

PERSPECTIVES OF CLIMATE SMART AGRICULTURE FROM ACROSS THE GLOBE

CLIMATE-SMART CASE STUDY FROM IRELAND

I. General overview

I.1 Climate of Ireland

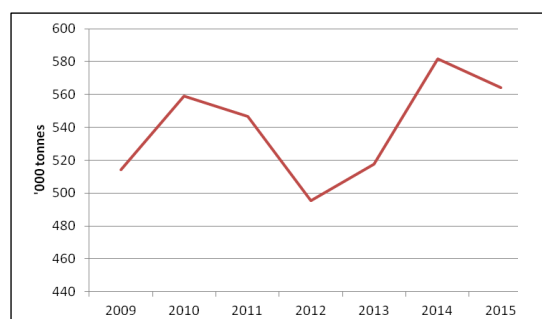
Ireland's climate is characterised as being mild and moist, with a significant maritime influence and an absence of temperature extremes. The average annual temperature is about 9°C ranging from 2-3°C winter average to 19°C summer average. Most of the eastern half of the country has between 750 and 1,000 mm of rainfall in the year. Rainfall in the west generally averages between 1,000 and 1,250 mm, and can exceed 3,000 mm per year in upland regionsⁱ.

I.2 Land use and agricultural activity in Ireland

The land area of Ireland is 6.9 million hectares, of which 4.5 million hectares, or about 65% of total land area, is used for agriculture. Some 92% of the agricultural land area is devoted to grassland (pasture and rough grazing) and represents the most important crop in Ireland, underpinning the Irish dairy and beef industry.

Irish dairy and beef production is predominantly a grass based system. Approximately 550,000 tonnes of beef are produced annually (Figure 1). In excess of 90% of net beef output is exported making Ireland the largest exporter of beef in the European Union (EU).

Figure 1: Production of cattle meat in Ireland (2009-2015)ⁱⁱ

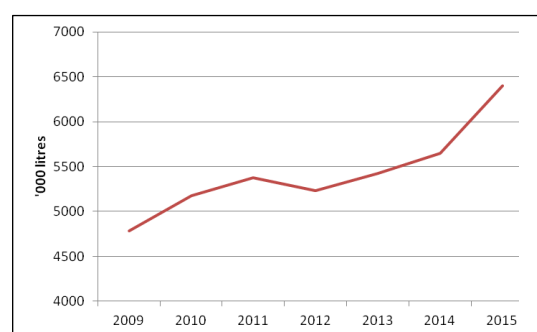


In 2015, in terms of export volume, approximately 272,000, 214,000 and 17,000 tonnes of beef were exported to the UK, other EU countries and international markets respectivelyⁱⁱⁱ.

Dairy production and output has steadily increased in recent years from 4.8 million litres in 2009 to

almost 6.4 million litres in 2015, an increase of 33% (Figure 2). This reflects opportunities to expand milk production following the abolition of milk quotas in the EU on the 31st March 2015.

Figure 2: Intake of Cows Milk by Creameries and Pasteurisers in Ireland (2009-2015)^{iv}



Dairy is a broad category encompassing both primary dairy products (butter; cheese, milk powder) and value-added dairy products (infant formula, casein, chocolate crumb). The United Kingdom remains a significant market for Irish dairy exports, accounting for approximately 30% of dairy export value in 2015. In 2015, the value of exports to other EU countries remained largely unchanged at 28%, while there has been significant growth in the value of exports to international markets, accounting for 42% of total dairy exports in 2015^v.

8% or 380,000 hectares is used for the production of cereal, fruit and horticulture crops. A unique feature of Irish croplands is that cereals dominate the land area laid down to crops^{vi}. Spring barley is grown for the malting, seed and feed industries in the country and accounts for between 50-60% of national cereal area, while winter wheat, winter barley and winter and spring oats are the other important grain crops, along with maize, potatoes and oilseed rape. The trend in cropland activity has seen production consolidate onto the suitable soils and favourable climate regions in Ireland. Ireland is not self sufficient in grain production and thus relies on imports to meet demand.

11%, or 737,904 hectares, of Ireland's total area is devoted to forestry. Since 1990, approximately 300,000 hectares have been afforested. Despite this rate of planting, the level of forest cover is low by

European standards where average forest cover among the EU-27 countries stands at 37%.

1.3 Economic and social importance of the agricultural sector in Ireland

In 2014^{vii}, it was estimated that the agri-food sector^{viii} accounted for approximately 7.6% of Gross Value Added^{ix} (GVA) at factor cost, and the primary agriculture, fisheries and forestry sectors together accounted for approximately 2.5% of GVA^x.

Table 1: Farm structures data for Ireland^{di}

Farm structures data for Ireland in 2013		
Statistic	Relevant data	
Total farm holdings	139,600	
Total family farm holdings	139,100	
Average farm size (ha)	32.5	
Family farm holders by age	<35 yrs	5.9%
	>55 yrs	52.7%

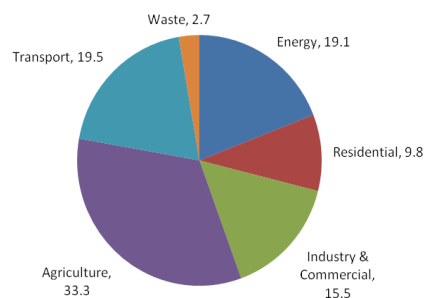
The agri-food sector is one of Ireland's most important indigenous manufacturing industries, employing in the region of 50,000 people directly, as well as providing the primary outlet for the produce of 139,100 family farms making it particularly important to the rural economy.

Nationally, it plays a key role in ensuring Ireland's export-led economic recovery while it also provides the foundation for sustainable rural development. At a European level, the unique national importance and scale of this sector relative to the rest of the economy is recognised.

1.4 Agriculture Greenhouse Gases (GHG) emissions

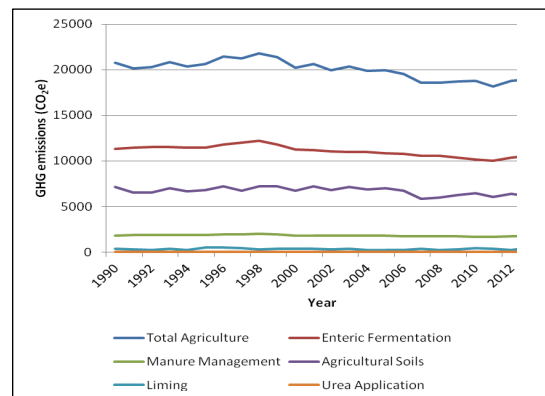
Agriculture remains the single largest contributor at 33.3% (19.4 Mt CO₂e^{xii}) of national GHG emissions (Figure 3).

Figure 3: Ireland's national GHG emission estimates 2014^{xiii} (sector contribution expressed as a % of total national emissions)



The main sources of agricultural emissions are methane (CH₄), arising from enteric fermentation and manure management, and nitrous oxide (N₂O) emissions from the application of nitrogen-based fertilisers (Figure 4).

Figure 4: Agricultural GHG emissions arising from activity



2. Climate Smart Agriculture Intervention

2.1 Country level policies/ enabling environment

Effort Sharing Decision (ESD) 406/2009/EC^{xiv}

The ESD establishes binding annual greenhouse gas emission targets for European Union (EU) Member States (MS) for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (ETS), including agriculture. Under the ESD, Ireland has been assigned an emissions reduction target of 20% below 2005 levels relative to an EU average of minus 10%. This sets a considerable challenge for Irish agriculture^{xv}.

EU Member States are discussing a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. An EU wide non-ETS target of a 30% reduction in emissions below 2005 levels has been agreed but no decision has been made on individual MS emission reduction commitments.

Climate Action and Low Carbon Development Act 2015^{xvi}

The Irish Parliament passed the 2015 *Climate Action and Low Carbon Development Act* with the objective to transition towards a low carbon, climate resilient and environmentally sustainable economy by the end of 2050. This will be achieved through a *National Mitigation Plan* (specifying policies to lower Ireland's

level greenhouse emissions) and a *National Adaptation Framework* (to provide for responses to changes caused by climate change), both of which will be renewed every five years.

The low-carbon roadmapping process will be guided by a long-term vision of low-carbon transition based on –

- an aggregate reduction in carbon dioxide (CO₂) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and
- in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

Agricultural Development Strategies

The Department of Agriculture, Food and the Marine (DAFM) is the government department for the regulation and development of Ireland's agri-food and marine sectors. Its mission is to lead the sustainable development of the agri-food, forestry and marine sector and to optimise its contribution to national economic development and the natural environment^{xvii}.

In July 2015, the Minister for Agriculture, Food and the Marine, Simon Coveney T.D., launched the latest in series of rolling ten-year strategies for the Irish agri-food sector called *Food Wise 2025*^{xviii} which sets out a vision for the sectors development over the next ten years. The report follows on from previous sector development strategies such as *Agri Food 2010*, *Agri Vision 2015* and *Food Harvest 2020*. *Food Wise 2025* outlines the key actions required to ensure that the agri-food sector maximises its contribution to economic growth and exports in an environmentally sustainable manner over the coming decade.

Sustainability is a major aspect of the current strategy. As part of the *Food Wise 2025* process, an Environmental Analysis Report (incorporating a *Strategic Environmental Assessment*^{xix} and an *Appropriate Assessment*^{xx}) was prepared in parallel and was the subject of a public consultation process. The environmental assessment and public consultation was taken into account in drafting *Food Wise 2025*

Food Wise 2025 recognises that a significant increase in food production cannot be considered in isolation from its environmental impact, in particular regarding concerns associated with the depletion of natural resources and the potential impact on climate change. To address this, future food production systems must be as focused on managing and sustaining our natural resources as they are on increasing production.

IIEA/ RDS Climate Smart Agriculture Forum^{xxi}

The Institute of International and European Affairs (IIEA) and the Royal Dublin Society (RDS) Currently collaborate to provide a neutral "Chatham House forum" for various stakeholders to discuss the implication of CSA for Ireland and internationally. This provides a platform for international speakers on the subject together with topical workshops and surveys. The IIEA/ RDS CSA Forum aims to launch a report on their findings in June 2016.

2.2 Investment climate

Common Agricultural Policy (CAP)

The CAP is the agricultural policy of the EU and combines a system of subsidies to farmers in the form of direct payments (Pillar I) and voluntary programmes for the social, economic and environmental development of rural areas. (Pillar II). The CAP strives to be the overall framework for a European system that allows farmers to fulfil their multiple functions in society - the first of which is to produce food. The 2013 Reform of the CAP aims at further integrating maintenance of biodiversity, soils, and landscapes. Farmers can be adversely affected by climate change and the CAP provides them with financial assistance to adjust their farming methods and systems to cope with the effects of a changing climate.

Ireland's total expenditure for the period 2014-2020 amounts to €12.6 billion. Of this, €8.5 billion will be distributed as EU Pillar I direct payments to farmers. €2.2 billion is allocated as Pillar II supports under Ireland's Rural Development Programme to cover multi annual rural development which include those that are beneficial for the environment and climate change. In addition, a further €1.9 billion in national funding will be added to the €2.2 billion in EU expenditure on rural development. While a minimum of 30% of EU funds are required to be linked to combating climate change including measures it is estimated that approx **87% of the Irish RDP is related to climate action.**

Overseas investment and development

Irish Aid^{xxii} has spent €20.7 million on agricultural programmes, 90% of which was climate proofed. Irish Aid is undertaking efforts to ensure full climate proofing in future programming through the integration of climate change into Development programming and the Climate Change and Development Learning Platform.

2.3 Climate Smart technologies and practices

2.3.1 CAP Pillar I Measures

CAP Pillar I provides direct payment to farmers in the form of a basic income support to help alleviate

the effects of market volatility. Following various reforms over the years; the CAP aims to integrate the multiple functions that agriculture and land use provides for society from food production to maintenance of biodiversity, soils and landscapes.

Direct payments contribute to providing basic public goods in the form of *cross compliance* and *greening*. *Cross compliance* is a mechanism that links direct payments to compliance by farmers with basic standards delivered through the Statutory Management Regulations (SMR's), including those related to climate and environmental management, such as the implementation of the nitrates regulations which contributes to ensuring nitrogen use efficiency is in line with crop requirements and minimising GHGs arising, as well as the requirement of maintaining land in good agricultural and environmental condition (GAEC), such as protection of soil carbon pools and landscape features such as hedgerows. *Greening* incorporates action towards the maintenance of permanent pasture, and the integration of ecological focus areas and the practice of crop diversification within arable farmland. It rewards farmers for adopting and maintaining a more sustainable use of agricultural land as well as enhancing the overall environmental performance of the CAP. *Cross compliance* and *greening* are regarded as important implementation tools to extend a basic level of environmental management to the majority of farmland in Europe.

2.3.2 CAP Pillar II Measures - RDP 2014-2020

The Department of Agriculture, Food and the Marine (DAFM) supports a strong Rural Development Programme (RDP) 2014-2020, co-funded by the EU, to develop and incentivise sustainable resource efficient farming activities and knowledge transfer in the sector. Substantial progress has been made in Ireland to integrate environmental considerations into agricultural policies and activities.

The Irish RDP provides support for a range of activities which could contribute to the reduction of agricultural emissions. Support under RDP 2014-2020 is delivered through measures and sub-measures^{xxiii}. Appendix 1 describes the projected impacts of the RDP measures towards achieving the objectives of CSA.

2.3.3 Origin Green^{xxiv}

Origin Green is a programme developed by An Bord Bia^{xxv} to encourage farmers and food processors to engage directly with the challenges of sustainability and climate action. To support the roll out of Origin Green at farm level, Bord Bia has integrated a sustainability and carbon audit in their Beef and Lamb Quality Assurance Scheme^{xxvi} (BLQAS) and Sustainable Dairy Assurance Scheme¹⁶ (SDAS). Currently over 45,000 Irish beef farms have

been audited to date under the BLQAS, accounting for 90% of our total beef production and 13,000 Irish dairy farms (approximately 75% of production) have signed up to take part in the SDAS. To further enhance this Bord Bia and Teagasc^{xxvii} collaborated to develop a *Carbon Navigator* support tool. The *Carbon Navigator* builds on farm management data collected during audit, and identifies practical areas that impact on the farms environmental and economic performance. The core elements of the Carbon Navigator to deliver economic and environmental benefits are as described in Table 2 below.

Table 2: Carbon Navigator efficiency measures

Dairy Carbon Navigator	Beef Carbon Navigator
Grazing season length	Grazing season length: Suckler cows and followers
Improved genetics and breeding	Age at first calving
Improved nitrogen efficiency	Calving rate
Improved Manure Management	Live weight performance
Energy efficiency	Improved nitrogen efficiency
	Improved Manure Management

The outputs are used to assess the performance of the farm against peers (Table 3). The programme delivers feedback and advice on practices that effectively reduce the carbon-footprint of farm produce and improve the economic performance of the farm.

Table 3: Beef Carbon Navigator audit results



The Carbon Navigator illustrates that the application of practical solutions to GHG emissions that also address specific productivity needs have the potential to succeed. The application of the Carbon Navigator at farm level is also linked to other

elements of Ireland's RDP 2014-2020 such as Knowledge Transfer Programme and Beef Data and Genomics Programme.

2.3.4 Smart Farming Programme^{xxviii}

The Smart Farm Programme is a voluntary farmer focused initiative that identifies ways in which to improve resource efficiencies at farm level under eight key headings: feed, grassland, water, inputs, time management, soil fertility, machinery management and energy use. The programme is promoted by the Irish Farmers Association (IFA)^{xxix}, with collaboration from the EPA^{xxx}, FAI^{xxxi}, Teagasc^{xxxii} and UCD^{xxxiii}, among others. Resource efficient farming not only saves money for the farmer but also benefits the environment through the optimal use of inputs.

2.4 Extension Services

The Irish agricultural sector is supported by a strong and dynamic extension and advisory service. Teagasc is the national public body responsible for agricultural research and education in addition to providing a comprehensive advisory service to farmers with qualified advisors on all farming enterprises. The organisation is funded by State Grant-in-Aid; fees for research, advisory and training services; income from national and EU competitive research programmes; and revenue from farming activities and commodity levies. In 2014, Teagasc employed 235 qualified farm advisors throughout the country^{xxxiv}.

The advisory and extension service is also supported by a large national network of qualified, independent advisors, including those affiliated to the Agricultural Consultants Association (ACA), whose association amounts to about 400^{xxxv}.

The farm advisory and extension network in Ireland provides a wide range of specialist knowledge services delivered on a one-to-one or group basis (see Box 1) to achieve the adoption of best practice, and provides assistance to farmers with meeting EU requirements under CAP (cross-compliance, GAEC, Greening), the RDP and European Environmental Directives.

Box 1: Demonstration of best practice

Discussion groups

Discussion groups consist of local farmers who meet regularly on local farms, under the guidance of a qualified farm advisor; to discuss and learn about technologies and practices that may be applied on their farms. The role of farm discussion groups has been enhanced in Ireland's RDP 2014-2020 under the 'Knowledge Transfer and Information Actions' measure (see Appendix 1) to address key aspects of a farmers' business, and will include, *inter alia*, environmental sustainability.

Teagasc/ Irish Farmers Journal BETTER farm beef programme

Teagasc and the Irish Farmers Journal, in association with a number of Irish beef processors, are developing a road map for profitable beef production. The programme, which includes a number of working farms as a means of demonstration, is focusing on improving technical efficiency inside the farm gate. Adoption and implementation of farm level technologies (see Appendix 1) to improve efficiency may make it possible to farm more sustainably and reduce GHG emissions per unit output in the beef herd.

Teagasc Sustainability Farm

Teagasc is showcasing its expertise on sustainability through a new sustainability demonstration farm situated at Kildalton Agricultural College in the South East of Ireland. This initiative will train the next generation of farmers in the concept and practical aspects of agricultural sustainability and provide a unique environment to evaluate emerging technologies in the context of an operational farm.

The effective transfer of existing best practice at farm level is dependent on a highly skilled and well informed advisory service to support a knowledge demand of agri-food sector. Teagasc has developed a new and innovative programme, ConnectEd^{xxxvi}, which aims to extend its knowledge support services to professional and corporate entities in Ireland.

Ireland's RDP 2014-2020, through the measure Continuous Professional Development for Agricultural Advisors, strengthens and enhances advisors knowledge base to support the sustainable growth of the sector. This will result in the more efficient delivery of the sustainability goals within the proposed Knowledge Transfer Groups in the various sectors under the RDP 2014-2020.

2.5 Metrics and methodologies

2.5.1 National emission inventories

The EPA^{xxxvii} compiles Ireland's national greenhouse gas emission inventory on an annual basis. Emissions data, including those arising from agricultural activities, are submitted to the European Commission and UNFCCC each year by 15 January and 15 April respectively. The EPA also develops national emission projections on an annual basis in collaboration with relevant State and other bodies. This collaboration ensures consistency with econ forecasts and with projected activity in sectors including agriculture.

DAFM is a key data provider of annual agricultural statistics, such as livestock populations and fertiliser/lime use, to the EPA. Other sources of activity data are provided by the CSO, Irish research outputs and farm infrastructure surveys.

Since 2006, Ireland has been deploying the use of IPCC Tier 2 (i.e. detailed country-specific) methods for the assessment of key sources of emissions from agriculture. Country specific emission factors have been developed for CH₄ emissions from enteric fermentation and manure management from the cattle population, and for indirect N₂O emissions from manure management. These would be considered key categories in Ireland's agriculture GHG inventory.

The development of higher tier methods is the subject of on-going research to increase the application of country specific emission factors in Ireland's GHG inventories.

2.5.2 Research

Scientific research has a central role to play in developing our understanding of cost effective mitigation options for agriculture and the carbon sequestration potential of our natural land resources. To this end, DAFM recognises the important role that the agriculture and land use sector plays in protecting the environment and is strongly committed to providing funding for targeted research in the area of agriculture, sustainable intensification and sustainable land management. DAFM's Sustainable Healthy Agri-food Research Plan^{xxxviii} (SHARP) has aimed to develop technologies and to advise the agriculture sector on how to improve the resource efficiency and sustainability of agricultural production.

Ireland participates in research on an international level such as EU Joint Programming Initiative: Agriculture, Food Security and Climate Change (FACCE-JPI), which provides and steers research to support sustainable agricultural production, and the Global Research Alliance on Agricultural GHG's.

2.5.3 RDP 2014-2020 monitoring and evaluation

Ireland's RDP has been developed to help towards reducing GHGs arising from agriculture, as well as enhancing the resilience of the sector towards climate impacts. DAFM is bound by EU regulation to provide annual implementation reports to the EU Commission based on specified indicators linked to specific measures of the RDP. Mandatory result indicators include emissions reductions resulting from farmer participation in Programme schemes such as GLAS and the BDGP. In addition, periodic

assessment of scheme impacts is an important element of the common monitoring and evaluation system for the RDP.

In addition, a quantitative and qualitative environmental assessment of GLAS will be undertaken to evaluate the environmental and climate impact of the various actions within GLAS. This will include the modelling of the potential effects of individual actions on climate parameters to provide an estimate of climate regulation impacts arising from system changes.

2.5.4 Teagasc National Farm Survey (NFS)

Teagasc collect data on farm output, costs and income in the form of an annual National Farm Survey (NFS) collecting data has been conducted by Teagasc on an annual basis since 1972. The NFS is currently being further developed to record, measure and publish information on the sustainability performance of Irish farms.

Farm-level indicators reflecting the multidimensional nature of sustainability have been developed using NFS data. This means that the indicators measure the economic, social and environmental sustainability of farms of all systems, sizes and location of production. The indicators can be 'back-cast' over the last number of years to see where we have come from and will be recorded on an annual basis moving forward in order to track our progress towards a more sustainable agricultural sector.

Box 2: Herd Plus

The Irish Cattle Breeding Federation (ICBF) Herd Plus service provides valuable management information and performance statistics on a whole-herd basis to Irish farmers to assist them with the identification herd characteristics that can be improved upon within the herd e.g. calving interval, mortality rate. Improvements associated with a superior genetic merit and production characteristics have been shown to lower the intensity of GHG emissions from within the herd.

The use of genetic evaluation information is a core element of the BDGP funded under Ireland's RDP 2014-2020. The BDGP requires the genotyping of bovine breeding stock, and selection and use of genetically superior maternal sires to produce a more climate efficient animal.

2.6 Planning and priority-setting for strengthening climate-smart food production systems

Following the publication of the draft Food Wise 2025 strategy (section 2.1), the Minister for Agriculture, Food and the Marine, Simon Coveney T.D., convened a *High Level Implementation Committee* (HLIC) for Food Wise 2025. The committee, which is chaired by the Minister for Agriculture, Food and the Marine, includes senior executive membership from State Agencies, Government Departments and the industry. The group is tasked monitoring progress by Government Departments and State Agencies in delivering on the actions for which they are responsible for in the Food Wise 2025 report, and to drive progress towards meeting the growth projections set out in Food Wise 2025 in a sustainable manner.

The HLIC has established a *Sustainability Committee* to oversee the monitoring of any impacts on the environment which may result from the implementation of Food Wise 2025^{xxxix}, and to monitor and drive the implementation of Food Wise 2025 sustainability actions^{xl} which are crucial to ensuring that environmental sustainability is maintained as the Agri-food sector grows and expands over the next decade.

2.7 Examples of ongoing action by Civil Society Organizations and the private sector

Irish Aid is the Irish Government's programme for overseas development. The programme is managed by the Development Co-operation Division of the Department of Foreign Affairs and Trade. Overseas development work supported by Irish Aid is described in Box 3 below.

Box 3:

In Ethiopia, the Irish Aid programme supports an Operational Research programme to enhance food security, improve nutrition and adapt to climate change through better access to drought resistant crop varieties, animal breeds and management techniques. Increasingly erratic annual rainfall and frequent drought makes farming difficult for Ethiopian communities. However, through the Operational Research programme, farmers have come together to form 'Farmers Groups', jointly identifying new seed varieties to improve crop performance and taking new agricultural technologies to scale through seed exchange and farmer field days.

Irish Aid also supports the CGIAR centre **ICRAF** (World Agroforestry Centre) and the regional Agriculture Ministry to add value to Irish Aid's previous watershed management engagement in Ethiopia's northernmost region of Tigray. The original soil and water conservation structures in the Gerghera watershed increased crop productivity by as much as 40 percent, and doubled the availability of feed for animals. Ongoing climatic changes demand further work, improving soil and water conservation through further reforestation to safeguard groundwater supplies and access to irrigation

Irish Aid supports the National Association of Smallholder Farmers in Malawi (NASFAM) to help 100,000 farmers in 19 Districts achieve higher and sustainable profits through Conservation Agriculture. Guidelines for Conservation Agriculture have been developed. The CGIAR centre ICRISAT is being supported to research the multiplication and provision of quality climate adapted seeds and planting materials. Pit mulching & total ground cover technologies have been demonstrated. The programme trained 'lead farmers' to share the new knowledge and the experience with better prices in domestic & global markets.

The CGIAR centre ICRAF (World Agroforestry Centre), with support from Irish Aid and in collaboration with the Government of Malawi have been piloting the inclusion of fertilizer trees in the Farm Input Subsidy Program (FISP) in Dedza District. This is the first time farmers have received fertilizer tree seeds as one of the additional inputs under the FISP package. Malawi's New Food Security Initiative research revealed that a combination of inorganic fertilizers and fertilizer trees improved the organic content of soils and maize yield performance.

2.7.1 International development action

In 2015, Teagasc and Irish Aid signed a Memorandum of Understanding, which provides for collaboration to enhance Ireland's contribution, through agricultural research, training and extension, to developing countries. The agreement supports Ireland's objectives of reducing hunger and under-nutrition in African countries. Under the agreement, Irish Aid will identify areas in food security and nutrition programmes where Teagasc can provide support. Envisaged areas of collaboration include scientific and technical advice; capacity building relationships with national agricultural research institutions such as in Ethiopia and Malawi; and establishing linkages between the Irish Agricultural Research sector and CGIAR – the Global Agricultural Research Partnership.

3. Projected impacts of existing CSA interventions

It is widely recognised that Irish agriculture has one of the lowest carbon-footprints internationally. The

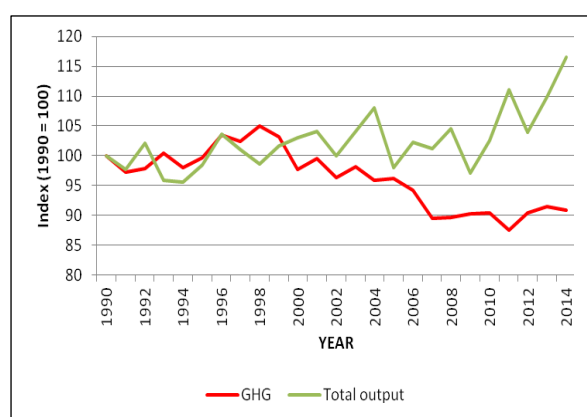
European Commission's JRC Report of 2010^{xii} recognised that:

- Ireland (with Austria) had the lowest cow milk emissions (1 kg per kg of product). This compares with an EU average of 1.4kg/kg
- Ireland had the lowest emissions per kg of pork (4.8 kg/kg) – EU average 7.5kg/kg
- Ireland's emissions per kg of beef were 18.4 kg/kg – EU Average 22.2kg/kg

Regarding dairy systems in Europe it reported that intensive systems create less CH₄ and N₂O emissions than extensive ones, but this is countered by higher emissions from land use and land use change. Lowest emissions are created by extensive grassland systems, such as those in Ireland.

These findings confirm Ireland's green credentials which underpin the development of an efficient and sustainable agricultural industry. It also demonstrates the sectors ability to achieve sustainable production goals (Figure 5). In this regard, Ireland is not complacent, and continues to seek even greater efficiencies in the sector.

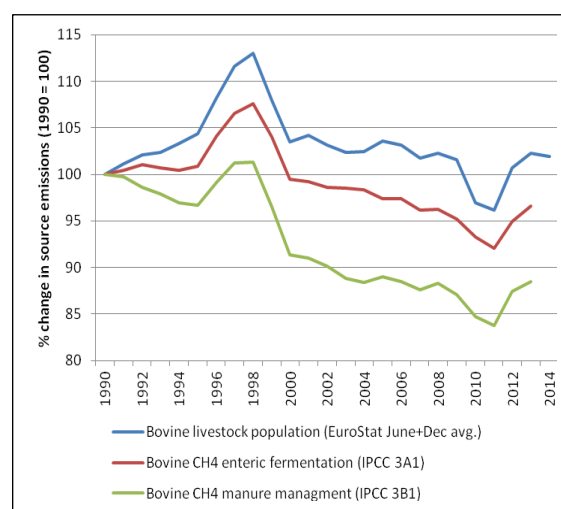
Figure 5: Trends in GHG emissions arising from agriculture and total agricultural output (1990-2014)^{xiii}



Bringing beef and dairy farms currently running behind national averages in terms of CO₂ eq. per unit output would potentially reduce emissions by almost 1 million t CO₂e annually. This equates to 6% of the total emissions from agriculture^{xiii}.

Appendix I describes the projected impacts of Ireland's RDP measures and environmental regulations towards delivering and achieving the objectives of CSA. It is anticipated that increasing the reach and penetration of these measures at farm level will further decouple GHG emissions from the national herd and build on the progress achieved to date (Figure 6).

Figure 6: Trends in the bovine livestock population against CH₄ emissions from enteric fermentation & manure management^{xiv}.



4. Challenges and opportunities for further implementation of CSA

I. Challenges to implementation or adoption

While there are many challenges ahead on the path to achieving long term environmental sustainability, Irish agriculture has not been complacent and over recent years major efforts have been made in further improving the climate efficiency of agriculture. The initiatives outlined in this case study including compliance with existing environmental legislation and key policy instruments such as CAP, especially the RDP, will play an important role in underlying sustainable production systems into the future.

Challenges towards mitigation

The latest EPA projections^{xiv} for Ireland indicate that GHG emissions from agriculture are on a rising trajectory, largely driven by a projected increase in the national dairy herd (+21% above current levels by 2020) and associated increase in fertiliser usage (+3% above current levels by 2020). Despite a projected decrease in the beef herd (-7% below current levels by 2020), total emissions from agriculture are projected to increase by 2% over the period 2013 – 2020 to 19.33 Mt CO₂e. Future food production systems must develop robust mitigation strategies that can lower emissions to help contribute to the development of a more sustainable agri-sector.

Challenges towards adaptation

The Irish agriculture sector has in recent years faced an increased number of extreme weather events. To date, efforts to deal with these events, such as the 2012/2013 fodder crisis in the livestock sector, have been reactive and highlight the lack of resilience in the sector. Building resilience for the future is an integral component in the sectors strategy and vision under Food Wise 2025 and the Climate Action and Low Carbon Development Act 2015.

Productivity challenge

Irish agriculture has significantly improved its performance in term of productivity and output in recent decades. These gains, can in part, be attributed to adoption of technologies and efficiencies that are compatible with our systems of farming. Ongoing investment in knowledge transfer, leading to a high adoption rate of best practices at farm level, will be a critical success factor in striving towards our environmental goals. Furthermore, overcoming the structural barriers that exist in Irish agriculture, such as relatively small size of Irish farms, unfavourable age structure and low levels of land mobility will also be a critical success factor.

4.2 Actions to address these challenges.

Establishing an enabling policy environment

The Minister has established of a High Level Implementation Committee (HLIC) to ensure a coherent approach by Government Departments and State Agencies to implementing the Food Wise 2025 actions under the remit of the State. This builds towards the harmonised delivery of the recommendations set out in the Food Wise Implementation Plan^{xvii} and provides for the engagement and coordination of sectoral responsibilities between the appropriate agencies, institutions and sectors of industry.

The Climate Action and Low Carbon Development Act established a Climate Change Advisory Council (CCAC). A key function of the Council is to deliver independent advice, and make recommendations, to Government and Ministers in relation to the low carbon transition process and the climate adaptation agenda as Ireland transitions to a low carbon, climate resilient and environmentally sustainable economy by 2050.

Adopting knowledge transfer to cater for the broad social dynamic of farming

The uptake of new technologies and climate friendly practices can be impeded by the social structure and demographic profile of farming. In Ireland this is particularly evident in the beef sector, where the age profile of farmers and a dependence on off-farm occupations, may result in slower uptake and participation in knowledge transfer programmes.

Understanding generational learning preferences and the development of knowledge dissemination techniques to cater for part-time farmers will be essential for the success of current and future knowledge transfer programmes. Fundamental to this is the presence of an extension service to deliver programmes that help to achieve our sustainability goals through knowledge transfer.

Addressing the barriers to land mobility and succession

In Ireland, approximately 40% of farm holdings include land that is under a rental or letting agreement^{xvii}. The majority of these cases are for short-term rental agreements. This can have a significant effect on farmers' willingness to invest in climate friendly practices on their land and improve productivity. A review of agri-taxation policy^{xviii} between DAFM and the Department of Finance was undertaken in 2014. It proposed recommendations to address these challenges to include incentivising the long-term leasing of land so as to allow progressive farmers to enlarge their holdings and increase productivity, and to allow young farmers to establish themselves in the sector through the acquisition of long-term land leasing agreements as distinct from alternatives such as securing land ownership with its associated high opportunity cost. These approaches provide security of tenure and the certainty required to encourage an investment in improving agricultural productivity.

Enhancing farmer participation

Involving farmers in the functions of decentralised agencies and institutions enables farmers to make services more responsive at local scales. One such example is the role that farmers play in the development of genetics and genetic selection in the Irish dairy and beef sector through the ICBF (see Box 2). Farmers provide accurate data from their own herds to the ICBF. By making full use of the information they receive back, farmers can develop long-term breeding programmes to increase productivity at farm level that also deliver towards sustainability goals through improved herd genetics.

5. Outlook/conclusion

The Agri-food sector is an industry which is strategically important to the Irish economy; however, agriculture is a major contributor to National GHG emissions that drive climate change. Irish agriculture has invested substantially in increasing the production efficiency of the sector. Pivotal to this is the adoption of climate beneficial technologies and dissemination of knowledge and research outputs to attain both environmental and economic sustainability. The further advancement of

practices that reduce GHG emissions and optimisation of the carbon efficiency in the agricultural sector; whilst ensuring need for resilience in agriculture to climate change and weather volatility, will be necessary to equip the agri-food industry with the ability to respond to future challenges.

Environmental sustainability will be an essential requirement for food production in the decades ahead. Producing more food, while at the same time combating climate change, is one of the most important policy challenges that we face both nationally and internationally. There is an ever growing need for increasing food security to combat global poverty, to meet the increasing and changing demands of an expanding world population and combat the impacts of climate change. DAFM is strategically investing in these environmentally sustainable approaches ensure that Ireland's agricultural output is viewed as a vital food security resource for Europe in the decades ahead rather than as a source of GHG emissions in isolation.

6. Further reading and information

ⁱ Average climate data taken from Met Éireann, the Irish National Meteorological Service, www.meteireann.ie.

ⁱⁱ Production of cattle meat in Ireland. Eurostat database. www.ec.europa.eu/eurostat

ⁱⁱⁱ Export Performance and Prospects: Irish Food, Drink and Horticulture 2015-2016 (Bord Bia, 2016). <http://www.bordbia.ie/industry/manufacturers/insight/publications/MarketReviews/Documents/Export-Performance-and-Prospects-2016.pdf> (accessed online 14th of March 2016)

^{iv} Intake of dairy cow milk by creameries and pasteurisers by domestic source. CSO (Central Statistics Office) StatBank. www.cso.ie

^v Export Performance and Prospects: Irish Food, Drink and Horticulture 2015-2016 (Bord Bia, 2016). <http://www.bordbia.ie/industry/manufacturers/insight/publications/MarketReviews/Documents/Export-Performance-and-Prospects-2016.pdf> (accessed online 14th of March 2016)

^{vi} In 2014, 305,892 ha was laid down to the production of cereal crops yielding a total of 2,597,800 tonnes

^{vii} 2015 data not yet available

^{viii} The Agri-Food Sector is taken to include primary production (Agriculture, Fishing and Forestry) along with Food, Beverages & Tobacco (grouped together in the National Income & Expenditure classification) and wood processing sectors.

^{ix} Gross value added at factor cost is GVA at market prices less any indirect taxes plus any subsidies.

^x Fact Sheet on Irish Agriculture (DAFM, 2016) <http://www.agriculture.gov.ie/media/migration/publications/2016/February2016Factsheet170216.pdf> (accessed online: 8th March 2016)

^{xi} Farm Structures Survey 2013 (CSO, 2015) <http://www.cso.ie/en/releasesandpublications/ep/p-fss/farmstructuresurvey2013/> (accessed online: 8th March 2016)

^{xii} Includes CO₂ from fossil fuel combustion (c.1Mt)

^{xiii} Irelands Provisional Greenhouse Gas Estimates 2014 (EPA, 2015) http://www.epa.ie/pubs/reports/air/airemissions/GHG_1990-2014_Provisional_11122015.pdf (accessed online: 8th March 2016)

^{xiv} EU Effort Sharing Decision (ESD) <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF>

- ^{xv} In 2014, agriculture accounted for c.45% of non-ETS emissions
- ^{xvi} Climate Action and Low Carbon Development Act 2015 <http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/html> (accessed online: 8th March 2016)
- ^{xvii} Statement of Strategy 2015-2017 (DAFM, 2015) <http://www.agriculture.gov.ie/media/migration/publications/2015/StatementStrategy201517230415.pdf>
- ^{xviii} Food Wise 2025 Final Report (DAFM, 2015) <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodwise2025/report/FoodWise2025.pdf> (accessed online: 8th March 2016)
- ^{xix} Food Wise 2025 Strategic Environmental Assessment <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodwise2025/finalenvironmentalanalysis/FoodWise2025SFEAEnvironmentalReport091215.pdf> (accessed online: 8th March 2016)
- ^{xx} Food Wise 2025 Appropriate Assessment <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodwise2025/finalenvironmentalanalysis/FinalFoodWise2025NaturalImpactStatement.pdf> (accessed online: 8th March 2016)
- ^{xxi} Further information on the IIEA/ RDS CSA Forum can be accessed through the following link: <http://www.iiea.com/ClimateSmartAgriculture/index.html>
- ^{xxii} Irish Aid is the Irish Government's programme for overseas development. The programme is managed by the Development Co-operation Division of the Department of Foreign Affairs and Trade
- ^{xxiii} A Summary of the Rural Development Programme 2014-2020 Ireland (DAFM, 2015) <http://www.agriculture.gov.ie/media/migration/ruralenvironment/ruraldevelopment/ruraldevelopmentprogramme2014-2020/AdoptedRDPIInfoBooklet150915.pdf> (accessed online: 8th March 2016)
- ^{xxiv} Further information on the Origin Green Programme can be accessed through this link: <http://www.origingreen.ie/> (accessed online: 8th March 2016)
- ^{xxv} Irish Food Board www.bordbia.ie
- ^{xxvi} As part of its mandate, An Bord Bia provides a number of farm quality assurance schemes. Quality assurance plays a fundamental role in promoting food and provides the platform for consumer promotion of product quality.
- ^{xxvii} Irish Agricultural and Food Development Authority www.teagasc.ie
- ^{xxviii} Smart Farming Programme <http://smartfarming.ie/>
- ^{xxix} Irish Farmers Association (IFA) www.ifa.ie
- ^{xxx} Environmental protection Agency (EPA) www.epa.ie
- ^{xxxi} Fertiliser Association of Ireland (FAI) <http://www.fertilizer-assoc.ie/>
- ^{xxxii} Teagasc www.teagasc.ie
- ^{xxxiii} University College Dublin www.ucd.ie
- ^{xxxiv} Strategic pathway for the Teagasc Agricultural Advisory Service 2015-2020 (Teagasc, 2015) http://www.teagasc.ie/publications/2015/3621/Strategic_Pathways_for_the_Teagasc_Agricultural_Advisory_Service_2015-2020.pdf (accessed online: 8th March 2016)
- ^{xxxv} Further information on the Agricultural Consultants Association (ACA) can be accessed through the following link: www.aca.ie (accessed online: 8th March 2016)
- ^{xxxvi} ConnectEd: Professional Knowledge Network (Teagasc, 2015) <http://www.teagasc.ie/ConnectEd/documents/ConnectEd-brochure.pdf> (accessed online: 9th March 2016)
- ^{xxxvii} Emission projections and Inventories (EPA) <http://www.epa.ie/climate/emissionsinventoriesandprojections/>
- ^{xxxviii} Sustainable Healthy Agri-food Research Plan (SHARP) <http://www.agriculture.gov.ie/media/migration/research/whatsnew/SustainableHealthyAgriFoodResearchPlan300315.pdf>
- ^{xxxix} Food Wise 2025 Implementation Plan (DAFM, 2015) <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodwise2025/FoodWise2025ImplementationPlan.pdf> (accessed online: 10th March 2016)

^{xi} There are 87 individual actions related to sustainability which aim to allow the sector reach its growth potential, while protecting and improving the environment, by managing finite resources in the most efficient and effective manner.

^{xii} Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS) http://ec.europa.eu/agriculture/analysis/external/livestock-gas/full_text_en.pdf (accessed online: 10th March 2016)

^{xiii} Agri-output data and GHG historic emissions sourced from European Environment Agency (EEA) datasets; 2014 GHG emission is a provisional EPA estimate

^{xiii} Sustainability Report 2015 (Bord Bia, 2015) http://www.origingreen.ie/wp-content/themes/origingreen/sustainability_report/Origin_Green_Sustainability_Report.pdf (accessed online: 10th March 2016)

^{xiv} **Category source emissions taken from EEA datasets; Livestock data taken from EuroStat data**

^{xiv} Irelands EPA GHG emission projections (2014-2035) <http://epa.ie/pubs/reports/air/airemissions/EPA%202015%20GHG%20Projections%20Publication%20Final.pdf> (accessed online: 8th March 2016)

^{xvi} Food Wise 2025 Implementation Plan (DAFM, 2015) <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodwise2025/FoodWise2025ImplementationPlan.pdf> (accessed online: 10th March 2016)

^{xvii} Teagasc National Farm Survey data <http://www.teagasc.ie/nfs/>

^{xviii} Agri-Taxiation Review (DAFM & DF, 2014) <http://www.agriculture.gov.ie/media/migration/agri-foodindustry/agri-taxationreview/AgritaxationRevFinal120315.pdf> (accessed online: 10th March 2016)