDES AND PREFERENCES FOR CLIMATE CHANGE ADAPTATION: AN IRISH CASE STUDY



Contributors

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Abbreviations

AES	Agri Environment schemes
AEOS	Agri Environment Options Scheme
BDGP	Beef Data and Genomic Programme
BETTER	Business, Environment and Technology through Training Extension and Research
CA	Conservation Agriculture
CCAC	Climate Change Advisory Council
CAP	Common Agricultural Policy
CSO	Central Statistics Office
DAFM	Department of Agriculture, Food and the Marine
EU	European Union
EIP Agri	European Innovation Partnership for Agriculture Productivity and Sustainability
GLAS	Green, Low-Carbon, Agri-Environment Scheme
GHG	Greenhouse Gases
IFA	Irish Farmers Association
IPCC	Intergovernmental Panel on Climate Change
KT	Knowledge Transfer
REPS	Rural Environment Protection Scheme
SSA	Sub Saharan Africa
TAMS	Targeted Agricultural Modernisation Schemes
NEO	Natural Environmental Orientation
US	United States of America
USEP	United States of America Environmental Protection Agency
UNFCCC	United Nations Framework Convention on Climate Change

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Executive Summary

Background

Agriculture is important to the economy as a source of food supply, employment and revenue. One of the key challenges facing the agriculture sector is climate change. Agriculture is very vulnerable to the effects of climate change and at the same time, agriculture is one of the main sources of greenhouse gas (GHG) emissions globally. In Ireland, one-third of GHG emissions are from agriculture. Significant work needs to be undertaken in the agriculture sector to reduce emissions (mitigation) and ensure better preparedness for climate change (adaptation).

Aims and Objectives

This report is developed as part of the EU-Interreg funded project *RiskAquaSoil* supported by the European Development Fund. The overarching aims of this report are to present findings on farmers beliefs regarding climate change, the drivers and barriers of climate change adaptation and the willingness of Irish farmers to engage in specific adaptation measures related to insurance protection for their own farm and flood protection for downstream communities. The specific objectives of the policy report are outlined in Figure 1.

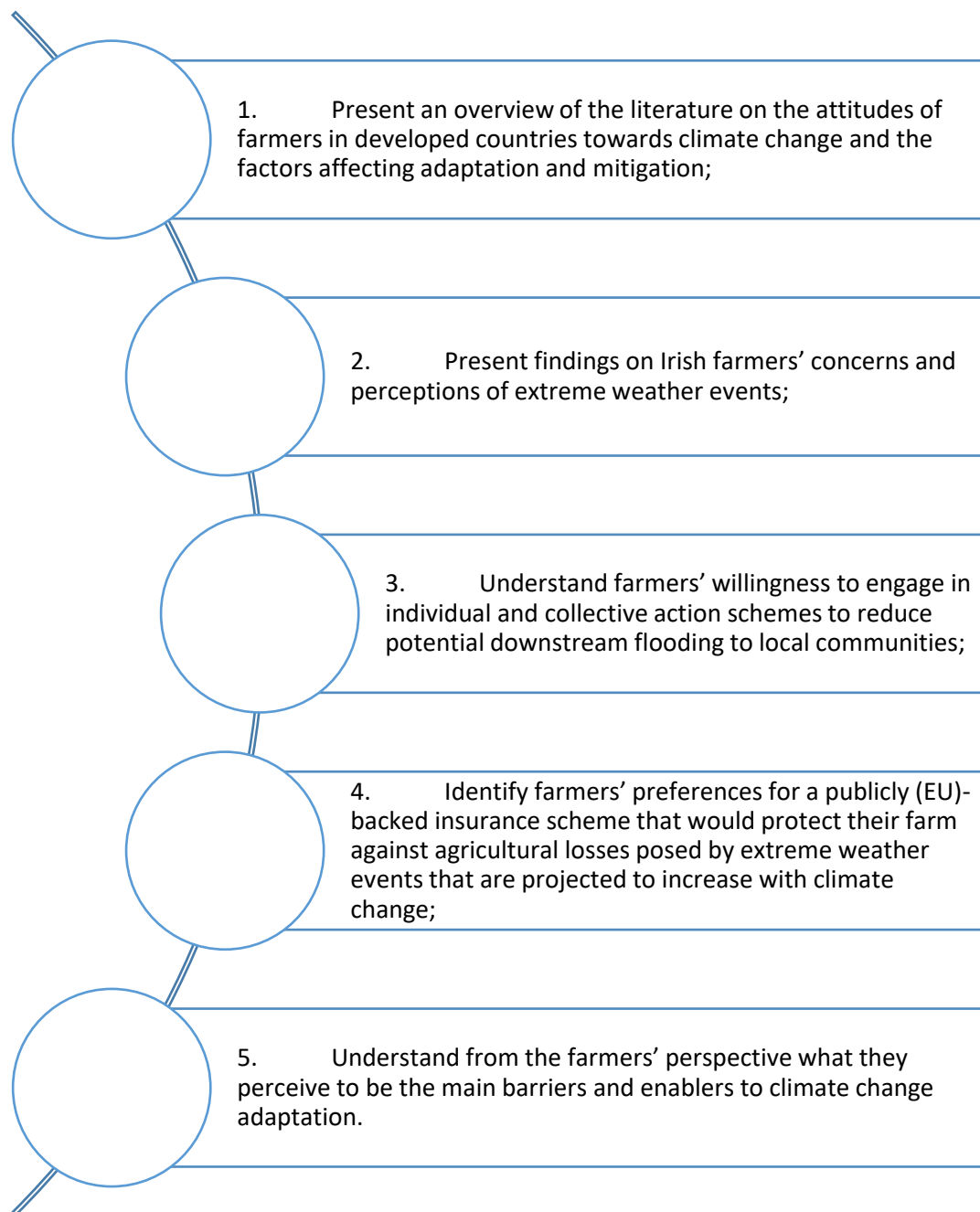


Figure 1: Objectives of the report

Objective one is based on findings from an international literature review of farmers in developed countries. Objectives 2 – 4 are based on findings from a national survey that was undertaken with 270 farmers living in Ireland in 2019. Findings from objective 5 are based on in-depth qualitative interviews that were taken from a select sample of Irish farmers.

Summary of Main Findings

Objective one of this report is to present an overview of the literature on the attitudes of farmers in developed countries towards climate change. For this, 20 studies published since 2010, are reviewed from across developed countries to understand farmers' attitudes to climate change. The review found that across all countries the majority of farmers agreed that climate change is occurring. However, many farmers believe that climate change is the result of both natural and human-induced factors rather than being mainly human-induced. Moreover, the majority of farmers do not perceive that climate change will substantially impact their farming activities. Generally farmers favour adapting their farms to the changing climate (adaptation) rather than undertake actions to reduce farm emissions (mitigation) in response to climate change. Overall, the results from the literature review suggest that policy-makers should emphasise the economic benefits of adaptation rather than just the environmental benefits as this is much more likely to induce farmers to adapt their farming practices.

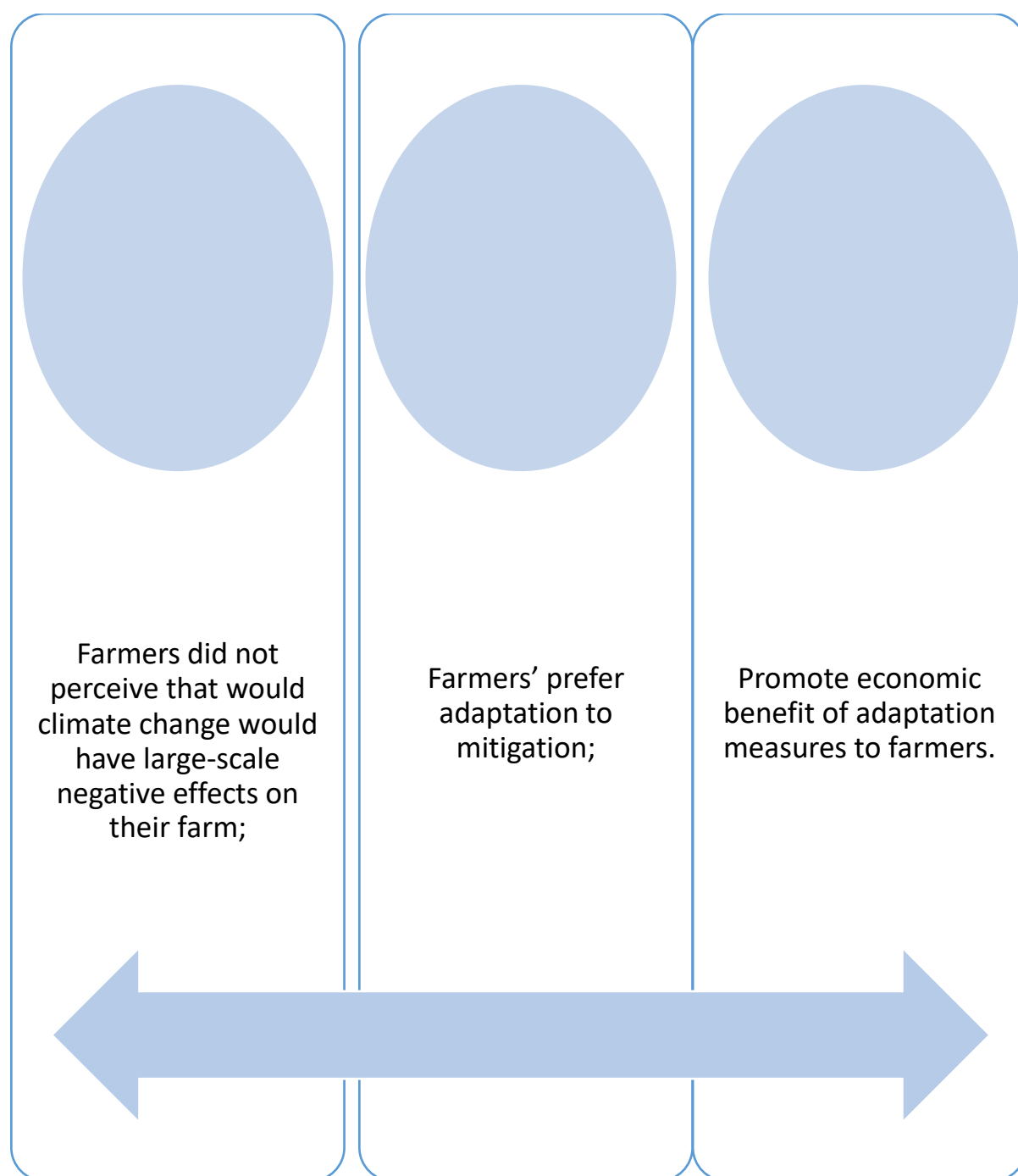


Figure 2: Key findings from the literature review

Objective 2 presents the findings on Irish farmers' concerns and perceptions of extreme weather events that are projected to increase with climate change and how these may impact on their farming activities. For this, the main findings are:

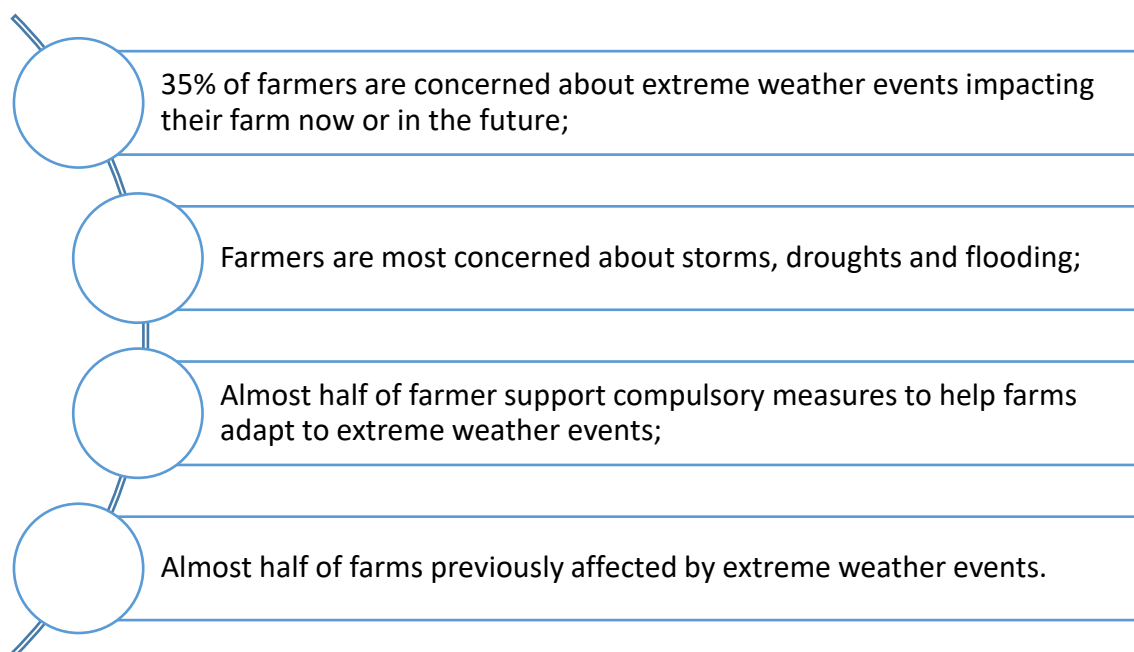


Figure 3: Summary of farmers' attitudes to extreme weather events

Within Ireland, increases in flooding events has been predicted to be one of the most significant impacts of climate change. As a result, we examined, within **Objective 3** of the report, farmers' willingness to engage in either individual or collective action schemes (which entails working with other local farmers) to reduce potential downstream flooding to local communities. The results show that:

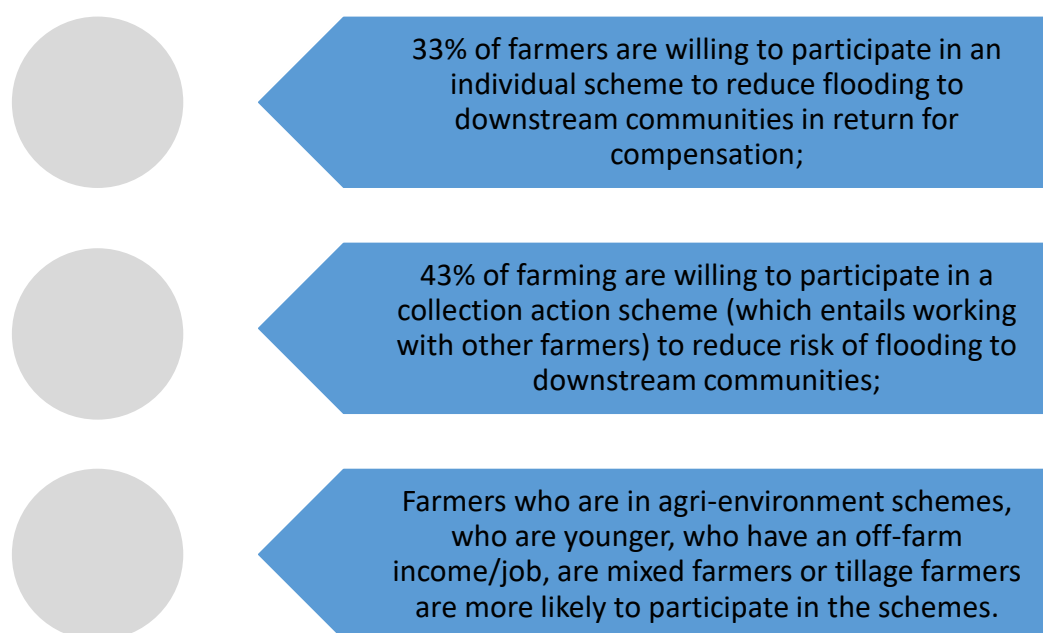


Figure 4: Summary of findings related to farmers willingness to protect downstream communities from flooding

The purpose of **Objective 4** is to identify farmers' preferences for a publicly (EU)-backed insurance scheme that would protect their farm against agricultural losses posed by extreme weather events. The focus on insurance in this report is based on the recognition among policy-makers of the need for innovate public-private partnerships to develop insurance products to help manage climatic-related risks. Despite the policy interest, few studies, particularly within Europe, has examined farmers preferences for public insurance for climate-related events. The results showed that:



Figure 5: Summary of farmers' preferences for publicly backed insurance for farm protection against extreme weather events

Objective 5 is based on findings from qualitative interviews with eight farmers living in Ireland and Figure 6 outlines the main findings from the discussions. The purpose of these interviews is to understand from the farmers' perspectives whether they perceive that weather patterns are changing, their views on adaptation and what they believe are the key barriers and enablers to climate change adaptation. According to the interviewed farmers:

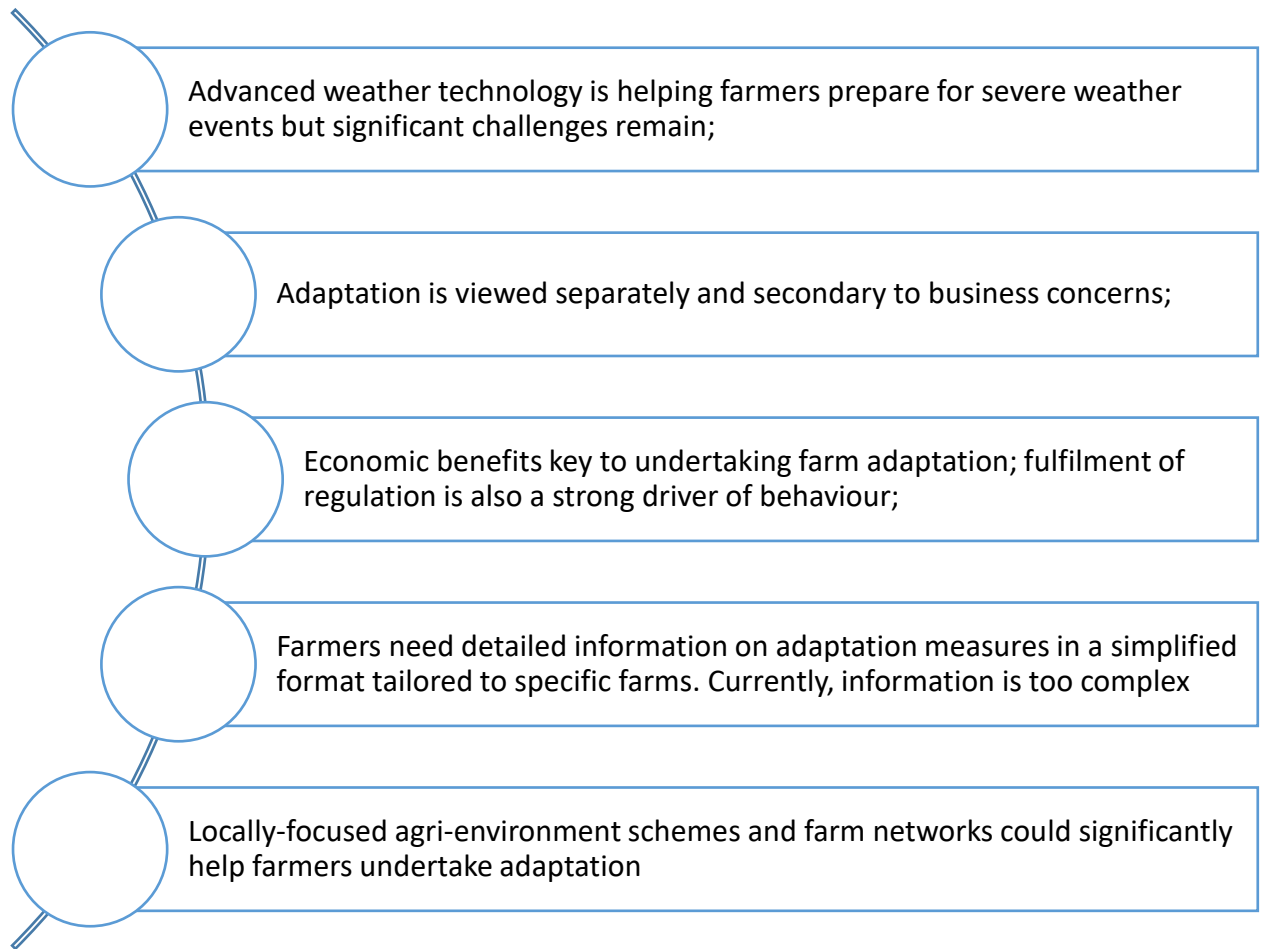
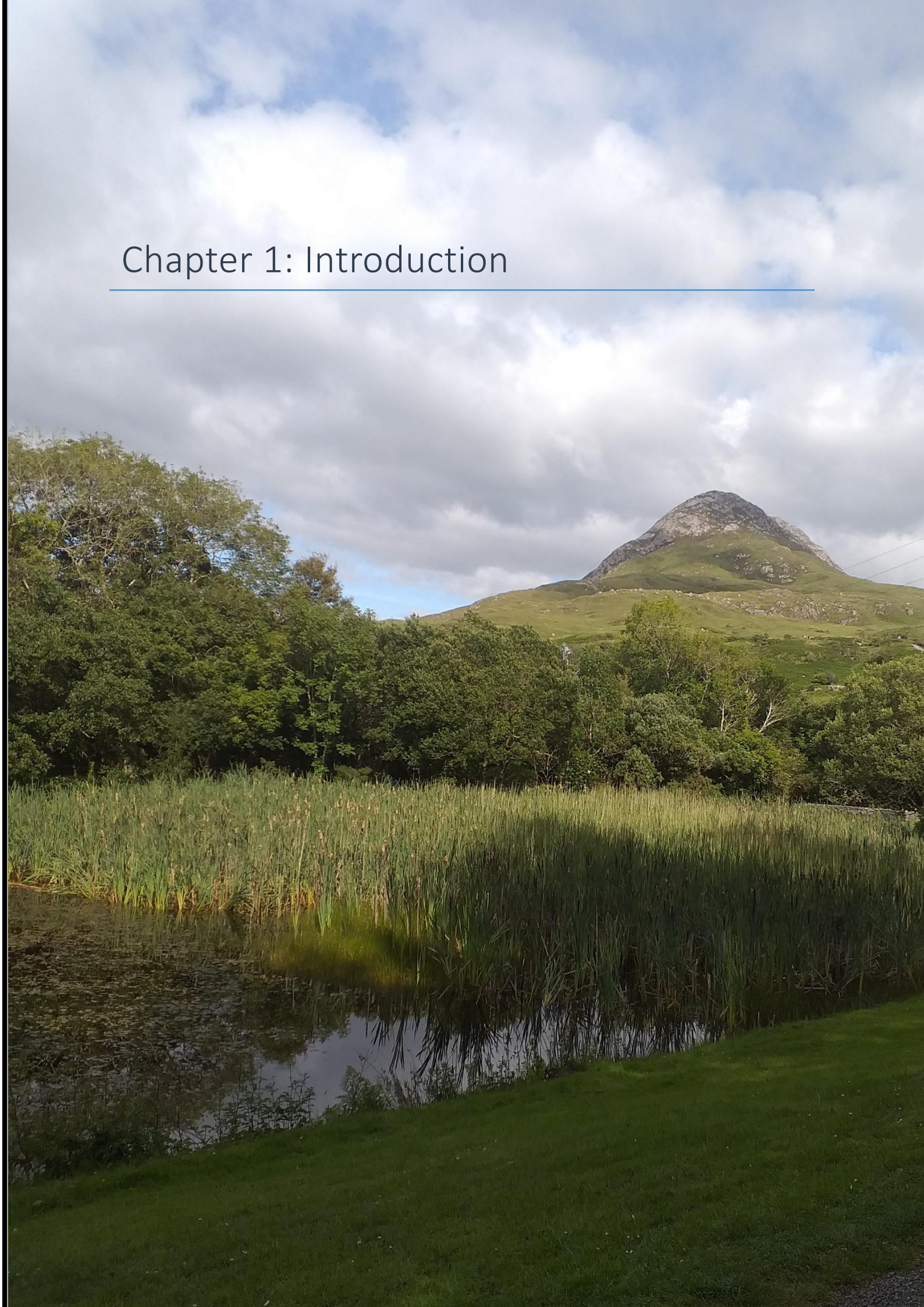


Figure 6: Summary of key findings from qualitative interviews with farmers

Chapter 1: Introduction



1 Introduction

This report is produced as part of the *RiskAquaSoil* project, which is an EU INTERREG Atlantic Arc project supported by European Regional Development Funds. The *RiskAquaSoil* project aims to develop a comprehensive management plan for risks in soil and in water to improve the resilience of the Atlantic rural areas. The need for *RiskAquaSoil* is due to the impact of climate change, presenting significant threats to the Atlantic Area. In the context of agricultural production in the Atlantic Area and globally, countries face challenges from changing temperatures and rainfall patterns, sea level rises and the impact of extreme climate events that could interrupt agricultural activity. This report presents findings from a component of one of the work packages for *RiskAquaSoil* called “*Implementation and Adaptation*”. The report is developed under Action 5.4 of the project which has the aim to examine farmers’ willingness to engage in adaptation to climate change, which aligns closely with the overarching themes of *RiskAquaSoil*.

Climate change adaptation involves the practical actions taken to manage risk from climate change impacts, while protecting individuals, communities, organisation, and natural systems. Adaptation can also strengthen the resilience to climate change. Many societies have developed coping strategies to face the unwelcome change in weather, for example extreme drought to torrential rain and vice versa. Adaptation is not only defined in a narrow sense referring only to the measures that are taken on the farm level. Adaptation is a wide concept involving national and international levels, and it takes into consideration more than one measure that at a national and international level is critical for agricultural and development policies. According to Adger (2001), mitigation (reducing greenhouse gas emissions) is an activity that must take place on a global scale. Adaptation, on the other hand, can take place at or on a number of scales in order to be effective from a local to global scale, in addressing climate related problems. Fundamentally, however, it is important to understand farmers’ willingness and capacity to respond to climate change. Farmers’ need to understand what has to be adapted and mitigated with the help of climatologists, scientists, policymakers and others who are effectively supporting the adaption and mitigation of climate change in agriculture. In this context, understanding farmers attitudes and willingness to engage in adaptation is crucial in informing policy.

1.1 Purpose of this Report

Given the importance of understanding farmers' attitudes and preferences with respect to climate change, this report presents findings with respect to farmers attitudes to climate change and their understanding/concern with respect to how climate change affects their farms. In this context, the objectives the report is

KEY OBJECTIVES OF THE REPORT

- 1.** Present an overview of the literature on the attitudes of farmers in developed countries towards climate change;
- 2.** Present findings on farmers' concerns and perceptions of extreme weather events and how farmers perceive these may impact their farm;
- 3.** Understand farmers' willingness to engage in individual and collective action schemes to apply flood measures to their land to reduce potential downstream flooding to local communities;
- 4.** Identify farmers' preferences for an EU-backed insurance scheme that would protect their farm against agricultural losses posed by extreme weather events;
- 5.** Understand from the farmers' perspective what they perceive to be the main barriers and enablers to climate change adaptation.

Objectives 2-4 are based on the results of a nationally representative survey that was conducted with 270 Irish farmers in 2019 for the RiskAquaSoil project. The survey mainly focused on the impact of extreme weather events that are projected to become more common as a result of climate change. The extreme weather events that we asked farmers about were related to storm damage (wind/snow/hail), flood damage, droughts and wildfires. The purpose of this survey is to identify how concerned farmers are regarding extreme weather events and whether they are willing to engage in adaptive behaviour (related to adopting insurance), which is widely discussed as a potential adaptation measures to manage risks in the climate economics literature (e.g. Faulkhauser and McDermott, 2014, Hallegatte, 2011, Hallegatte, 2014, Surminski, 2016). Also, as effective flood adaptation is likely to be more successful if farmers' act collectively in a local area, this report examined whether farmers would be willing to participate in individual or collection action schemes to reduce potential flooding to downstream

communities. Objective 5 was addressed through the collection of in-depth qualitative interviews with eight farmers in Ireland, representing a diverse cohort of farm typologies.

1.2 Policy Context: Irish Agriculture and Climate Change

Ireland's 2020 GHG emissions target is to achieve 20% reduction of total emissions (including from agriculture, transport, built environment, waste and non-energy intensive industry) on 2005 levels with annual limits set for each year over the period 2013-2020. Ireland has further pledged to reduce its emissions by 40% by 2030 in accordance with other European Union countries. Of the projected land mass of 6.5 million hectares, 65% of land is currently used for agriculture in Ireland. Approximately 81% of agricultural land is used for grass (silage, hay and pasture), 11% rough grazing (0.47 million hectares) and 8% to crops, fruit and horticulture production (0.38 million hectares). Beef and milk production currently account for 68% of agricultural output. A livestock count in 2015 found that Ireland has 6.9 million cattle, 5.1 million sheep and 1.5 million pigs (Department of Communications, 2017).

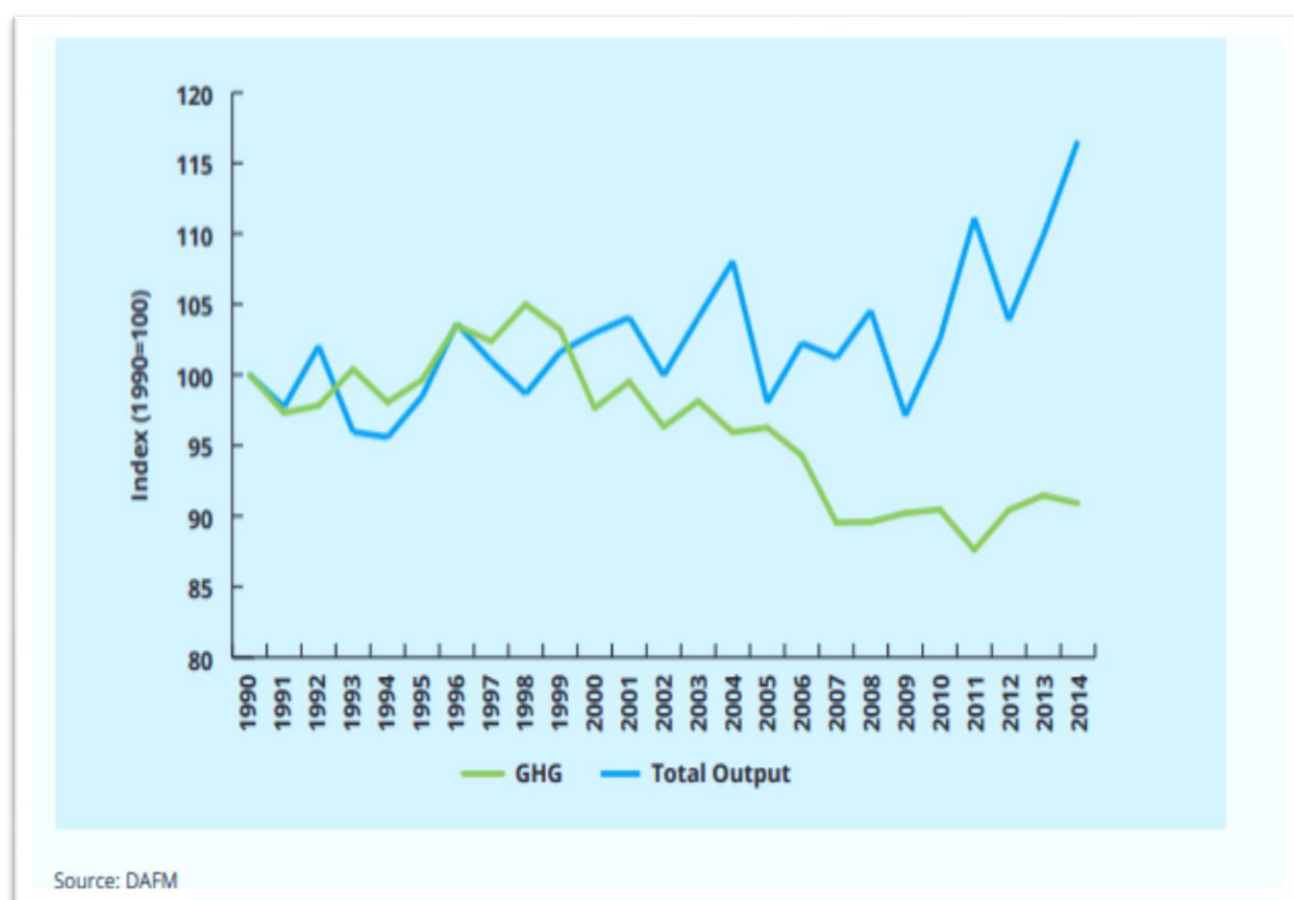


Figure 7: Trends in Greenhouse Gas Emissions from Agriculture and Total Agricultural Output

Ireland's maritime climate favours a grass-based system for agricultural production. Estimated permanent grassland maintains a carbon pool of 608 million tonnes of carbon at 0-30 cm in contrast to approximately 37 million tonnes of carbon in arable land (Department of Communications, 2017). In Ireland, agriculture accounts for about 33% of national emissions. The dominance of cattle and sheep in Ireland results in methane and nitrous oxide contributing the most to Irish agriculture GHG emissions. Figure 8 outlines the emissions from agriculture, relative to other sectors and the main contributors of agricultural emissions.

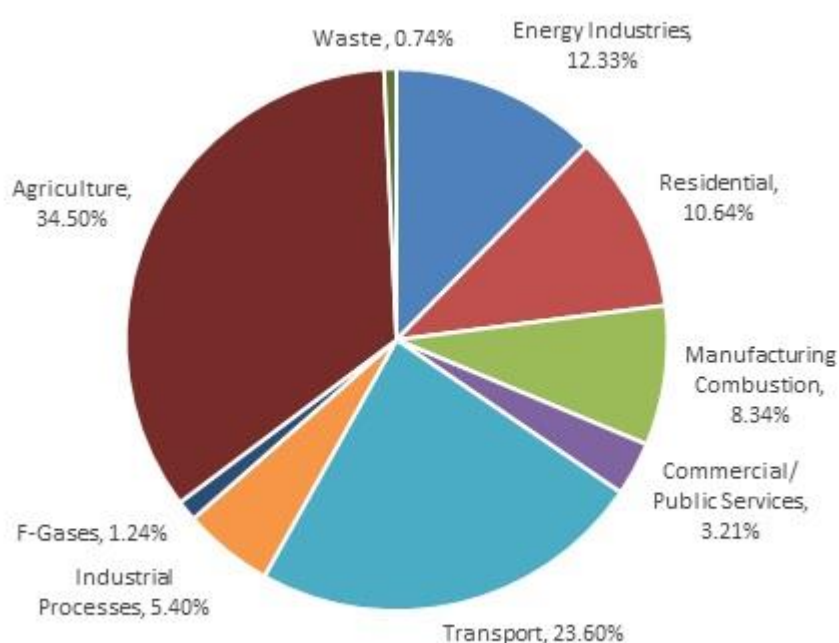


Figure 8: Greenhouse Gas Emissions share by sector in 2019 (EPA, 2020)

Methane is the most significant GHG emitted from agricultural activity in Ireland accounting for 64.5% of emissions (Department of Communications, 2017). Projections suggest that by 2030, agricultural emissions will just be below 2005 levels, suggesting that there are significant challenges to achieve the stated targets in reducing emissions and adapting farms to climate change risks.

Chapter 2: Review of the international literature on climate change attitudes and views on adaptation amongst farmers in developed countries



2.1 Introduction

A key component to achieving targets with respect to climate change goals for agriculture is to engage and change farmers' behaviour. In this section of the report, we present findings from a literature review of previous studies undertaken internationally to understand farmers' attitudes and preferences for climate change mitigation and adaptation within developed countries. According to Adger (2001) adaptation (unlike mitigation) is not a global scale issue but is made up of individual choices to which collective action at local levels is often the most appropriate response. The particular focus is to examine attitudes of farmers in developed countries, which are similar to Ireland, as developing countries face differences in vulnerabilities to climate change compared to richer countries (Arbuckle *et al.*, 2013, Barnes and Toma, 2011, Gagnon-Lebrun and Agrawala, 2006, Rosenzweig and Parry, 1994).

Despite the importance of farmers' in adapting to climate change, there has been significantly less studies conducted in developed countries compared to developing countries – with few studies published prior to 2010 (Prokopy *et al.*, 2015). According to Barnes and Toma (2011) and Arbuckle *et al.*, (2013a), early studies in developed countries such as Adger, 2001, Iglesias *et al.*, 2011 and Howden *et al.*, 2007., focused on conceptual issues rather than examining farmers' attitudes. However, this has changed in recent years, with more studies emerging across countries. In this chapter, we provide a review of 20 studies from across developed countries since 2010 that aimed to examine farmers' perceptions of climate change on agricultural activities and understand farmers' willingness and motivations to engage in adaptation and/or mitigation. The purpose of the literature review is to provide a summary of attitudes of farmers in different countries, illustrating findings from various types of farmers (in terms of farm holdings). Table 1 presents details of the studies that are reviewed in this chapter.

Author Name and Year Published	Sample Size	Location and type of farmers
Barnes and Toma, 2012 & Islam <i>et al.</i>, 2013	540	Scotland; Dairy Farmers
Haden <i>et al.</i>, 2012	162	United States; California Central Farmers: Mix Grain, Vegetable, Orchard and Livestock
Arbuckle <i>et al.</i>, 2013a & Mase <i>et al.</i>, (2017)	4778	United States: 11 States Spanning US Corn Belt; Farm with more than 80 acres of corn production
Arbuckle <i>et al.</i>, 2013a & Arbuckle <i>et al.</i>, 2015	1276	United States; Iowa; Corn and Soybean Farmers
Gramig <i>et al.</i>, 2013	724	United States; Indiana; Row crop farmers
Rejesus <i>et al.</i>, 2013	1380	United States; Mississippi; North Carolina, Texas, Wisconsin; Crop farmers
Wheeler <i>et al.</i>, 2013	1510	Australia; Mixed
Eggers <i>et al.</i> (2015)	82	Northern Germany; Grassland farmers
Galdies <i>et al.</i>, (2015)	172	Malta; Mixed
Hogan <i>et al.</i>, 2011	4000	Australia; Mixed
Niles <i>et al.</i>	490	New Zealand; Crop farmers
Woods <i>et al.</i>, (2017)	1053	Denmark; Mixed
Li <i>et al.</i>, (2017)	219	Hungary; Mixed
Hamilton-Webb <i>et al.</i>, 2017	200	Gloucestershire, England: Mixed (41% livestock and remaining arable or horticulture)
Tzemi and Breen, 2019	746	Ireland; All farming systems
Menapace 2017	195	Italy; Perennial crop farmers

Table 1: Outline of studies reviewed in this chapter

2.2 Findings from Studies from North America, Australia and New Zealand

In one of the first studies in the United States (US) exploring farmers perceptions of climate change, Rejesus *et al.*, (2013) surveyed 1380 crop farmers across four US states (Mississippi, North Carolina, Texas and Wisconsin) on their opinions on climate change. The results showed that a significant proportion of farmers disagreed that climate change

had been scientifically proven (representing approximately 50% of farmers in Mississippi and Texas) or many farmers did not have an opinion on the issue. North Carolina had the largest proportion of farmers, representing 36% of farmers, who believed that “*climate change has been scientifically proven*”, while 24-25% of farmers in Mississippi, Texas and Wisconsin agreed with this statement. In terms of farmers perceptions of the effects of climate change on their farm, the study found that over 70% of farmers in all four states did not believe that climate change will affect their crop yield by more than 5% in total. The majority of remaining farmers felt that climate change could increase or decrease their yields by more than 5% in total. Only a tiny proportion of farmers (representing approximately 1-2% of farmers) expected their yields to increase or decrease by more than 10% because of climate change.

Also in the US, Haden *et al.*, (2012) surveyed farmers, representing a mix of farming types, in California Central Valley. They found that over half of farmers (54%) in their study agreed that the climate is changing and poses a threat to global agricultural activity. However only 37% of farmers believed that global temperatures were actually rising while 31% of farmers disagreed and the remaining farmers were neutral or uncertain. Moreover, only 35% of farmers agreed that human activity was the primary driver of climate change. Overall, farmers in their sample were more concerned about future changes in water availability relative to local temperature changes. This study also asked farmers how likely they would be to undertake several mitigation and adaptation activities as outlined in Figure below.

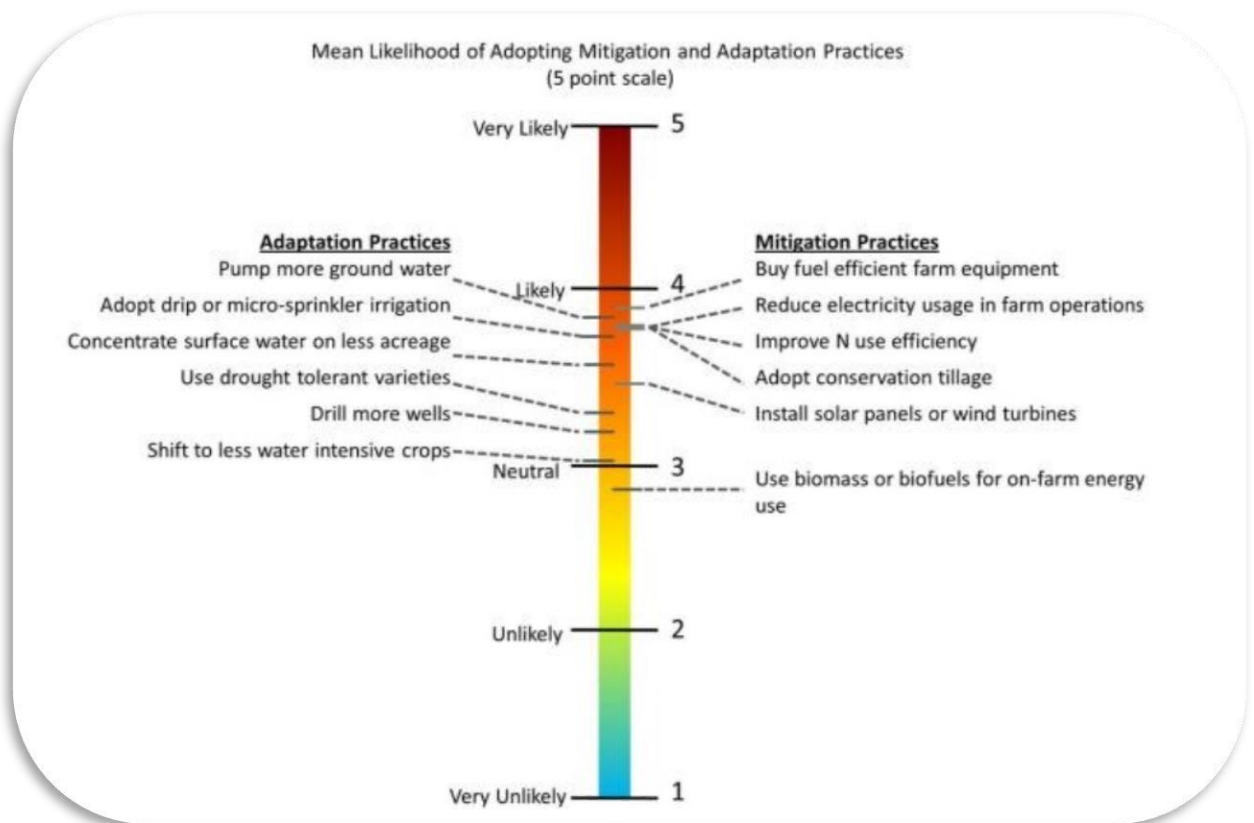


Figure 9: Mean likelihood of farmers adopting various mitigation and adaption practices in California: (taken from Haden *et al.*, 2012)

With respect to adaptation, they found the farmers would prefer to pump more ground water or apply irrigation rather than adopt new cropping practices. In understanding the motivation for potentially adopting either mitigation or adaptation, Haden *et al.*, (2012) argued that mitigation behaviour is driven by global beliefs and concerns regarding climate change and adoption of mitigation practices may be better motivated to farmers' by framing these in the context of long-term risks to society rather than near-term personal risks. Contrarily, motivation to adapt their farming activity is related to local concerns and therefore, to engage farmers' in adaptation behaviour it may be more beneficial to draw farmers' attention to highly specific local impacts and the private benefits that might accrue to their farm from adaptation.

In Indiana, US, Gramig *et al.*, (2013) found that 79% of farmers believed that climate change is an ongoing natural process, compared to 45% who believe that human activities are contributing to climate change, while 31% did not have an opinion on whether human-activity or natural processes primarily cause climate change. Overall, they found that farmers' awareness of climate change is lower than the publics and outreach activities to farmers should focus on raising awareness of the effects of climate change on farming

activity. Also, within the US, Arbuckle *et al* (2013a) carried out a survey of Midwestern farmers representing 27% of farms with crops in the US and 78% of all cropland acres in the US. They found that only 8% of farmers believe that climate change is occurring and is mostly caused by human activity. Approximately 33% of farmers believe it is occurring but caused equally by natural and human activities. One quarter of farmers believe that it is occurring but mainly due to natural causes and 31% of farmers did not believe there was enough scientific evidence to definitely state that climate change is occurring and 3.5% of farmers did not believe in climate change. Therefore, the results suggest that while 66% of these farmers believe that climate change is occurring there is a significant proportion of farmers who believe it is primarily caused by natural processes. They also found that farmers who believe that human activities is a substantial contributor to climate change are also more concerned about the potential risks to their farm. In this study, they also asked farmers about their general attitudes towards mitigation and adaptation and they found that support for mitigation and adaptation differ substantially based on farmers' climate change beliefs. Farmers who primarily thought that climate change is driven by human activities are more likely to support both adaptation and mitigation. Generally, the study found farmers are more willing to undertake adaptation rather than mitigation. For example, support for protecting land from water variability ranged from 42-73% among farmers depending on their climate change beliefs. However, support for on-farm mitigation measures ranged from 8-45% depending on climate change beliefs.

Arbuckle *et al.*, (2013b) conducted a similar study of Iowa Corn Belt farmers, the largest producers of corn and soybean in the US³. The study found similar opinions amongst farmers with respect to climate change compared to Arbuckle *et al.*, (2013a). In total, the study reported that 68% of Iowan farmers believed that climate change is occurring with large variation amongst farmers as to primary causes of climate change. In this study they also found that more farmers favoured on farm adaptation than government-led mitigation actions. With respect to specific adaptation behaviour, 62% of farmers agreed that farmers should take steps to protect their farm from increased precipitation and 46% agreed that farmers should increase investments in agricultural drainage systems to prepare for increased precipitation. Approximately, 33% of farmers supported government led action to mitigate GHG. The study found that farmers who indicated they were concerned about climate change were significantly more likely to support both adaptation and mitigation.

³ Representing over half of the US's output (Arbuckle *et al.*, (2013b).

They also found that farmers who believed primarily in human-driven climate change and older farmers were significantly more likely to support mitigation. In a later study, Arbuckle *et al* (2015) noted that climate change adaptation and mitigation measures in agriculture are related concepts but there is a physical and conceptual difference and this difference may impact on farmer's beliefs and attitudes towards climate change action (Arbuckle *et al.*, 2015). They argue that outreach activities to farmers should focus on adaptation that may also have mitigation benefits and this could engage farmers who do not believe in human driven climate change.

In a later study, Mase *et al.*, (2017) aimed to understand how US corn farmers were adapting to climate change – using the same data as reported in Arbuckle *et al.*, (2013a). They found that 64% of farmers were currently managing climate and weather risks by implementing in-field conservation practices, 59% by buying insurance, and 43% by using new technologies. They found that 10% of farmers were willing to diversify into other forms of production or other crop systems and 14% of farmers have left or considered quitting farming because of climate or weather related risks. The most important factor in explaining farming adaptation decisions was their level of concern with the impacts of climate change. In this study, they also found that approximately 14% of farmers believed that changes in weather had negatively affected their farming activity and approximately, 56% of farmers indicated that they noticed more variable/unusual weather during the previous 5 years.

In Australia, Hogan *et al.*, (2011) examined responses from almost 4000 farmers on their adaptation behaviour. The study identified three clusters of farmers. The largest group, representing 55% of farmers, were labelled as the “*cash poor long-term adapters*”. This group sought to adapt their farming practise to manage climate-related risks and ensure the long-term sustainability. However, while this group believed in climate change and they were affected by climate change, they suffered significant resource constraints that inhibited their ability to adapt. The second group as described by the authors as the “*comfortable non-adapters*” representing 26% of farmers. This group did not believe in climate change or perceive any immediate threats from it. Their focus was in continuing their existing farming practices. The final group that the authors described as the “*transitioners*” represented 19% of farmers. This group were less certain than the first group about climate change however they were trying to adapt their farm and be sustainable

in the long-run, however, this group faced the largest barriers (both financial and otherwise) to adaptation.

Also, in Australia, Wheeler *et al.*, (2013) found that farmers, who expressed a willingness to engage in adaptation due to climate change vulnerability were: younger, have identified farm successors, more productive, innovative, traditional and environmentally focused farmers'. Contrary to other studies, Wheeler *et al.*, (2013) found that farmers who believe in climate change (or have been affected by climate change) were less likely to engage in adaptation – although the note that this is driven by a lower likelihood of planning for more expansive strategies to adapt their farm. They found that while these farmers are less likely to engage in expansive strategies, they were more likely to engage in accommodating strategies (improve irrigation efficiency and change their crop mix). They also found that farmers who had previously engaged in adaptation were much more likely to undertake it again. The authors argue that adaptation outreach to farmers should focus on how adaptation could increase farm profitability and strengthen the viability of the farm, as focusing only on educating farmers on the effects of climate change may not be sufficient to promote adaptation.

In New Zealand, Niles *et al.*, (2016) undertook a survey of 490 farmers to understand their perceptions of climate change and its impact on agriculture. They found that 66% of farmers believed that climate change was human-induced. In the study, they wanted to gather data on farmers' perceptions of historical climate change. They found that farmers' perceptions of climate change (whether there were changes in summer and winter temperature and precipitation rates) did not consistently track with historical changes in climate over time. They also found that farmers who believed that climate change was occurring had a stronger belief that the climate had already changed, whether this perception was accurate or not.

2.3 Studies from Europe

Eggers *et al* (2015) conducted a study of Grassland farmers in Germany aimed at understanding farmers' perspectives on climate change in order to identify appropriate targeted adaptation policies. They found that 67% of farmers believed that climate change had influenced their agricultural production, such as livestock and crop production, compared to 15% of farmers who did not believe that climate change had affected their farm. Farmers who had large farms and those with lower quality soil had higher climate

change awareness. Within this study the authors also asked farmers about the acceptance of different types of adaptation practices. The study found that farmers favoured more cost-effective adaptation practice (such as the introduction of new varieties of crops) somewhat more than costly practices like irrigation. This contrasts somewhat to Haden *et al.*, (2012) who found that farmers' in California favoured irrigation – which may reflect significant previous experience with irrigation practices among those farmers. The study also found that adaptation preferences depended on the type of farmer and targeted messages may be effective for different groups of farmers. For example, for more economically minded farmers, the study argued that it may be useful to highlight the potential of adaptation for minimising longer-term risks to the farms. While for environmental minded farmers, emphasizing the environmental benefits of adaptation may be more effective to engage farmers in adapting farming practices.

Li *et al.*, (2017) undertook a survey of 219 farmers in two regions in Hungary, representing a mix of farming activity. They found half of farmers were already engaged in a variety of adaptation activities. The authors were primarily interested in exploring actual adaptation behaviour (rather than planned adaptation) and they found that only awareness of extreme weather events had a positive and significant relation to adaptation behaviour – awareness of other climate-induced factors did not influence actual adaptation. Moreover, they did not find consistent evidence that beliefs in climate change risks can lead to actual adaptation behaviour – actual adaptation behaviour was explained only by a limited extent by perceptual factors alone. The authors note that financial and managerial motivations had much stronger explanatory power for farmers' actual adaptation rather than concern for climate change. Similar to previous studies, the authors suggest that linking adaptation behaviour to profitability and better farm management may be an effective strategy rather than simply trying to raise awareness of the risks associated with climate change.

Menapace *et al.*, (2015) conducted a study with 195 perennial crop growers in Italy (mainly Apple and Grape growers). The aim of their study was to understand whether farmers believed in climate change and to understand whether farmers' risk perceptions influenced their perceptions of future losses associated with climate change. They found that awareness of climate change was generally high amongst these farmers – with 83% of

farmers stated that they believed in climate change. Similar to other studies, there was variation in responses regarding the causes. Approximately, 22% of farmers believed that climate change was predominantly or wholly due to human causes; 58% of farmers believe that it was equally due to natural and anthropogenic causes and 20% of farmers believe it is solely due to natural causes. In total, 72% of apple farmers and 85% of grape growers have reported they had witnessed disastrous hail damage to a farm in their region in the previous five years. Overall, farmers perceived a higher long-run risk of crop losses compared to short-run losses. The study found that farmers who believed in climate change expected larger increases in median crop damages due to hail and dieback compared to non-believers. In the case of powdery mildew, they found no statistical difference in risk perceptions between climate change believers and non-believers. The authors argue, similar to other studies that a segmented approach should be taken to farmer outreach. Some farmers may benefit from general education on the risks to crop losses from climate change while other farmers may benefit with help in implementing cost-effective measures to mitigate the risks.

Woods *et al.*, (2017) collected data from 1053 Danish farmers, representing a mix of farm types. In their study, they found that 54% of farmers either agreed or strongly agreed that global climate change is occurring. With respect to farmers' perceived effects of climate change on their farms' there were a mix of attitudes among farmers. Approximately 51% of farmers did not believe that climate change would affect their farm in the future. Approximately 17% of farmers believed that the effect of climate change would be positive while only 14% believed climate change would have a negative effect on their farming activity. The remaining 18% of farmers did not know. Overall, concern among farmers in Denmark regarding climate change is low. Moreover, when farmers were asked whether they would adapt their farms to climate change, the study found that farmers' indicated a greater willingness to take advantage of what they perceived as the opportunities presented by climate change rather than protect their farm against the negative effects posed by it. However, in line with other studies, farmers who indicated greater concern about climate change indicated a greater willingness to adapt their farming practices to cushion against negative impacts. When asked regarding specific adaptation measures that farmers would be willing to undertake the study found that farmers favoured smaller flexible adjustments to their farming systems. This includes measures such as changing their irrigation, pesticide use, adding crops or extending the growing season. These smaller measures were preferred

over permanent changes— such as increased rotation, intercropping or expanding the cropping area.

Galdies *et al.*, 2016 conducted a study with Gozitan farmers in Malta, who face a range of economic and environmental vulnerabilities from climate change. Agricultural practices are characterised by the small size of the land, the special distribution of cultivation areas for the most important agricultural crop such as forage, fruits, grapes, potatoes and vegetables over arable farming in this region. The study found that the majority of farmers perceived negative effects of climate change on their farming practices. For crop cultivators, they noticed the rate of pests had increased in recent years due to warming weather. Farmers had perceived increases in adverse weather conditions due to increases in droughts (54.3%); intense rainfall (35%) and strong winds (10.6%). They also found that 41% of livestock farmers had said their productivity had worsened principally because of increase heat stress on their livestock. They found that the majority of farmers who believed that climate change is occurring were more ready to express concern about climate change risks, and were supportive of farmer level adaptation. In the case of crop farmers, of the 54% of farmers who indicated a willingness to adapt, approximately 86% favoured more drought and pest resistant crops, while 53% indicated a preference to change their cultivation period. The least favoured option amongst this group was reducing their fertiliser use. For livestock farmers, they showed a willingness to adapt through using new machinery and implementation of measures that would reduce heat stress on their animals. The farmers indicated in the study that their largest barrier to adaptation was cost. In this study, they identified three typologies of farmers. The “*innovator*” (represent 75% of farmers) who had a strong willingness to adapt and who perceived high risks of doing nothing. The second typology were characterised as “*profit-orientated entrepreneurs*” (representing 13% of farmers). This group of farmers showed a low level of concern or awareness of climate change but would adapt if they measures enhanced farm profitability. The final group, which the authors characterised as “*disengaged*” (representing 12% of farmers) had no opinion on climate change, they did not perceive a changing climate and mainly thought that natural processes caused climate change.

In the UK, Barnes and Toma (2012) published a study based on the results from large-scale survey of dairy farmers conducted in 2009 in Scotland, which is climatically and geographically similar to Ireland. They found that less than half of livestock farmers agreed or strongly agreed that temperatures would increase in the future and there were generally

uncertainty surrounding the impact of climate change on farming activity. Only 25% of farmers believed in predominantly human-induced climate change and 45% of farmers perceived climate change would affect farming activity. The majority of farmers' surveyed indicated that their farming activity had not been affected to date by climate change. In their study, they created a typology of different farmers based on their attitudes to climate change and they identified six clusters of farmers. The first cluster was described in the study as the "regulation sceptic" (representing 12% of farmers). Farmers belonging to this cluster did not expect that climate change would affect their future productivity decisions and they expressed negative attitudes towards any types of regulation of GHG. The second group identified was called the "the commercial ecologist" (representing 15% of farmers). This group expected the impact of climate change to be predominantly negative but they do not perceive climate change as a large enough threat to change their business practices. The third group they called the "innovator" (representing 16% of farmers) – farmers in this cluster expressed an openness to adapting to new farming practices as long as improved profit and resource maximisation. The fourth group called "the disengaged" (representing 23% of farmers) – farmers in this cluster did not have strong opinions on climate change or generally showed much interest in the topic and therefore were less likely to adapt farming practices. The fifth group called the "negativist" (representing 22% of farmers). Farmers in this group mostly believed that climate change would affect them negatively. Therefore, they are more open to adopting best practices for adaptation. Finally, the sixth group called "the positivist" – (representing 12 percentage of farmers) - these farmers believed that climate change would bring mostly positive effects to their farming activity and therefore are less likely to adapt to climate change threats.

In a later study in the United Kingdom (UK), Hamilton-Webb *et al.*, (2017) explored attitudes of farmers towards climate change including farmers who had experienced a previous flooding event on their farm in Gloucester, UK. They collected responses from 200 farmers representing a mix of different farm types. In their study, they found that 71% of farmers acknowledged that the climate is changing, 41% believed that it was already affecting their farm while 54% believed that climate change would affect their farm in the future. Despite these beliefs, 58% of the surveyed farmers stated that they were not concerned or only slightly concerned about climate change. Approximately 29% of farmers indicated they were moderately concerned about climate change and only 14.5% of farmers indicated they were very concerned about climate change. They found that farmers who

had experienced a previous flooding event were more concerned about climate change although farmers did not necessarily perceive climate change and flooding as related. The study found that concern for climate change was not a significant motivation for behavioural responses among these farmers, and climate change is overall considered a low priority risk in relation to other common threats to their farming business. However, farmers have been engaging in behaviour such as adaptation, not necessarily because of climate change but other factors such as profit maximisation. For example, among this sample, 64.5% of farmers were reducing their energy use; 59.5% of farmers were preparing buildings for stormy weather; 52% of farmers were reducing their use of inorganic fertiliser, 46% were increasing their use of minimum tillage and 44% of farmers were improving farm drainage.

In Ireland, Tzemi and Breen (2019) published findings from 746 farmers collected during 2014, representing a mix of farm types operating in Ireland. The study found that over half of farmers in the survey agreed that human activities were contributing to global climate change, with some variation among different types of farms. However almost half of farms either expressed uncertainty or did not believe that climate change would affect their farming activity. Moreover, approximately one third of other farmers believed that climate change would only affect their farm in the very long run. In this study, farmers were asked how much additional cost they would be willing to incur to reduce their GHG emissions. Approximately 78% of farmers indicated that they would not be willing to incur any additional expenses and the remainder of farmers would only be willing to incur between small additional costs. The study also asked farmers whether they would be willing to use an advisory tool that would show the potential reductions in GHG emissions from the adoption of new technologies. Only 35% of farmers indicated that they would be willing to use the tool, 52% indicated that they would not use the tool, while the remainder were unsure.

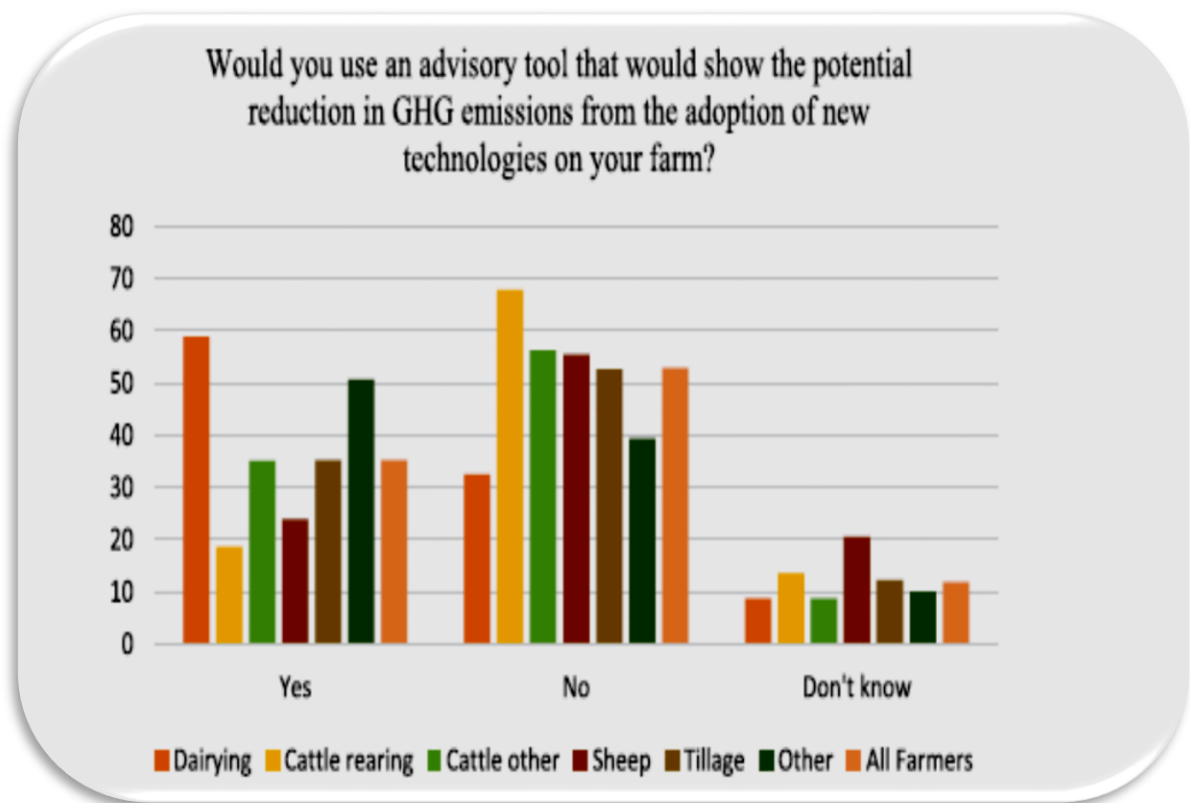


Figure 10: Willingness to use an advisory tool by farm type in Ireland: (Tzemi and Breen, 2019)

Figure 11 shows variation in willingness to use the advisory tool by farm type. Specialist dairy farmers (who contribute substantially to GHG emissions from agriculture) showed the most willingness to use the tool. Cattle rearing and sheep farmers showed the lowest willingness to use the tool. The study also found that farmers who are more aware of climate change, who used social media, who received agri-environmental advice or training and had a larger farm income, were more likely to use the advisory tool.

2.4 Summary of Literature Review

The purpose of this chapter is to review the international literature that examined farmers' perceptions of climate change and the risks posed by it. This chapter also examined farmers' willingness to engage in farm adaptation or mitigation and what factors might explain this behaviour. Our review showed that across all countries, there were a large proportion of farmers who agreed that climate change is occurring. However, there were large variations between farmers in different countries. For example, a large proportion of farmers in Southern Europe, such as Malta and Italy, believed that climate change is occurring (84%

of farmers' believed that climate change was happening in Italy). In comparison, Rejesus *et al.*, (2013) in the US, found that in some of their states (e.g. Texas and Mississippi) almost half of farmers' do not believe that climate change is scientifically proven. Moreover, while, on average, across the studies, a majority of farmers' agreed that climate change is occurring, there were large variations in beliefs as to the causes of climate change. For example, in many of the countries, many farmers did not attribute climate change to human-induced activities but many believed climate change was caused by natural causes or by both human and natural causes.

Key Findings: Farmers Attitudes

1. On average, most farmers agree climate change is occurring although big differences in beliefs across countries;
2. Many farmers believe climate change is the result of natural processes or natural and human factors rather than mainly human-induced;
3. Vast majority of farmers do not believe that climate change will negatively impact their farming activities.

Another important finding from the literature review was that many studies reported that farmers do not perceive large-scale negative effects from climate change on their agricultural activities. For example, in the US (Arbuckle *et al.*, 2013a) found that 70% of crop farmers did not expect that climate change would affect their crop yields by more than 5%. In the UK, Hamilton-Webb (2017) found that 58% of farmers are not concerned or only slightly concerned about the effects of climate change on their farm activities and concerns for climate change are low priority compared to other concerns. Tzemi and Breen (2019) found that half of farmers in Ireland are unsure or do not believe that climate change would affect their farm. Similarly, Woods *et al.* (2017) sampling Danish farmers, found that half of farmers do not perceive any effects of climate change on their farm and of the farmers who do believe that climate change would affect their farm, a higher proportion of farmers' perceived the effects would be positive. For farmers' who were aware of climate-change or believe that it is primarily caused by human activities, are more likely to believe that climate change will negatively impact their farming activities. Taken together from the

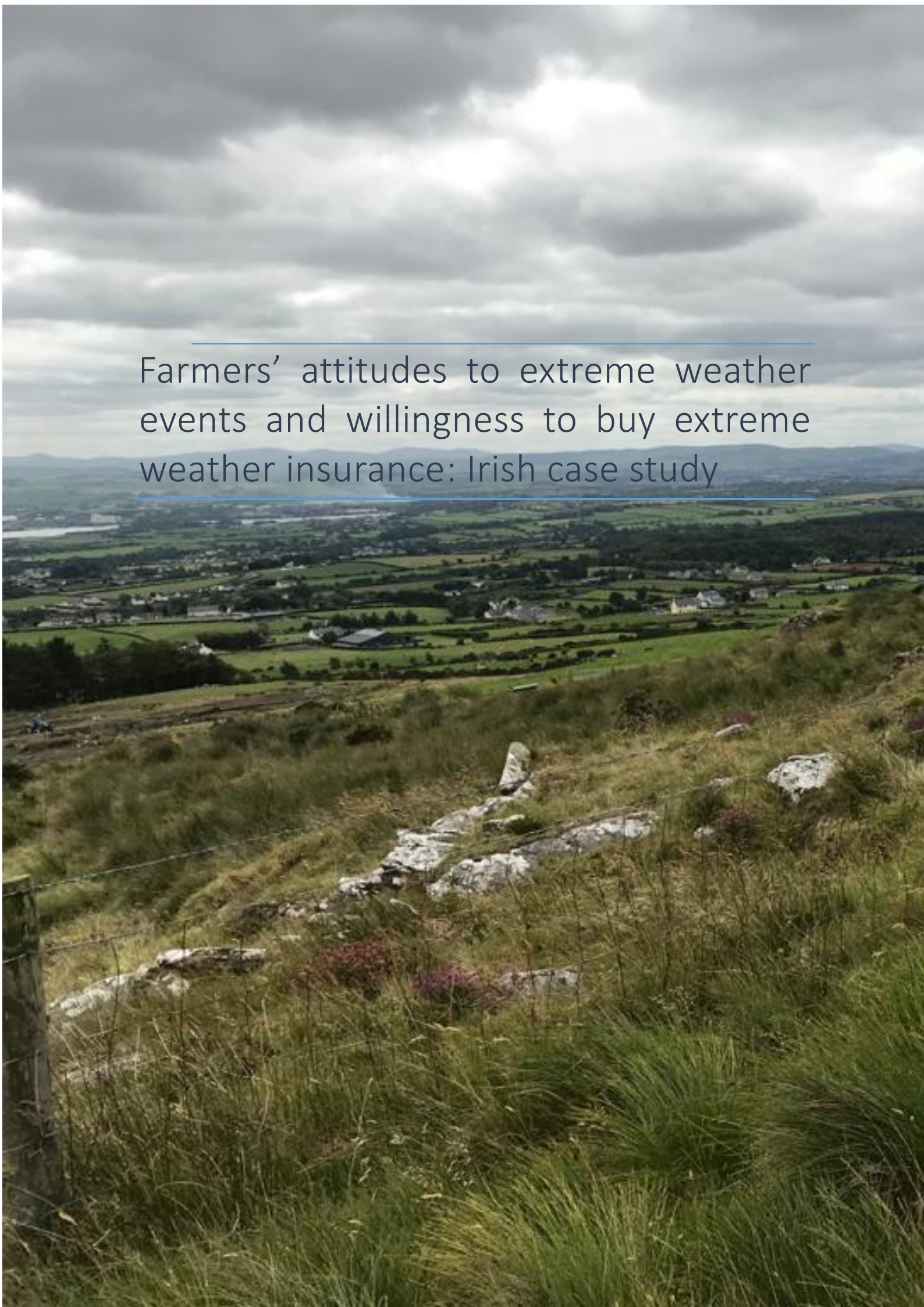
reviewed studies, the results suggest low awareness amongst farmers of the negative effects of climate change on farming activities.

Within this chapter, we also reviewed studies to examine farmers' willingness to engage in adaptation and/or mitigation behaviour. Studies that have examined both, suggest that farmers prefer to undertake adaptation rather than mitigation. For example, Arbuckle *et al.*, (2013) found more support for farm adaptation (ranging from 42-73% of farmers depending on their beliefs on climate change) compared to mitigation (ranging from 8-45% of support). In Ireland, Tzemi and Breen (2019) found that 78% of farmers who not be willing to incur any additional expenses to reduce their GHG emissions and only 35% of farmers would be willing to use a tool that could inform them of the mitigation potential from adopting new technologies. On the other hand, it appeared that many farmers would be willing to participate in certain adaptation behaviours, although preferences for particular adaptation measures varied across countries. Moreover, farmers who were already engaging in adaptation were more likely to undertake more adaptation in the future. In some studies preferences for adaptation is motivated by beliefs about climate change while for other studies it is not. For example, Li *et al.*, (2017) examined actual adaptation behaviour rather than willingness to undertake potential adaptation and they found that actual adaptation was not driven by climate change beliefs or perceptions but rather by financial and management concerns. Several of the studies, also created a typology of farmers and they found that this is a useful way to identify a segmented approach that could be used to target farmers to engage in adaptation behaviour. In these studies, they also identified farmers who would be motivated to engage in adaptation behaviour beyond just concern for the environment.

Key Findings: Policy Implications

4. Greater support among farmers for adaptation compared to mitigation;
5. Increasing awareness of climate change may not be sufficient to spur farmers to change farming practices;
6. Need to promote economic/ financial benefits of adaptation or mitigation;
7. Farmers may be most willing to do cost-effective adaptation/mitigation – providing both economic and environmental benefits.

With respect to outreach to farmers, some studies suggest that it might be useful to heighten farmers' knowledge with respect to climate change. However, a pervasive message from across studies suggests that it may be useful to persuade farmers' by highlighting the economic benefits rather than simply trying to increase farmers' environmental awareness. For example, several studies suggest that farmers would be willing to engage in adaptation for profit maximisation reasons rather than environmental concerns. Moreover, outreach activities to farmers should promote cost-effectiveness adaptation as "win-win" in that they provide economic benefits while also improving adaptation to climate change. Furthermore, as Arbuckle *et al.*, (2013b) pointed out, some adaptation behaviour may also have mitigation benefits that could be promoted to farmers, rather than solely making appeals to reduce their mitigations.



Farmers' attitudes to extreme weather events and willingness to buy extreme weather insurance: Irish case study

Introduction

This chapter presents findings from a national quantitative survey that was undertaken with Irish farmers' as part of the *RiskAquaSoil* project. A quantitative survey was developed to ascertain Irish farmers' attitudes towards extreme weather events and to understand their willingness to undertake actions on their farms to adapt to changing weather. Within the survey we also collected information on the economic value that farmers' assign to insurance that will protect them against output losses that are caused by extreme weather events that are projected to increase as a result of climate change. We designed the survey in collaboration with the *RiskAquaSoil* partners and the data was collected by an external survey company, Behaviour and Attitudes. The data was collected from 270 farmers between April to August 2019. The survey company used quota control methods to ensure that the farmers surveyed were representative of the Irish farming population based on demographic profile of the farmers and the farm (in terms of size, geographical location and farm type).

The survey had a number of sections and the report presents results from the sections in this chapter. First, the chapter will present an overview of the characteristics of the farmers and their farms that were interviewed as part of this survey. This provides an overview of the farms and subsequently many of these variables are used as explanatory variables in models of farmers' choices surrounding actions for protection from extreme weather events. Second, the chapter provides an overview of farmers' attitudes and perceptions of the risk posed to their farms from extreme weather events. We present these results broken down by region and farm type to understand whether there are any differences in attitudes based on these farm characteristics. Third, the chapter presents results from questions that were included in the survey related to whether farmers' would be willing to participate in a scheme to apply flow restrictors on rivers near their land to reduce the likelihood of flooding on downstream communities. We included two questions on this section related to whether farmers would be prepared to undertake individual action (i.e. work by themselves) or collective action (work with other local farmers) to apply restrictors that may subsequently lead to flooding on their land. This is of interest as the larger RiskAquaSoil project is investigating different methods to enhance protection from flood events. Finally, we present results from a contingent valuation section that was included in the survey to ascertain farmers' willingness to pay (WTP)/ economic value that they attach to a guaranteed insurance scheme that would protect their farm against agricultural output losses caused by extreme weather events. The purpose of this is to

provide a monetary estimate of farmers' perceived value of protecting their farm against extreme weather events and it provides a quantitative estimate of the risks that farmers' foresee from extreme weather events. The survey also included a discrete choice experiment section that ascertains farmers' preferences for different characteristics of climate-based insurance. However, we do not present these results in this chapter but in separate publications arising from the survey.

Key Objectives of the Chapter

- Present findings related to farmers' attitudes towards extreme weather events and their perceptions of the impact of extreme weather on their farm.
- Determine farmers' willingness to participate in individual and/or collective schemes to prevent downstream flooding to local communities.
- Understand farmers' willingness to buy insurance to protect their farm against agricultural losses caused by extreme weather events, which are projected to increase due to climate change.

3.1 Methods

Principally the *RiskAquaSoil* partners at NUI Galway designed the survey with significant input from the wider research project research team as well as with other researchers at NUI Galway. This approach was to design a survey that could be collected from all farmers in Ireland. After wide consultation and discussion with the research team and experts at NUI Galway, the survey was designed to collect key information around farmers' attitudes to extreme weather events, their preferences to work with other farmers for climate change adaptation behaviour relevant for *RiskAquaSoil* and their preferences for climate-based insurance. Prior to the main data collections, members of the research team at NUI Galway conducted one to one interviews with farmers on their views on climate change and we also asked them to complete draft versions of the survey. In addition, once a draft survey had been developed, the research team also did some pre-pilot interviews with farmers to ascertain their in-depth views on the survey. Subsequently, the survey was also piloted with 50 farmers by the external survey company.

The chapter presents summary statistics of the main variables of interests. We also present findings from multivariate statistical analysis that we conducted to examine the determinants of participation in individual or group action to reduce downstream flooding. As a final section

in this chapter, we present results from our multivariate statistical analysis exploring farmers' willingness to buy insurance to protect their farm from agricultural output losses caused by extreme weather events.

3.2 Results

3.2.1 Background Characteristics of the Sample

Table 2 presents descriptive statistics of the farmers and the farm characteristics in the sample.

Descriptive Characteristics	Percentage
Gender: Male	84%
<u>Age Categories:</u>	
18 – 34 Years	17%
35 – 44 Years	13%
45 – 54 Years	21%
55 – 64 Years	30%
65 years or older	29%
Married	76%
Has Children	69%
Average number of years farming	31 years (Std Deviation: 16 years)
<u>Education Level</u>	
Primary School	14%
Some Secondary	29%
Complete Secondary	33%
Professional Qualification	14%
College/University Degree Level	10%
Identified a farm successor	50%
Has an Off-Farm Job	40%
<u>Farm Size</u>	
Up to 10 hectares	5%
10 – 20 hectares	21%
21 – 30 hectares	22%
31 – 50 hectares	26%

51 – 100 hectares	19%
Over 100 hectares	7%
<u>Farm System</u>	
Mainly Dairying	23 %
Mainly Cattle rearing	36%
Mainly Cattle Other	17%
Mainly Sheep	11%
Mainly Tillage	5%
Mainly Mixed Livestock	7%
<u>Stocking Numbers: Self-Identified</u>	
Top	19%
Middle	67%
Bottom	14%
<u>Regional location</u>	
Border	23%
Midland	10%
West	8%
Mid-East	13%
Mid-West	9%
South-East	17%
South-West	20%

Table 2:: Descriptive statistics of the sample

As shown in Table 2 the majority of farmers in our sample are male and older. In total, 84% of farmers in our sample are men, which reflect the gender distribution of farmers' in Ireland. Almost 60% of farmers are older than 55 years old. Reflecting the age pattern of the sample, the average number of years that the farmers' have been farming in their own right is 31 years (with a standard deviation of 16 years). Approximately half of farmers' in the sample have identified a successor to take over their farm, while 40% of farms have an off-farm job or income. In terms of farm characteristics, nearly half of farmers surveyed had between 21-50 hectares of farmland, with a predominant livestock/dairying farm system. Compared to other countries in the Atlantic Area, Ireland has a relatively small tillage sector. To determine the intensity of farming activity, we asked farmers to self-assess

in terms of their own stocking density compared to other farmers and the majority of farmers have characterised themselves as being in the middle of the stocking numbers.

As the project is interested in flooding, we were interested in determining the number of farms that have a watercourse or stream running near or through them. The Midwest region of Ireland has the highest proportion of watercourses (75%) and the lowest proportion of watercourses on farms is in the MidEast/Dublin Region (47%). The other regions have a similar proportion to the average.

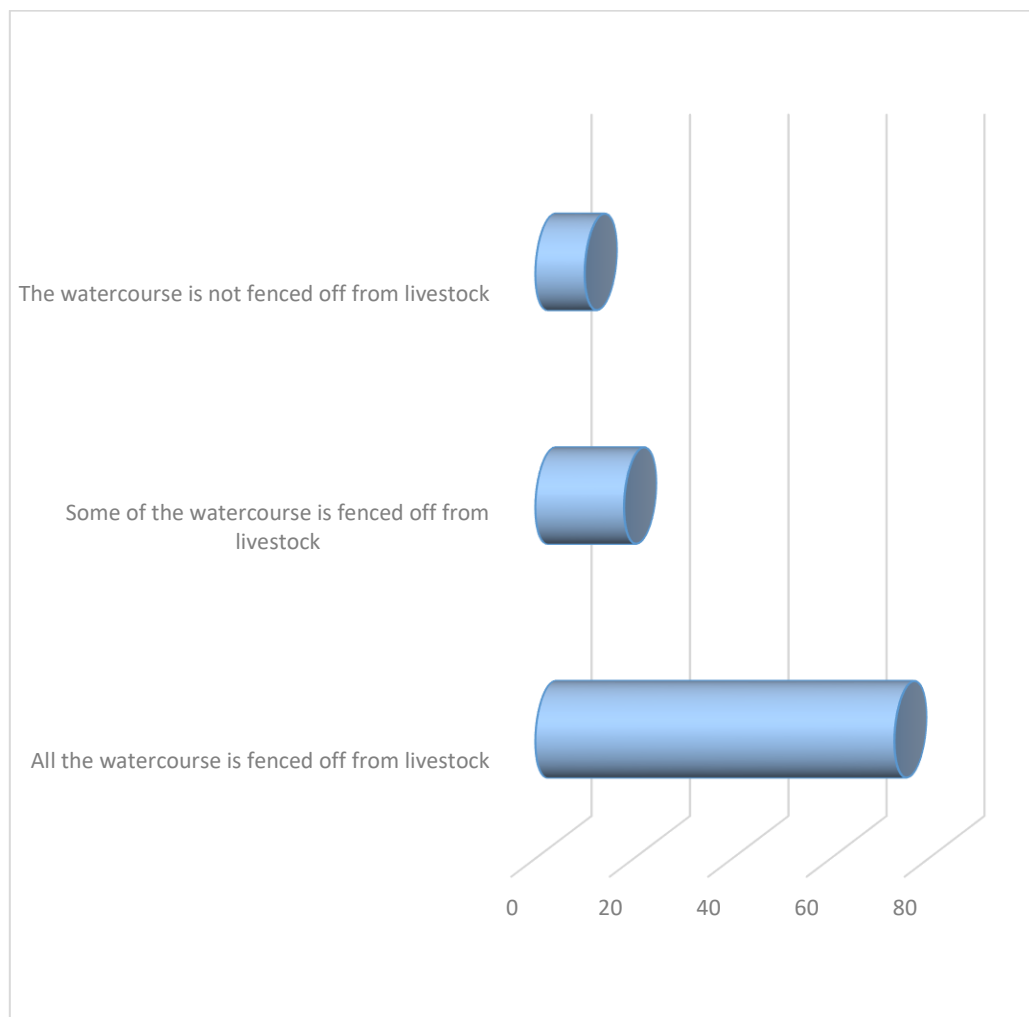


Figure 11: Watercourse management

As illustrated for the proportion of farmers who have a watercourse running through their farms, 90% of these watercourses are either fully (73%) or partially (18%) fenced off from livestock.

We also asked farmers whether they currently or previously participated in any major agri-environmental scheme, as this could be an important indicator of farmers' environmental behaviour (these include the rural environmental protection scheme (REPS), agri-environment options scheme (AEOS) and the green low carbon scheme (GLAS)). Approximately 62% of farmers have participated in a previous major agri-environmental scheme. On average, for farmers who have participated in an agri-environment scheme, the average length of participation amongst farmers is 11 years with a standard deviation of 8.6 years.

In order to understand differences between regions, we also present participation in agri-environment schemes by region in Ireland in the Figure below. We do observe some substantial differences, with much lower rates of participation in the Mideast region compared to other regions in Ireland.

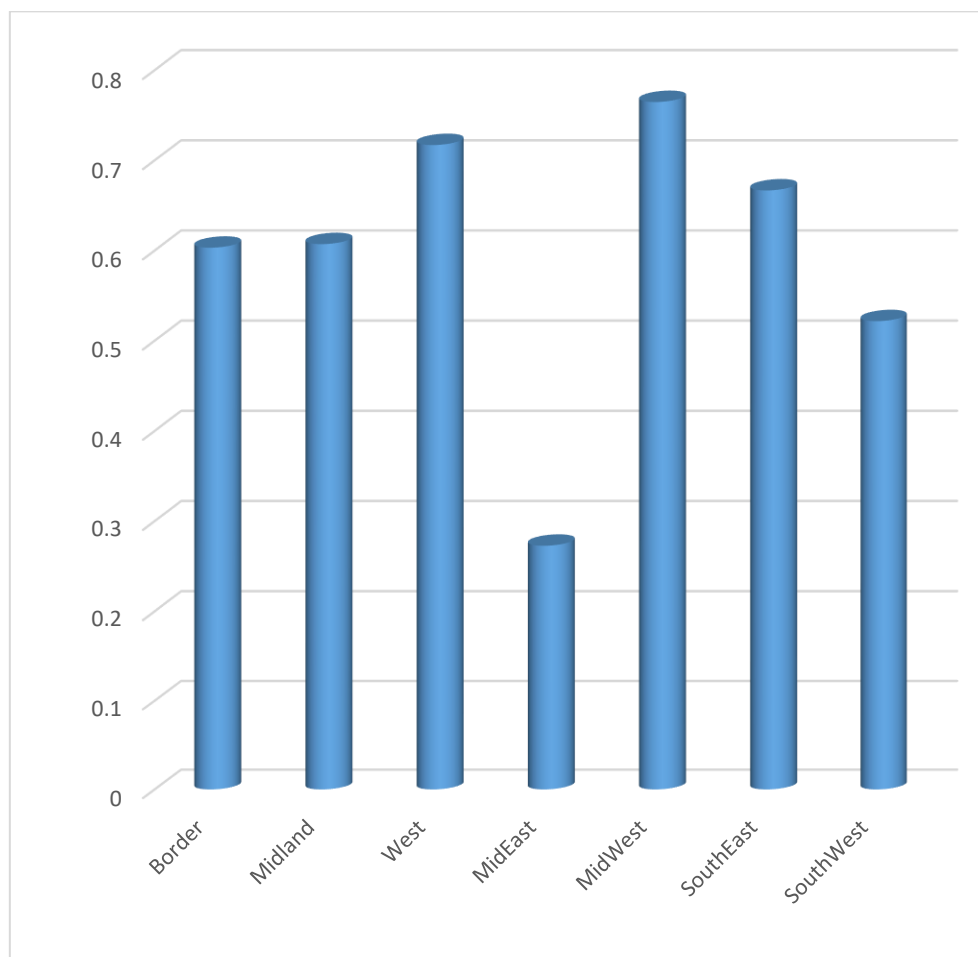


Figure 12: Participation across agri-environmental schemes by region

3.2.2 Attitudes towards extreme weather events

As part of the survey on the attitudes and perceptions of risks associated with extreme weather events that are occurring more frequently as a consequence of climate change, we asked farmers a number of questions regarding their perception of the impact of extreme weather on their farms. In the first instance, we examined whether farmers' thought that their farm has been ever negatively impacted by extreme weather events. Approximately, 48% of farmers have stated that their farm has been affected by extreme weather events in the past. We asked farmers specifically about the nature of the events and we see significant variation by type of extreme weather events as shown in the Figure below.

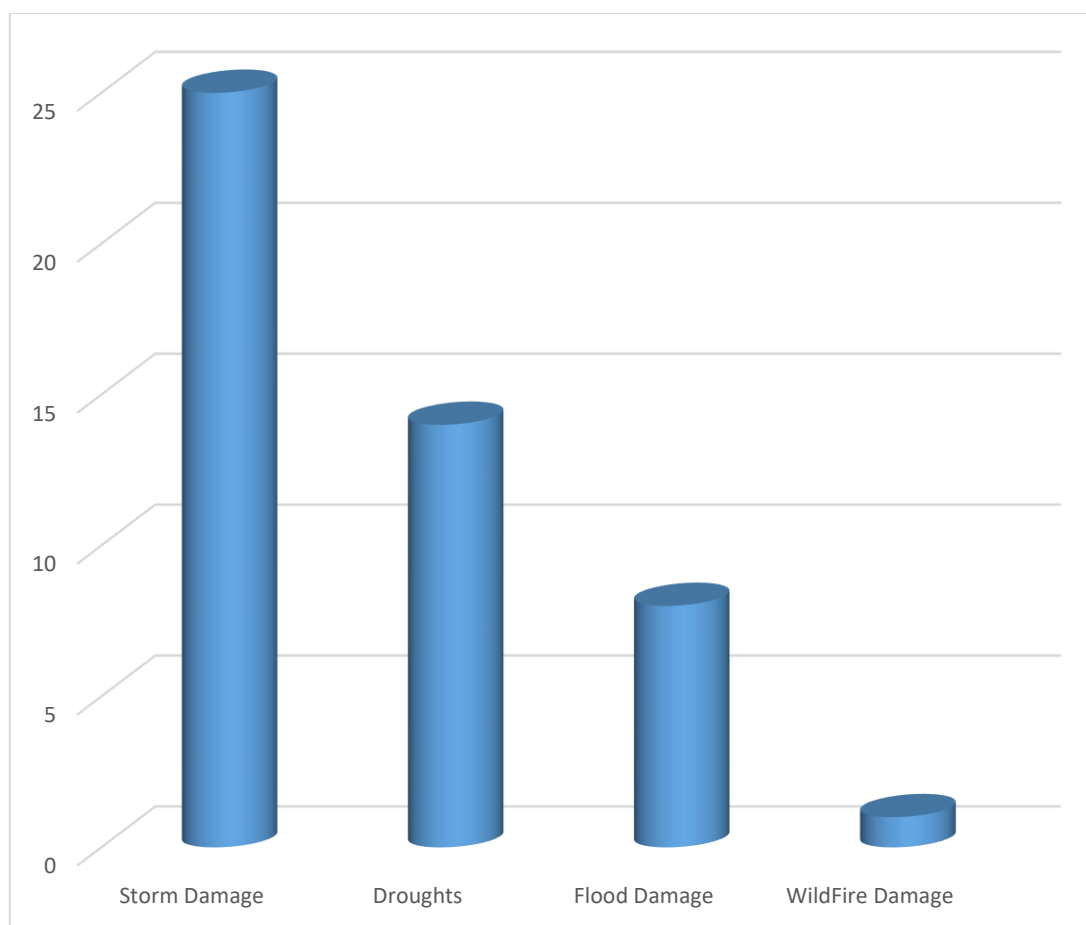


Figure 13: Percentage of Farms affected by extreme weather events in the past

As shown of the farmers who have indicated that their farm was affected by extreme weather events in the past, approximately 25% have stated that they have been affected by storm damage (including wind/hail or snow damage), 14% have been affected by droughts, 8% by flood damage and approximately 1% by wildfire damage.

We also asked farmers whether they are concerned about extreme weather events affecting their farm now or in the future. Approximately 35% of farmers indicated they are concerned and 65% of farmers have indicated that they are not concerned regarding current or future weather events affecting their farm. In general, there is significant variation across regions in their concerns regarding extreme weather events. In the Midlands and Midwest regions of Ireland, approximately only 22% and 25% of farmers respectively are concerned about extreme weather events. In the Southeast region, over half of farmers are concerned about extreme weather events affecting their farming activity.

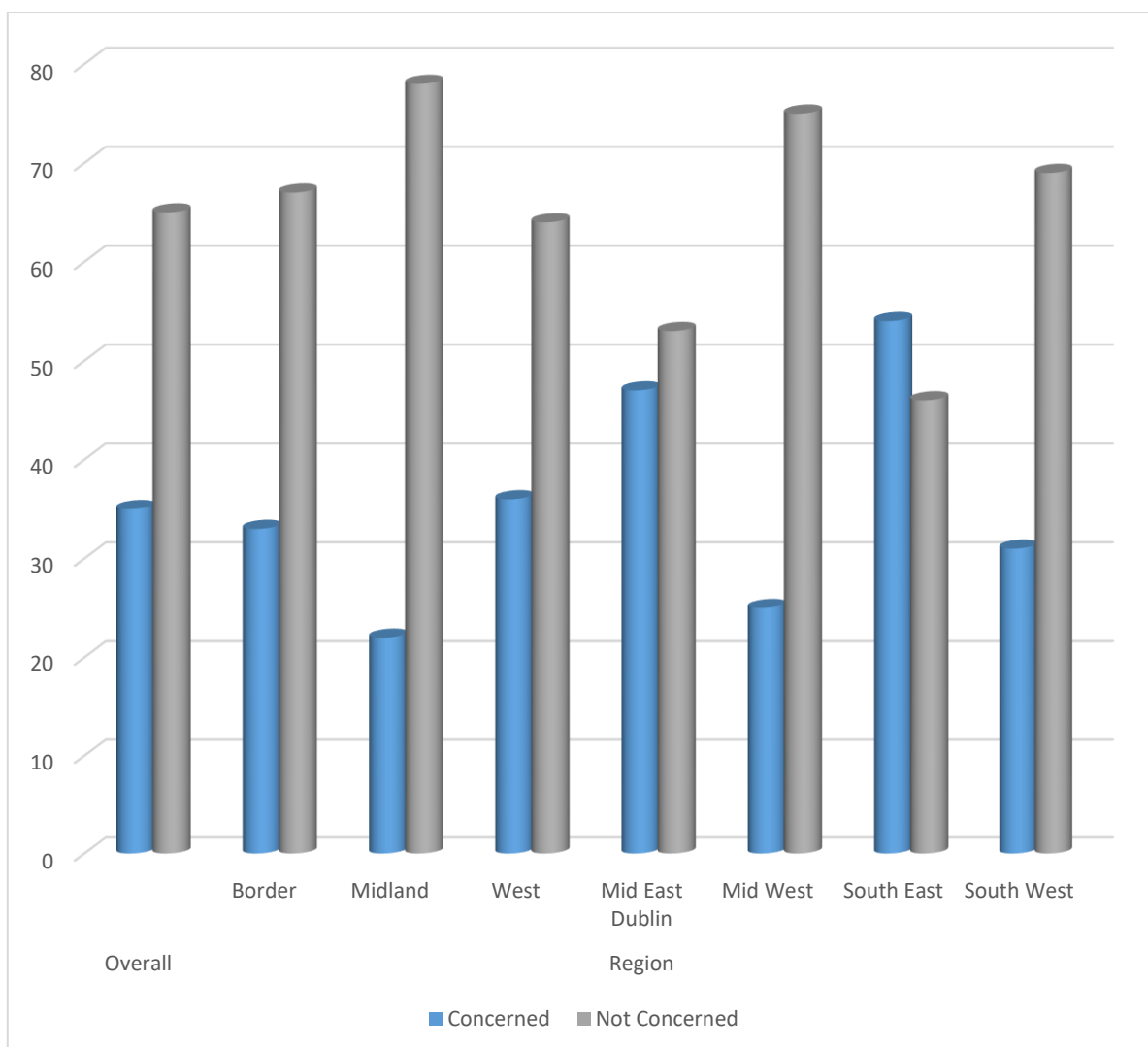


Figure 14: Concerned about Extreme Weather by Region in Ireland

For farmers, who indicated that they were concerned about extreme weather events affecting their farm as a result of climate change, we asked them what they are most concerned about as shown below.

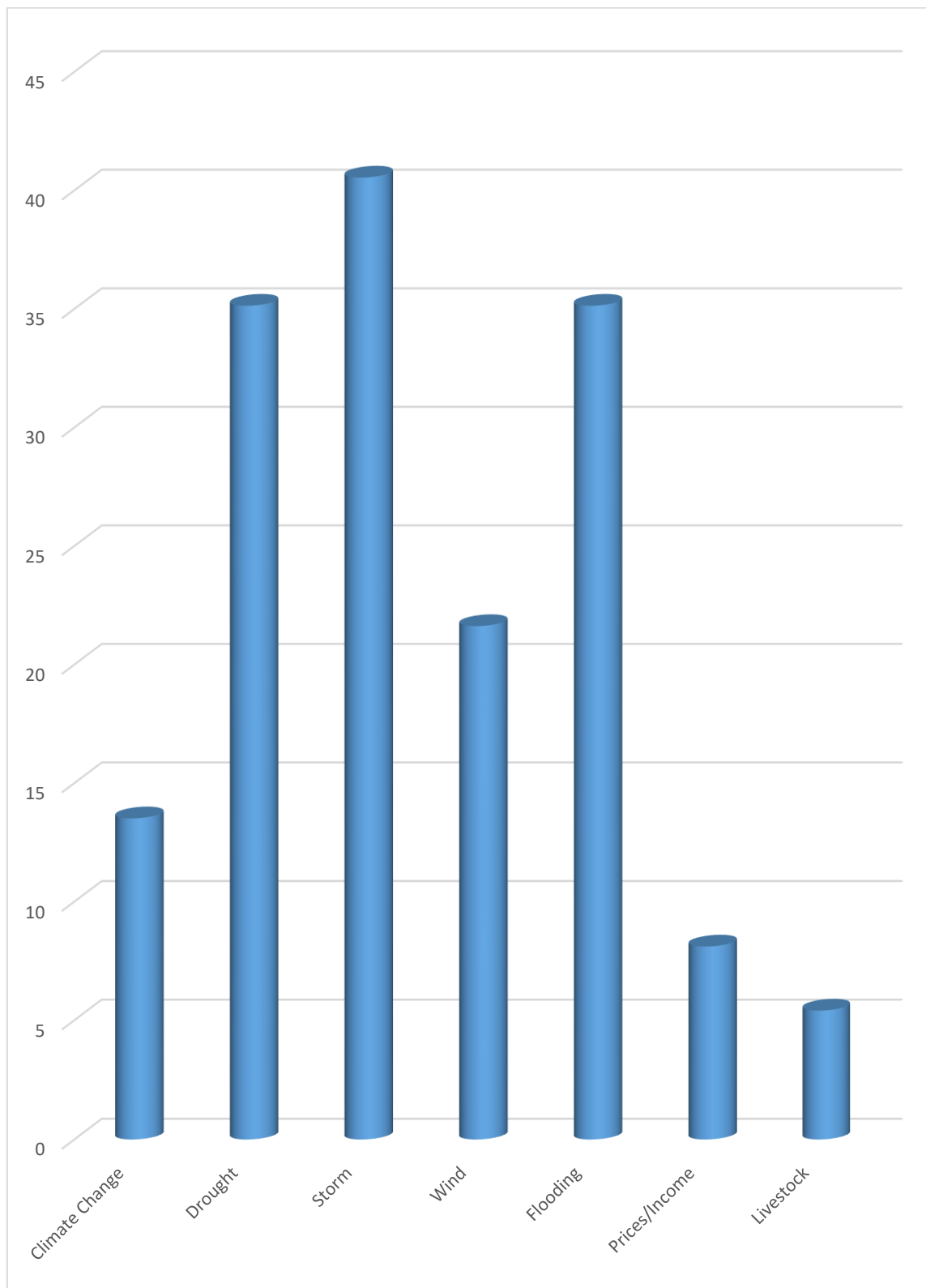


Figure 15: Main worries about extreme weather amongst farmers

As illustrated the main concerns raised by farmers are related to storm damage, droughts and flooding. Figure 18 examines these relationships by farm size and type; we observe some variations in concerns across the farms. The largest farmers' (holdings with 50 hectares or more), report the largest proportion who are concerned with extreme weather events, compared to smaller farmers

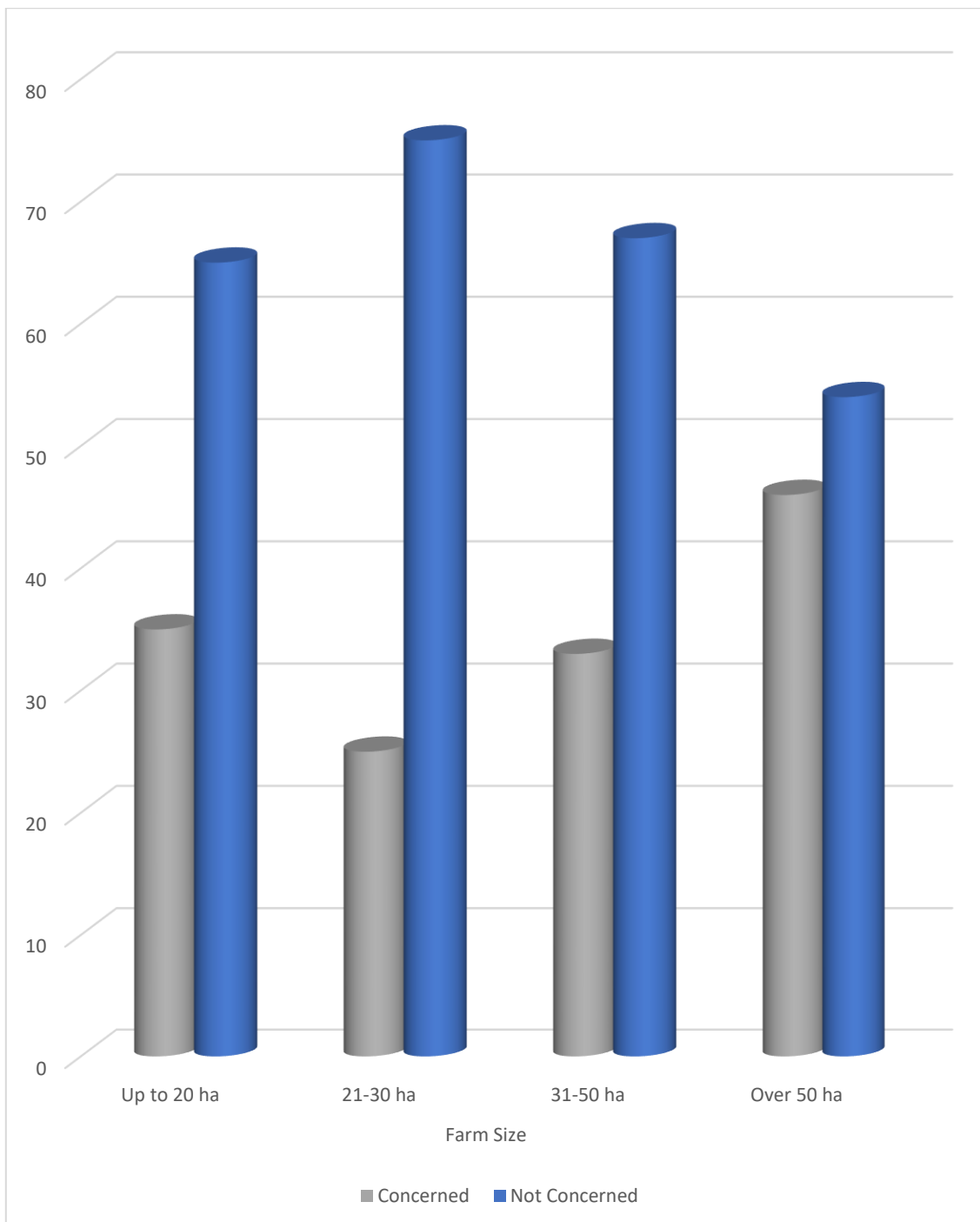


Figure 16: Concerned about Extreme Weather by Farm Size

There are some variations in concerns by type of farm system also. Farmers who have mixed livestock holdings are most concerned while respondents who have mainly cattle report being less concerned. It appears that a higher proportion of sheep, tillage and mixed livestock farmers are concerned about extreme weather compared to dairy, cattle rearing or cattle other farmers.

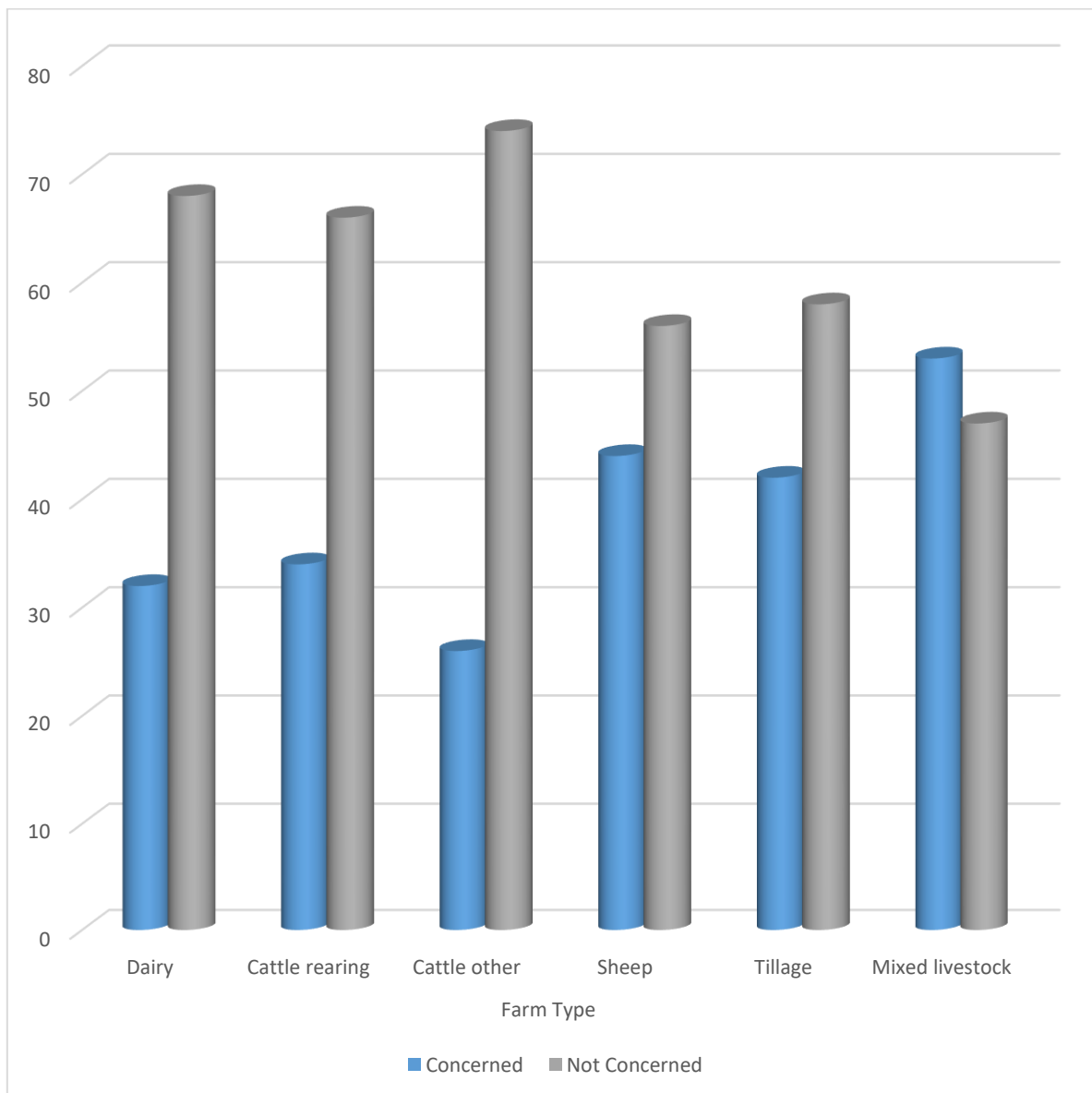


Figure 17: Concerned about extreme weather by farm type

In addition, we asked farmers' whether they believe that extreme weather events are a serious enough problem that farmers should undertake compulsory measures to help their farm adapt to them. Figure 20 presents these results from this analysis, showing the overall level of agreement (yes) and the level of agreement across regions.

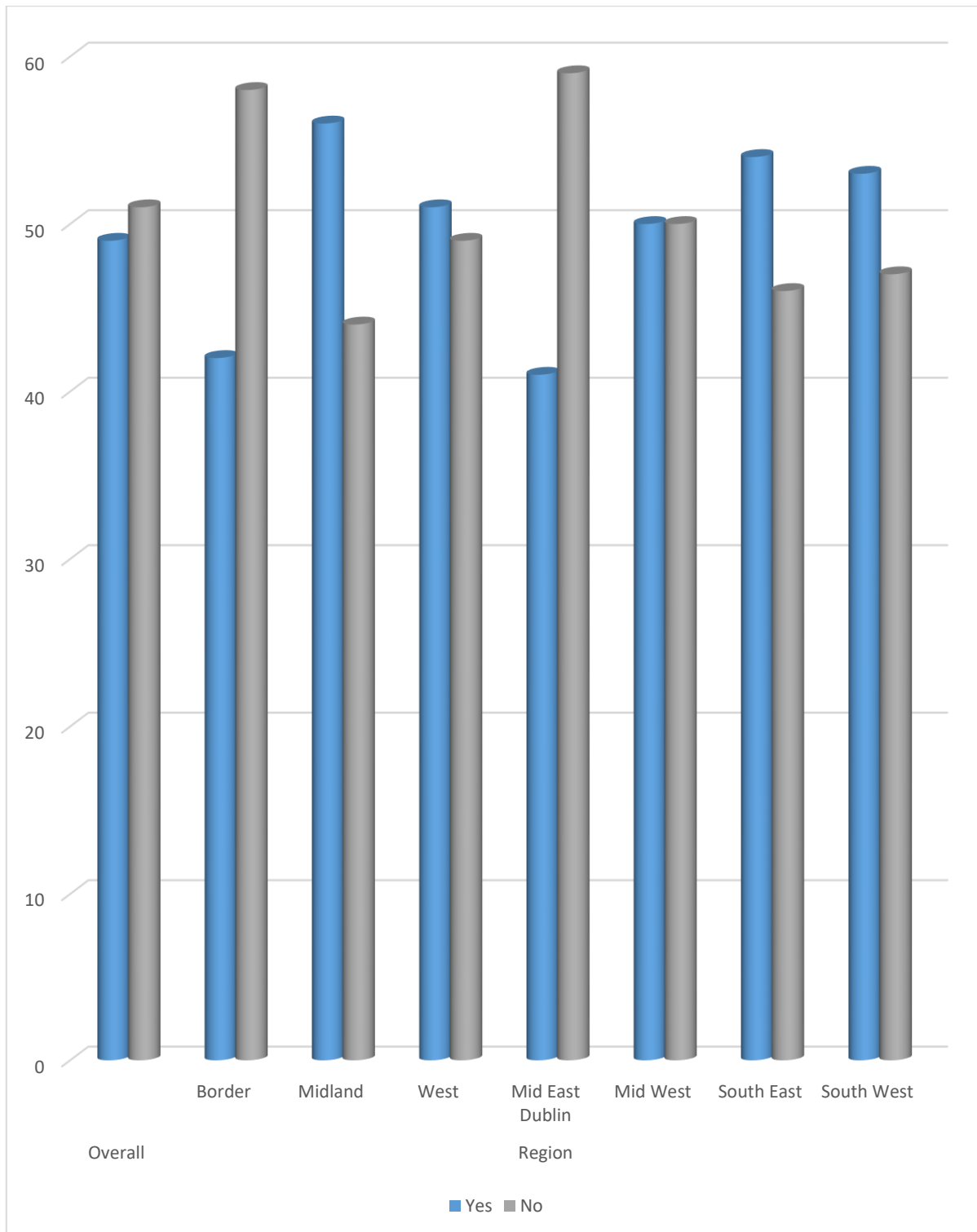


Figure 18: Farmers' should undertake compulsory measures on their farms to adapt to extreme weather events

It is evident that approximately half of farmers believe that they should undertake compulsory measures to help their farm better adapt to extreme weather events. In terms of regional variation, most regions present similar overall patterns with the exception of the Border and Mid East/Dublin regions, we have a higher proportion on average that do not support compulsory measures.

3.2.3 Farmers willingness to apply flood measures to protect downstream communities from flooding

One of the key questions that we wanted to ascertain from the *RiskAquaSoil* survey is whether farmers would be willing to accept some flooding on their land to reduce the risk of downstream flooding to downstream communities in return for compensation that would cover their potential agricultural losses. Our particular interest in this question is how many farmers would be willing to allow some flooding and also the characteristics of these farms. We separated this into two questions, whether they would be willing to work individually to protect downstream communities or whether they would be willing to work collectively with other farmers in their local area to protect downstream communities.

For the individual action question, we asked farmers whether they would be willing to participate in the following scheme as described in the survey as:

“It is possible to reduce the risk of flooding to downstream communities by placing flow restrictors on rivers near your farm. Flow restrictor reduces the volume of water travelling down the river. However, flow restrictors would increase the chances of flooding on your farmland during the summer months. If you were offered a scheme that could lead to flooding on up to 1 hectare or 2.5 acres of your farmland to protect downstream communities from flooding, would you be willing to participate in such a scheme? As part of the scheme you would be compensated for the value of the lost agricultural output associated with the flooding”

We then asked farmers’ a follow-up question in the survey related to whether they would be willing to participate in a collective with other farmers’:

“If you were offered a scheme like the above but you were asked to work with other farmers in your local area to allow flood restrictors on rivers near your land, would you be willing to participate in such a scheme. The area of flooding would be decided collectively for each farm and you would be compensated collectively for the value of lost agricultural output associated with the flooding”.

The Figure below shows the percentage of farmers who would be willing to work individually to allow flood restrictors on their land.

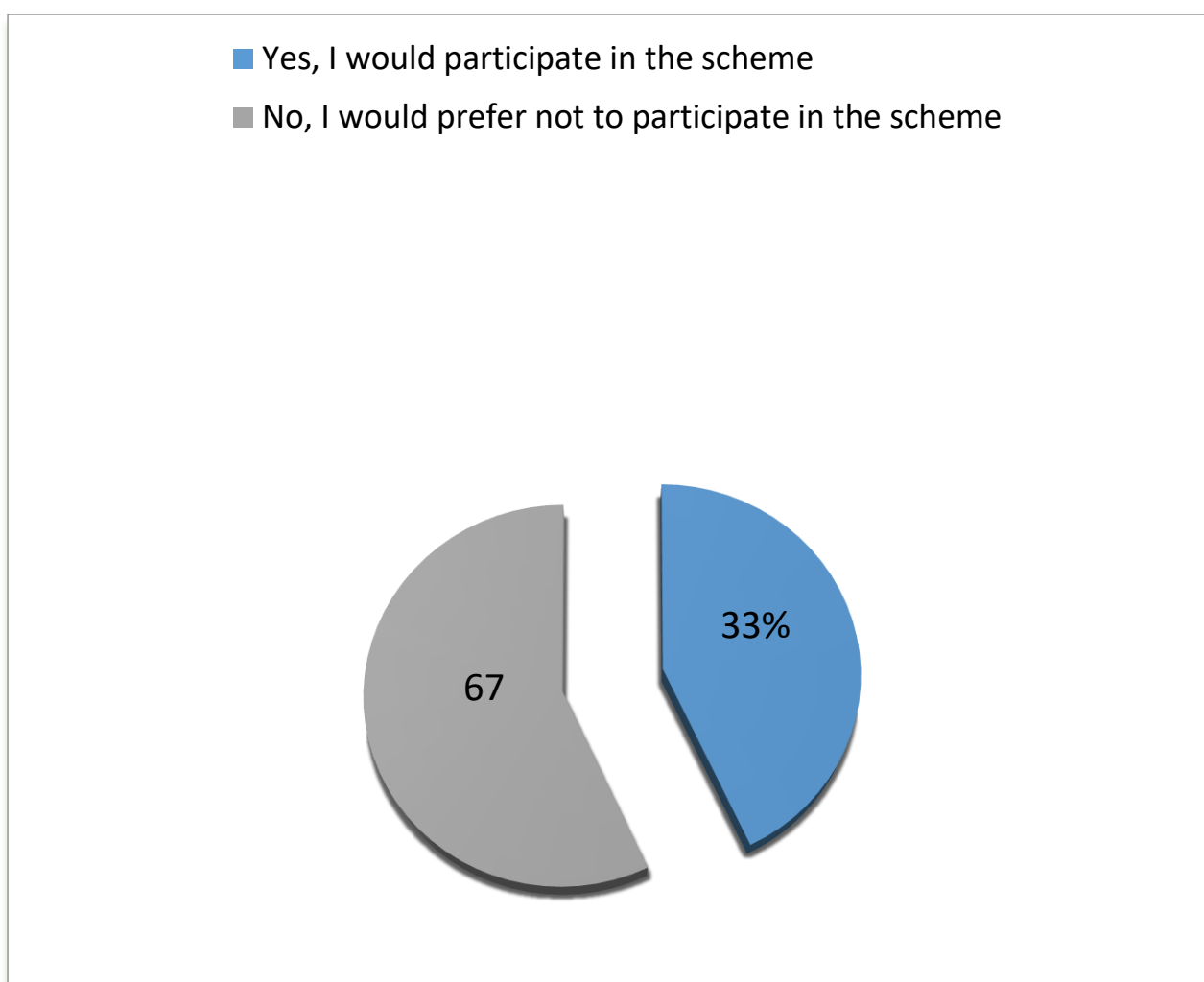


Figure 19: Proportion of farmers' who would be willing to participate in an individual flood protection scheme

In total 33% of farmers indicated that they will be willing to participate in an individual scheme to place flow restrictors on rivers near their land.

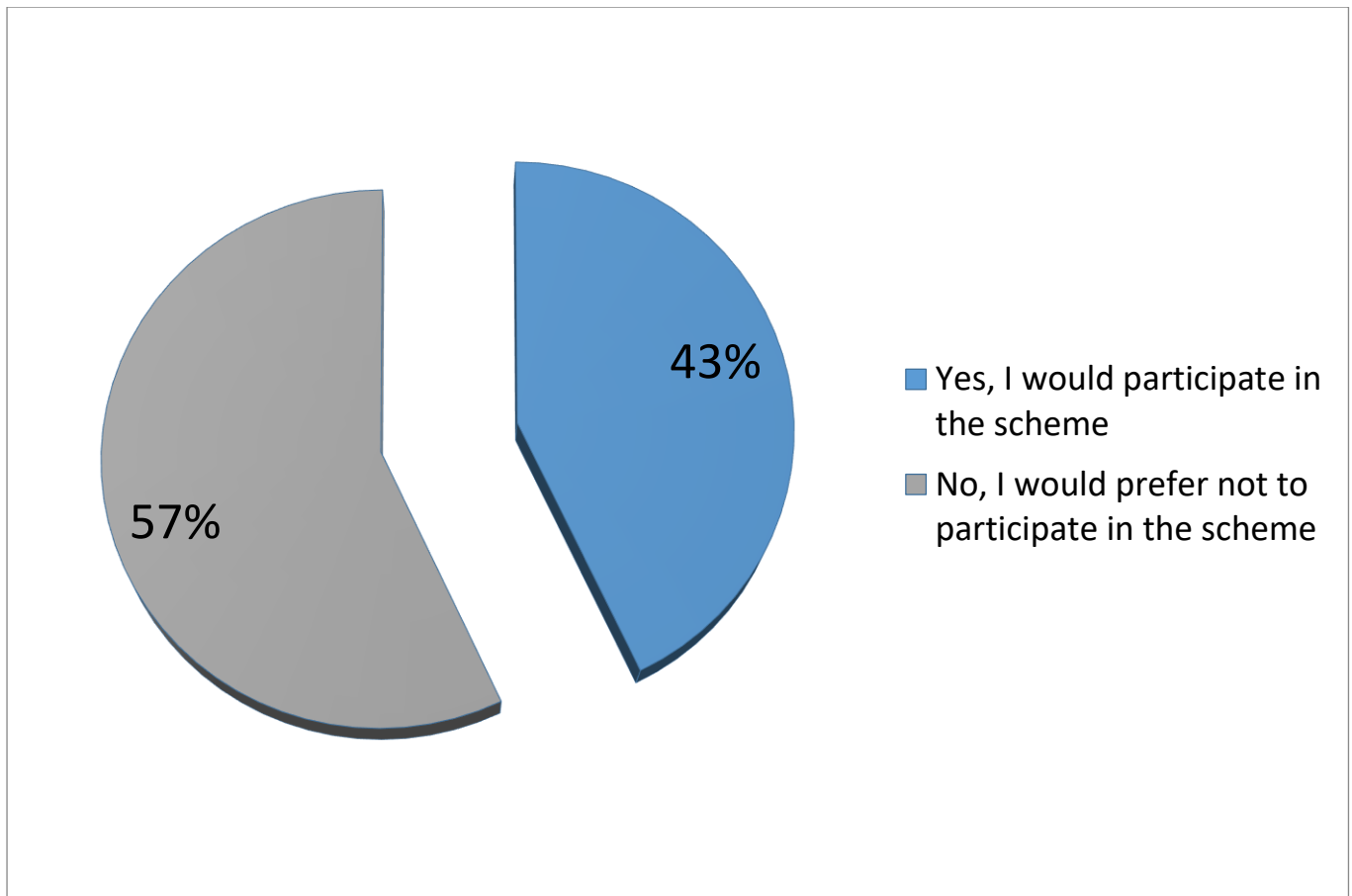


Figure 20: Proportion of farmers' who would be willing to participate in a collective flood protection scheme

There is a higher proportion of farmers who would be willing to work collectively (i.e. with other local farmers) to prevent downstream flooding than to undertake individual action. In total, 43% of farmers who were surveyed stated that they would be willing to work collectively with other farms compared to 33% of farmers' who would be willing to participate in an individual scheme to reduce downstream flooding. To gain a greater understanding of the characteristics of the farmers or farms that were more likely to be willing to participate in the individual and collective schemes we estimated a number of multivariate logistic models. Table 3 outlines the factors associated with farmers/farmers who are willing to participate in an individual or collective scheme to protect downstream communities.

Table 3: Factors associated with participating in either individual or collective action schemes

Factors significantly associated with participation in either individual or collective flooding scheme	Member of agri-environment scheme (+); Dairy (-)*; cattle (-)*; cattle other (-)* sheep (-)*; age (-); off-farm income/job (+) ;located in south east (-)
Factors not significantly associated with participation in either individual or collective flooding scheme	Farm size; farmer's gender or educational attainment; previously affected by extreme weather.

(+) means that a farmer is more likely to participate in a scheme; (-) means that a farmer is less likely to participate in a scheme; *relative to tillage and mixed livestock farmers; off farm income/job is significant for the individual scheme only.

Table 3: Factors associated with participating in either individual or collective action schemes

Examining Table 3 we find a number of significant indicators of participation in individual and collection schemes to reduce flooding to downstream communities (the full model results are available in appendix one). With respect to the type of farming system, we observe that farmers who predominantly have dairy cows, cattle rearing, cattle other activities or are predominantly sheep farmers are significantly less likely to participate in an individual scheme relative to tillage farmers or farmers who have mixed livestock holdings. Farmers who had or are participating in a formal agri-environment scheme (such as REPS, AEOS or GLAS) are significantly more willing to participate in either schemes to protect downstream communities. Similarly, younger farmers and those who have an off-farm job or income are more willing to participate in an individual scheme but not the collective action scheme.

3.2.4 Willingness to buy insurance against extreme weather events

We included a section within the survey that ascertains farmers' willingness to pay for insurance to protect farms against agricultural output losses caused by extreme weather events. There has been significant interest among policy-makers and academics in using publicly-backed insurance as a mechanism to manage risks associated with disaster events caused by climate change. As a result, we were interested in understanding Irish farmers views on insurance as a mechanism to manage damages from extreme weather events. The

insurance is described as EU backed insurance that would cover farm against agricultural output losses caused by extreme weather.

It is evident from the Figure below that most farmers (78%) would value EU-backed insurance to protect their farm financially against agricultural output losses caused by extreme weather events (including floods, wildfire, storm damage and droughts).

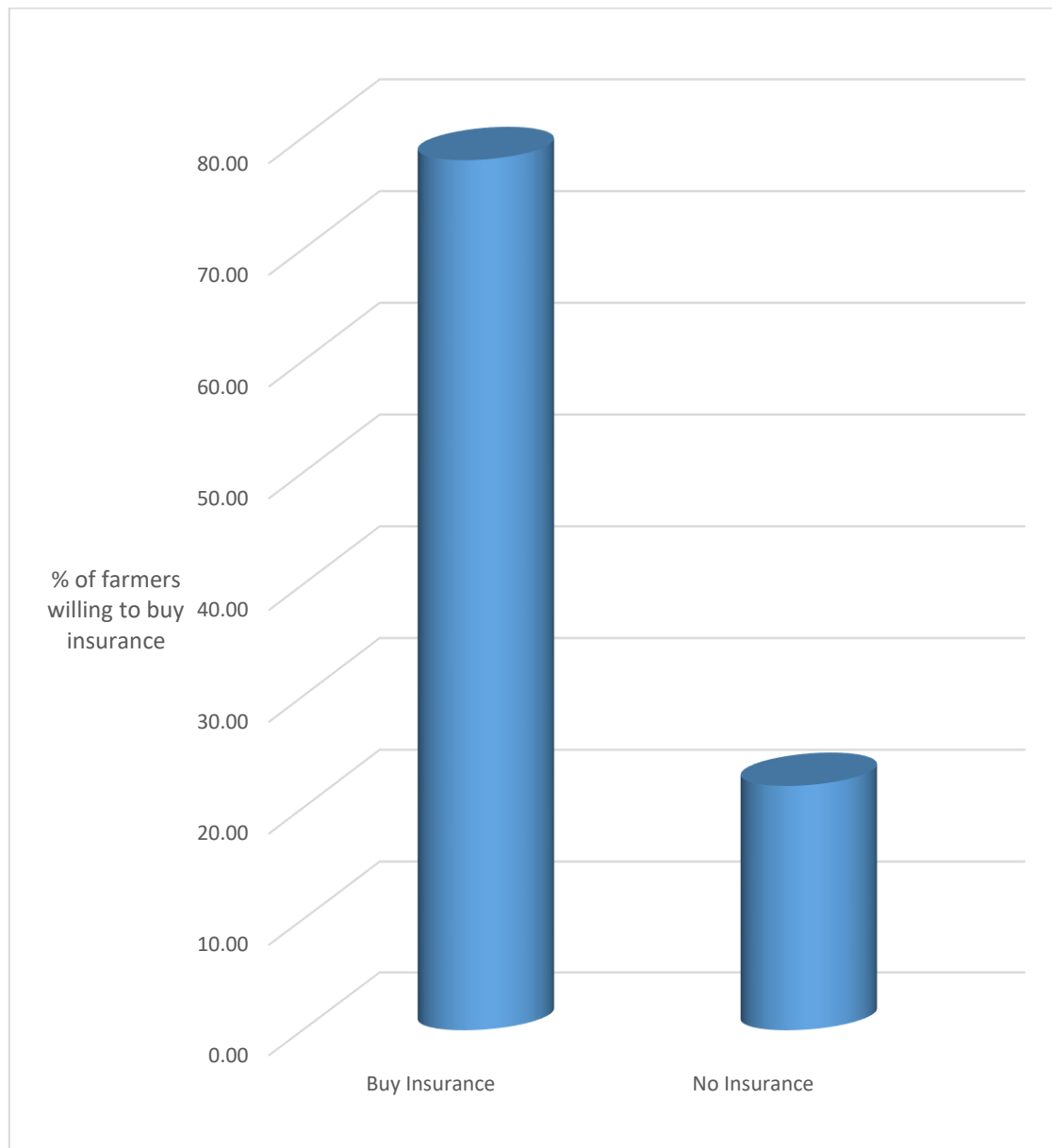


Figure 21: Percentage of farmers willing to buy insurance to protect their farm against extreme weather events

Table 4 presents findings from an analysis explaining the factors that are associated with farmers' willingness to buy insurance to protect their farm against extreme weather events (Full model results are presented in appendix two).

Table 4: Factors associated with farmers willingness to buy EU-backed insurance against extreme weather events

Factors significantly associated with farmers willingness to buy insurance	Willingness to participate in flooding scheme (+); age (-); previously affected by extreme weather (+); regional location (+)*
Factors not significantly associated with farmers willingness to buy insurance	Farm type; Farm size; farmer's gender; educational attainment, off-farm income status; identified farm-successor

*Farmers from the Border, Midlands, West, Mid-West and South-East are significantly more likely to buy insurance relative to farmers located in South-West.

Table 4: Factors associated with farmers willingness to buy EU-backed insurance against extreme weather events

There are no significant differences in the willingness to buy insurance across the type of farm system or based on the size of the farm. This means that farmers from all types of farm systems and sizes have a similar willingness to buy insurance. The results show that farmers who are willing to participate in an individual or collective scheme to reduce downstream flooding are more likely to buy insurance on average compared to respondents who were not willing to participate in such schemes. We also observe that younger farmers have a significantly greater willingness to buy insurance compared to older farmers. We do not observe any significant differences in willingness to buy insurance based on gender, educational profile, whether the farmer has an identified successor or whether they have an off-farm job or income. Farmers who have indicated that their farm was previously affected by extreme weather (such as flooding, wildfires, storms or drought) are significantly more willing to buy insurance. We also included regional indicators as explanatory variables to determine whether preferences for insurance is different between farmers based in different geographic regions. We find that with the exception of the Mideast region in Ireland, farmers in all geographic regions are more willing to buy EU backed insurance compared to farmers located in the Southwest of Ireland.

Table 5 presents the mean and median willingness to pay for EU-backed insurance. This is the annual average amount in euros that farmers would be willing to pay to protect their farms financially against agricultural output losses that are caused by extreme weather events.

Annual Average WTP For Insurance (including “zero” values)	
Average € per year	€252 (€359: Std Deviation)

Table 5: Annual WTP amount for farm insurance against extreme weather events

On average farmers are willing to pay €252 per year in insurance costs to cover their farm against agricultural losses caused by extreme weather events. The insurance is described as a guaranteed insurance scheme that is provided by the EU. Farmers in the survey currently have a median spend of €1600 per year on farm insurance (covering the farms against various losses and not just against extreme weather). This indicates that as a percentage of insurance costs, farmers value additional guaranteed insurance from extreme weather events at 16 percent of median insurance costs. The large standard deviation suggests that there is also significant variability amongst farmers in how much they are willing to pay for insurance against extreme weather events.

3.3 Summary and Conclusions

Farming activity generates a significant proportion of Ireland’s overall output of greenhouse gas emissions. At the same time, given farming dependence on weather conditions, agriculture is one of the most vulnerable sectors to climate change. This chapter provided an overview of Irish farmers’ attitudes and preferences for action to adapt to extreme weather events that are projected to become more common as a result of climate change.

There are three overriding objectives of this chapter. First, we present findings in this chapter related to farmers’ attitudes towards extreme weather events and their perceptions of the impact of extreme weather on their farm. Second, we present findings related to whether farmers would be willing to undertake either individual and/or collective action to

prevent downstream flooding to local communities. As part of this, there is a focus to understand the characteristics of farmers who would be willing to participate in either or both individual or collective action flooding schemes. The third objective of this chapter is to determine farmers' willingness to buy insurance to protect their farm against agricultural losses caused by extreme weather events. Authors in the climate economics literature have discussed the potential for insurance as an important adaptation mechanism against extreme weather events. Findings from the chapter are based on representative data that we collected as part of the *RiskAquaSoil* project from 270 Irish farmers.

With respect to findings regarding farmers' concern about extreme weather events, approximately only 35% of farmers stated they are concerned about extreme weather events affecting their farm. While this seems low, the results are in line with studies conducted in other developed countries that we reviewed in Chapter 3. For example, Tzemi and Breen (2019) found that approximately half of Irish farmers' surveyed in 2014, believed that climate change would not affect their farming practices or they were unsure of the impact. Moreover, approximately a third of farmers believed that climate change would affect their farm only in the long-term (more than 20 years). This suggests that the majority of farmers' do not potentially recognise the consequences that climate change may play for them or perceive it as a large threat to their agricultural activities. Our results suggest that farmers' attitudes in Ireland have not changed substantially between data collected in 2014 by Tzemi and Breen (2019) and data we collected in 2019. Despite the relatively low recognition among farmers' we do observe that a large proportion of farmers' (nearly half) have indicated that they have been affected by extreme weather events in the past, with the highest proportion being affected by storms, (25%), droughts (14%) and floods (8%). Additionally, in terms of farmers' who are concerned about extreme weather events now or in the future, 40% of these farmers are concerned about storms, 35% of farmers are concerned about droughts, 35% of farmers indicated they are concerned about flooding and 20% of farmers are concerned about wind damage. Moreover, we note that almost half of farmers believe that farmers' should implement compulsory measures that would protect their farm against damages caused by extreme weather events. Therefore, while initially, it seems that only over a third of farmers' are concerned about extreme weather events, almost half still believe that extreme weather is a serious enough problem that farmers' should undertake compulsory measures to protect their farm against extreme weather

events. This suggests that there may be avenues for potentially working with farmers to enhance farm adaptation.

KEY FINDINGS: CONCERN ABOUT EXTREME WEATHER EVENT

1. 35% of farmers are concerned about extreme weather events impacting their farm now or in the future.
2. Farmers are most concerned about storms, droughts and flooding.
3. Almost half of farmer support compulsory measures to help farms adapt to extreme weather events.

The second section of the chapter focuses on farmers' willingness to apply flood restrictors on rivers near their land to prevent downstream flooding to local communities. We asked two questions on this as we wanted to establish whether farmers' favoured individual-based action or collective-based (i.e. working with other farmers) action. These questions were developed alongside the wider *RiskAquaSoil* team (principally WRT and ACGM) as we aimed to establish the altruistic motives of farmers as well as their willingness to act collectively to adapt to potential increases in flooding events. Approximately 33% of farmers indicated they would be willing to undertake individual action to adopt flow restrictors. We undertook a multivariate statistical analysis to establish which farmers' would be more willing to participate in an individual scheme. On average farmers, who had mainly dairying or cattle-based systems were less willing to apply flood restrictors'. These farm systems also had lower percentages of farmers' who were concerned about extreme weather compared to the average also. Sheep farmers were statistically the least likely to apply flood restrictors on their land as they had the lowest odds ratio relative to tillage and mixed livestock farmers. Previous participation in agri-environmental schemes is a positive predictor of willingness to participate in an individual scheme. This is not overly surprising as these farmers' have experience of implementing agri-environmental measures and suggests an openness amongst these farmers' for this type of scheme. Farmers' who have an off-farm job were statistically more willing to participate in an individual scheme. Younger farmers were also more likely to participate in either individual or collective

action scheme. This may reflect the general trends among the populations, of greater concern about climate change amongst younger populations and willingness to adapt behaviour for climate change. However, in Ireland, farming activity is skewed somewhat by older farmers (with almost 60% of farmers being over 55 years old). Older farmers are less concerned about extreme weather events and are less willing to participate in individual or collective action schemes.

Overall, 43% of farmers indicated a willingness to work with local farmers to apply flow restrictors to reduce downstream flooding, 10% more farmers indicated a willingness to participate in a collective action scheme compared to an individual scheme. This is a positive result as collective action may be more effective in the context of flood control and it suggests that farmers tend to favour collective action schemes. Many of the factors that were significant predictors of willingness to participate in an individual scheme were also significant predictors of participation in a collective action scheme – with the exception that having an off-farm job was not significantly positively associated with participation in a collective action scheme. This may reflect some time constraints among these farmers who may find it somewhat easier to implement individual action on their own farm rather than participating in collective action with other local farmers.

Key Findings: Participation in Flood Protection Schemes

4. Approximately 33% of farmers willin to participate in an individual scheme to reduce flooding to downstream communities in return for compensation.
5. Approximately 43% of farming are willing to participate in a collection action scheme (work with other farmers) to reduce risk of flooding to downstream communities.
6. Farmers who are in agri-environment schemes, who are younger, who have an off farm income/job, are mixed farmers or tillage farmers are more likely to participate in either individual or collective flooding schemes.

The final section of the report asked farmers about their willingness to buy insurance that would protect their farms against agricultural output losses caused by extreme weather events (such as storms, droughts, floods or fires). As a potential way to adapt to climate

change threats, a number of studies have discussed the potential for insurance to deal with income shocks arising from disaster events (e.g. Surminski, 2016, Hallegatte, 2011, Hallegatte, 2014, Faulkhauser and McDermott, 2014). According to Surminski (2016), the rapid increase in global economic losses from climate-related disasters has increased the focus on the role of insurance in addressing these risks and supporting climate resilient development through a more anticipatory risk view. With this in mind, this report aimed to ascertain whether Irish farmers' value insurance that would protect their farms against extreme weather events. By asking how much farmers would be willing to pay for insurance we can establish the monetary value that the farmers' attach to protecting their farm against agricultural losses associated with extreme weather events. We described the insurance as a guaranteed EU-backed insurance scheme and using the contingent valuation method with a payment card to ascertain the farmers' monetary estimates of their WTP for insurance against extreme weather events.

Overall, 78% of farmers surveyed in our study would be willing to buy EU-backed insurance against extreme weather events, which are projected to increase with climate change. On average, farmers are willing to pay €252 per year for EU-backed insurance, which is approximately 16% of current median costs (covering all types of damage) of insurance for farmers surveyed in this study. The results are somewhat in line with the international literature reviewed earlier that highlighted that farmers generally preferred adaptation rather than mitigation. It may be the case that farmers' perceive that mitigation suggests a need to reduce farming activities while adaptation measures (like insurance) means that farmers' can continue farming activity and therefore they are willing to pay for insurance. With respect to factors that are affecting farmers' willingness to buy insurance and the monetary amounts they have indicated they would be willing to pay, we observed significant regional variations between farmers. We also observed that younger farmers, farmers who had previously been affected by extreme weather events are also more likely to buy insurance. Not surprisingly, we also observe that larger farms are willing to pay more for insurance.

KEY FINDINGS: FARM INSURANCE FOR EXTREME WEATHER EVENTS

7. Approximately 78% of farmers willing to buy EU-backed insurance to protect their farm against agricultural losses from extreme weather events.
8. Farmers are willing to pay an average of €252 per year for additional EU-backed insurance to protect against extreme weather events.
9. Younger farmers, farmers from different regional locations (except the South-East and Mideast), farmers who are previously affected by extreme weather events are more likely to buy insurance.

Chapter 4: Understanding farmers views on the barriers and enablers to adaptation: Results from qualitative interviews with Irish farmers



4.1 Introduction

As part of the *RiskAquaSoil* project, and in addition to the quantitative survey that was described in the previous chapter, NUI Galway also undertook in-depth qualitative interviews with eight farmers in Ireland. This part of the research is entitled “*conversations with farmers*” and it is also recorded and produced as podcasts. In this chapter a summary of key findings from this qualitative work is presented. The questions were designed alongside the French Partners in ACGM – who also undertook complementary survey work asking similar questions with French farmers. The purpose of these interviews is to broaden the understanding of challenges that farmers face, their views on a range of issues that are relevant for *RiskAquaSoil* and their attitudes and willingness to implement adaptation behaviour related to climate change.

The study explored several topics with the farmers highlighted in the Figure below. First, we were interested in determining whether farmers believed that climate change or severe weather were impacting their farming activities. Second, we asked farmers their views on farm adaptation and what did they perceive to be the main barriers or enablers to farm adaptation. Third, we were interested in understanding farmers’ views on two potential mechanisms to help farmers adapt; agri-environmental schemes and farm networks. Finally, we briefly asked farmers to outline their soil management practices and specifically whether farmers did any soil testing to improve the quality of their soil, which was of interest to the *RiskAquaSoil* project.

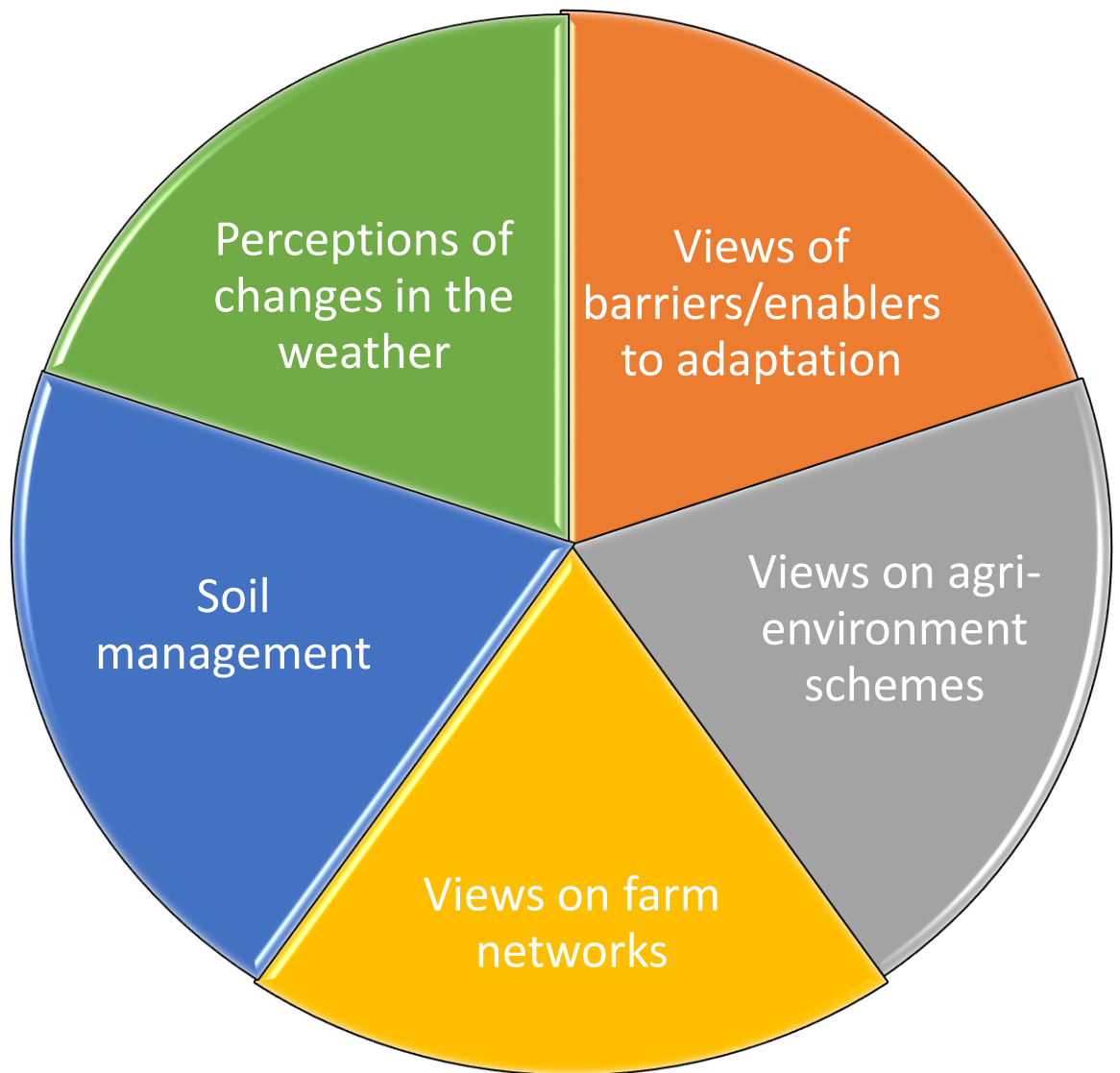


Figure 22: Key topics discussed during the qualitative interviews

4.1.1 Summary of Participant Farmers

A total of eight farmers were selected for in depth interviews. Of this cohort, four farmers were predominantly beef farmers, one farm had a mix of beef and sheep livestock, one farmer had a mixed livestock holding of beef and pig, one dairy farmer and one beef and dairy farmer.

Code	Type	Size	Location
FR 1	Dairy	Big	West
FR 2	Beef and Sheep	Big	West
FR 3	Beef	Small	West
FR 4	Beef	Small	West
FR 5	Beef	Small	South West
FR 6	Pigs, Beef	Big	South West
FR 7	Beef	Medium	West
FR 8	Beef and Dairy	Big	South East

Table 6: Typology of farms interviewed for the study

4.1.2 Farmers perception of climate change and severe weather events on their farming activities

Key Finding 1: Changing weather patterns were affecting farming and making it harder to plan farming activities

All farmers interviewed believed that climate change had an impact on farming and farming had an impact on climate change. The financial impact of climate change and severe weather was mentioned by farmers, in particular the long winters, which has caused, for example, fodder shortages and late turn out of livestock. Excessive dryness caused by drought and wet weather were mentioned as impacting the quality of soil. Some participants (FR 1, FR2 and FR 3) stated that the weather has got a lot wetter and this posed challenges for making silage and other fodder. The farmers mentioned the variation in regional weather and explained that on the West coast of Ireland the weather was always poorer and more severe so farmers are used to dealing with severe weather. On the South West coast there was a perception that the weather is much milder (FR 5, FR 6).

“We don’t seem to get the nice evenings, Springs are mild which is not a good thing, we don’t seem to get the four seasons anymore. It was easier to plan in the past”. (FR7)

FR 1 expressed concern about severe weather events ‘in 2018 we had all kinds of weather’.

“We have to plan our business model with that in mind. Weather is the number one challenge for farmers, if you gave dairy farmers a choice of a strong milk price or good weather, 8 out of 10 would take the weather because it impacts everything” FR1

The impact the severe weather on the mental health of the farmer was also mentioned by the farmers. The stress, financial strain and a sense of hopelessness and despair were discussed by the famers in relation to the challenges of the severe weather on farming livelihoods.

Key Finding 2: Early warning on the weather forecast and technology are helping the farmers to mitigate and prepare to lessen any potential damage with the changing weather

A number of farmers mentioned the importance of good weather forecasting in helping them prepare for changing weather. FR1, FR2 and FR 6 highlighted that the advanced weather forecast which can predict (around five to six days in advance) accurate weather forecasts makes it more possible to plan activities. FR2, FR6 also mentioned specific snow events and how receiving early warning helped them to prepare better.

Key Finding 3: Farmers are not prepared for very severe weather events

Even though farming by nature is a profession of coping, the farmers say they have to try and work around the weather, the overall consensus is that the farmers are not prepared for very severe weather events.

4.1.3 Farmers decision-making related to adaptation measures

Key Finding 4: Adaptation or mitigation came second to business concerns

The participants in this study stated that business survival is the main priority rather than climate change initiatives such as adaptation or mitigation, which is in line with other micro-enterprises decision making on environmental issues. (Devins *et al.*, 2005; Roper, 1999; Testa *et al.*, 2015)

“You have to look after your own business needs first before you can think of green issues”

The importance of economic concerns in all aspects of decision-making for farmers was evident throughout the interviews. The farmers were aware of new practices such as slurry injections and dribble bars which decreases the emissions for slurry as it is being spread. The disadvantage as mentioned by the farmers was the extra cost involved in using the new technology. Although, several farmers were also aware of positive benefits related to using up slurry, which the farmers considered to be a nuisance (FR1, FR7).

The farmers outlined that not all adaptation and mitigation measures were suitable to all farms for various reasons. The farmers interviewed felt forestry wasn't suitable for their farm, but they were not against the planting of trees on a small scale. However, farmers did not favour covering vast areas of productive land in forestry. The farmers were cognisant of the benefits of forestry and suggested that poor farmland planted with forestry is more productive. The evidence of the positive impact on soil and water was cited '*When the trees are cut the amount of water that comes down the mountain is greater. The forestry absorbs an incredible amount of water*'. (FR6). The public benefits were also mentioned including the use of forestry as a recreational use. The financial incentives and conditions of the forestry initiatives were not seen as an attractive and viable long-term solution for the farmers. The specific reasons indicated by the farmers for not planting forestry included: insufficient funding (FR3, FR7) and that payment can only be drawn down for twenty years, which the farmers considered to be more attractive for older farmers who do not have a farm successor (FR5, FR6).

Key Finding 5: Economic benefits key to undertaking farm adaptation; fulfilment of regulation also a strong driver of behaviour

The financial gains are important and it was stated that the targeting approach of the current GLAS scheme works well according to FR1, FR2, FR6 and FR8. The respondents also spoke about contemplating energy-saving initiatives using cost-benefit analysis.

"We have looked at solar panels but it isn't economically viable for us, everything has to have an economic benefit for me to do it" (FR 8)

Positive economic impacts or cost-saving measures are, therefore, perceived as an enabler for adaptation and mitigation actions by farmers, particularly if coupled with the penalties associated with non-compliance, *“All the plastic is put in on spot and we pay to dispose of it. If we use chemical sprays they also have to be disposed of properly. There are environmental regulations across Europe, if you don’t follow it you are penalised”* (FR 8). All respondents experienced similar resource constraints consistent with their small operation size and limited human resource, and the primary strategic goal in all cases was one of survival. The drivers of behavioural change as identified by farmers’ related to the importance of economic gain/benefits as a key driver as mentioned by all farmers, coupled with changing customer preferences for agricultural produce and fulfilment of regulatory/legal requirements. The relatively high costs associated with running the farms were a challenge for optimised business development, *‘the water rates, and insurance, all that is through the roof’* (FR8). One farmer also believed that there should be greater support from funding sources for small firm operations, *‘Banks should be more appreciative of what farmers are doing, the co-ops, they have tough credit systems which makes it hard for farmers. The targets are difficult to achieve’*. (FR8). Time constraints was also of particular concern to the farmers; highlighting the need for additional resources when pursuing new innovation.

Key Finding 6: Farmers need detailed information on adaptation measures in a simplified format tailored to specific farms

There was consensus with all the findings that the documentation available rarely provides enough information to enable farmers to support and implement strategies. Some farmers perceive form filling as complex; it was argued that the information needed to be simplified and tailored for farmers in order for it to act as a useful resource for capability development in the farms. There was also a perceived lack of documentation regarding the means and mechanisms that might support adaptation and mitigation in agriculture. All farmers noted the difficulties in finding information in simple/ accessible language that they could understand.

‘Most farmers, in particular small farmers don’t understand the terminology or understand what they need to do’ (FR7).

The lack of suitable information appears to be an inhibiting factor in the adaptation and mitigation engagement, there is a need for material to be less complicated with language. The lack of access to information in simple language, specific to the different type of farming sector, region and size of the firm was evident in all interviews and one that acted as a perceived barrier to changing in line with climate change. There was general recognition that '[farmers] *find administration very difficult and the regulations are killing us*' (FR8).

4.1.4 Potential enablers of adaptation; agri-environment schemes and farm networks

Key Finding 7: Farmers viewed agri-environment schemes favourably and believed that locally-tailored schemes worked best.

Many farmers acknowledge the benefits of agri-environment schemes and use them where possible. The farmers believed them to be effective strategies in pursuit of business improvements. However, farmers also experienced barriers to using the schemes including lack of financial resources, assumptions of high cost of innovation, poor information and communications technology (ICT) infrastructure and lack of manpower. The farmers felt that there should be more schemes in place. Farmers (FR 2, FR 3, and FR7) also acknowledged that having schemes that were specific to local areas was important. In particular farmers (FR 1, FR 2, FR 6, and FR 7) mentioned that variability in land and the need for locally-focused schemes. For example as noted by one farmer (FR 7) within a twenty mile radius the land could change from dry land to water logged land. "*Each farm and sometimes field had different requirements*" (FR 2). The Burren Life Scheme in the Burren, Co.Clare was perceived to be a successful environmental scheme but the farmers interviewed were not members due to location, but they believed from talking to farmers involved that it is a beneficial scheme because it was output-based, had simplified funding process and was relevant to the specific local area (FR 2, FR 3). In general there was also positive feedback on GLAS. GLAS was seen as a good initiative but one farmer believed it was becoming more rigid (FR 2), while another farmer pointed out the ease of achieving results in GLAS (FR 6). The farmers also mentioned a few more targeted schemes that they perceived worked well in particular the schemes surrounding plastic collection and hedge cutting. The farmers were asked why they considered these examples to be good initiatives

and they noted a few reasons including; the simplicity of the scheme with no paperwork involved, the convenience of drop off locations for the plastics scheme and the use of fines for non-compliance.

Key Finding 8: Farm networks are a very important resource for farmers and are useful in promoting new farming methods

Farming networks were seen to be particularly valuable as a source of information, as they alleviate the challenges of geographical isolation for these farmers, and engagement can result in economic or information exchanges and new or improved relationships. The farmers interviewed quoted a few sources for finding information including local counsellors and elected local politicians, the agricultural advisors and Teagasc. In particular the local agricultural advisors were quoted as being essential in keeping farmers informed and assisting with completing funding application. All farmers were a member of some network; some were members of a number of different networks and forums, including Teagasc, Bord Bia and Glanbia. The networks regularly organised training, marketing workshops, provided online and paper-based information resources, and offered green innovation, knowledge transfer, knowledge exchange and mentoring supports. The benefits of being part of a network and the value of the network as an additional resource was echoed in the findings and internal documentary evidence

, “*They do everything. They organise training, mentoring, advice ... One group focuses on farm management other on grass management*’ (FR8). One farmer described network engagement as a ‘*huge*’ influencing factor for survival, growth and support for the firm.

The network exhibited proactive and vigorous activities in providing both information and face-to-face support to assist the farmers in reaching regulations and standards by providing resources and information pertinent to environmental capability development,

‘Teagasc brings [the] county council along for talks to ensure that people policing [regulatory fulfilment] are approachable to farmers, no barriers to communication, open discussion, relationships good, treated fairly’.

The training from networks was noted as enhancing capabilities. In particular, the skills training in grassland management in the last five years have improved according to the farmers, this allows increased production (FR 1) resulting in financial gain. Teagasc was

recognised by the participants for doing ‘*great work on the ground providing information*’, communication and knowledge transfer was evident in other networks, including the co-ops which run monitoring groups, this includes selecting a small group of farms and identifying best practice and organising knowledge exchange and knowledge transfer. However, the farmers acknowledged that they found the conversion of ideas into workable solutions in the farm setting was challenged by resource limitations and their own capacity.

4.1.5 Soil Management

There was a consensus that an individual farm approach is required in relation to soil and water management. ‘*Some areas need to be re-ploughed and re-seeded but resources (time, money, people) are limited, weather is also a factor*’ (FR7). ‘*Each field is different*’ (FR2). However, lack of resources was a common theme in the ability of the farmer to understand what the requirements were and what action was required for improvement in soil and water management. Three of the eight farmers tested the soil. The small farmers were not aware that soil testing was possible or required, nor were they aware of the benefits that could be achieved on the farm or to the community i.e. more resilient to severe weather events, cost savings from targeted fertilisers, reduced risk of flooding. When the benefits to soil testing were explained during the discussion the farmers expressed surprise that this information wasn’t provided to them and queried whether they would have the required expertise and knowledge for implementation. For the larger farmers, who regularly tested their soil, they understood the clear benefits of testing. They noted that they use testing to target any areas that are deficient with the relevant fertilisers in order to maximise the amount of grass they grow in order to reduce costs “*It’s a simple business model but it’s what makes us competitive*”. (FR1).

4.2 Conclusion

The chapter summarised some of the key findings from qualitative interviews with eight farmers in Ireland. The interviews focused on several key topics. First, whether farmers in this study perceive that the weather is changing and whether they believe this has impacted on their farming activities. Second, what are the farmers’ views on adaptation and the perceived key barriers or enablers of farm adaptation. Third, what are the farmers’ views on

agri-environment schemes and farm networks. Finally, the interviews asked farmers about their soil management practices specifically related to soil testing.

The farmers interviewed as part of this chapter, could clearly identify changes in weather patterns that have occurred over time, which affected their farming practices and the financial costs of running their farms. Farmers because of the nature of their work have to work around the weather. The use of technology in forecasting in advance allows the farmer to prepare for severe weather events but it doesn't help to mitigate against all the losses. The overall consensus with the farmers interviewed was that farming is becoming more challenging. This viewpoint contrasts some earlier studies of farmers in other developed countries who did not perceive negative impacts of climate change on farms. Moreover, while farmers in other developed countries perceived some positive benefits from climate change (e.g. Woods et al., 2013), this was not the case with the farmers interviewed here and overall, the farmers felt ill-prepared for large scale changes to climate. On a positive note, however, the farmers indicated that improved weather forecasting has helped them overcome some of the challenges associated with changing and difficult weather patterns.

In terms of enablers and barriers to adaptation, it was evident that farmers felt resource-constrained both financially and in terms of personnel and "know-how" to implement changes to their farming practices. Discussions of financial restraints pervaded the interviews with all farmers. One finding from the study was that farmers considered "green issues" as secondary to business survival. However, farmers would be willing to implement changes if there were financial benefits to do so. This finding was echoed in other studies also. For example, Li *et al.*, (2017) examined actual adaptation behaviour and they found that actual adaptation was not driven by environmental concerns but rather by financial and management issues. In addition, the farmers believed that in the context of specific adaptation measures that they could undertake, they still lacked simplified information on what to do, specific to different farming types, regions and size of the farm. According to the farmers, the uniqueness of each geographical region and sometimes differences even within farms created uncertainty for them in decision making and planning on the farm that inhibited their ability understand what they could do to address climate change.

In the interviews we explored farmers views on two mechanisms that could help farmers engage in adaptation. First, we asked farmers about their views on agri-environment

schemes and we found that farmers had positive views on agri-environmental schemes. The farmers believed that simplified schemes (i.e. not administratively burdensome) that were based on local areas would be the most beneficial as they would account for differences in farms between different areas. Simplified schemes would also help farms overcome administrative challenges that currently act as a disincentive to participate in schemes. When noting schemes that they believed work-well, they felt that locally adapted schemes such as the Burren Life Programme were most successful. The farmers also felt that financial incentives for achieving scheme objectives that penalised for non-compliance were the most effective in ensuring compliance. It might be the case that agri-environment schemes might be particularly useful for adaptation measures that currently not cost-effective as farmers may not be willing to undertake such measures without incentives. Second, we asked farmers their views on farm networks and the main networks that they are involved with. All farmers interviewed in this study were part of some type of farm network and many of them indicated that networks were crucial in ensuring their farm's survival. They also found that the network was vital in providing them with the knowledge to implement different farm practices. However, many farmers believed they lacked by capacity and resources to implement changes. Moreover, when we asked farmers specific question surrounding soil testing, several farmers had not heard about it or were aware of the benefits.

Overall, while the farmers in this qualitative study could recognise the effects that climate change was posing to their farms, they currently felt underprepared for the challenges of climate change and lacked expertise in how to addresses the challenges of climate change. This suggests that significant work may be needed in terms of helping farmers to overcome resource constraints, both financial and in expertise i achieve adaptation or mitigation. While the sample size in this study is small and we do not claim it is representative of farmers in Ireland, some important themes did emerge from the study. Primarily, promoting the economic benefits of climate change measures provides an avenue to appeal to farmers while supporting farmers through training and financial incentives through farm networks and agri-environmental schemes appears to be worthwhile based on the discussions with these farmers. It may be the case that farmers should have input into the design of measures addressing climate change challenges in agriculture, as they are they central players in achieving changes to farming practices. This exploratory study provided a basis on which

further research can be undertaken in the area of adoption of adaptation measures, this would further inform public policy makers thereby assisting in climate change policies.

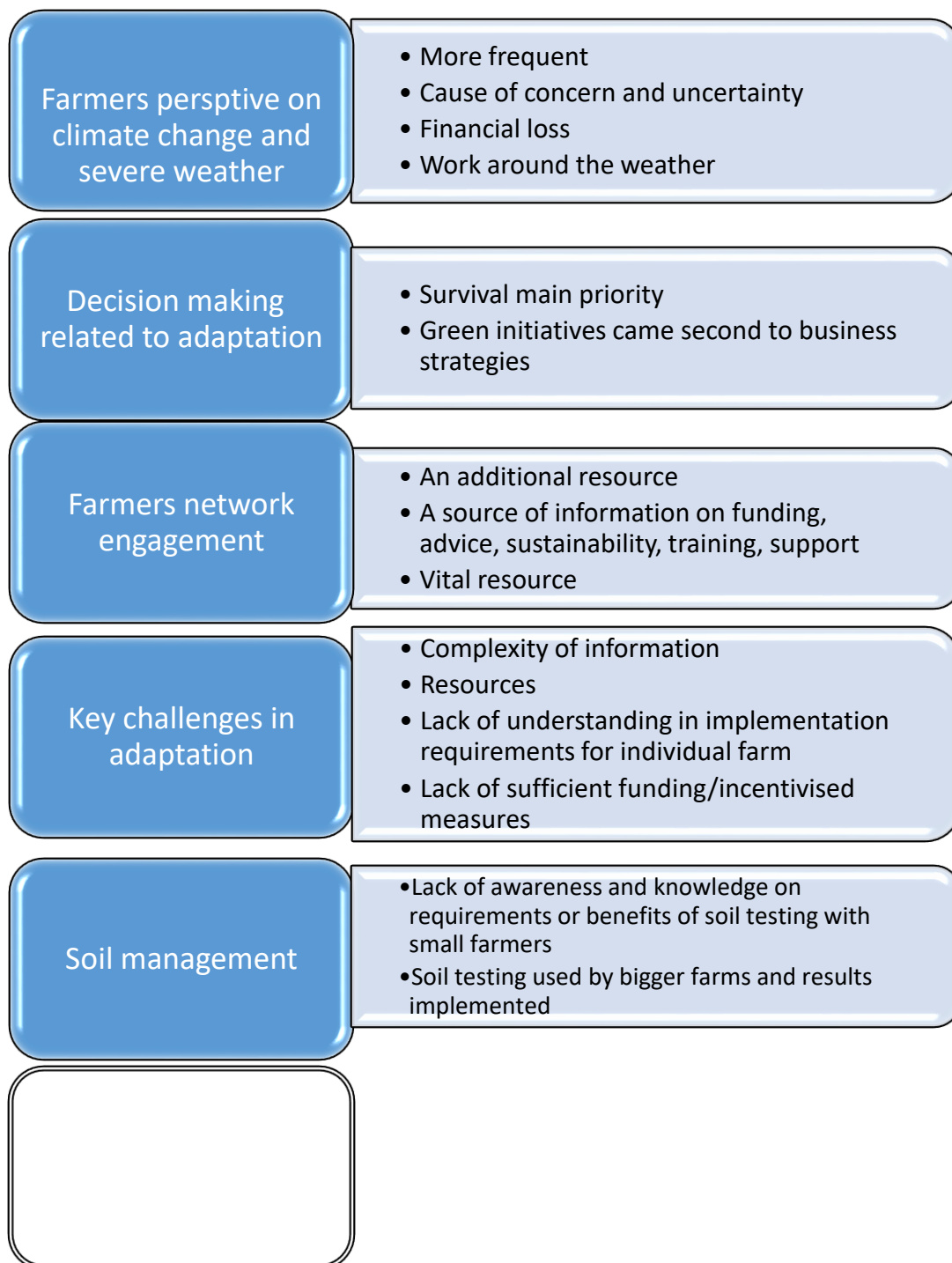


Figure 23:: Summary of findings from the qualitative interviews

Chapter 5: Policy implications and conclusions



5.1 Introduction

This chapter presents an overview of the key findings and the main policy implications arising from this report. The chapter starts with presenting an overview of the policy implications arising from the findings in the quantitative survey. Subsequently, the implications of the findings from the literature review and qualitative interviews are discussed.

5.1.1 Farmers would be willing to buy publicly-backed insurance to protect their farms against losses caused by extreme weather events that are projected to increase with climate change.

There is a recognition among policy-makers of the need for innovative public-private partnerships to develop insurance products to help manage climatic-related risks (e.g. IPCC, 2012, OECD, 2009, Munich Climate Insurance Initiative, UNU, 2020). According to Surminski (2016), the rapid increase in global economic losses from climate-related disasters has increased the focus on the role of insurance in addressing these risks and supporting climate resilient development through an anticipatory risk view. Insurance schemes are increasingly being used as a means of coping with weather risk for agriculture, both in wealthier countries such as the U.S, as well as in developing countries where government backed schemes are becoming more common (see ADB, 2019). Despite this, there has been relatively few studies, particularly within Europe, that have examined whether farmers would be willing to buy publicly backed insurance that could protect their farm against losses caused by extreme weather events.

Results from this report showed that approximately 80% of Irish farmers would be willing to buy EU-backed insurance to protect their farms from agricultural losses posed by extreme weather events. Given the recognised role that insurance could play amongst policy-makers internationally in managing risks from climate related disasters, this is an encouraging finding. However, it is important that the design of any insurance contract does not discourage farmers from participating in wider farm adaptation or mitigation. For example, insurance schemes could be designed so that coverage is conditional on farmers also taking other adaptation measures. It might also be effective to offer farmers lower insurance premiums in return for undertaking other adaptation measures to protect their

farm against climate-related risks. A further policy mechanism could be to offer farmers insurance discounts in return for wider undertaking of farm mitigation. While realistically, this would not impact on the risk reductions at an individual farm level, it could be an effective incentive to promote farm mitigation.

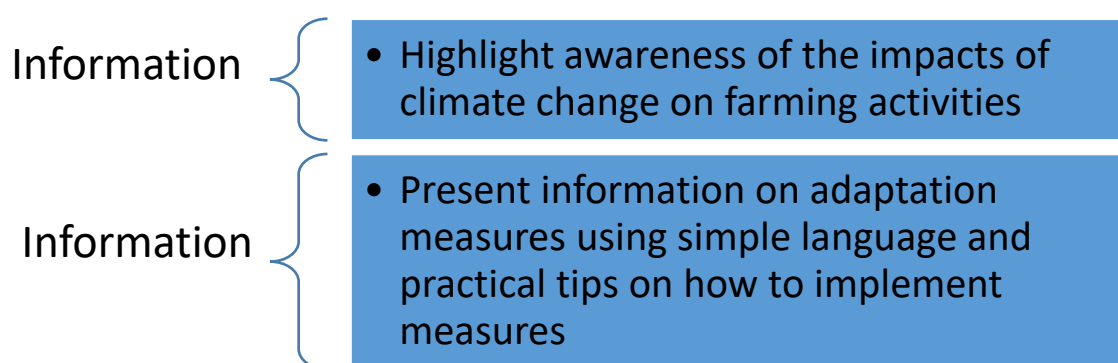
5.1.2 Farmers could help protect downstream communities from flooding

Increased flood risk has also been identified as one of the main threats to Ireland from climate change (McDermott, T, 2020). Given this possibility and the general risks associated with flooding to the Atlantic Area, as part of this report, we examined farmers' willingness to adapt measures that could reduce flooding to downstream communities. In addition, since flood measures are likely to be more effective if a number of farmers implement them along a river, we examined farmers' willingness to work with local farmers (through a collective action scheme) to reduce flooding to downstream communities. Our results are encouraging and we found that a significant proportion of farmers, approximately 43%, would be willing to engage in a collective action scheme to reduce flooding to downstream communities. Moreover, more farmers were willing to engage in a collective action scheme (43% versus 33%) compared to an individual scheme (where farmers just implement flood measures on their own farm without working with other farmers).

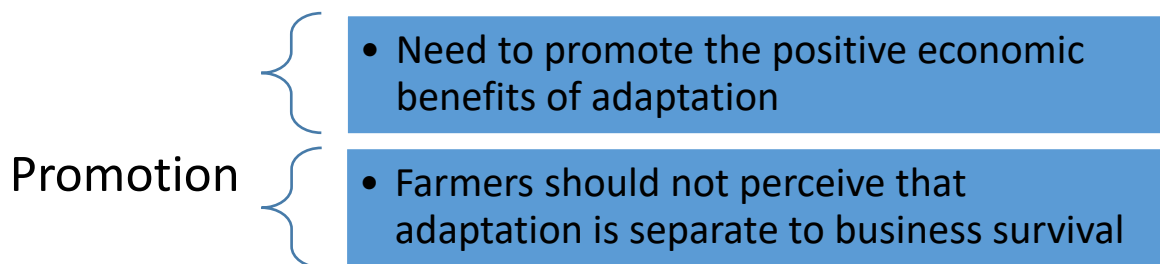
5.1.3 Farmers need more information on potential impacts of climate change on farm activities and how to implement adaptation measures on farms

It was evident from the international literature review and quantitative survey, that farmers were not aware of the potential impacts that climate change could have on their farm activities. Therefore, it is useful to help provide information to farmers so they can understand how climate change may impact their farming activities. Another key recommendation is to ensure that any information that is given to farmers on adaptation measures should ensure that these are presented using simplified language with practical ideas of how to implement measures. This finding was highlighted during the qualitative interviews as the farmers mentioned how they lacked information that is specific to their farm and region and expressed in accessible terminology/language in order to successfully embed in their farm setting. As farm networks are one of the main sources of information for farmers, the network has the potential to act as a conduit promoting information on

climate change through training, workshops and the provision of farm-specific adaptation measures.



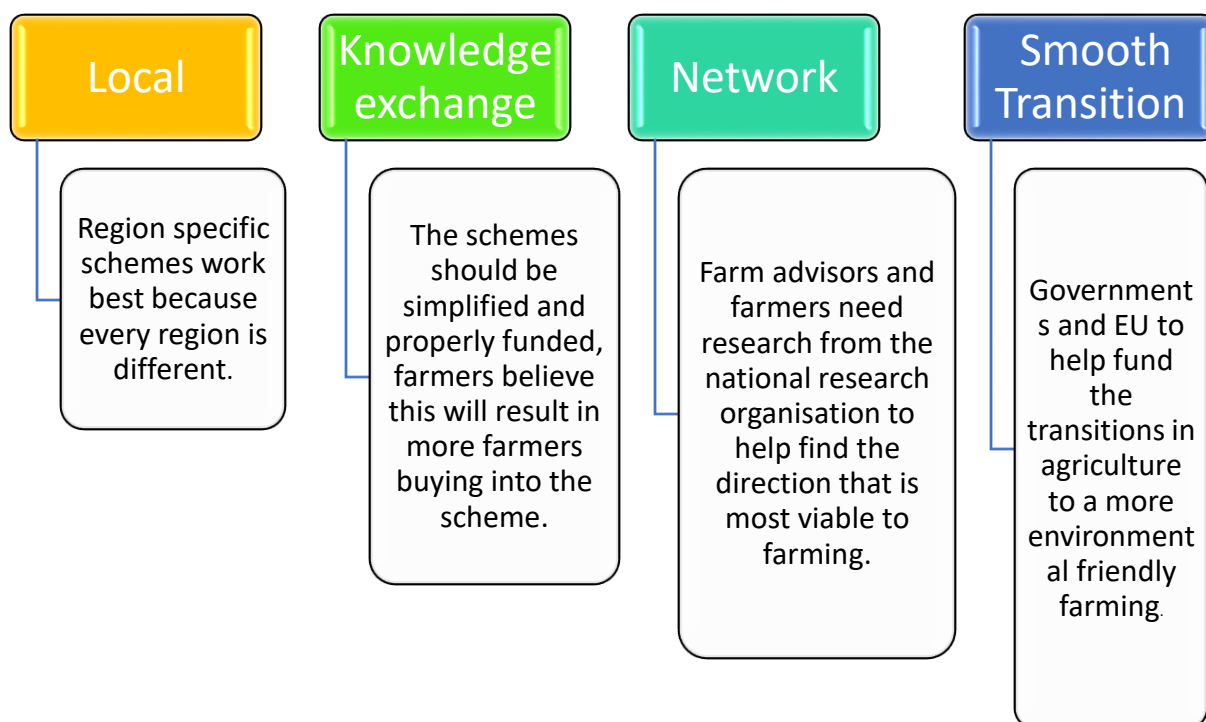
5.1.4 It is important to promote and highlight the economic benefits of adaptation; farmers should not perceive the business survival as separate from adaptation. In relation to promotion currently farmers perceive that business survival is separate from “green issues”. Therefore, it is important to promote the economic benefits of adaptation measures so that farmers are aware of the business benefits of adapting their farm. Several studies in the literature review found that the main drivers of farmer behaviour related to adaptation is financial concerns rather than environmental concerns. Therefore, rather than promoting the environmental benefits of certain measures, policy-makers and stakeholders should highlight the economic benefits, as this may be a more important driver of behavioural change. By promoting the link between climate change engagement and productivity and by demonstrating the return on investment that can be achieved from adaptation, farmers may see the benefits of incorporating adaptation initiatives into practice as part of their core farming strategies.



5.1.5 Farmers face significant resource constraints including financial, capacity and time constraints which inhibit their ability to adapt farming practices.

In addition to the need to promote economic benefits, farmers are likely to need additional financial resources to implement measures that are costly or not cost-effective. The main source of information for the farmer is the farm advisor and the farming networks, these sources provided information on funding, farm management, planning and offered training and mentoring. However, the farmer as a single worker often lacked the resources and capabilities to implement the initiatives as discussed during the qualitative interviews. The solution mentioned by all farmers was more incentives and grants to subsidise environmental initiatives. One possible mechanism is the use of agri-environment schemes, which the farmers viewed positively although farmers noted that the administration of some schemes can be cumbersome. Overall, farmers felt that locally-based schemes worked best. The farmers also noted that meeting regulatory requirements was a key factor in decision-making. This suggests that a combination of schemes with regulation might work well in promoting adaptation, particularly adaptation that is currently not cost-effective.

In terms of a potential overall framework the figure below might be useful in considering a policy framework to help farmers adapt. This framework brings in the elements of what the farmers discussed as important mechanisms of behavioural change including the use of locally-based schemes, the need for more information on the ground with respect to what farmers need to do and the need for support from national governments and the European Union to help them transition to more sustainable agricultural practices.



5.2 Conclusions

In conclusion, this report highlighted a number of findings surrounding farmers attitudes to climate change and developed some recommendations that can contribute to policy-developments in this area. Our findings highlight the positive willingness of farmers to buy climate-related insurance, which is considered a much more efficient means of ensuring financial security rather than post-disaster aid relief in the face of rising losses from climate-related events. A significant portion of farmers are willing to help with flood measures to protection downstream communities which is important given that increased flooding is predicted to be among the more significant impacts of climate change in Ireland. Finally, our highlighted a number of areas that could help farmers adapt to better climate resilient farming.

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Appendices

	Model 1: Logistic model explaining willingness to participate in individual flooding scheme (Z-Values)	Model 2: Logistic model explaining willingness to participate in collective flooding scheme (Z-Values)
Farm Type: Reference Level : Tillage + Mixed Livestock		
Dairying	0.375* (1.86)	0.601 (1.02)
Cattle	0.335** (2.16)	0.359** (2.12)
Cattle Other	0.215** (2.54)	0.365* (1.81)
Sheep	0.08*** (3.70)	0.165*** (3.02)
Farm Size:		
Farm Size: 50 Hectares or more(Reference < 50 hectares	1.65 (1.42)	1.16 (0.47)
Participant in Agri-Environment Scheme (REPS/AEOS/GLAS)	1.439** (2.29)	1.401** (2.25)
Farmer Characteristics		
Male	1.830 (1.34)	1.76 (1.38)
Age	0.781** (2.22)	0.796** (2.28)
Education: Professional Qualification or Higher (Reference: lower than Professional Qualification)	1.372 (0.62)	1.465 (0.78)
Off-Farm Job/Income	2.12** (2.27)	0.953 (0.16)
Farm Previously Affected by		
Floods	2.18 (1.44)	1.01 (0.03)
Wildfire	6.20* (1.72)	2.08 (0.71)
Storms	1.322 (0.79)	2.19** (2.43)
Droughts	0.659 (0.86)	0.678 (0.89)
Region (base South-West)		
Border	1.39 (0.70)	1.65 (1.10)
Midland	0.364 (1.49)	0.745 (0.51)
West	2.35 (1.68)	1.98 (1.42)
Mid-East	1.34 (0.49)	2.60 (1.66)
Mid-West	0.55 (0.97)	1.20 (0.36)
South-East	0.286* (1.77)	0.478 (1.18)

*Logistic Odds Model: Factors affecting participation in individual and collective schemes to protect downstream communities from flooding. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. The models presents odd ratios. A significant odd ratio of less than one means that the variable is associated with a higher likelihood of not participating in a scheme, while a significant odds ratio of greater than one means that they are more likely to participate.*

	Model 3: Logistic Model explaining Willingness to Buy EU-Backed Insurance: (Z-Values)	Model 4: Factors explaining amount(€) farmers' are willing to pay for insurance (Z-Values)
Farm Type: Reference Level : Tillage + Mixed Livestock		
Dairying	2.14 (1.47)	0.732* (1.74)
Cattle	2.35 (1.28)	0.274 (0.70)
Cattle Other	1.59 (0.64)	0.195 (0.42)
Sheep	2.40 (1.13)	0.693 (1.47)
Farm Size:		
Farm Size: 50 Hectares or more (Reference < 50 hectares)	1.65 (1.09)	0.594** (2.16)
Participant in Agri- Environment Scheme (REPS/AEOS/GLAS)	1.51 (1.14)	0.105 (0.44)
Favour Compulsory Measures	1.67 (1.40)	0.530** (2.34)
Farm at Risk Flooding	1.77 (0.68)	0.067 (0.17)
Willing to participate in scheme to reduce downstream flooding	3.87*** (3.33)	0.231(1.00)
Male	0.495 (1.23)	-0.079 (0.25)
Age	0.644 (2.81)**	-0.225** (2.53)
Education: Diploma or Higher (Reference: lower than Diploma)	0.520 (0.387)	0.359 (0.91)
Farm Successor	1.30 (0.67)	0.188 (0.76)
Off-Farm Job/Income	1.46 (0.94)	0.318* (1.73)
Farm Previously affected by extreme weather	3.68** (2.97)	0.782** (2.16)
Region – reference is Southwest Region		
Border	2.42* (1.69)	0.637* (1.73)

Midland	5.65** (2.42)	1.379*** (3.06)
West	2.87* (1.80)	0.824** (2.05)
Mid-East	1.08 (0.12)	-0.086 (0.18)
Mid-West	3.42* (1.81)	1.390** (3.16)
South-East	15.13** (2.51)	1.01** (2.14)

*Analysis of results exploring farmers' willingness to buy EU-backed insurance against extreme weather events. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level. Model 3 presents odd ratios. A significant odd ratio of greater than one means that the variable is associated with a higher likelihood of buying insurance, while a significant odds ratio of less than one means that they are less willing to buy insurance. Model 4 presents results from an ordered regression model that examines factors that are associated with farmers who are willing to pay more in euros for insurance to cover their farm against extreme weather events*