Optimising Water Quality Returns from the Reform of the Common Agricultural Policy (CAP): A Rapid Evidence Assessment Report

Institute for Policy Research, University of Bath, UK.

A Report to An Fóram Uisce| The Water Forum

Submitted by Dr Charles Larkin[1]

9 October 2020

[1] I would like to thank Lucy Jackman & Elena Ahonen who provided invaluable research assistance.

Table of Contents

Executive Summary

The purpose of this study was to look at the effects of the Common Agricultural Policy (CAP) on the quality of Ireland's water resources as defined and required under the EU Water Framework Directive (WFD). Ireland's rivers and catchments have deteriorated over recent years and steps are being put in place now to develop an integrated land and landscape management structure to ensure that EU regulatory requirements are met while preserving the environment, the rural economy and achieving the 2030 UN Sustainable Development Goals.

Fundamentally environmental problems are difficult to resolve due to their complexity in the public policy system. In this policy space we are discussing externalities - the by-products of another policy where the external and indirect costs are not appropriately accounted for and therefore constitute a market failure. The challenge of the rapid evidence review presented here is to address a complex problem, where multidisciplinary analysis is required to form policy recommendations.

Past policy proposals have been systematically siloed and treated as a question to be addressed at the level of the farmer via an environmental scheme, a subsidy, a regulation, a fine or some other incentive/disincentive structure that fits into the wider complex of the modern agriculture sector. While there are clear benefits to this approach there are also unintended consequences, which are difficult to resolve. The failures of many well-intended schemes in the past can be found in this non-systematic approach to policy formation and most importantly, implementation.

At the core of the agricultural policies investigated in this report is the role of the food system. The current food system is built on a dual requirement to provide cheap and plentiful food and to ensure for Europe a modicum of food self-sufficiency, reflecting the original intent of the Common Agricultural Policy. The reality is that there is no such thing as "cheap" food. It is also a fact that no food system is simple, and all choices incur trade-off costs that necessitate dialogue and consultation, which An Fóram Uisce provides.

The fundamental conclusion from analyses reviewed and elite interviews was that a consensus has formed around the principle of *public monies for public goods.*

Following on from that, these key discussion topics will need to be addressed by An Fóram Uisce:

- What are our subsidies buying?
- Should subsidies be assessed on economic efficiency or by alternative criteria such as land utilization and environmental impact?
- What are our objectives for the environment and the maintenance of the rural economy?
- Can we move away from an agricultural/food chain approach that prioritizes yield?
- How do we ensure a constant level of renewable natural capital?
- How do we implement policy changes to ensure minimal disruption and greatest stakeholder engagement?
- How to change CAP so that it delivers on sustainability, food security and ensures the viability of farmer and consumer households while protecting water quality?
- ***How do we ensure that public monies buy public goods?***

The sustainable approach to agriculture that is in keeping with the new direction of European Union policy in the Farm to Fork and the Biodiversity Strategies and the wider Green Deal has been accepted as a high-level policy framework. The matter of implementation will be a more difficult task for policymakers and the research presented here has led to the following non-binding recommendations to help guide that debate. These recommendations are made across multiple scales: the macro (EU CAP) scale; the meso (national) scale; and the micro (farm) scale.

High Level Recommendations:

Macro-scale – EU CAP:

- Reform Direct Payments in Pillar 1 CAP to ensure that it equally values both biodiversity and production. Pillar 1 single farm payments must be moved out of a hectare mode with a shift to a basic household income support to farmers who do not have off-farm income and move to a results-based structure of supplemental payments. All Pillar 1 payments will now be conditional on dedicating 25% of land to directly benefit biodiversity, climate and water-quality. This embodies the concept that subsidies be directed to ensure public good but also maintain security of farm income. Any move to a new results-based structure of payments cannot be universalist in approach. It must allow for local variation and be designed in a compact agreement between the farmer and the relevant evaluation authority. The results-based additionality under Pillar 1 would bring that 25% of land to 50%.

- Food consumption changes. Adopt a "Food Systems" approach to reform. Change supply chains and food policies in Ireland. Shorten supply chains and encourage a policy of smaller producer purchase by multiples. Ultimately the decisions made with respect to CAP will be reflected in the food system but if the food system does not change it is not plausible to expect even a reformed CAP to achieve the aims and objectives outlined in Farm-to-Fork and Biodiversity Strategies. This is a matter of looking at the food system in Ireland in the round. Households in Ireland are in a price sensitive situation due to the wider income inequality issues in the Irish economy. In addition, reforms to CAP that are understood to be exclusively reforms for the purposes of biodiversity and the environment are incomplete. Complete reforms include changes to how the Irish population consumes food and has a real public health role, as reforms to CAP should work in concert to address Ireland's emerging obesity and Type II diabetes crises.

Meso-scale – National:

- Long-term investment in agri-environmental schemes that are results-based and tailored to the catchment/farm needs. Pillar 2 payments will become more actively orientated towards rural development as well as agri-environmental schemes. As in the case of the new Pillar 1 structures, these must be results-based and incorporate compact agreements between farmers and the relevant evaluation authority. These compacts must be co-developed and tailor-made to their particular context with clear key performance indicators.

- Upskilling of farm advisors towards a more knowledge co-production approach to developing new agri-environmental schemes.

- Rural broadband. Infrastructure investment in the form of farm advice and rural broadband is an essential initial condition to reforming and improving the outcomes of CAP.

- Development of alternative markets avenues.

- Diversity around forestry schemes so that they are cohesive with agri-environmental schemes. A more biodiverse and context-specific approach to forestry that addresses farmer concerns about restrictive land use.

- National policy to shorter supply chains for environmental policy purposes.

- The development of an asset-based approach to agricultural land management. At the present time the valuation of agricultural land is based on the latent value of CAP Pillar 1 subsidies based on hectares or by the designation of that land for planning purposes for commercial or residential property development. The value of the land for the public goods it provides is not possible at present. Creating an agreed precise calculation of the natural capital of Ireland will allow agricultural land to be valued for its biodiversity and ecological contribution to the wellbeing of Ireland; it will allow the public good of the land to be valued. It also will allow a depreciation framework to be developed that will allow Pillar 2 programmes to operate more effectively, directly purchasing public goods of biodiversity and also putting in place a structure for investment in a sinking fund that would counteract asset depreciation, such as declining air, biodiversity, soil, and water quality. Regulations and standards can also be deployed to state the acceptable levels of depreciation allowed at any one time and under what conditions. Ultimately applying the natural capital framework will allow for a more sophisticated approach to land management and usage and a clear statement of the public goods that will be purchased by public monies.

Micro-scale – Farm:

- Farm advisors support and facilitate development of farmer discussion groups across the country and ensure that these are not production focused but are spaces where environmental concerns and communications can be raised. Enabling a communication channel between farmers, regulators and the environmental community. Use of pilot farms would be useful here because they could show the realities of certain agri-environmental schemes. Pilot programmes, such as the Burren Project and the Bride Project must be investigated for expansion for introduction in the rest of Ireland. Foster peer-learning networks in the farming community and link those to farm advisers and the research community.

- Better enforcement of cross compliance in combination with better communication about impacts of certain practices. Compacts and key performance indicators should give rise to standards, co-produced by the authorities, informed by research and developed with recognised leaders in the farming community

- Uptake of technology to better assess the needs of each field. This uptake would be done with support of advisors who are well trained. This requires the roll out of rural broadband to be completed.

- Better procurement policies and feed policies to reduce polluting run-off.

These recommendations are not all encompassing but they hinge on the idea that financial sustainability goes hand-in-hand with environmental sustainability and that when the public purse is used to support or purchase goods and services, it should, as far as possible, direct those funds towards activities that improve the public good.

Further original research is needed, for example an implementation plan for the above recommendations is necessary; but this report constitutes the beginning of an engaged debate on what do we want from our agricultural system and how can our land and landscape management be used to improve water quality throughout Ireland?

Crucially, the findings presented here highlight that a one-size-fits-all policy approach is dangerous and counterproductive. A solution needs to be found that will ensure that different consumer household and different types of farmers and different types of land are taken in account, while not breaking that essential link to maintaining the single market and the level playing field. Sustainability is about finding a balance through evidence-informed debate and consensus. It will be the role of An Fóram Uisce to navigate that compromise.

1. Introduction, Conclusions & Recommendations

1.1 Introduction

Environmental problems are difficult to resolve. They typically are the by-product of another policy where the external and indirect costs are not appropriately accounted for and constitute a market failure. The challenge of this rapid evidence review is to address a complex problem, which is typically understood as a complicated problem.[2] By this it is meant that it has been systematically siloed and treated as a question to be addressed at the level of the farmer via an environmental scheme, a subsidy, a regulation, a fine or some other incentive structure that fits into the wider complex of modern agriculture. While there are clear benefits to this approach that can be seen in the evidence presented below, there are also failures, which are difficult to resolve. The complexity of the problem is that it is ultimately non-linear and multi-dimensional involving upstream and downstream policy decisions and cannot be made without reference to the wider context of the food system and the economy.

At the core of the agricultural policies investigated in this report is the role of the food system. The current food system is built on a dual requirement to provide cheap and plentiful food and to ensure for Europe a modicum of food self-sufficiency, reflecting the original intent of the Common Agricultural Policy. The reality is that there is no such thing as "cheap" food. It is also a fact that no food system is simple: even at its most reductive schematic, it is highly complex (Figure 1).

The EAT-Lancet Commission[3] in 2019 highlighted that our current food system is neither healthy for ourselves nor our planet (Willett *et al*., 2019). The challenge of changing our food system is not small. Even successful examples of more sustainable agriculture in Ireland, such as the Bride and Burren Projects, are extremely difficult to scale-up to the national level. The complexity of our food system makes simple solutions appear attractive, but these are not effective when faced with the challenges of implementation. Success in implementation is where the more positive environmental outcomes will be obtained but that implementation strategy requires macro, meso and micro-level sub-strategies. To ensure that any approach taken to reform is successful, multiple stakeholders need to be engaged with, not just the agricultural sector, which is why this report attempts to draw on multiple disciplines in its analysis.

---

[2] In a traditional understanding of problems there are: simple, complicated and complex. Most approaches to evidence-based policy understand problems to be complicated, such that standard linear models and optimization techniques are useful. Increasingly it is understood that policy problems are complex, meaning that they involve multiple inputs, behave in a nonlinear fashion, are subject to indeterminate or bi-directional causation and subject to uncertainty. Reforming CAP to ensure that ecosystems are supported, climate change is mitigated and households have access to sustainable, healthy and affordable food is a complex problem.

[3] The EAT Lancet report concluded:
"Food systems have the potential to nurture human health and support environmental sustainability; however, they are currently threatening both. Providing a growing global population with healthy diets from sustainable food systems is an immediate challenge. Although global food production of calories has kept pace with population growth, more than 820 million people have insufficient food and many more consume low-quality diets that cause micronutrient deficiencies and contribute to a substantial rise in the incidence of diet-related obesity and diet-related non-communicable diseases, including coronary heart disease, stroke, and diabetes. Unhealthy diets pose a greater risk to morbidity and mortality than does unsafe sex, and alcohol, drug, and tobacco use combined. Because much of the world's population is inadequately nourished and many environmental systems and processes are pushed beyond safe boundaries by food production, a global transformation of the food system is urgently needed."
A key message from the EAT Lancet report is that "Current dietary trends, combined with projected population growth to about 10 billion by 2050, will exacerbate risks to people and planet. The global burden of non-communicable diseases is predicted to worsen and the effects of food production on greenhouse-gas emissions, nitrogen and phosphorus pollution, biodiversity loss, and water and land use will reduce the stability of the Earth system."

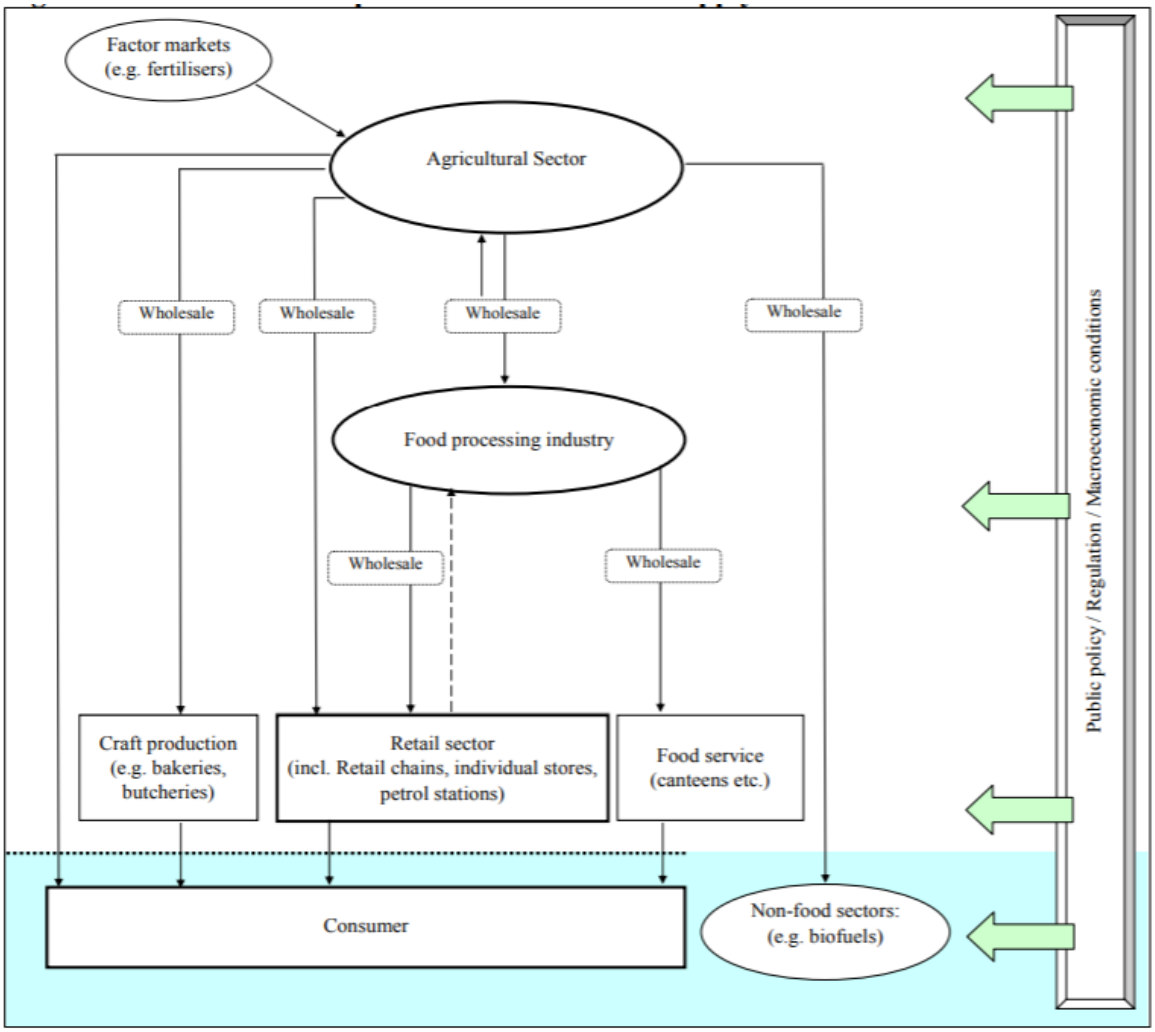


Figure 1: Schematic representation of the food supply chain. Source: Bukeviciute et al., 2009.

The policy of "cheap" food is difficult to overcome for economic reasons. Household expenditure on food has consistently fallen throughout the 20th century. As recently as 1980, Irish people spent 28% of their household income on food. According to Eurostat, in 2018 Irish people spent, on average, 8.7% of household expenditure on food and non-alcoholic beverages (% of total expenditure), significantly less than the average for the EU-28 (12.1%). The only member state that spent a lower proportion on food and non-alcoholic beverages was the UK (7.8%)[4]. Interestingly, spending on 'Housing, water, electricity, gas and other fuels' in Ireland compare to the average for all the EU-28 (24.3%); though unlike food expenditure, which has reduced and increased over time to reflect a similar proportion of expenditure since 2008, the proportion of expenditure spent on 'housing, water, electricity, gas and other fuels' has increased from €19267.16m in 2008 to €23691.82m in 2018 (most notable increases in rent and water)[5]. Housing, not food, is where additional Irish disposable income has gone. Economic changes have resulted in housing moving from 7.2% to 19.6% of expenditure by 2016. This indicates that household expenditure is being redirected from food to accommodation, making any action that increases the price of food detrimental to the overall financial security of households. In the vernacular: "rent eats first".

[4] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20191209-1
[5] https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE5

In Ireland the 2017 "enforced deprivation" rate is 19% of households, meaning that they responded that they were unable to afford two or more basics, such as going without heating in the past year, or being unable to afford items such as two pairs of strong shoes, a warm waterproof coat or a meal with meat, chicken or fish every second day. When this is expanded to include those at risk of poverty the figure rises to 43% (at risk being defined as having a household income less than €27,000, i.e. less than 60% of median). Ireland has the 3rd highest percentage of children under 15 years of age living in severely food insecure households, behind the UK and Romania (Lang, 2020). Food prices in Ireland are already above average in the EU – joint fourth place for most expensive food prices according to Eurostat.[6] While average spending on food is especially low in Ireland, there are significant differences between income-brackets. A 2018 study examining the cost of the Minimum Essential Standard of Living (MESL) Healthy Food Basket found that for those on low-income salaries spending can be as high as between 14% and 33% of their household expenditure.[7]

As highlighted in this report, the position of many farms is also precarious with farm incomes outside of the dairy sector being dominated by the Pillar I single farm payment, up to 70% on average.

The above is presented to provide a context to the issue of addressing water quality conditions in Ireland and how it relates to agriculture. This is a complex problem that cannot be understood as being exclusively a matter of farming. At the core there are policy frameworks and economic incentives as well as cultural issues that have locked Ireland into a series of behaviours that are suboptimal from the point of view of the water system. Much of this has to do with Ireland's food policy and that of the European Union as a whole. What makes it difficult to change this is that Ireland's inequality conditions make it difficult for it to make radical changes without imposing distress on financially vulnerable households. Further to this, the agricultural community, though economically small from the position of the national accounts and direct employment, is disproportionately large as a sector outside of Ireland's major urban districts. Ireland, outside of Dublin, did not experience the fruits of the post-crash economic recovery and now have been deeply damaged by the COVID-19 economic contraction with further vulnerabilities to decline due to what is developing into a "hard" Brexit.

These constitute multiple market failures. The most common way to address a market failure where a good or service is underproduced is to provide a subsidy. In agricultural and food systems these subsidies suffer from a problem of "coupling". Changes in subsidy schemes directly impact on downstream prices for households, resulting in resistance to changes. The closer farmers and households are to being "in the red", the greater the resistance. De-coupling is difficult and is seen as a major challenge to making agricultural systems more environmentally sustainable. This challenge currently is the focus of a major research programme at the OECD, where they are seeking to shift subsidy regimes from supporting activities that are damaging to ecosystems and the climate to one that aims to at least minimize the damage. Part of the process of focusing incentives towards minimizing damage is to understand that there is a quantifiable economic cost to "cheap" food. A method of accounting for this cost is to calculate the economic value of the natural world.

While at first this may appear perverse, there is a clear logic to this exercise. As the saying goes, "economists know the price of everything and the value of nothing", but it does help to have an extrinsic value to begin a serious conversation about the intrinsic value of something we all agree is valuable. Given the importance (and admittedly growing inaccuracy) of GDP and Ireland's home grown GNI* in any policy conversation, the encapsulation of biodiversity and the environment into the economic idiom has become (some would say an unfortunate) necessity. That is the aim of the natural

[6] https://www.thejournal.ie/ireland-food-drink-4692116-Jun2019/
[7] https://www.budgeting.ie/download/pdf/vpsj__safefood_-_food_basket_research_-_report_roi_-_2018.pdf

capital exercise. A major origin point for the problem of environmental degradation and overexploitation. The environment is a "common", in the sense that it is not owned exclusively by any one person, therefore the property right is poorly defined and difficult, if not nearly impossible to monetize. Under such conditions people will overuse a common space relative to their clearly owned space, resulting in the classic "tragedy of the commons" where fish stocks or common land is over exploited and destroyed. Collective action frameworks are created to solve this failure to maintain the common resource. The most obvious example being the EU Common Fisheries Policy. Some commons are more difficult to address through collective action frameworks as upstream and downstream property rights are diffuse.

While it is easy to ascribe value to a semi-detached house in Dublin, a printing press, a software patent or even to a hectare of Pillar 1 land due to their revealed value in transactions, it has not been the case to place an economic value on the endowments of air, water, soil, minerals, flora and fauna and to put in place measures to maintain their value in the same way houses and software capability are maintained. An asset value (80% of current farm zoned land valuation is based on amortized CAP Pillar 1 payments) can be placed on the natural capital asset owned by farmers individually and collectively (i.e. commons, like rivers and open pasture land) such that it can become an asset with a depreciation value, and so farmers can be subsidized to off-set the natural depreciation, and fined when they incur excessive depreciation of the asset (i.e. sweating it). To ensure that consumers, firms and governments take account of asset-depleting externalities on the natural ecosystem, in this report we have attempted an initial calculation of a natural capital valuation, fully aware that a more complete exercise is being undertaken through the EPA-funded INCASE Project. To ensure that policymakers take the environment seriously, steps should be taken to agree a common definition of natural capital at European Union level and to make that part of the national accounts while addressing the treatment of capital depreciation, currently under-accounted for in GDP. As a first step, CAP can require natural capital calculations and depreciation values and sinking fund requirements to begin the process of linking CAP Pillar 1 payments to the idea of paying farmers for the maintaining of a national capital asset, a public good. Such an approach would discourage the abuse of the asset by farmers in the same way that manufacturing or capital-intensive service firms do not abuse their fixed assets. In addition, it will require policymakers to understand that Ireland's ecosystems and biodiversity is of equal value to its educated population and broadband network, requiring more proactive policy planning.

Action can be taken to address damage to ecosystems by looking at how we address current market failures. Market failures are rife in the agricultural sector and food system. Under such conditions public subsidies are designed to *correct* for market failures. Yet in the current environment, subsidies do not correct but in many ways amplify market failures. While matters of economic development and income inequality are beyond the capacity of this report, they are important to understand when re-framing the conversation. There are two core principles that need to be accepted in the re-framing of the conversation about the future of agriculture and how it relates to water quality:

1. It is hard to be green if you are in the red
2. Public monies should be directed to public goods[8]

[8] In England the response has recently been to introduce the 'public pay for public goods' approach and propose linking farm payments to ecosystems management. (376) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/741461/future-farming-consult-sum-resp.pdf
"what is land for?...Switching subsidies from food to ecosystems misses the point. Both 'services' are needed…In the extreme, simply cutting subsidies could herald a policy framework in which UK land is used only for expensive unsubsidized food – 'local', high quality for the elite – while mass, cheap food is imported from where land and labour are cheaper. Somehow, as I argued in relation to the first 'Food problem', more of what consumers pay for food needs

As part of this project a series of interviews were conducted (see Appendix 1), and indicative quotes will be presented throughout this report to provide the voice of practitioners, farmers, experts and civil society to the academic and institutional documentation. In this quote we hear from the Irish Farmers' Association (IFA). The IFA presents the two points made above that it is difficult to reform CAP and make CAP focus on "green" environmental issues when farms are in financial difficulty. This is a principle that the Director of the Agricultural Sustainability Support and Advisory Programme (ASSAP) at Teagasc accepts as well. At the same time, there is also acceptance that CAP is a public subsidy system and those subsidies should be purchasing public goods, such as ecosystem, biodiversity and climate upkeep.

- "We've been starved of financial resources for maybe 12 years now, since the very last of what would have been REPS 3 - the Rural Environmental Protection Scheme 3. That was a proper, fully-funded, 5-year plan that farmers went into, then we went into REPS 4 that was more advanced, and unfortunately when the economic downturn happened in the country, the first thing that was pulled was an environmental scheme – it was reduced. It's hard to be, as we've always said, **it's hard to be green if you're farming in the red.** A lot of the pent-up frustration of the farmers would very much be, look, we would join an environmental scheme but it has to be fully-financed and it has to be ring-fenced, so we know that if we adopt new farming practices that will have ticked all the boxes of maybe improving water quality, reducing greenhouse gases, you know increasing field margins around water course ways. If we do all of that, that the funding isn't going to be pulled overnight when the first economic issue arises. I think that sends out a very bad picture for environmental schemes, that one of the first things when the last economic downturn happened, was the pulling or the reduction of money going into an environmental scheme. So, that kind of government perception – that will have to change if we are to go on this road to decarbon the economy, to improve water quality. It has to be supported by government policy, clear direction, and clear money. You know, **public money for public good**." [original emphasis] (Paul O'Brien – IFA)

- "'you can't be green when you're in the red', you can't be green if you're losing money, farming has to be financially viable, so that's the first thing." (Noel Meehan ASSAP)

It is important not to exclusively focus on ecosystems and biodiversity. Yes, CAP does need to be reformed and to ensure that the requirements of the Water Directive are achieved you must make those changes but there are wider social implications. Food systems are complex and the work by Tim Lang in *Feeding Britain* (2020) highlights that you cannot debate farming and food systems without talking about economics – most importantly the economics of inequality. Policy solutions that also place households in the red will be by definition be not green as they will induce a move by those households to more processed, lower cost, lower national value foods creating a cost for the health service in the near to medium-term future. Already Ireland suffers a Type II diabetes crisis with costs estimated to rise to €2bn by 2030.

to be equitably distributed to SMEs rather than the big economic actors. We cannot expect good food if those whom we want to grow, process and transport high-quality healthy food to use are being unjustly treated." Rethinking food policy: A fresh approach to policy and practice. Brief 5: policy coherence in food systems. Centre for Food Policy. 2019.
https://www.city.ac.uk/__data/assets/pdf_file/0018/504621/7643_Brief-5_Policy_coherence_in_food_systems_WEB_SP.pdf

At the core we must ask:

- What are our subsidies buying?
- Should subsidies be assessed on economic efficiency or by alternative criteria such as land utilization and environmental impact?
- What are our objectives for the environment and the maintenance of the rural economy?
- Can we move away from an agricultural/food chain approach that prioritizes yield?
- How do we ensure a constant level of renewable natural capital?

And then:

- How do we implement policy changes to ensure minimal disruption and greatest stakeholder engagement?
- Where does the incidence of subsidies have the most impact – farmers or consumers?
- Does that fulfil our needs, wants and policy objectives?

The approach to modern food policy in Europe is based on the idea of food self-sufficiency. This is a notion that has been under sustained attack for several decades as a more macroeconomic approach to food supply management has been adopted. Despite this, the idea is still maintained via Pillar 1 payments. The alternative model that is commonly advocated by economists is a "globalist" perspective that seeks to use the power of comparative advantage in trade to ensure a stable food supply. This model creates long supply chains that tend to be fragile and require extensive quality assurance and regulatory compliance policing. The recent experience of COVID-19 has indicated that while the global supply chains have not failed, they are much more fragile than initially assumed. European policy, as indicated by the present approach to Pillar 1 and Pillar 2 and the recently announced Farm-to-Fork and Biodiversity strategies, has embraced an approach that will aim at food self-sufficiency in the context of environmental sustainability, largely moving beyond the "globalist" policy objectives.

The Common Agricultural Policy (CAP) creates incentives for certain activities and approaches to land use. Pillar 1 and 2 payment systems create artificial separations between agricultural activity and the environment. The approach taken by Pillar 1 mitigates against integrated land management and this allows for that artificial separation to dictate progress on environmental indicators. Part of this separation is brought about by an interpretation of the agri-food sector from the point of view of industrial activity. As discussed below, while the agri-food sector may have an important regional economy role to play, it is not a major actor in the overall Irish economy and the underlying logic of Pillar 1 becomes difficult to justify when that statistical reality is accepted.

As An Fóram Uisce's *Protecting and Enhancing Our Environment: A Framework for Integrated Land and Landscape Management* (2020) highlights:

> The EU Water Framework Directive (WFD) is the corner-stone of European water policy. It has provided the structure for integrated water resource management across the European Union over the last 20 years. The central concept to the WFD is **integration** as this is seen as key to the management and protection of water within river basin districts. This includes integration of, for instance: i) all water resources combining fresh surface water and groundwater, wetlands and coastal water resources at the catchment scale; ii) environmental objectives for water bodies; iii) water uses, functions and values; iv) disciplines and expertise; v) stakeholders and civil society; vi) measures to achieve the objectives; and vii) the different decision-making levels (local, regional and national) that influence water management. The

> Integrated Catchment Management (ICM) approach was developed as the means of enabling the required integration. This is acknowledged in the RBMP for Ireland 2018-20215 as follows: "*A new approach to implementation known as 'integrated catchment management' is being used to support the development and implementation of the RBMP, using the catchment (an area that contributes water to a river and its tributaries, with all water ultimately running to a single outlet) as the means to bring together all public bodies, communities and businesses.*" ICM is the 'starting point' for a new broader approach to environmental management, which is provided by the Framework for Integrated Land & Landscape Management (FILLM)… [original emphasis] (An Fóram Uisce, 2020: 5)

At the core of Pillar 1's structure is land use. This drives the payment structure and therefore incomes. This payment system locks in farmers to a form of land use that does not favour biodiversity or the sustainability targets for climate change or the UN Sustainable Development Goals (SDGs). These incentives can result in the increased intensification of farming and therefore runoff that damages rivers and watersheds. Farmers are highly sensitive to these incentives. They will follow what CAP incentivises but also where trade is expanding, as illustrated by the expansion into dairy following the lifting of quotas. While dairy global demand remains high, beef has wavering demand brought about by nearly 50% of the product being exported to the UK, where damaging tariffs are likely in a post-Brexit scenario. Subsidies and global trade positioning matter to Irish farmers.

- "Is it a productionist mentality amongst farmers or is it a food chain that is not placing any value on environmental protection. Is it a food chain that is squeezing the farmers? Is it farmers who are trying to make ends meet who are trying to ensure they can pay off their debts, and is it consumers who effectively say 'oh 20cent carrots, I'll get that' without having any consideration for it. So, I don't think we have an issue of a productionist mentality amongst our farmers, I think we have an issue of consumerist's lack of knowledge of the value of food – and a lack of appreciation for the value of biodiversity." (Alison Graham – ICOS)
- "Definitely get rid of this perverse incentive for people to have land in good agricultural condition. Which [leads to] clearing out scrub, [and] draining wetlands …that's something that we're very much in agreement with farmers on. So that's something that there's no disagreement from anybody on." (Sinead O'Brien - SWAN)

CAP directs on average 25% of resources towards rural development. This is to maintain rural communities and biodiversity. The GLAS scheme is part of the current rural development strategy in Ireland with mixed results. Generally, CAP incentives have results that are suboptimal. This is partly due to a one-size approach but also due to a non-market approach to the problems of environmental degradation and climate change. The successes in this area are largely functions of the regulatory state, where European Directives, Regulations and standards have addressed information asymmetries and market failures based on the precautionary principle. Market failure solutions addressed by subsidies have tended towards deadweight losses. If the aim of a subsidy is to achieve greater market efficiency to offset failures or negative externalities a more lateral approach needs to be taken, evaluating the environment as an asset class as described above.

In Ireland the success of these programmes is connected to marginal land and marginal farms that are farming locations that have limited economic viability. The power of subsidies in such conditions can be enormous as they will constitute a large part of farm income. It also acts as a useful counterfactual

to the ineffectiveness of subsidies when applied to market viable farms, such as in the case of dairy. In such a case changes to the regulatory regime as well as changing the structure of Pillar 1 payments will be essential. Moving farm income support away from a hectare-based system and orientating the entire Pillar 1 system towards a results-based system would be a useful first step in more effective environmental policies.

These reforms must be put in place soon and with a clearly landmarked but brief transition window, much like the UK's Agriculture Bill. The UK legislation is important to reflect upon. While the UK is not the same as Ireland, its economic, socio-economic stratifications and political system share many similarities. Crucially, the agricultural community in the UK has accepted the principles of "public goods for public monies" accepted by the IFA in Ireland.

According to the House of Commons Library:

> Farming organisations and environmental groups both broadly support the new 'public money for public goods' approach to future farm support schemes. Farmers however want food production itself to be considered a public good and for food production to be central to the Bill. This Bill (unlike the previous Bill) requires Ministers to have regard to the need to encourage the production of food in England, in an environmentally sustainable way. The NFU has welcomed recognition in this Bill that "food production and caring for the environment go hand-in-hand".
>
> Farmers and environmental groups are also concerned that there are no commitments to maintaining food and animal welfare standards for imports under new trade deals. Some 62 farm and environment organisations wrote to the Prime Minister on 27 January calling for legislation to underpin Government commitments not to reduce such standards in future trade deals.
>
> Farmers also want longer-term assurances on funding. The National Farmers' Union has called for a "multi-annual budgetary framework that provides certainty for farmers and allows them to plan and invest for the future". It has welcomed measures in the 2019-21 Agriculture Bill requiring the Government to publish longer-term plans. (House of Commons Library, 2020)

The acceptance of this idea of "food production and caring of the environment go hand-in-hand" is an essential principle of policy formation. There are two reasons for this: first, that the window of opportunity to address climate change and biodiversity collapse is very small (10-12 years given the current IPCC calculations) and second, rural Ireland needs an economically sustainable future immediately. Rural Ireland's economic system has been cited for failure by the former Secretary General of the Department of Finance. Former Secretary General John Moran declared "the State can't afford rural Ireland" and that rural Ireland is defined by depopulation and high dependency ratios.

Yet, the environment cannot afford to lose the farmers. You remove the farmers you not only remove part of the land management but medium to long term solutions to the carbon and biodiversity problems are to be found in changes in land use.

So, the question becomes how do we change behaviours of farmers such that you can motivate them out of the mass production of beef, high intensity dairy production into biodiversity management and native afforestation and maintain the economic viability of rural communities?

This question has to be answered in two ways:

- How to change CAP so that it delivers on sustainability and food security?

- How to change CAP to ensure the viability of households? (Both farmer and food consumer households.)

1.2 Initial Conclusions, Discussion Points & Recommendations

Given the analyses that were reviewed and the subsequent interviews undertaken, the following conclusions were made:

1. Pillar 1 single farm payments must be moved out of a hectare mode with a shift to a basic household income support to farmers who do not have off-farm income and move to a results-based structure of supplemental payments.
2. All Pillar 1 payments will now be conditional on dedicating 25% of land directly to biodiversity, climate and water-quality benefit. This embodies the concept that subsidies such be directed to ensure public good but also maintain farm income surety.
3. The move to a new results-based structure of payments cannot be universalist in approach. It must allow for local variation and be designed in a compact agreement between the farmer and the relevant evaluation authority.
4. The results-based additionality under Pillar 1 would bring that 25% of land to 50%.
5. Pilot programmes, such as the Burren Project and the Bride Project must be investigated for expansion for introduction in the rest of Ireland. (This requires an additional conversation about land use in Ireland. This conversation is not exclusive to agricultural land use but also incorporates the designation of agricultural land for residential use.)
6. Pillar 2 payments will become more actively orientated towards rural development as well as agri-environmental schemes. As in the case of the new Pillar 1 structures, these must be results-based and incorporate compact agreements between farmers and the relevant evaluation authority. These compacts must be co-developed and tailor-made to their particular context with clear key performance indicators.
7. Compacts and key performance indicators should give rise to standards, co-produced by the authorities, informed by research and developed with recognised leaders in the farming community
8. Infrastructure investment in the form of farm advice and rural broadband is an essential initial condition to reforming and improving the outcomes of CAP.
9. A more knowledge co-production approach to developing new agri-environmental schemes.
10. Foster peer-learning networks in the farming community and link those to farm advisers and the research community.
11. A more biodiverse and context-specific approach to forestry that addresses farmer concerns about restrictive land use.
12. Adopt a Food Systems approach to reform. Change supply chains and food policies in Ireland. Shorten supply chains and encourage a policy of smaller producer purchase by multiples. Ultimately the decisions made with respect to CAP will be reflected in the food system but if the food system does not change it is not plausible to expect even a reformed CAP to achieve the aims and objectives outlined in Farm-to-Fork and Biodiversity Strategies. This is a matter of looking at the food system in Ireland in the round. Households in Ireland are in a price sensitive situation due to the wider income inequality issues in the Irish economy. In addition, reforms to CAP that are understood to be exclusively reforms for the purposes of biodiversity and the environment are incomplete. Complete reforms include changes to how the Irish population consumes food and has a real public health role, as reforms to CAP should work in concert to address Ireland's emerging obesity and Type II diabetes crises.
13. The development of an asset-based approach to agricultural land management. At the present time the valuation of agricultural land is based on the latent value of CAP Pillar 1 subsidies based on hectares or by the designation of that land for planning purposes for commercial or residential property development. The value of the land for the public goods it provides is not

possible at present. Creating an agreed precise calculation of the natural capital of Ireland will allow agricultural land to be valued for its biodiversity and ecological contribution to the wellbeing of Ireland; it will allow the public good of the land to be valued. It also will allow a depreciation framework to be developed that will allow Pillar 2 programmes to operate more effectively, directly purchasing public goods of biodiversity and also putting in place a structure for investment in a sinking fund that would counteract asset depreciation, such as declining air, biodiversity, soil, and water quality. Regulations and standards can also be deployed to state the acceptable levels of depreciation allowed at any one time and under what conditions. Ultimately applying the natural capital framework will allow for a more sophisticated approach to land management and usage and a clear statement of the public goods that will be purchased by public monies.

These recommendations are not all encompassing but they hinge on the idea that financial sustainability goes hand-in-hand with environmental sustainability and that when the public purse is used to support or purchase goods and services, it should, as far as possible, direct those funds towards activities that improve the public good. There are many more questions than answers that have arisen as part of this study. Most of these are normative questions as they relate to policy and the future of the CAP from the point of view of balancing environmental and agri-business priorities. The capacity of Ireland to *independently* decide these factors is limited, as much of the sustainability agenda has become of remit of the European Union. Ireland can *influence* the debate on reform and policy formation and will have an active role in transposing EU policies into national law and local enforcement.

There are many avenues for future research highlighted in these recommendations. There is a need for more national and regional multidisciplinary research and a wider discussion of the future of agriculture and the environment. Academics may be capable of acting as co-producers of this knowledge, and it may emerge as an important opportunity for the Technological University sector to be a hub for knowledge co-production and knowledge transfer with a "What Works Centre" dimension.[9]

Implementing these policies will not be easy but a robust conversation about the Irish food system and land usage policy is a first phase. This means taking famers seriously and developing a co-production approach to reform. Without true buy-in from the farming community that there is a better way there will be no progress. Second, Ireland must address matters of inequality. Food scarcity is a real issue in Irish households and in the absence of decoupling changes made to CAP for the good of the environment may hurt those most vulnerable in society. Usefully there are examples. Ireland's two domestic projects show that the alternative can work with sufficient attention and effort. The UK has decided to embark on a great natural experiment in agriculture. The Agriculture Bill 2020 is a useful learning tool for Ireland as it takes many of these recommendations and tries to put them in action, which suffering the same inequality and public health problems. Time will tell if it will be superior to the present situation, but business as usual is unsustainable and change is required. Further original research is needed and an implementation plan for the above recommendations is necessary, but it constitutes the beginning of an engaged debate on what do we want from our agricultural system.

[9] Please go here to find out mor about this important and effective initiative in the UK government: https://www.gov.uk/guidance/what-works-network

2. Methodology

A rapid evidence assessment (REA) aims to provide an assessment of what is known (and not known) in the scientific literature about an intervention or phenomenon (Barends, Briner, & Rousseau, 2017). An REA uses a systematic methodology to search and critically appraise empirical studies and while similar to a systematic review in that it uses systematic and explicit methods to collect and analyse data, it operates a number of limitations. REAs are increasingly used by policymakers because they are both systematic and relatively quick to undertake in comparison with a systematic review. In order to progress a rapid review of evidence in a particular area or phenomenon of interest, however, concessions are generally made to both the depth and breadth of the search process (Barends, Briner, & Rousseau, 2017).

This methodological approach is now being used by the Oireachtas Library and Research Service to draft pre-legislative scrutiny reports, which subsequently inform Joint Oireachtas Committee reports and recommendations.

2.1 Search Criteria

The review of grey and academic literature supporting this rapid evidence assessment was conducted between April and July 2020. It includes material published from 2013 to present day, in order to capture debate surrounding the 2014 CAP as well as recent and current debate surrounding the CAP reform and the impact of agriculture on water quality. Though it is important to note that exceptions have been made where information has been critical to the integrity of this report.

Using set search terms, the academic review was conducted using ScienceDirect, HeinOnline, Web of Science, JSTOR, Google Scholar and Scopus. A preliminary search was conducted to identify relevant literature according to article titles and abstracts, followed by a secondary search applied to rank the material according to citations, and articles with more than 10 citations were first to be reviewed. Due to the relevance of recent publications, the inclusion criteria were not capped at a minimum of 10 citations. A number of sites were used to source grey literature.

2.1.1 Search terms

"the CAP" AND Ireland
"the CAP" AND environment* AND Ireland
"the CAP" AND water AND Ireland
"the CAP" AND environment* AND water
"the CAP" AND environment* AND water AND Ireland
"the CAP" AND "water quality"
"the CAP" AND "water quality" AND Ireland
"the CAP" AND farming* AND "water quality"
"the CAP" AND farming* AND "water quality" AND Ireland
"the CAP" AND farming* AND water AND rural

2.2 Limitations

REAs are increasingly used by policymakers because they are both systematic and relatively quick to undertake in comparison with a systematic review. In order to progress a *rapid* review of evidence in a particular area or phenomenon of interest, however, concessions are generally made to both the depth and breadth of the search process (Barends, 2017). For example, this REA has not critically appraised the properties of the various tests, measures, or questionnaires in any of the studies as might be expected of a full systematic review.

The objective of the exercise was to look at the existing academic evidence over a limited time period and to not seek to replicate or advance upon that work.

2.3 Underlying Matters

Ireland, as the topic area is well-researched in comparison to other jurisdictions. In the case of this assessment we felt it was important to highlight some underlying matters:

- Ireland continues to have some significant data gaps which made developing the natural capital assessment difficult and necessitated the use of proxies.
- These gaps make a time series analysis or a transnational benchmarking exercise very difficult to undertake.
- Data gaps also limit the possibility to move agricultural statistics towards a more environmentally friendly approach which focuses on extraction as opposed to economic value. This approach is now advocated by OECD and UN Economic Commission for Latin America and the International Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) when talking about the sustainable agricultural economy.
    - A highly relevant gap for this project was the lack of a long time series of water abstractions.
    - We looked to find disaggregated data on the quantum of nutrients entering farms but could not find anything beyond ad hoc data.
- We found a significant amount of analysis of poultry farming in the academic literature, but this was largely related to the United States, with a particular interest in the Chesapeake Bay watershed (Federal Superfund site). There is one very recent paper from late July 2020 (Mooney, *et al.* (2020)) that addresses the impact of poultry farming and livestock pharmaceuticals on water quality.
- Analyses of aspects of Irish agriculture outside of wet and dry-stock cattle is extremely limited.
- Peer-reviewed publications in the area of Irish agriculture as it relates to CAP, environmental practices and agri-environmental schemes are dominated by Teagasc or by senior researchers that spent a large part of their career at Teagasc and now run research groups in Irish higher education institutions. The role of Teagasc in setting the research agenda for Irish agricultural studies cannot be understated.
- Forestry is analysed but from a commercial point of view, reflecting the aims of Coillte.
- It has been noted that in Continental Europe, the equivalent bodies to An Taisce take on/are granted a more active role in agri-environmental schemes when compared to Ireland.
- The focus on GLAS is a function of the requirements of the Department of Public Expenditure's pursuit of value-for-money. The consideration of the scheme is as a function of the Exchequer funding that supports it and the opportunity costs it generates. As Pillar 1 is part of the EU budget, it is not a concern of the Department of Public Expenditure during the budget expenditure review process. This has created a lack of analysis of Pillar 1 and a very limited analysis of Pillar 2 by Irish authorities. A comprehensive analysis of CAP (both Pillar 1 and Pillar 2) by the Irish Governmental Economic Evaluation Service (IGEES) would be a welcome development.
- The analysis of farm incomes is looking at CAP incomes to the farm itself, it does not constitute the actual farmer household income. Farmer household incomes are commonly supplemented by alternative income sources, either from the primary farmer or by other members of the household, such as spouses, engaged in obtaining non-farm income. The discussion of farm-gate income is a discussion of income generated exclusively for the farmer from produce of the farm. It highlights the interaction between the farmer and intermediate purchasers, such as processing

plants, the agri-food sector and wholesalers. It is understood that the income that sustains farming households is more complex and will require a more in-depth survey.

- Forestry features heavily in this report. This is not due to the inherent interest of An Fóram Uisce's initial commission or a reflection of the importance of forestry to water quality. The extensive presence of forestry in the report is a reflection of the research focus on forestry by the agricultural policy community given the consistent difficulties with the take-up and success of agri-environmental schemes involving forestry. This has created an extensive literature in this space, which has been encountered and reported upon as part of the rapid evidence assessment. As a matter of analytical commentary, the need for greater research on agri-environmental schemes outside of forestry should be considered a research priority and that future analysis of forestry should be situated within the wider framework of agri-environmental scheme evaluations. It should be noted that while such contextualization will be useful for policymakers and evaluators, it will run contrary to the habits and customs of academic publications.
- Ireland, as a small open economy, attracts limited direct analysis. Such analysis can only be successfully conducted by Irish public service agencies and as an occasional feature of multilateral agencies and supranational bodies, commonly for the purposes of legal compliance. As such many of the opportunities to engage with Ireland is as part of a wider regional conversation, either as a region within the European Union or as a region within the construct of the UK and Ireland (which has been the common treatment of Ireland in financial and logistical circles). This creates limitations to granularity for the sake of cross-country comparisons, which are useful for benchmarking purposes. While it may be important to understand that the UK is *not* Ireland, the UK's legal and economic system, as well as similar consumer tastes and preferences and a *de facto* UK-Ireland single labour market, makes comparisons to the UK policy system important. It is the case with studying Irish political economy that proxies are sought and the UK can provide many of those proxies but with the necessary caveat that relate to national differences. This comparison will obviously become much more difficult now that the UK is leaving the EU and divergence will take place rapidly, especially in phyto-sanitary regulations.
- It should be noted that the "market" for studies of Irish topics in the peer-reviewed academic literature, especially in the bibliometrically important publications that advance a researcher's career, is exceptionally limited. As such the publications in this space are limited in number and require supplementation by grey literature supported by domestic research-led and research-informed agencies.

As part of the REA, we undertook a series of interviews to add some context to the academic studies and to see if the academic results were in keeping with the understanding by officials, civil society organizations and farmers. The technique was that of elite interviewing.[10] The rigor of elite interviews is similar to that of traditional journalism and follows the ethical framework of that discipline. It is accepted that this methodology, when not being used to generate qualitative data directly, is used to obtain a more complete explanation of superficial results obtained from surveys. In the case of this study, our aim was to seek comments on some of the findings we had and to hear possible policy ideas on how to improve the CAP system for the purposes of watercourses and biodiversity. The framework

[10] For more on elite interviewing please see here: https://scholar.harvard.edu/jlhochschild/publications/conducting-intensive-interviews-and-elite-interviews

of our questions was to ask for confirmation and/or explanation from the interviewee of our findings from the academic literature and to seek policy recommendations for improvements.[11]

The selection of interviewees was assisted by the An Fóram Uisce secretariat (Appendix 1). You will find selected quotes from the interviews throughout this report. Permission was obtained from the interviewees to use the quotes that appear in this report.

3. Evidence Assessment - Background Context

3.1 Context

Ireland's need to comply with the Water Framework Directive has created a debate about water quality and the role of agriculture. An Fóram Uisce already accepts that the context for this discussion requires:

> "…the overarching framework for environmental management as a means of connecting, for instance, the Water Framework Directive, Urban Waste Water Treatment Directive, Habitats Directive, Floods Directive, Drinking Water Directive, climate change adaption and mitigation, soil conservation, spatial planning, and sustainable food and timber production. In addition, it is a means of achieving the UN Sustainability Goals for 2030." (An Fóram Uisce, 2020: 1)

This approach is embodied in Figure 2 devised by An Fóram Uisce.

[11] Our questions for discussion were as follows:

1. Firstly, I'd like to share some of the key findings from the literature survey we've conducted, and ask whether you consider them to be accurate, and if not, to expand on this and highlight what we might explore further. We've found:
    a. That GLAS and agri-environmental schemes have had limited success and do not currently provide value for money.
    b. That farmers have internalised a productionist mentality that makes it difficult to change their farming practices for a more sustainable approach
    c. That reforestation policies have limited attraction for farmers
    d. That there are limited policy tools for dealing with the impact of the expansion of dairy farming, due to its high earnings relative to other areas of agriculture.
    e. That farmers prefer to learn and exchange knowledge via peer learning interventions due to the value attributed to applied knowledge and experience.
    f. That lack of peer acceptance within localised farming communities can affect the uptake of agri-environmental scheme
2. In your opinion, what changes could be made to agricultural policy to improve water quality?
3. Do you feel that a move to increasing taxation on pesticides and fertilizers would reduce their use and reduce pollution?
4. How best do you move the farming community into a different model away from the productionist mentality?
5. How best can farming be directed towards a more biodiversity and climate-focused approach with shorter supply chains?
6. Is there an avenue for public-private partnerships to bring about sustainable farming and economically revitalize rural communities? Elaborate on the responses.

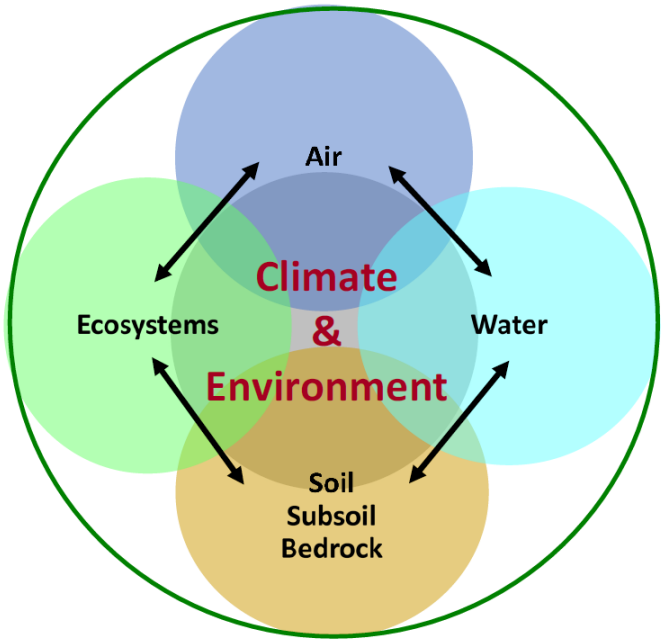


Figure 2: The intimate interactions of our climate and environment. Source: An Fóram Uisce (2020) Protecting and Enhancing Our Environment A Framework for Integrated Land and Landscape Management. p2.

There is concern about the thresholds for water quality, which are evidence-based and empirically evaluated but are subject to debate with respect to how to balance environmental and economic considerations. The health of Ireland's rivers has historically been taken for granted, a legacy of low-intensity agriculture and the country's limited industrial heritage. Recent changes in population density and distribution and the intensification of agriculture for commercial purposes has changed that status in negative ways. While there have been a series of high-quality publications from the Irish government agencies and the European Commission on the state of water quality in Ireland, they have only begun to draw international attention. A recent article by Ella McSweeney in the international newspaper *The Guardian* (28 September 2020) highlighted how water pollution has become a major issue for Ireland. The role of export-orientated intensification on the Irish river system was the focus of this article.

> …There's no doubt about it – we've crossed a threshold. It's saturated with pollution."
>
> It's a wretchedly familiar story, because Ireland is experiencing a water pollution crisis. A lack of investment in managing sewage is part of the story: half of urban wastewater treatment plants don't meet minimum EU standards, while raw sewage from 77,000 people across Ireland flows into the environment every day. Nutrient runoff from sitka spruce plantations also has a negative impact.
>
> Rivers are increasingly polluted with phosphorus and nitrogen, and scientists say this tracks the rise in cow numbers and fertiliser use, especially in the more intensively farmed areas of south and south-east Ireland. Late last year, data released by the Environmental Protection Agency showed that the number of pristine rivers has fallen from 575 in the 1980s to an all-time low of just 20 today.
>
> …

"I have huge sympathy and admiration for farmers, especially those with smallholdings, who are trying the best they can. But a government-supported policy of intensification is not the way to protect and restore water quality," says Ken Irvine, professor of aquatic ecosystems in the Delft Institute in the Netherlands, who has spent decades studying water quality in Ireland. "As long as we say: 'compared with other countries we are somehow better,' we're not solving the environmental problems, and frankly it misses the point."

Ireland was flat broke when the government's huge export-led intensification plan – Food Harvest 2020 – was launched. A series of banking scandals and lax regulation had crippled the economy. On the same rainy day in July 2010 that Ireland's credit rating was downgraded by Moody's, the government announced that it had found a way out for the battered economy: Ireland would become a global player in food production. Powerful figures from the agricultural industry were asked to draw up an expansion plan, and millions of euros of public money would fund it.

Under the government's plan, milk production would increase by 50% and thousands of new rural jobs were promised.

…

Since 2010, carbon dioxide, nitrogen and ammonia emissions from agriculture have increased. Dairy cow numbers have gone up by 400,000 in the past five years – Cork has the highest number in the country – to 1.5 million.

…

"The number of animals is far too great," says Dan Ryan, a beef and dairy scientist who worked for years at Teagasc, the state agency for agri-food research. "Ultimately it's affecting water quality. It's shocking."

Ryan says that the environmental price being paid for dairy expansion is not acceptable. "We have driven a system that is compromising the environment. On the Dingle peninsula on the south-west coast, smaller farmers are disappearing. Large-scale dairy production is being pushed – which pushes individual small dairy farms to a scale which is going to wipe them out."

Nutrient pollution isn't the only problem. Last month, scientists from Trinity College Dublin reported that veterinary medicines, mainly from intensive poultry farming, had been detected in groundwater for the first time. The medicines – primarily antibiotics – are added to chicken feed as a way to treat a painful parasitic disease of the intestines. Since more than a quarter of Ireland's drinking water supply comes from groundwater (that figure jumps to 75% across the EU) there are concerns that this may drive antimicrobial resistance, and pose chronic toxic risks to human health.[12]

Many individual farmers are trying to move away from the extreme model of intensification, to regain control over the way they want to farm. Donal Sheehan, a dairy farmer who lives in the River Bride valley in north Cork, believes that the way forward for future generations is to take an ecological approach to farming. In 2018, he set up an EU-funded project that has

[12] See Mooney, *et al.* (2020) for a discussion of how the poultry industry has impacted on the water table via anticoccidials. Also see Bermejo, *et al.* (2019) on how the current nutrient runoff is resulting in "green tides" with runoff volumes that exceed current Water Framework Directive thresholds by 5 to 3 times. This places Ireland on levels, while not as bad as the Venice Lagoon, equal with other major European estuaries.

brought together intensive lowland farmers in his catchment. They've changed the way they farm to restore life back to their farmland and the river, while maintaining their profits. It's a tantalising example of an alternative future for farmers.

Getting Teagasc to step back from pushing chemical fertilisers is a first step. "We need to limit artificial nitrogen use," he says. "That would have a huge impact on water quality." (McSweeney, 2020)

3.2 COVID-19

The importance of COVID-19 must be noted on the overall performance of the economy and the wider implications of that on the Irish economy and its capacity to adapt to the additional exogenous shocks of a likely hard Brexit and the medium-term effects of climate change. This matters as Ireland's fiscal capacity is essential for the operation of Pillar II CAP funding which supports environmental and rural development objectives. As was made clear in McDermot (2019), the weak fiscal position of the exchequer necessitated changes to the rural development support scheme under CAP, creating the GLAS scheme. The future capacity of the exchequer will be determined by present economic conditions.

The Irish economy is expecting a year-on-year contraction of between 15% and 21% for the month of April, largely in line with other OECD economies. Unemployment has expanded to 23%. The impact on the overall economy is profound and while corporate taxation and surprisingly robust income tax figures have allowed the exchequer deficit to be not as severe as initially estimated, the fiscal capacity of the Irish state is dependent upon the kindness of strangers as defined by favourable international borrowing conditions. Given ECB interventions, those conditions will be maintained for a significant period into the future, but Long-Term Refining Operations by the ECB will be moving more towards green bonds and alignment with the Commission's declared Green Deal, which will require Ireland to become more focused on activities that are in keeping with the requirements of the Green Deal and KPIs linked to green finance.

Agriculture, though a small sector of the economy, remains robust during this downturn. It is important to note that the present economic configuration of Ireland is generally experiencing largely unprecedented events, there having been last experienced either during the 1930s Great Depression, or as indicated by Bank of England data, for the first time in 300 years.

Ireland is also an unusual economy in terms of income distribution. This is important as it relates to the ability of households to absorb changes to food prices brought about by the modification of the existing CAP framework to increase sustainability. To make high level policy changes to how CAP operates in Ireland there will need to be a decoupling between changes in agricultural subsidies and household food prices. If that decoupling cannot be managed, then measures need to be put in place to ensure that food insecurity does not increase for those households with low or no market income given the structure of Irish inequality.

Ireland has the greatest level of inequality in the Europe Union before taxes and transfers. The entire taxation structure of Ireland is designed to deal with the fact that a large proportion of households in Ireland have no market income. Ireland has the highest share of working age single parents in Europe without a market income, at roughly 30% of those without market income. At 7% of all households in the economy, Ireland also has a comparatively high proportion of households falling into this category (similarly for the UK). These household are entirely dependent upon the income obtained from social transfers. Within the cohort of individuals without market income, 19% are permanently

disable/unable to work. Ireland also has a low pay economy that has been highlighted by many economic authors such as Logue & Callan (2016) and Sweeney (2019). Those at the 40% level of income distribution rely on 74% of their income in the form of transfers. A quarter (23%) of the labour force is in low paid work, a figure which is only bested by Latvia and Romania. Only 30% of single parent households can save income on a regular basis and 20% of renters who are in the bottom 40% income brackets (Lajoie, 2020). It is important to note that these are all figures which predate COVID-19.

- "There's this public perception out there, that I think needs to change. Okay, farmers will always adapt, we're a very evolving business, but I think consumer expectations have to change as well. They have to pay more for food, food has become so easy to obtain now, that a considerable amount of it, it's lost its respect maybe." (Paul O'Brien - IFA)

Recognising the issue of income inequality, reference should be made to Ibec's Reboot and Reimagine campaign. Agricultural policy changes will have wide-ranking implications for the expenditure patterns of households but also for more wholistic indicators of social and economic progress. Moving to a social progress indicator model would be helpful for this exercise. "As we work towards building a better Ireland, the role of housing; infrastructure; public services; and the environment will have a greater impact on quality of life and well-being. Ireland should and can be a global leader in seeking to supplement measures of economic prosperity with a wider social progress indicator model." (Ibec, 2020: 17)

COVID-19 and Brexit are similar problems for rural Ireland. Ibec conducted a survey of firm CEOs in Ireland to see how they would respond over the next three years given the experience of COVID-19 and home working. It has underscored that the regions and sectors of the Irish economy that are best able to weather the challenges of Brexit are also the ones that are best prepared to weather the impact of COVID-19. As rural Ireland has not fared well from COVID-19, it should be expected that it will not be resilient in the face of Brexit, most especially a "hard" Brexit, which is appearing a likely possibility. The implication of this being that any changes that are made to farm income supports, most especially Pillar 1 supports, will need a transition period and be mapped out over several years.

The UK Agriculture Bill 2020 envisions a 5-year transition period in England starting in 2022 from the old Pillar 1 system to a new UK Environmental Land Management Scheme, with the possibility of early exit lump-sum payments for farms seeking to make the transition quicker.

As an addendum to the resilience conversation, it is important to note how robust agriculture as a sector is to digital disruption. While many high prestige positions are quite easily displaced by the coming waves of automation and machine learning, such as solicitors and accountants, the disruptive events for agriculture have largely been in the past, meaning that while employment in agriculture is unlikely to grow significantly, it will most likely not shrink much over the coming decades. The robustness of rural Ireland remains low, as many of the other economic activities located in adjacent townlands are subject to disruption, further eroding the possibility of non-farm incomes for famers and their families.

The economic importance of the agricultural sector to the overall Irish economy is limited. While it may have an outsized presence in the economic conditions of rural Ireland, it no longer has a significant role in the overall economic health of Ireland. Yet politically it remains disproportionally important. Agricultural policy can have a profound impact on the quality of life in Ireland and on the future economic possibilities of the country due to biodiversity and environmental damage, its limited economic importance, especially when placed against the intangible intellectual property imports that

support exchequer revenues, results in policy attention that is somewhat incomplete and excessively focused on the commercial sector. The disconnect between agriculture's real long-term economic implications taken from a multidimensional perspective of the environment and sustainability and immediate economic policymaking has implications for policy solutions.

4. CAP and Ireland

- "CAP has now become weaponised, maybe. In the sense that all of this money is going into an industry, but the reality is we have never been as dependent on CAP money as we are now. It's because when you look at all of the farm income levels in Ireland, the vast majority of them are totally dependent on our basic payments, our a and c money. We are totally dependent on that money just to survive." (Paul O'Brien, IFA)

The discussion of CAP cannot take place without a reference to Brexit. Brexit, outside of complicating Irish market access to the UK, has budgetary implications for the EU and the CAP. Approximately €10bn will be lost from the EU budget annually. CAP makes up 37.8% of EU budget expenditure. The departure of the UK will leave a €3bn "CAP Gap" that will need to be realized by reducing expenditure or asking for greater contributions from Member States. The present Multiannual Financial Framework (MFF) proposal by the Commission recommends a 5% reduction in the CAP budget line. The Commission proposal is: €265.2bn for direct payments; €20bn for market support measures (EAGF) and €78.8bn is for rural development (EAFRD). Direct payments (under Pillar I) will remain but will be conditional on enhanced environmental and climate requirements. Rural Development (Pillar II) will also remain, but national co-financing rates will increase. Member States will have the option to transfer up to 15% of their CAP allocations to rural development. In addition, Member States may also transfer an additional 15% from Pillar 1 to Pillar 2 for spending on climate and environment measures (without national co-financing). Strategic Plans covering the MFF period will set out how each Member State intends to meet 9 EU-wide objectives. Annual direct payments to farmers in excess of €60,000 will be reduced and capped at €100,000 per farm, which would affect approximately 1,000 farmers in Ireland who receive a payment of more than €60,000. It is also proposed that small and medium sized farms will receive a higher level of support per hectare and that at least 2% of direct payment allocation will be set aside to assist young farmers in establishing themselves. At least 30% of each rural development national allocation will be dedicated to environmental and climate measures. 40% of the CAP is expected to contribute to climate action. Importantly the Pillar 2 payments from a 2020 baseline shows a reduction in current terms of 17% and in real terms of 23%. The Commission's data shows almost no reduction in the nominal volume of resources programmed over the whole period (i.e. MFF 2014-2020 v MFF 2021-2027) in current prices, but a real reduction in the volume of resources of 13%. (Parliamentary Budget Office, 2018a)

A total of €78.8 billion is provided for Rural Development (EAFRD) – of which Ireland's allocation for the new MFF period is €1.853 bn (2.4%). In the context of Rural Development, when still responsible for DG Agriculture, Commissioner Hogan was reported as stating that "continued financing of grants to rural development projects would require the Government to find an extra €47m a year from the Irish budget if they are to be sustained." It should be noted that the proposed proportional split, in Ireland's case, between Direct Payments and the EAFRD is 78:22. This contrasts with other Member States, some which are more equal (Romania has a 50:50 split) or less (France has an 83:17 split), but in all circumstances the Member State exchequer must support Rural Development (Parliamentary Budget Office, 2018a).

Providing a clear overview of the role of the CAP in Ireland, Figure 3 tells us that Ireland's Pillar 2 payments currently make up 20% of Irish CAP payments, compared to 24% on average for the EU. Depending on the final treatment of Pillar 1 payments, Ireland, as a net beneficiary of funds could find itself with reduced resources after the next CAP reform.

Pillar 1 payments are based on hectares and have a profound impact on land use policy in Ireland. As they dominate as a source of income for most types of farming, they also have a strong impact on biodiversity decisions:

- "a farmer might look at a wetland in a corner of a field and the perception is that this isn't eligible land, I need to clear that out so I can plant it up, and I suppose, maybe they've forgotten that these are the biodiverse rich corners of their land, and that wetlands can help water quality and all those multibenefits. So, one of the things we're trying to do is focus on multibenefits on the farm. I suppose the biggest issue for us is around the land eligibility for the basic payment scheme and just to ensure that where land is providing an eco-system service rather than a direct agricultural service, that it doesn't lose its eligibility." (Carol McCarthy - LAWPRO)

Pillar 2 payments require co-funding and are sensitive to the fiscal capacity of the member state. The fiscal capacity of Ireland will be weakened by COVID-19 and by Brexit.

The EU, under the von der Leyen Commission, has re-orientated policy towards the "Green Deal". This is an ambitious agenda with an estimated cost of nearly €1tr, with €503bn coming from the EU budget and €141bn coming from matching funds provided by Member States. The COVID-19 recovery programme agreed by the Eurogroup on April 9th allocates €540bn in funds, including €410bn from the European Stabilisation Mechanism. The Multiannual Financial Framework (the EU "budget") has yet to be decided by the Member States. Recent political developments on the mutualisation of Eurogroup debt (i.e. Eurobonds) and the decision by the German Constitutional Court ruling against the Public Sector Purchase Programme (a form of quantitative easing) as the ECB acting *ultra vires* subsequently provoked a declaration from the European Court of Justice that the German court was itself acting *ultra vires*. The consequence is a potentially debilitating legal dispute at the heart of European policymaking.

4.1 Regulation and the "Brussels Effect"

The importance of the European Union as an export destination has a profound de facto and de jure effect on the behaviour of farmers around the globe (including the US), as it sets stringent rules with respect to the use of chemicals, animal welfare and GMO use under the REACH[13] regulation and incorporation of EU standards into the GlobalGAP (global agricultural practices) industry standardization process. This is what is phrased in the regulatory literature as the "Brussels Effect" where EU regulations and standards have global implications.

Why does this "Brussels Effect" matter? Regulatory norms that are adopted by the European Union take on a much stronger standards effect than initially thought. The global dimensions of EU regulations arise from trade pressures. Therefore, the capacity for local various are limited. Part of

[13] There are useful Eurobarometer and international polling data that supports the strong support of the European citizens for strong consumer, food safety and environmental regulations.

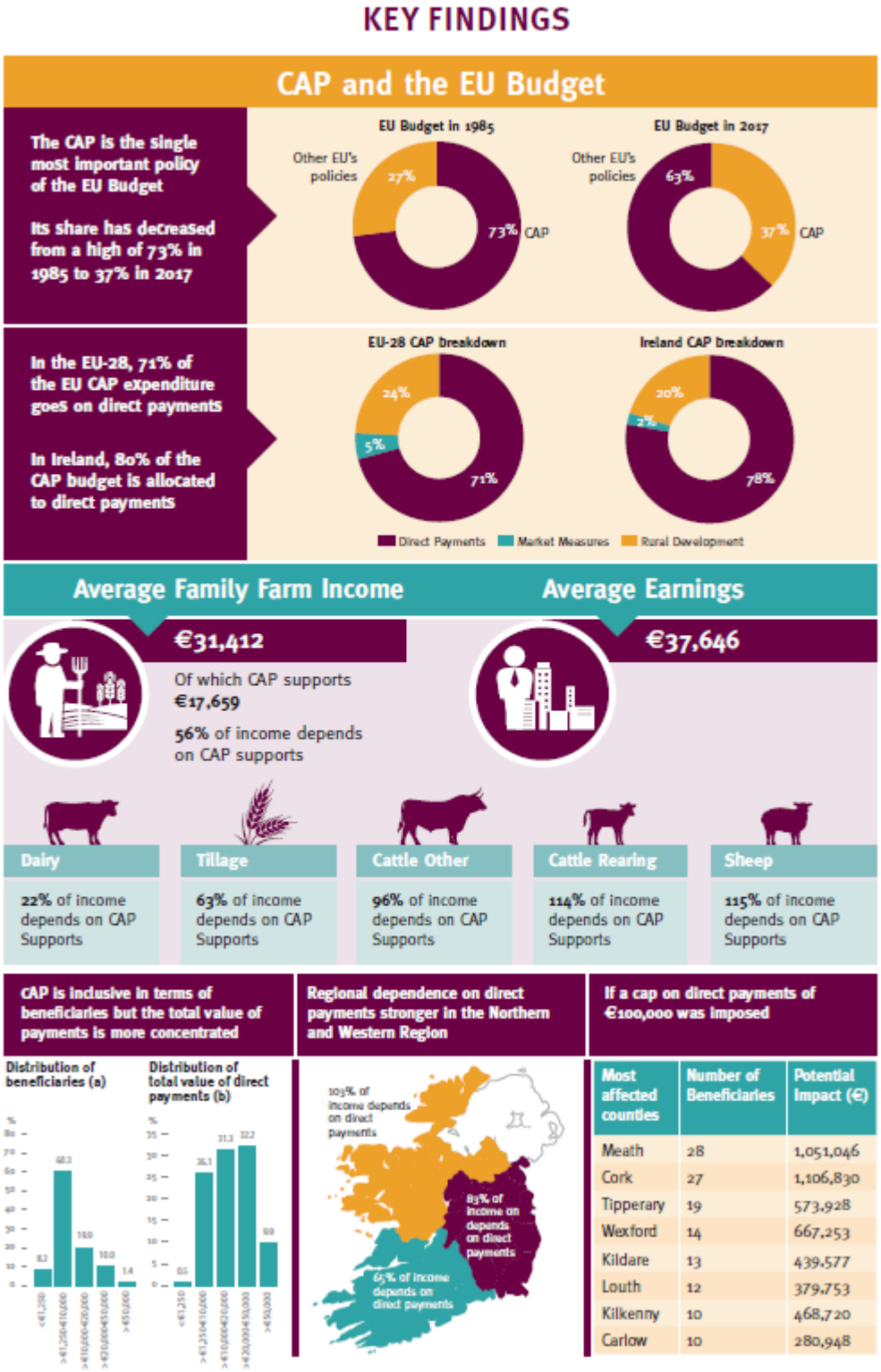


Figure 3: An overview of the Common Agricultural Policy in Ireland and potential regional and sectoral implications of future reform. Source: Parliamentary Budget Office. An Overview of the Common Agricultural Policy. 2018: 3.

the attraction of the EU regulatory system is that it is designed to provide high-quality (i.e. not lowest common denominator) regulations and standards which have the capacity to be homogenously applied and enforced across multiple jurisdictions despite cultural, legal or political differences. This limits the capacity for local variation but also ensures that a single market with a level playing field can be maintained between member states.

While the UK Agriculture Bill may provide a natural experiment in how best (or not) to reform the Common Agricultural Policy, the actual progress of reform in CAP and the associated new regulatory framework because they provide clear rubrics by which firms can engage and where creating different standards (i.e. pursuing high EU standards simultaneously with lower national standards) becomes cost prohibitive, driving export-orientated firms towards the EU regulatory standard, most especially when the EU is a significant trading partner or when supply chains interact with EU firms and consumers. Here, market failures that exist in the form information asymmetries, are effectively addressed using the precautionary principle approach to regulation which bootstraps market conditions.

The implications for this report of the "Brussels Effect" is that it makes local variations and modifications of enforcement difficult. The beauty of the "Brussels Effect" is its seamless application and transparency of use in implementation and enforcement from a producer and consumer perspective. Many of the challenges in the implementation of CAP reform will be about maintaining the "Brussels Effect" while allowing for local environmental conditions, regional variations, to be taken account of and for the principle of subsidiarity to be applied effectively in agri-environmental schemes. All this must be achieved without prejudicing the single market, the level playing field or the supranational prerogative of the European Union in the creation and enforcement of regulations as they relate to agriculture and food. As a future study of implementation science, the rolling out of the Farm-to-Fork and Biodiversity Strategies while also reforming CAP, forming a new relationship with the UK and achieving the 2030 SDGs will be a worthy topic for Irish scholarship.

4.2 CAP Reform – Financial Conditions

It is in this context that the conversation of CAP reform takes place. Recent studies, such as the Commission's *Evaluation of the impact of the CAP on habitats, landscapes, biodiversity* and *Evaluation of the Impact of the CAP on Water* have been critical of CAP environmental and biodiversity programmes. (Commission, 2019a & 2019b) The recent review finds mixed results from the various CAP initiatives undertaken. Most importantly, the review highlights that these programmes do not provide value for money given their limited and varying efficacy. The need for more subsidiarity in the design and execution of these projects is highlighted.

The legacy of Pillar 2 projects in Ireland with respect to value for money has been questioned as part of the Department of Public Expenditure and Reform's annual expenditure review process of GLAS. The value for money prospect of GLAS is in part coloured by the economic fundamentals of different types of farming (McDermot, 2019).

Looking at farm income in Ireland (Table 1), there is great variation on farm dependency on CAP subsidies, changing their sensitivity to CAP policy changes. Dairy farming is the least sensitive to CAP support changes and it clearly linked to the behaviour of international commodity markets.

Table 1: CAP Farm Support. Source: Teagasc National Farm Survey Report 2017.

Farm system	Family Farm Income	CAP* Supports	Income Dependency on CAP	Size (ha)	Income per hectare
Dairy	€86,069	€19,328	22%	56	€1,529
Tillage	€37,027	€23,239	63%	60	€617
Cattle Other	€17,199	€16,436	96%	37	€461
Cattle Rearing	€12,529	€14,242	114%	35	€354
Sheep	€16,586	€19,145	115%	51	€323
Family Farm Income	€31,412	€17,659	56%	45	€693

It is important to note from the calculations presented in the Tables 1 and 2 that Ireland is now a net contributor to the European Union, and while Ireland receives vastly more benefits in terms of trade and geopolitical cooperation from EU membership than would appear in a simple financial calculation, CAP is clearly no longer a process of the EU subsidizing Ireland with funds obtained from other member states. Ireland's contribution to the EU that returns to Ireland in the form of CAP is a recirculation of Irish funds. If there is a general acceptance that public funds should support public goods such as the environment and biodiversity, then Irish policy should be to support CAP reforms which move the CAP payment system more actively in that direction. It is already the case that CAP has extensive support among the citizens of EU Member States as a support mechanism for food production, food quality, farmers and the rural economy, as well as environmental dimensions. (see Appendix 2)

Based on the evidence presented by the Parliamentary Budget Office, dairy farming remains the most lucrative form of farming, and 70% of dairy farms have an income over €50,000. This compares with all categories of farming, where 35% make less than €10,000 and 46% make between €10,000 and €50,000.

- "if I were ten years younger I would be going dairy farming because that's the only show in town at the moment. And that's the harsh economic reality." (Paul O'Brien – IFA)
- "We should be saying, well, if beef farming, sheep farming, or tillage farming were doing relatively as well, there would be less need to go into dairy farming. So, if there was enough support, enough EU directives to protect the primary producer when it comes to helping sustainable farming in the drystock sector, then there wouldn't be the pent-up demand to go into dairying in the first place." (Paul O'Brien – IFA)
- "…if there were two litres of milk sitting on the shelf, but one was maybe 50 cents a litre more because it was farmed in a more environmentally friendly matter, there was a benefit there on hedgerows or bio-diversity habitat, I wouldn't be convinced that the public would pick up that product and that that price would be fed down the line to the food producer. I think consumers want more and more for less and less, it's only driving

production one way for the farmer to think how cheaply he can produce…" (Peter Linden – IFA)

- "…we're still trying to tie the science down on whether we can link that to the intensification of agriculture, where people are moving from drystock and other elements of farming into dairy. But certainly, one of the things we can see out on the ground is that land preparation for intensification is having quite an impact. So, that's where marginal land is maybe being drained and being improved and those elements, even before the intensification happens, are leading to impacts on water quality." (Carol McCarthy – LAWPRO)

Table 2: Ireland total contribution to EU Budget (EUR Million)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total EU spend in Ireland	**2,310.5**	**2,597.5**	**2,497.5**	**2,690.2**	**2,814.8**	**2,493.6**	**2,461.8**	**2,156.7**	**2,051.6**	**1,378.0**	**2,065.6**	**1,639.5**	**2,013.2**	**1,731.2**	**1,650.6**	**1,839.3**	**2,130.4**	**1,818.3**	**2,063.7**
Total national contribution to the EU budget	875.2	1051.2	933.8	1023	1122.1	1266.2	1279.7	1368.3	1576.6	1357	1208.6	1139	1235.6	1520.6	1425.1	1558.4	1845.3	1777.1	2320.2
CAP PAYMENTS TO IRELAND																			
Payments from EAGF	48.5	10	11.4	16.6	75	40.5	46.5												
Payments from EAFRD	390.7	180.5	443.2	294.4	449.4	233.4	190.1												
PRESERVATION AND MANAGEMENT OF NATURAL RESOURCES																			
Agricultural markets								1320.2	1298.9	733.1	1296.9	873	1289.7	1248.6					
SUSTAINABLE GROWTH: NATURAL RESOURCES																			
CAP payments under pillar 1																			
European Agricultural Guarantee Fund (EAGF) - Market related expenditure and direct payments															1232.3	1224	1225.9	1229.9	1220.6
CAP payments under pillar 2																			
European Agricultural Fund for Rural Development (EAFRD)															0	381.9	399	254.6	318.7

Source: Eurostat.

Work by the Oireachtas Parliamentary Budget Office highlights the extent of direct payments under the Basic Payment Scheme is shown in the figure below. The importance of the basic payment scheme to farmers cannot be understated and a fundamental reform of how Pillar 1 operates is essential to the reform of CAP (Figure 4). Any changes which ignore Pillar 1 will not achieve any material improvement in the condition of water courses, carbon emissions or biodiversity.

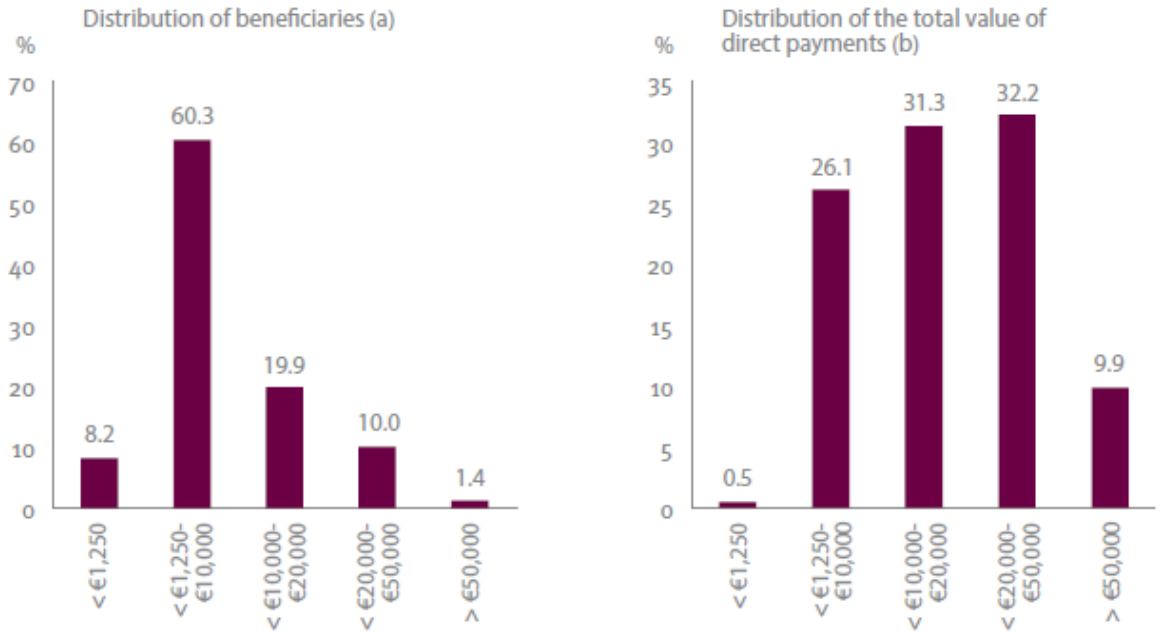


Figure 4: Distribution of basic payment scheme. Source: Parliamentary Budget Office. An Overview of the Common Agricultural Policy. 2018: 15.

The sensitivity of farmers to global prices, especially in the dairy sector is apparent (Figure 5). An overview of the price responses in light of COVID-19 and trends in pricing based on UN FAO price indices over the past 20 years are found Appendix 3. The important takeaways to note are the increased interdependence of the global food system. This interdependence is important from the point of view of the impact of agriculture on the environment.

This Irish data is of concern as the overall meat sector has the potential for technological as well as Brexit-based disruptions. Cattle is heavily reliant on CAP for income, ranging between 114%-96% of income. This in effect makes the cattle business almost entirely dependent upon CAP. Any further depressing effects on beef prices in Ireland would result in a sector that existed due to CAP. Under such conditions the externalities that CAP subsidy is designed to support should be directed towards the amplification of positive ones related to biodiversity and rural economy. It is important to note that Brexit is not the sole exogenous pressure on the Irish meat sector.

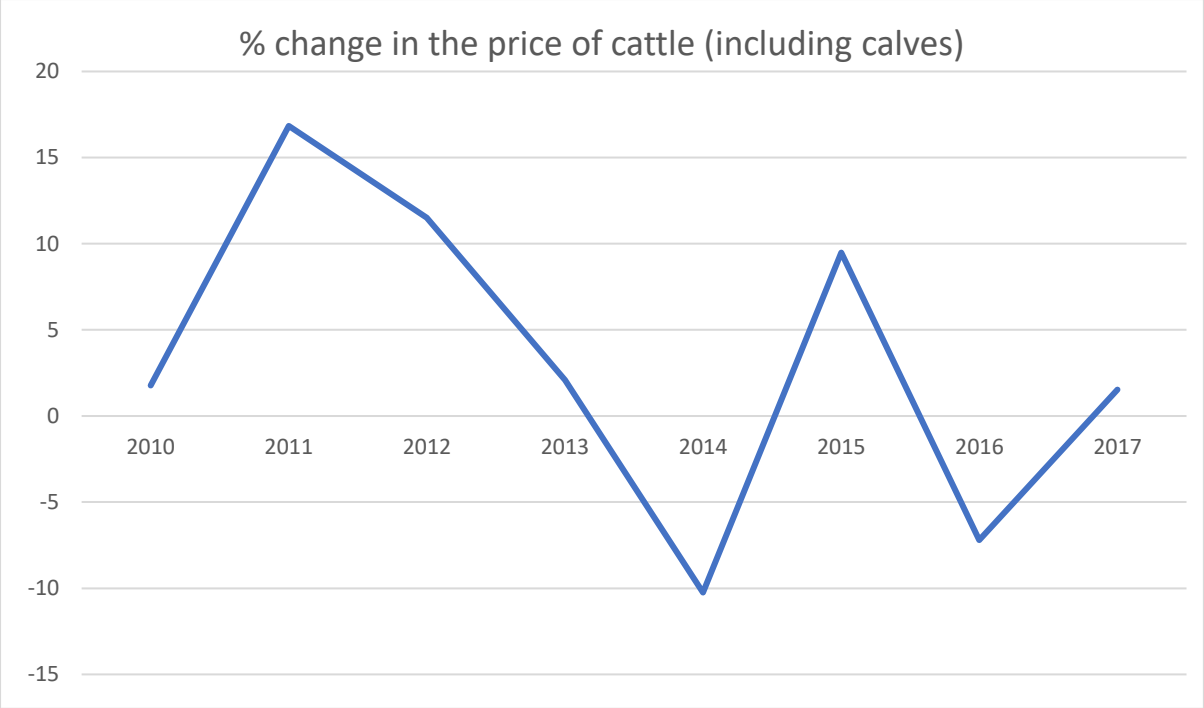


Figure 5: Irish Cattle Prices

Looking at the gross margin of Tyson Foods, the globe's second largest meat producer, gives pause when compared to the artificial meat production, and the reduction in gross margin is of concern. New firms, such as Beyond Meat, have a gross margin of 38.8% before achieving the benefits of economies of scale. Obviously for the European Union, the regulatory burden will be higher than in the US for the introduction of these types of products but it will impact on global prices as gross margin differences of that size afford greater opportunities for price competition over the short and medium term. The likely outcome is that major processors, like Tyson, will begin to actively move into this high gross margin area of the market. This will bring downward price pressures on farmers. In the European Union, where animal welfare regulations are more stringent, this will impose cost recovery limitations that will potentially change the behavior of farmers, requiring them to obtain more direct subsidies or to gain access to alternative sources of funding, such as the climate change, environmental and biodiversity-orientated Pillar 2 programmes.

It is important to also note the behavior of the dairy sector (Figure 6). Dairy farms are the most commercially viable of all Irish agricultural endeavors, with only 22% of dairy farm income dependent on CAP. As Figure 6 illustrates, there is a high degree of volatility in the global dairy market. The Irish prices though have experienced several years of price expansion.

Figure 6: Milk price change per year. Source: CSO.

The changes in CAP payment policy proposing to limit payments over €100,000 has been calculated by the Oireachtas Parliamentary Budget Office (2018a). The most heavily impacted counties are Cork and Meath. These are also counties that have very low take up of the existing GLAS scheme. It has not yet been determined how the additional resources freed up by this change will be allocated (Parliamentary Budget Office, 2018a), though the most likely options would be for it to be generally redistributed to farms with lower incomes, or allocated to more environmental and rural development funding.

Preliminary econometric analyses indicate that Irish farmers are highly sensitive to subsidies. Following Engle and Granger (1987), we investigate the relation of Irish agri-food exports by sector, environmental subsidies for farming and net farming subsidies by cointegration analysis. As mentioned by Engle and Granger, when two time series Y_t and X_t are cointegrated if they. are both (I) and there is a θ such that $Y_t - \theta X_t$ is I(0). Interrogating 15 time series, which include total food and live animals exports (SICT section 0), live animals except fish etc. exports (00), meat and meat preparations exports (01), dairy products and birds eggs exports (02), fish, crustaceans, molluscs and preparations thereof exports (03), cereals and cereal preparations exports (04), vegetables and fruit exports (05), sugar, sugar preparations and honey exports (06), coffee, tea, cocoa, spices and manufactures thereof exports (07), feeding stuffs for animals, excluding unmilled cereals exports (08), miscellaneous edible products and preparations exports (09), beverages and tobacco exports (10) and beverages exports (11). The data also includes time series of environmental subsidies for agriculture and net agricultural subsidies (including indirect subsidies).

We computed augmented Dickey-Fuller tests and DF-GLS tests for each time series with one lag to check whether they have unit root. The null hypothesis of unit root is rejected for the time series of sugar preparations and honey exports (06) and coffee, tea, cocoa, spices and manufactures thereof exports (07). Based on the results, we chose to investigate the relation between the exports by sector and subsidies with EG-ADF test, Engle-Granger Augmented Dickey-Fuller test for cointegration (Engle & Granger 1987), which allows θ to be unknown.

We then computed OLS regressions for the time series and tested the residuals for the unit root with EG-ADF test. The results suggest that there is a relation between live animals except fish etc. exports (00) and net subsidies at 1%, 5% and 10% significance level; dairy products and birds eggs exports (02)

and net subsidies at 5 % and 10 % significance level, cereals and cereal preparations exports (04) and net subsidies at 5% and 10% significance level and beverages and tobacco exports (1) and net subsidies at 5% and 10% significance level. These findings are an initial starting point for linking potential environmental behavior changes being related to the modification of CAP subsidies, as export-orientated producers are sensitive to movements in the subsidy structure.

The subsidy system is going to be subject to modification in the upcoming round of CAP changes. The most dramatic being the ending of payments to farms in excess of €100,000. While not a large number of farms fall into this category in Ireland (Table 3), it offers opportunities for subsidies to be reallocated with policy objectives in mind. Our initial results indicate that Irish farmers will be sensitive to these subsidy changes.

Table 3: Direct Payments over €100,000 per county. Source: Parliamentary Budget Office. An Overview of the Common Agricultural Policy. 2018a: 19.

County	**Beneficiaries (No)**	**Potential Impact (€)**	**Potential Average Impact per farm (€)**
Cork	27	1,106,830	40,994
Meath	28	1,051,046	37,537
Wexford	14	667,253	47,661
Tipperary	19	573,928	30,207
Kilkenny	10	468,720	46,872
Louth	12	379,753	31,646
Dublin	9	332,506	36,945
Waterford	8	293,965	36,746
Carlow	10	280,948	28,095
Kildare	13	260,822	20,063
Galway	4	199,212	49,803
Donegal	9	161,339	17,927
Westmeath	9	159,780	17,753
Wicklow	6	153,671	25,612
Limerick	3	134,711	44,904
Offaly	6	115,791	19,299
Cavan	2	106,049	53,025
Laois	7	102,601	14,657
Kerry	1	55,550	55,550
Leitrim	1	2,643	2,643
Mayo	1	1,869	1,869
Clare	0	0	0
Longford	0	0	0
Monaghan	0	0	0
Roscommon	0	0	0
Sligo	0	0	0
Total	199	6,608,987	33,211

5. State of agricultural activity in Ireland

What does Irish agriculture look like when placed outside the lens of economics and CAP. The Central Statistics Office (CSO) *Farm Structure Survey 2016* tells us that there are approximately 137,500 active farms in Ireland, covering almost 4.9 million hectares of Agricultural Area Used (AAU). Farms in the Southern and Eastern (SE) region of Ireland are larger on average (38.3 hectares) than those in the Border, Midland and Western (BMW) region (27.1 hectares), with over 70% of farms of 100 hectares or more located in the SE region compared to 60% of farms of 10 hectares or less located in the BMW region (CSO, 2016). Across the country, the majority of AAU land is comprised of Grassland (almost 4.1m hectares), while the remaining is made up of Cereals (280,400 hectares), Other Crops, Fruit and Horticulture (71,100 hectares) and Rough Grazing (16,300 hectares). Identifying eight distinctive farm types in their survey, the CSO found that the most common farm type or activity was 'Specialist Beef Production', accounting for over half (56.9%) of all farms in 2016, followed by 'Specialist Dairying Farms' (11.7%) and 'Specialist Sheep Farms' (11%) – see Figure 7.

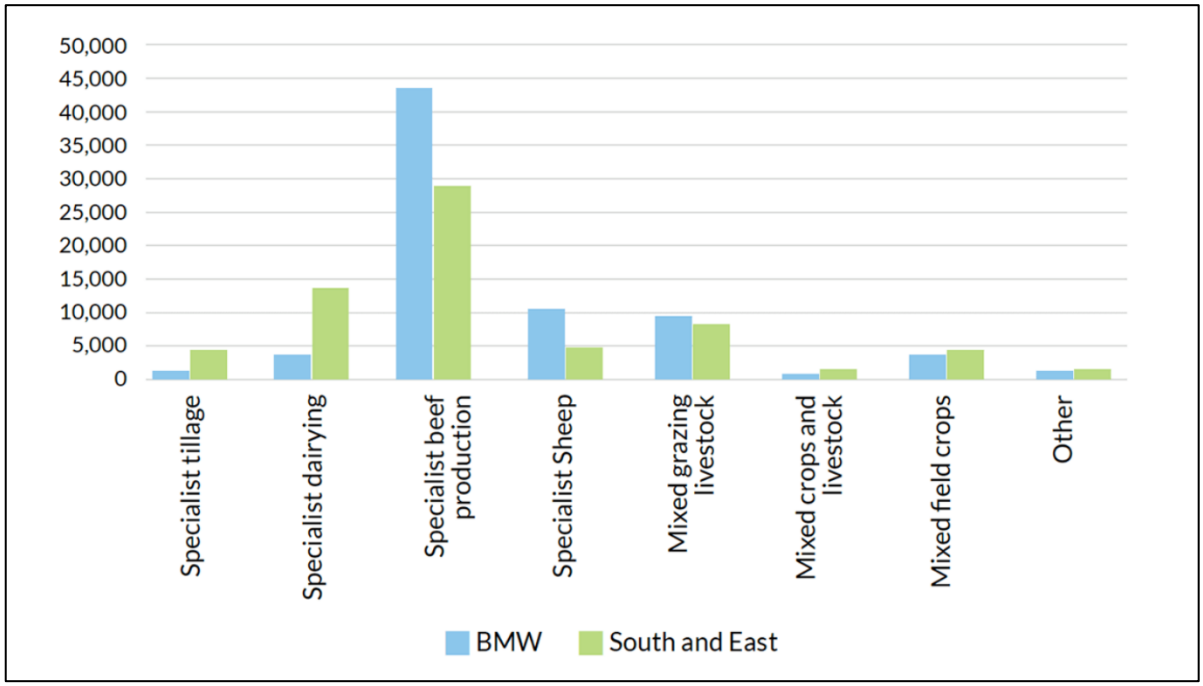


Figure 7: Number of farms by category and region, 2016. Source: Central Statistics Office 'Farm Structure Survey 2016'

Between 2013 and 2016 the number of total farms in Ireland decreased by 1.5% (from 139,600), while the total number of livestock in the country increased. Poultry increased by 9.1% to 11.1 million, cattle by 4.6% to 7.2 million, sheep by 4% to 5.1 million and pigs by 3.4% to 1.6 million (CSO, 2016). According to Eurostat, Ireland is among the bottom three EU countries in terms of land allocated to organic production and in 2016 only 1.7% of total AAU was allocated to organic farming (DAFM, 2020).

The Farm Structure Survey identified the vast majority (99.7%, or 137,100) of farms in Ireland as 'Family Farms'. The majority (88%) of Family Farm holders were male, and more than half of Family Farm holders were over the age of 55, with only 5% under the age of 35 (Figure 8). Farm holders over the age of 65 (30% of all farm holders) were most commonly found to work 'Mixed Field Crops' (40.2%), 'Specialist Beef Production' (32.4%) and 'Specialist Sheep' (29.8%) farms.

	2013		2016	
	Number	%	Number	%
	000s		000s	
< 35	8,200	5.9%	7,400	5.4%
35-44	22,800	16.4%	21,400	15.6%
45-54	34,800	25.0%	32,500	23.7%
55-64	35,600	25.6%	34,700	25.3%
>65	37,700	27.1%	41,200	30.0%
Total	139,100	100%	137,200	100%

[1] *Family Farms only therefore lower total figure as Family farms account for 99.7% of all farms.*

Source: Central Statistics Office, Farm Structures Survey 2013

Source: Central Statistics Office, Farm Structure Survey 2016

Figure 8: Number of farms[1] by age of farm holder, 2013-2016

- "the average age of farmers in Ireland is 59 years of age. A considerable amount of them have no successor in place, people are educating their children to go to college, knowing that they will be the last generation to farm. It's because once that child has gone to college they are not going to go back and accept the average farming wage compared to the average wage of somebody in the public service. So we have to be realistic here, if dairying is the only opportunity to expand and get two incomes from the one farm for multigenerational purposes, then dairying is the way to go, and I applaud them." (Paul O'Brien – IFA)

More than half (72,500) of farm holders stated that farming was their sole occupation, and of these, over half (52.1%) worked 'Specialist Beef Production' farms. While 'Specialist Dairying' only accounted for 17.5% of total sole occupation farmers, the majority of people who ran 'Specialist Dairying' farms did so as their sole occupation (78.9%) – a higher proportion than any other farm type. Those least likely to have farming as their sole occupation were most often holders of 'Specialist Sheep' (45.7%) and 'Mixed Field Crop' (45.1%) farm types. While just under a quarter (23.5%) of all farm holders regarded farming as their subsidiary occupation.

Teagasc's National Farm Survey 2018 differentiates Ireland into three regions – South, North & West, and East & Midlands - and find that farms in the South region are the most economically 'viable' (44% viable farms) compared to the Northern and West region who have the highest proportion of 'vulnerable' farms (41%), and largest proportion of 'sustainable' farms (43%). These farms are considered sustainable because of the presence of off-farm income.

5.1 The GLAS Scheme – An Economic Evaluation

The Department of Public Expenditure and Reform (DPER) undertook an economic analysis of the GLAS scheme as part of the Budget 2020 exercise. Using survey data, DPER con indicates that some of the actions incentivised under GLAS may already be in place on participating farms with additionality ranging from 20% to 67% (Table 4). DPER considers this being the result of existing scheme or actions undertaken as standard operating procedure. This results in the GLAS scheme contributing a deadweight loss. It is accepted by DPER that this is not uncommon in agri-environmental schemes but is obviously sub-optimal and represents a value for money problem.

Table 4: Additionality related to GLAS actions. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019

Measure	**Proportion of farms changing land management to meet actions**
Minimum Tillage	67%
Arable grass margins / riparian margins	62%
Protection of watercourses from Bovines	52%
Low input permanent pasture	41%
Farmland birds	33%
Traditional hay meadow	31%
Farmland habitats	25%
Commonage	24%
Hedgerows (coppicing / laying /planting new hedgerows)	20%

DPER evaluates projects from the point of view of value-for-money. This requires that almost all outputs are quantifiable for analysis. The use of multi-criteria analysis, more effective when looking at system with large numbers of non-quantifiable outputs, tends to be avoided by DPER except when extreme data limitations require that methodological approach. As such this evaluation reflects that methodological approach and may differ from the viewpoints of line departments and agencies responsible for policy implementation.

DPER investigated inspection data for compliance. Inspection results for 2018 resulted in an overall error rate of around 4% with relatively small reductions to payments based on minor infringements being common. The prevalence of minor reductions resulting from inspections may reflect difficulties with understanding or applying the terms and conditions of the actions or more general non-compliance with the terms and conditions.

Inspection issues may impact negatively on achieving the scheme's objectives. DPER did accept that an independent evaluation commissioned by the DAFM reported good overall implementation of GLAS actions on the farms subject to a field survey and implementation check (McDermott, 2019).

Figures 9-14 outline the nature of participation in the GLAS scheme. The less commercially viable farms are more heavily involved in the scheme. Given this tendency, it is not surprising that dairy farms are not well represented. This is problematic from the point of view of policy as they place significant stress on river systems. Though they are export-orientated, they are not heavily dependent on subsidies, therefore are less likely to respond to incentives driven by subsidies. This means that if there is a market failure where:

- negative externalities are not accounted for adequately,
- reverting to direct regulations, or

- the use of an economic tool that internalises the cost of social harms in a classic Pigouvian fashion.[14]

DPER finds:

> There is low participation among dairy farms which have the highest average GHG emissions, highest nitrogen surplus in the soil and the largest farms on average. Farms that do participate in GLAS cite the income as the most important influencing factor in their participation while farms that do not participate cite the low level of payment as the main reason for not applying. GLAS is more successful at enticing lower output (e.g. non-dairy farms) which are attracted to the scheme as a useful source of non-market income. Payments are not attracting the more profitable environmentally impactful dairy farms in similar numbers to other farm types. However, supporting farmers to farm less intensively decreases the likelihood of more farmers moving into more intensive environmentally detrimental forms of farming. (McDermott, 2019:28)

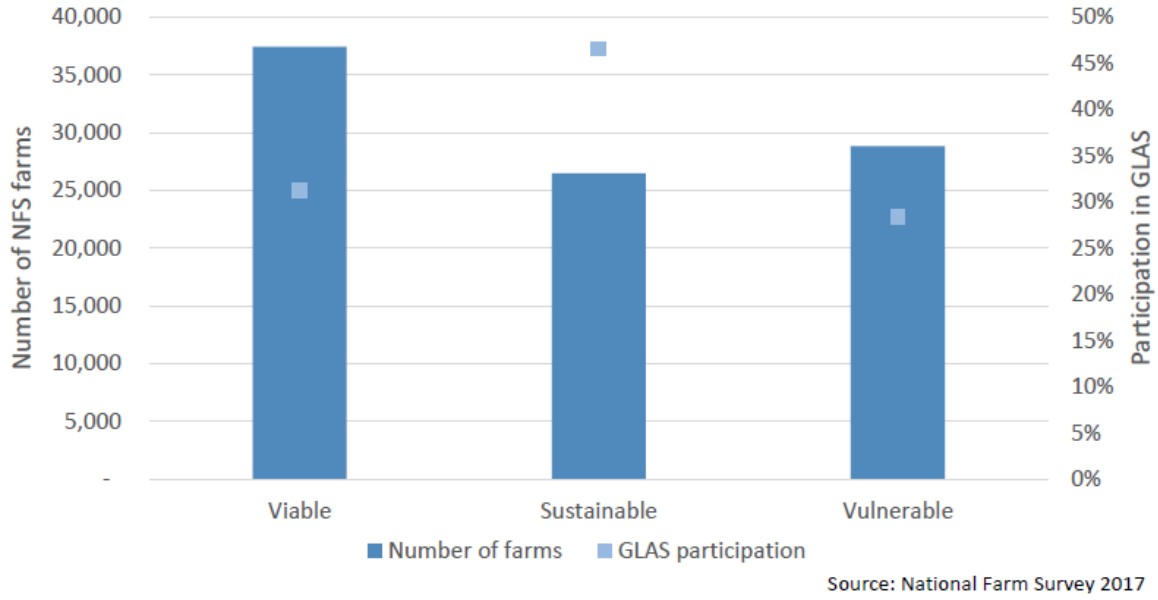


Figure 9: Likelihood of NFS farms being in GLAS by economic viability – 2017. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:16.

[14] A Pigouvian subsidy is a subsidy that is used to encourage behaviour that have positive effects on others who are not involved or society at large. Behaviours or actions that are a benefit to others who are not involved in the transaction are called positive externalities. A Pigovian (Pigouvian) tax is a tax assessed against private individuals or businesses for engaging in activities that create adverse side effects for society. Adverse side effects are those costs that are not included as a part of the product's market price.

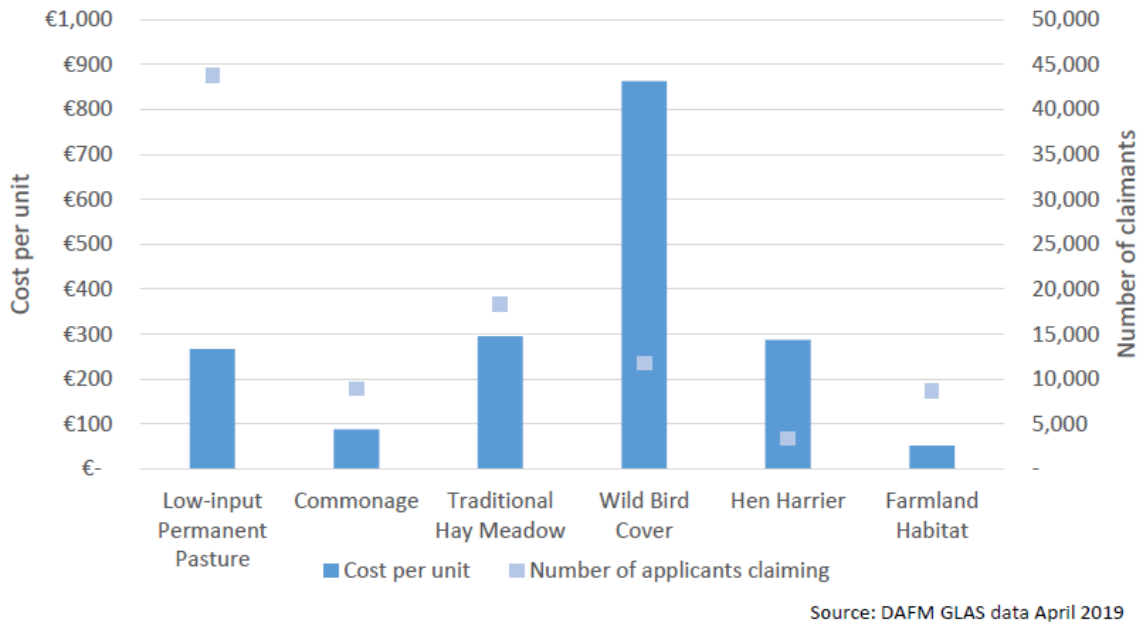


Figure 10: Number of claimants by average payment per hectare. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:18

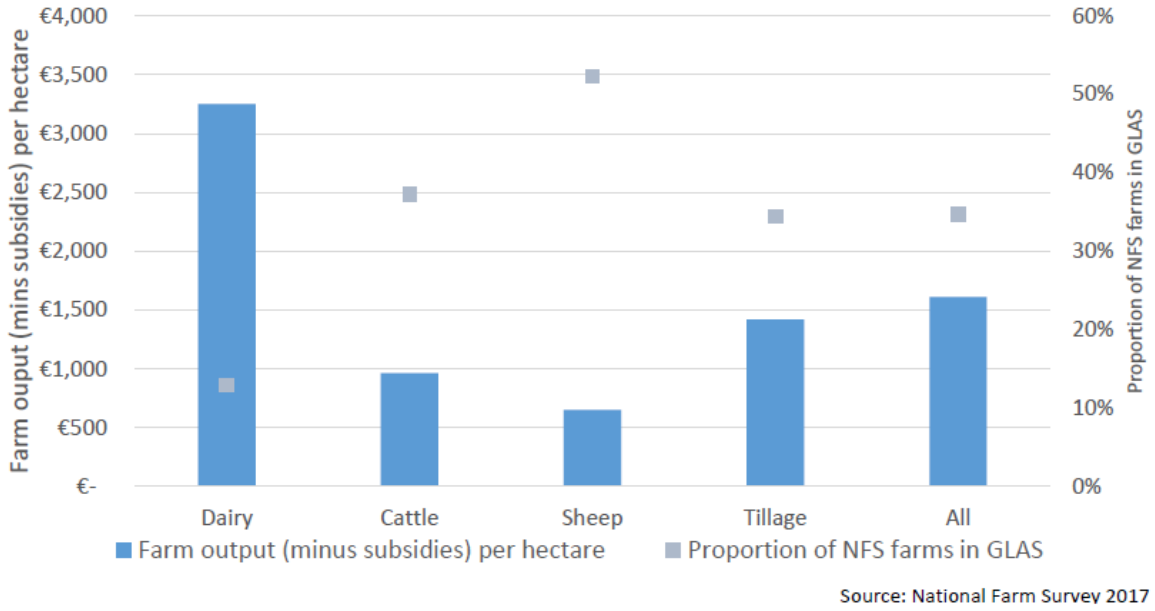


Figure 11: Average farm output per hectare and proportion of NFS farms in GLAS by farming system. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:19

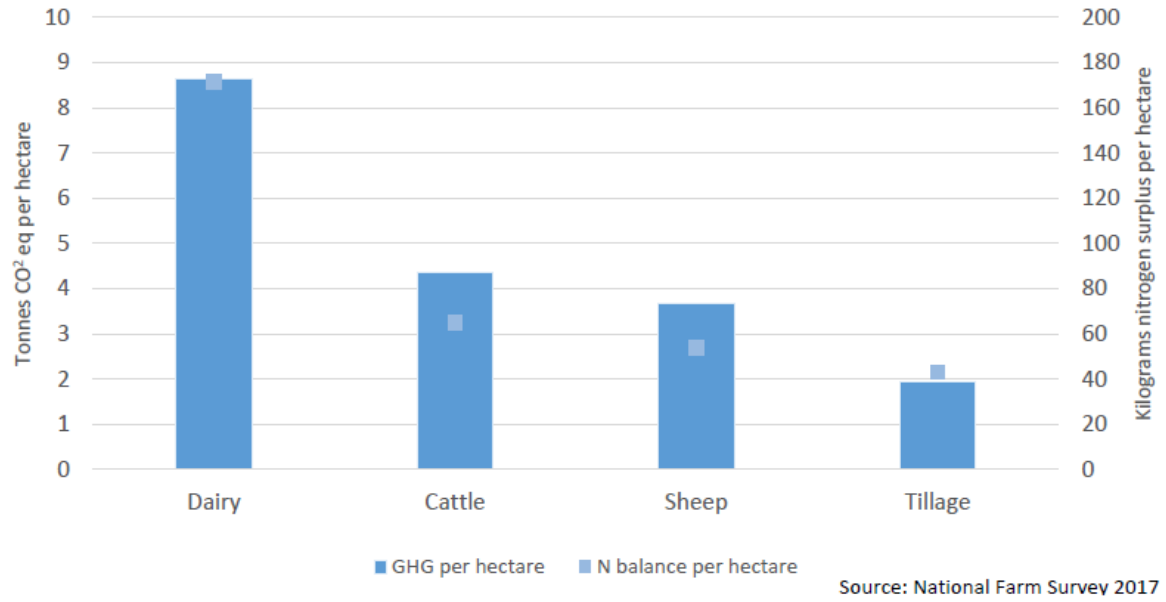


Figure 12: Average GHG emissions and nitrogen surplus by farm type – NFS 2017. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:19

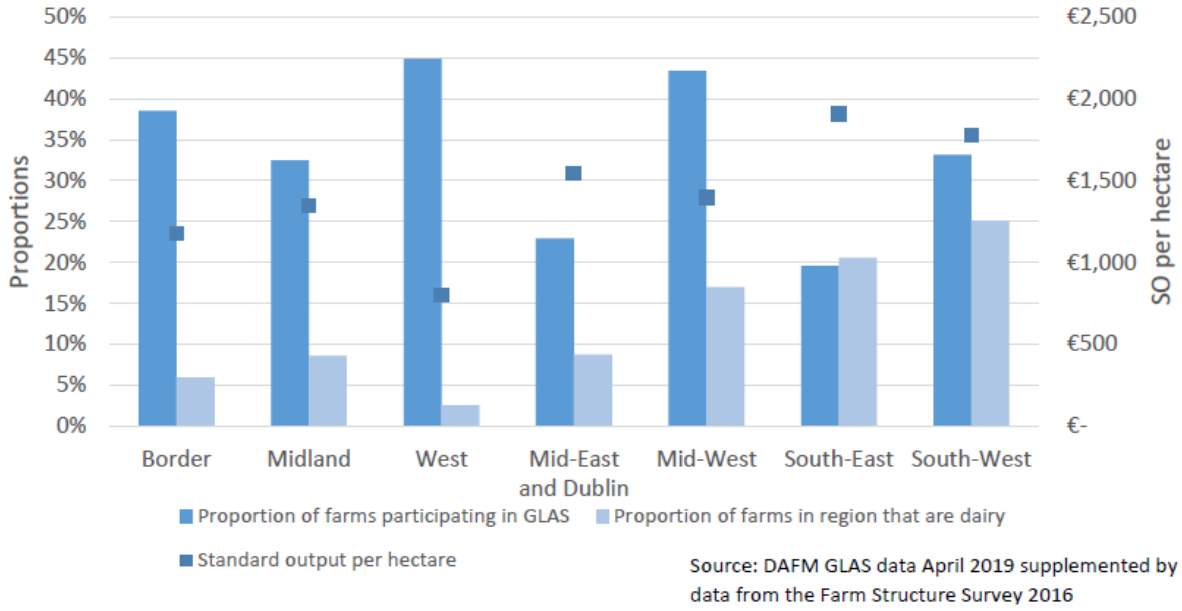


Figure 13: Proportion of farms that are GLAS, proportion of farms that are dairy and standard output per hectare by region – 2017. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:22

Figure 14 - NFS GLAS farms participating in other schemes - 2017

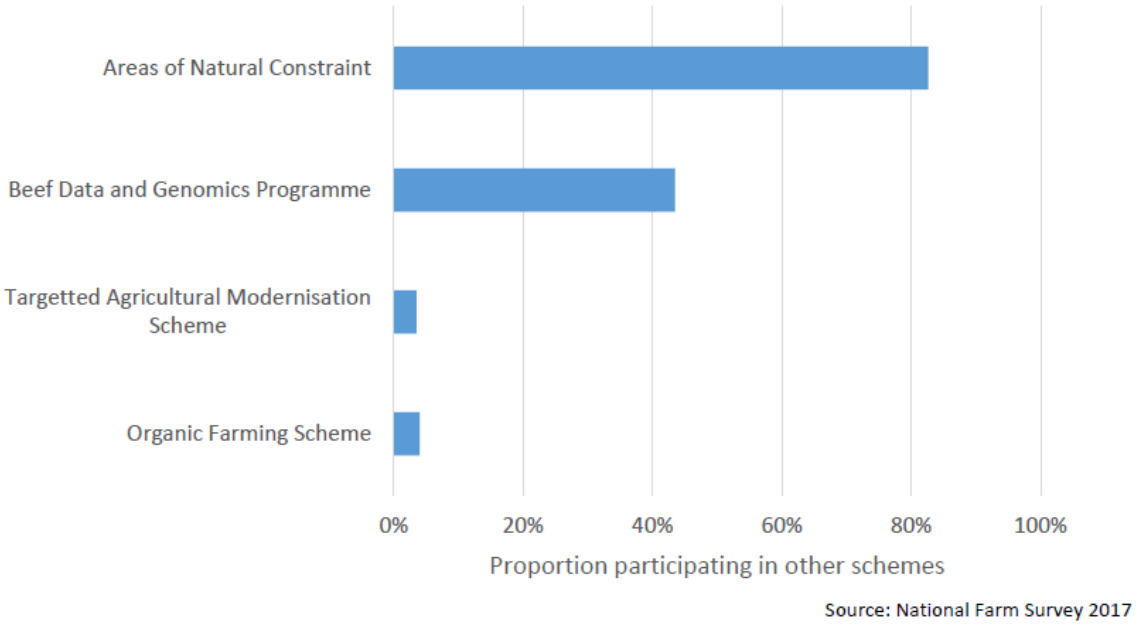


Figure 14: NFS GLAS farms participating in other schemes – 2017. Source: McDermott, Cathal. The Green, Low-Carbon Agricultural Scheme Department of Public Expenditure and Reform Spending Review. 2019:27

Commentary provided in our interviewees support the sceptical view taken by the Department of Public Expenditure of different agri-environmental schemes.

- "…those schemes probably aren't targeted enough at the locations that we would like to see them targeted... So, the work that we do is trying to be much more specific to look at what we call the critical source areas on each farm. Which are the specific areas on the farm that are causing problems for water quality and trying to focus in on those areas rather than doing, a measure across the whole farm. We want to be much more targeted than that. And I don't think the schemes to date they haven't been targeted enough for our purposes." (Carol McCarthy – LAWPRO)

- "…the interaction of farmers, in any environmental scheme has been limited because of the number of farmers that have been allowed into the scheme, full stop. That would be my view on it. That every scheme that has been out there since the mid-90s has been oversubscribed by farmers wishing to participate. So, it's only been limited by its financial ambitions by Central Government, and also by money in the European Union handed down in CAP money – that would be pillar 2 money directly. So, it's only been limited by its financial constraints." (Paul O'Brien – IFA)

6. State of water quality in Ireland

According to a recent report[15] published by the Environmental Protection Agency (EPA, 2019), overall surface water quality in Ireland has declined between 2013 and 2018; with only 52.8% of surface water in Ireland of 'satisfactory' ecological health, a decline of 2.6% compared to 2010-2015 (55.4%). Coastal waters have the highest proportion of 'satisfactory' ecological status (80%), followed by rivers (53%), lakes (50.5%) and transitional waters (38%). Considering overall net change, there has been a 4.4% decline in surface water quality, despite slight improvements to lakes and coastal waters. This is largely due to a 5.5% decline in the quality of river water bodies since 2010-2015. The number of 'high' status river bodies have dropped by almost a third (91 rivers) and the number of 'poor' status river bodies have increased by a third (110 rivers). This change speaks to a continuing decline in 'high' status surface water bodies across categories, which have decreased from 12.9% in 2007-2009[16] to 8.5% in 2013-2018; coupled by an increase in 'poor' status surface water bodies, increasing from 14.8% to 17.9% during the same period. In comparison, 92% of groundwater quality has remained in good status.

6.1 Impact of Irish agriculture on water quality

Covering more than 65% of Irish land (EPA, 2019a), agriculture most commonly impacts on water quality through nutrient pollution (from nitrogen, phosphorus, potassium and ammonium), sediment pollution, and pesticide[17] pollution. It is the most frequent significant pressure on water bodies that are not meeting their Water Framework Directive targets (EPA, 2019:97), and of the 1,460 individual water bodies identified in this 'at-risk' category, 53% were affected by agriculture (Figure 15).

Agriculture affects 53% of all at risk water bodies in Ireland, with nutrient pollution the most prevalent agricultural pressure on water quality (EPA, 2019: 20). Nutrient pollution from nitrogen and phosphorus has the biggest impact on water quality in Ireland. Approximately a third of rivers (35.8%) and lakes (29%) and a quarter of estuaries (23.3%) fail to meet their nutrient-based environmental quality standards (EPA,2019:9.) In addition to this, over a quarter of rivers are seeing increasing nutrient concentrations; total phosphorus concentrations are rising in over a quarter of monitored lakes. The marine environment has seen as increase in phosphorus load by almost a third and nitrogen by 16% since 2012-2014. There has been a 6.5% increase in the percentage of groundwater sites with nitrate levels above 25 mg/l NO3. Stating that agriculture is the most frequent significant pressure in water bodies that are not meeting their Water Framework Directive targets (EPA, 2019:97), the report correlates the increase in nitrogen pollution to increased fertiliser use and cattle numbers since 2013. The report also identifies that point source pollution from livestock has a notable impact on water quality as well as other diffuse pollution from sediment and pesticide runoff (EPA, 2019:9&20).

[15] The 'Water Quality in Ireland 2013-2018' report evaluates the ecological health of Ireland's rivers, lakes, canals, groundwaters, estuaries and coastal waters in accordance with the standards and objectives set out in the National River Basin Management Plan 2018-21 and the EU Water Framework Directive.

[16] EPA note that the first Water Framework Directive baseline assessment took place between 2007-2009.

[17] The term 'pesticides' includes herbicides, insecticides, and fungicides

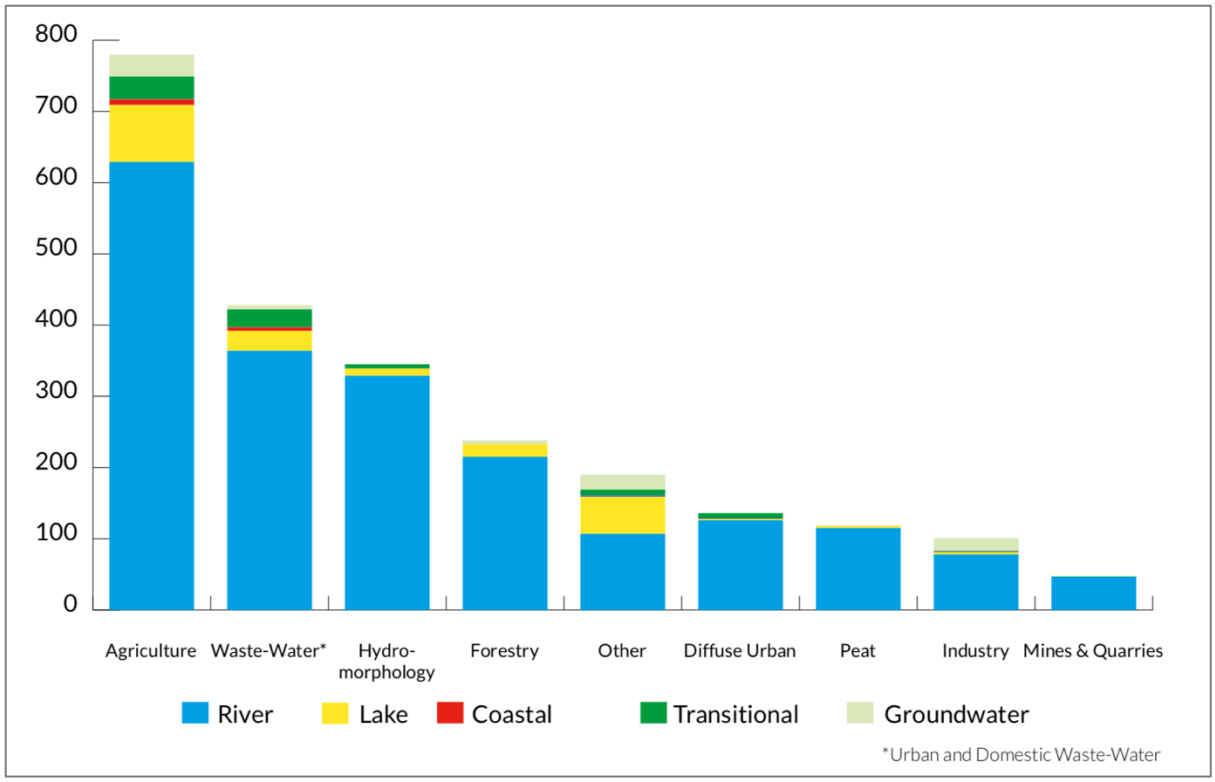


Figure 15: Frequency of significant pressures on 'At-Risk' water bodies in Ireland. Source: River Basin Management Plan, p.40

As table 5 illustrates, of the individual 'at-risk' water bodies affected by agriculture, 629 are rivers, 80 are lakes, 8 are coastal waters, 32 are transitional waters and 31 are groundwater bodies (River Basin Management Plan, 2018: p. 40).

Table 5: Number of 'at-risk' water bodies where agriculture is a significant pressure. Source: 'Significant Pressures: Agriculture' (Catchments.ie)

Waterbody (WB)	Number of WBs	Number of At Risk WBs	Number of waterbodies with agriculture as a significant pressure	% of WBs with agriculture as a significant pressure	% of At Risk WBs with agriculture as a significant pressure
River	3192	1178	629	19.7%	53.4%
Lake	818	132	80	9.8%	60.6%
Transitional	195	56	32	16.4%	57.1%
Costal	111	13	8	7.2%	61.5%
Groundwater	513	73	31	6.0%	42.5%
	4829	1452	780	16.2%	53.7%

6.2 Agricultural pollutants in water

Agricultural pollutants enter waterbodies from point (often farmyards) and diffuse sources (for example, spreading of fertilisers, manure and slurry), entering groundwater bodies through the soil in the form of leaching. Pollutants return to water and land through processes of atmospheric ammonia deposition, and through direct pollution in on-farm or nearby waterbodies through contact with livestock, farm runoff and spray drift.

6.2.1 Nutrient pollution

Water pollution from nutrients such as phosphorus and nitrogen is caused by processes of soil leaching, volatisation, and direct pollution from livestock access points and farm runoff. It is of particular concern in Ireland water, because of increasing levels found in water bodies (EPA, 2019a). Approximately a third of all rivers (35.8%) and lakes (29%), and a quarter of estuaries (23.3%) have failed to meet nutrient-based environmental quality standards due to nutrient pollution from nitrogen and phosphorus (EPA, 2019a: 9). Over a quarter of rivers are seeing increasing nutrient concentrations, while total phosphorus concentrations are rising in over a quarter of monitored lakes. The marine environment has seen as increase in phosphorus load by almost a third, and nitrogen by 16% since 2012-2014, and there has been a 6.5% increase in the percentage of groundwater sites with nitrate levels above 25 mg/l NO_3 (EPA, 2019a: 9).

Nutrient leaching occurs when there are more nutrients in the soil than can be taken up by plant life. It is a process that interacts with soil composition and is a problem for different types of waterbodies. For example, when there is an excess of phosphorus in poorly draining soil or sub-soil, phosphorus loss is more likely to occur. This is primarily an issue for rivers, lakes and estuaries; while freely draining soils are susceptible to nitrate leaching, which primarily affects coastal waters and estuaries (EPA, 2019: 9 & 97).

Atmospheric ammonia (NH_3) emissions released from agriculture through a process called 'volatisation' accounts for almost all (99.1%) of ammonia emissions in Ireland, the main source of which comes from the use of nitrogen-based fertilisers (both organic manure and synthetic urea) (EPA, 2019[18]). In recent years, ammonia emissions have increased in Ireland and in 2017 emissions were 7.9% higher than in 1990. Upon returning to the land and water through wet and dry deposition, it can cause soil acidification and eutrophication by increasing nitrate-levels.

Nutrient pollution also occurs through agricultural runoff, when water from fields and farmyards flows over the earth entering waterbodies directly (EPA, 2019a); and when livestock have direct access to on-farm waterbodies (Kilgariff et al., 2020).

Freshwater bodies are typically nutrient poor, meaning that small increases in nutrient supply can cause nutrient overload, known as eutrophication. This process culminates in the production of aquatic plant life, most notably the mass growth of algal bloom, which has significant knock on effects for the ecosystem. It reduces biological diversity within water bodies, as not only does it grow on the surface of the water, preventing sunlight from reaching underwater plants that shelter and feed other organisms; but it reduces oxygen levels in the water when it decomposes. It can produce toxic plant life that is consumed by other organisms, moving up the food chain (Freshwater Protection, 2017: 9-10[19]).

[18] EPA. 2019. Ireland's Transboundary Gas Emissions 1990-2030

http://epa.ie/pubs/reports/air/airemissions/irelandsairpollutantemissions2017/Irelands%20Air%20Pollutant%20Emissions%202017.pdf

[19] https://www.europarl.europa.eu/RegData/etudes/IDAN/2017/599280/EPRS_IDA(2017)599280_EN.pdf

6.2.2 Sediment pollution

Sediment pollution is caused by runoff from ploughed or arable land and farm roadways, erosion of riverbanks from livestock, rainwater erosion, land drainage and channel maintenance, and agri-forestry activities (Catchments, 2019[20]; River basin, p.41).

Sediment pollution from agricultural activity can affect stream morphology and excess fine sediment is a particular issue for rivers and lakes where it can interfere with aquatic ecosystems, further endangering species such as Freshwater Pearl Mussels. Sediment also acts as a vehicle, transporting chemicals and nutrients attached to sediment particles, a particular problem in lakes where phosphorus can deposit in sediment (Freshwater Protection, 2017: 9).

6.2.3 Pesticide pollution

Pesticides can enter waterbodies through soil leaching, sediment pollution, agricultural runoff and spray drift, and is a concern for drinking water. According to the European Commission evaluation of the impact of the CAP on water, pesticide concentration in waterbodies directly depends on the quantity spread per hectare (EC, 2019: 5). In 2018, the EPA investigated 42 water supplies, serving 283,500 people, due to failures to meet pesticide standards. A reduction from 2017, when 53 water supplies, affecting 660,000 people, failed to meet pesticide standards. The most commonly found pesticide in drinking water in Ireland is 2-methyl-4-chlorophenoxyacetic acid (MCPA), which is used to control thistle, dock and rush, and accounts for 75% of all pesticide failures (EPA, 2019b[21]: 23; Moran, 2018[22]). While pesticides are often assessed with regards to quality of drinking water for human consumption, chemical pollution from pesticides is also extremely toxic to aquatic life, and can impact on the aquatic environment (EPA, 2019a: 9).

6.3 Farming activity and water quality

The extent to which agriculture impacts on water quality is contingent on the type of farming activity that occurs. This activity also relates to the geographical composition of farmland, soil type and its proximity to waterbodies. This section explores the role of farm enterprise types in the continued deterioration of water quality.

There are consistently identified reasons for the deterioration of water quality:

- mismanagement of land through nutrient applications to agricultural land and crop coverage;
- pesticide applications (directly correlate to application) though reducing in waterbodies due to directives;
- waste mismanagement (Livestock access to on-farm waterbodies) and due to high concentration livestock farming (poultry and concentration of ammonia emissions);
- dairy farming – the intensity of dairy production;
- clear fell tree harvesting impact on leaching and sediment to do with machinery.

Emphasises the importance of farming activity to the extent to which these pressures impact positively or negatively on water. They use the term 'farming practices' as a generic term to designate the strategic decisions taken by farmers that affect land occupation, such as the introduction of ecological features or specific types of areas (e.g. nitrogen-fixing crops or permanent grasslands), as well as decisions taken concerning crop/plot management or livestock management.

Soil coverage and landscape features can have an effect on water quality. They can act as a physical barrier to water – protect the soil from erosion, by limiting sun and wind exposure and organic matter

[20] https://www.catchments.ie/significant-pressures-agriculture/
[21] http://www.epa.ie/pubs/reports/water/drinking/EPA%20DW%20Public%20Supplies_web.pdf
[22] https://www.independent.ie/business/farming/forestry-enviro/environment/pesticides-levels-in-water-supplies-in-four-areas-of-the-country-above-eu-standards-irish-water-37376914.html

can affect soil structure and biological activity. Improved soil stability reduces pollutant loss through runoff or leaching by immobilising them in the upper layers of soil. Vegetative matter acts as a buffer catching nutrients chemicals and sediment thanks to large roots system. Crop management systems can be implemented to reduce level of input on plot – by using nitrogen-fixing crops, adapt the quantity of inputs applied to meet the plot's requirements (precision farming) or optimise conditions and timing of applications. Investment in between water management equipment can make it possible to decrease water abstraction and thus limit concentration of pollution in waterbodies.

If poorly managed, livestock can be a heavy source of pollution from effluents and access to waterbodies (Figure 16). Good management practices – particularly along watercourses can avoid the direct discharge of faeces in water and prevent bankside erosion (e.g. fences along watercourses). Also limit overgrazing, promote transhumance and limit water abstraction for livestock and forage production.

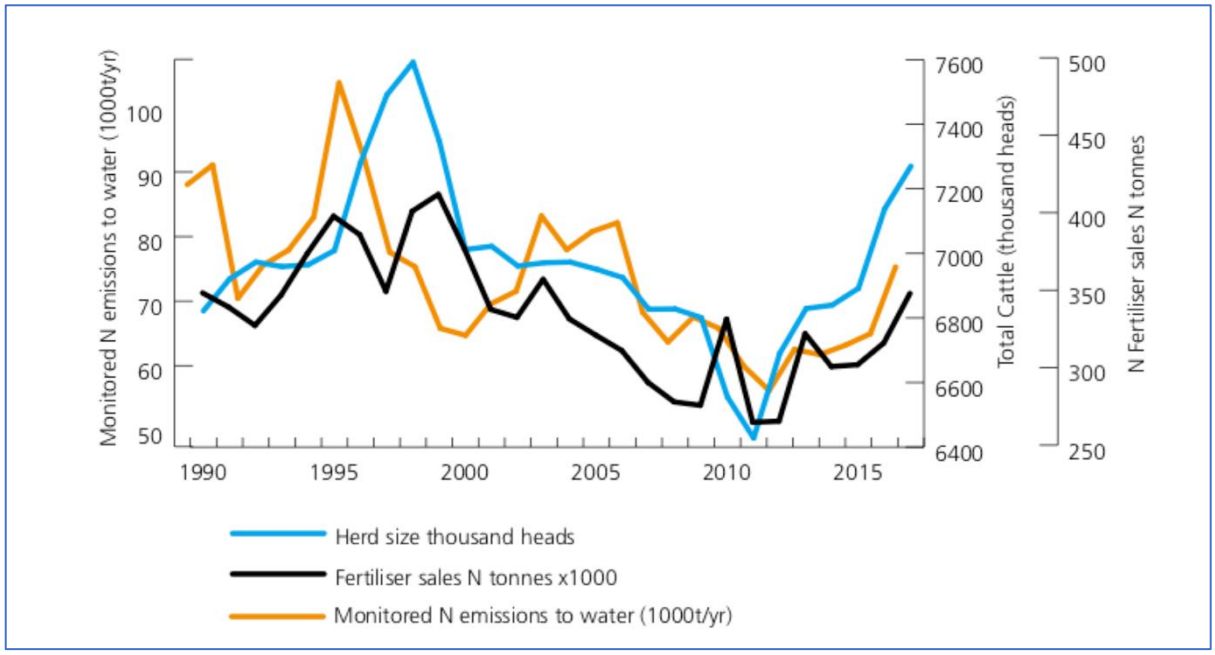


Figure 16: Trends in nitrogen emissions to water, total cattle and nitrogen fertilizer sales from 1990 to 2018. Source: EPA (2019) 'Water Quality in Ireland 2013-2018', p.98

The EPA report (2019: 9) states that phosphorus is primarily an issue for rivers, lakes and estuaries, while nitrogen is primarily an issue for coastal waters and estuaries. The report found that nitrogen emissions to water were particularly concerning in the south and southeast of Ireland where nitrogen levels were higher than average and increasing in the marine environment, and where river sites had higher nitrate concentrations. The report attributes this to farm intensity and freely draining soil that is susceptible to nitrogen leaching – stating that the higher the application of nitrogen to the land, the higher the nitrate concentrations in water (EPA, 2019: 98).

Excess nutrients are not the only issue impacting Irish waters. Excess sediment in run-off from land, and land drainage and channel maintenance also impacted habitat quality in many places. There is evidence that chemicals such as pesticides and herbicides, are impacting on the aquatic environment in some areas and a number of drinking water supplies in Ireland have been affected by pesticide exceedances. The National Pesticide and Drinking Water Action Group is working with stakeholders to raise awareness of best practices and the requirements of the Sustainable Use of Pesticides and Good Agricultural Practice regulations.(EPA, 2019)

Buckley et al. (2013) while investigating the cost-effectiveness of using less nitrogen, highlights education as reason for overuse and as a way of tackling change in policy. Teagasc's actions are following this approach and they are monitoring impact. The need for site specific measures (or area specific) is emphasized because of diversity in soil composition. Ultimately there are financial savings for farmers from the reduced use of less nitrogen.

Inadequate and inaccurate information relating to specific crop nutrient requirements and farm nutrient balances are potentially contributing factors to diffuse pollution from agriculture. Promotion of nutrient management practices such as periodic soil testing and adoption of nutrient budgeting and management systems would assist in addressing any asymmetric information gaps at farm level. It may encourage farmers to inform them-selves on optimum nutrient levels for their crops. (Blackstocket al., 2009.) Extension work, based on a participatory approach which engages farmers, may influence farm level nutrient management practices and promote desirable normative behaviour. However, further research is required to investigate the factors that drive farmer uptake of nutrient management best practice and adoption of technology in this area. (Buckley et al. 2013: 123)

6.3.1 Cattle Farming

Cattle farming and the application of nitrogen fertilisers are particularly related to ammonia emission levels (EPA, 2020). It is estimated that approximately 15% of nitrogen in animal manures and 2% in synthetic fertilisers is lost to the atmosphere as NH_3 (EPA, 2019), while up to 90% of nitrogen in cattle urine may escape into the air as ammonia[23]. (Ghaly et al., 2015: p.14, referencing Varel., 1997[24].) Emissions commonly occur from livestock buildings, open feedlots, manure storage facilities as well as manure handling and application to the land (Ghaly et al., 2015: 7). Between 2012 and 2017 there was a 26% increase in dairy cow numbers and a 24% increase in nitrogen fertiliser use, which have been found to be the main drivers of the increase in ammonia emissions during this time (Figure 17). Since 2017, the EPA have found that NH_3 emissions have increased by 2.4 kt in Ireland, due to a 3.1% increase in the size of the dairy herd and an 8.8% increase in synthetic nitrogen-based fertiliser use (EPA, 2019b: p.13).

[23] according to a study exploring livestock feedlots.

[24] Ghaly et al. 2015. Nitrogen Sources and Cycling in the Ecosystem and its Role in Air, Water and Soil Pollution: A Critical Review https://www.longdom.org/open-access/nitrogen-sources-and-cycling-in-the-ecosystem-and-its-role-in-air-waterand-soil-pollution-a-critical-review-2375-4397-1000136.pdf

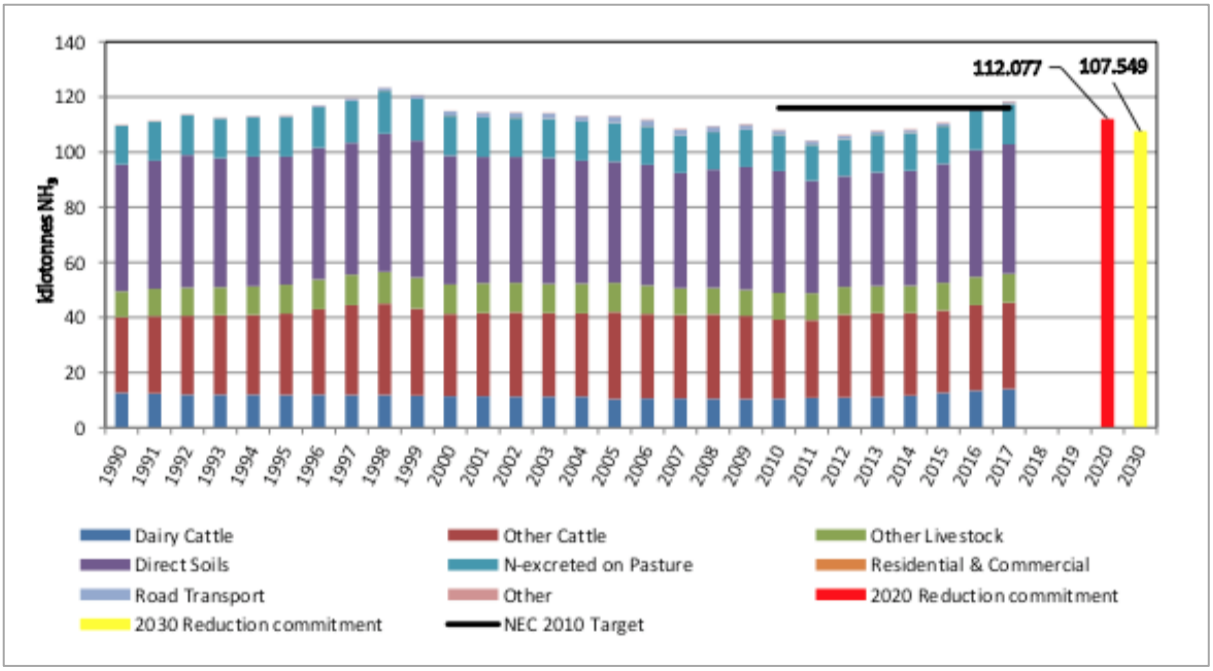


Figure 17: Trends in NH3 emissions in Ireland – 1990 to 2017. Source: EPA, 2019

Cattle farming can directly and negatively impact on water quality when cattle are allowed direct access to on-farm waterbodies as a source of drinking water (Conroy et al. 2016[25]; Kilgarriff et al., 2020; Ó hUallacháin, 2019[26]). Though little of their time is spent in waterbodies (2%), cattle preferentially defecate in water when they have unrestricted access, producing direct nutrient pollution and sediment pollution from where their presence results in 'poaching' (Conroy et al., 2016: 18).

In an interview extract below, Jenny Deakin, a senior analyst at Environmental Protection Agency Ireland (EPA), explains what kind of pollutants threaten water quality in Ireland. She emphasises the importance of better targeted measures for monitoring water quality especially in rivers.

> "…traditionally Ireland has had a one size fits all approach. We've only just started to move towards better targeting of measures with the second cycle river basin management plan, and I'd expect that to continue. We need 'the right measure in the right place'. [Q: At what scale would you say that needs to be addressed?] It depends on the issue, for phosphorus, sediment and pathogens it's local scale, so that's field, farm and sub-catchment scale. It's very driven by the poorly draining soils and the hydrology. But for nitrogen it's typically a much wider scale issue, at catchment scale. In this case it is the more freely draining soils that are the risky areas. For nitrogen, it is the catchments in the south and south east of the country that are of the greatest concern and this is where most of the intensive dairy farming takes place." (Jenny Deakin – EPA)

25 https://www.sciencedirect.com/science/article/pii/S0048969715312754?casa_token=SZxQSK8om9YAAAAA:IvrO34MCx0HcbHoRyRHaJ24vvHmSb2CYCRalgihLwmuINTOXFP5-03DNbB_kG6TkM_jDQ8mRFaM

26 https://www.teagasc.ie/media/website/publications/2020/6758_CattleAccessToWatercourses_DOhUllachainCELUP.pdf

Policy/practice recommendations

Based on the literature and expert interviews, the following four policy recommendations for improving the quality of Ireland's water resources can be concluded:

- **Soil testing** prior to spreading of slurry, manure and synthetic fertilisers; considerations of seasonal rains and fertiliser applications with regards to ammonia deposition;
- Use of **urease inhibitors**[27];
- **Fencing of waterbodies** to prevent cattle access (of which there is a cost-efficiency model) reduce concentration of livestock in areas where there are at-risk waterbodies.
  Fencing off on-farm water bodies is a preventative measure that can prevent this form of agricultural pollution but is an expensive intervention to impose.
- **Impact of time of year on fertiliser use ought to be considered.**

The cost-efficiency of the third policy recommendation, fencing of waterbodies, has been recently expolered by Kilgarriff et al. (2020). They found that targeting high intensity and mid intensity farms, namely derogation farms, is overall the most effective strategy to elicit optimum impact for the least cost. However, they highlight that derogation farming alone does not take into account the spatial differences within regions and the location of dense waterbodies. To be most cost-efficient, the intervention must consider both farm intensity and length of on-farm watercourses, as some low intensity farms may have large on-farm water bodies which will have less impact on water quality than to fence a high intensity farm with a short on-farm water body, as the high density of stocking rates will produce higher amounts of manure and slurry, with higher potential for pollution. As Kilgarriff et al. (2020) note: "An examination of costs in isolation will not provide all the necessary information. The inclusion of benefits, in the form of reduced in-stream faecal deposition, highlights the cost effectiveness of fencing the farms with the lowest levels of on-farm watercourse first. Breaking down this sub-sample further, those farms with the highest stocking rate and largest paddocks with access to a watercourse should be prioritised. The corollary to this is that although some areas may have high levels of on-farm watercourse, if they have low levels of agri-cultural intensity, the effectiveness of fencing is reduced" (Kilgarriff et al., 2020: 66)[28]

The last policy recommendation suggests that the time of year has an impact on fertiliser use. In the United Kingdom, organic nitrogen has estimated to make up to 24-40% of the total amount of dissolved rain and snow. During springtime, rain has a maximum concentration of ammonium and nitrate while there is more water-soluble organic nitrogen in late summer rain. (Cape et al.: 2001; Cape et al.: 2004.)^footer Seasonal variation in contribution from rainwater to nitrogen added to soil or runoff water was recognised by Goldberg in 1970. In addition to time of the year, it is dependent upon the location of a farm. Goldberg stated that seasonal and geological variation have a great implication not only the amount of fertiliser used by farmers but the consequent air and water pollution. (Ghaly et al., 2015: 10)

---

[27] Tzemi, D., & Breen, J. 2019. Reducing greenhouse gas emissions through the use of urease inhibitors: A farm level analysis. *Ecological Modelling,* 394, pp.18-26

[28] Kilgarriff, P., Ryan, M., O'Donoghue, C., Green, S., & Ó hUallacháin, D. 2020. Livestock exclusion from watercourses: Policy effectiveness and implications. *Environmental Science & Policy*, 106, pp.58-67. https://www.sciencedirect.com/science/article/pii/S146290111930989X

Footnote 15. Cape et al. 2001, cape et al. 2004,

6.3.2 Tillage

Soil erosion from rain, wind, livestock and other agricultural activities such as the use of machinery and crop management can result in nutrient and sediment loss to waterbodies. But there are notable differences between grazed grassland and tillage condition.

According to the River Sediment Studies by EPA, there are two ways which can result soil erosion in nutrient and sediment loss to waterways:

> "Depending on rainfall the suspended solids loss from grazed grassland in Ireland can range between 45 and 90 kg per hectare which is relatively low compared to losses of several tonnes per hectare that can occur with severe soil erosion under tillage conditions. Any remedial measures to improve the mussels' and fishes' habitat, if focused on reducing fine material transport into streams, would also help to reduce diffusion of nutrients." (EPA, https://www.epa.ie/pubs/reports/water/rivers/EPA_River_Sediment_Studies.pdf)

"Modelling of water and tillage erosion rates across Europe suggests that soil is being lost at a rate greater than it can be replenished by natural soil formation which can result in nutrient and sediment loss to waterways (Regan *et al*., 2012). Depending on rainfall, suspended solids loss from grazed grassland in Ireland can range between 45 and 90 kg per hectare (Tunney *et al*., 2007) which is relatively low compared to losses of several tonnes per hectare that can occur with severe soil erosion under tillage conditions (Morgan *et al*., 1998). Approximately 80 per cent of agricultural land is devoted to grass, 11 per cent to rough grazing and nine per cent to arable cereal and crop production (Regan *et al*., 2012)." (EPA, https://www.epa.ie/pubs/reports/water/rivers/EPA_River_Sediment_Studies.pdf: 50)

6.3.3 Forestry

Negative impact on clear-fell forest harvesting because of nutrient leaching through the uprooting of plant life that takes up nutrients and sediment pollution from the process and use of machinery. Also mention of the negative *initial* impact of returning forests to peatlands/wetlands for carbon sequestering. Apparently, this can negatively impact on water quality in the first few years. (Shah & Nisbet, 2019; Nieminen, et al, 2020)

Policy recommendations:

Staged felling. Taking this approach to allow for the net present value of the investment in forestry to be more easily managed and for opportunity costs not to be understood as irrecoverable sunk costs.

6.3.4 Intensive Poultry Farming

Issues with poultry farming are the energy feed ratios. Phosphorus levels in their litter which, combined with high concentration farming is an issue for waste management. French poultry farm and Brazilian comparison of Da Sulva et al. (2014) remarks upon how concentration of broiler chickens impacts on the environment because of high feed-conversion ratio of production system. Feed-production stage contributed most to overall environmental impact of poultry farming. This due to the fact that intensive poultry farming has high feed-conversion ratio, around 3.1. kg of feed per kg of live weight. (Da Silva et al. 2014.)

7. Agri-Environment Schemes

7.1 Barriers/incentives to Agri-environment schemes (AES)

Agri-environment schemes (AES) are voluntary, which means that participation is crucial for policy objectives to be achieved. The closer the participation rates are to AES uptake targets, the greater probability the schemes will have of achieving their aims and improving the environment

(Mettenpenningen et al., 2013; Lastra-Bravo et al., 2015). This section identifies the key factors that influence farmers' participation in agri-environment schemes (AES), with a particular focus on Ireland.

7.1.1 Actual AES uptake potential

In Ireland, a recent study investigating AES participation[29] found that up to 70% of farmers are open to the idea of participating in agri-environment schemes, depending on financial compensation (McGurk et al., 2020). This indicates that a significantly higher proportion of farmers would be open to AES participation in Ireland, compared to actual participation rates[30] (McGurk et al., 2020). Interestingly, the study also found that 30% of farmers were unlikely to ever participate in agri-environment schemes, regardless of financial compensation. Identifying uptake limits also enables policymakers to understand what can be achieved through AES (McGurk et al., 2020: 7).

One of the experts interviewed for the report was Sinead O'Brien, the coordinator of the Sustainable Water Network of Ireland. In the following interview extract, she mentions a few potential reasons for farmers' low interest in attending AES:

> I think the reason farmers distrust it is because they're [Department of Agriculture] saying, on the one hand you're telling me that I should be intensifying, increasing my dairy herd, and on the other hand you've got this scheme that I'm invited to go along to meet some farmers to tell me to keep my wetlands, but actually I'm being penalised for keeping my wetlands, because that land is not in good agricultural condition, and so it comes out of the eligibility for my single-farm payment. So I think it's these mixed messages that lead to distrust." … "I think we need to deintensify, we need to cut the national herd, and we need to bring our production targets way down and concentrate on quality rather than quantity of food. Agri-environmental schemes on their own aren't going to do that." [original emphasis] (Sinead O'Brien - SWAN)

Policy Recommendations:

As McGurk et al. (2020) mention, 30% of farmers were found unlikely to ever participate in AES regardless of income, other compulsory policy options may be needed to ensure that farmers ensure conservation management. McGurk et al. (2020:8) note that: "This is already happening under the CAP with cross compliance and a likely increased demand for higher levels of environmental stewardship in order to receive the single farm payment under future reforms."

7.2 Financial incentives: influence behaviour but are not always enough

The literature is clear that while financial compensation does contribute to farmers taking up AESs, financial incentives alone cannot ensure conservation management. Afforestation is a clear example of this. Afforestation policies ensure that farmers are able to maximise farm profitability, yet there was and is very little uptake of this practice by farmers in Ireland. The main findings in the literature are concluded below:

[29] Using a contingent valuation exercise

[30] Peak rates were seen for REPS 3 and 4 where almost 50% of farmers were participating in an AES (Murphy et al., 2014, referenced in McGurk et al., 2020)

- **Financial incentives matter.** In the accordance with Duesberg et al., (2013: 157), while farm management does not revolve around economic goals, prior to the premium scheme, little afforestation took place, showing that financial incentives do have a place.

- **Financial compensation increases participation.** McGurk et al. (2020) found that a high number of farmers would consider participating in AESs if they were appropriately compensated financially. Though they remark that "increasing payments would lead to greater overall scheme costs in the absence of more precise targeting of funds".

- **The level of payment in important.** Interestingly, Lastra-Bravo et al. (2015) found that the level of payment offered by the scheme is one of the most important drivers for farmers to adopt AES. This due to the fact that these payments are an important source of income for farmers. As Lastra-Bravo et al. (2015:8) note:" Many farmers would consider fair payments and lower levels of disruption to their normal agricultural activities, as an acceptable alternative to higher payments requiring greater changes to their farming systems."

- **However, farmers do not always prioritise financial gains.** As mentioned by Lastra-Bravo et al. (2015:2), adequate payments alone cannot ensure conservation management. Thus, in order to make agri-environmental policies successful, the participants of the scheme should gain some level of cultural understanding around the need of management. As Lastra-Bravo et al. (2015) and Wynne-Jones (2013) conclude, farmers do not simply prioritise financial gains above all other factors. On the contrary, as Wynne-Jones (2013) suggests, farmers may gain equal or greater utility from environmentally or societal beneficial actions.

Ultimately, the using of financial incentives may not make sense from the point of view of the farmer on the ground:

> "Generally, when you tax something, you're trying to encourage use or behaviour change onto a different method. There is no alternative there that these methods could be replaced by. What that would do from a production point of view, from a security point of view, it would threaten it quite a bit." (Peter Linden - IFA)

Policy recommendations:

McGurk et al. (2020) and Prager et al. (2012) suggest that future AES ought to be planned, designed and implemented at a landscape scale. This would help to optimise the provision of ecosystem services on farmland.

7.3 Values: Extrinsic & Intrinsic Motivation

In their study, Russi et al. (2016) talk about extrinsic motivations (in most cases money) and intrinsic motivations (in this case normative/environmental concern) and how they interact in farmers decision-making. They point out, along with Muradien (2013), that incentives work well if conservation is driven by both extrinsic and intrinsic motivations. As Russi et al. (2016:75) write: "Farmers who choose to maximise the income from their grassland through intensive cattle husbandry or biogas production, and are not very interested in environmental conservation, will not decide to modify their management practices because of an incentive, unless this (or a proper market-based instrument that can provide a strong extrinsic motivation) covers all their opportunity costs". Interestingly, all of their

interviewees had agreed that MEKA-B4's payment was not enough to encourage them to change their management practices towards a less intensive use of grassland.

7.3.1 Farmer values:

Beyond the financial, studies have found that farmers' identity and attitudes hold great influence on their participation in agri-environment schemes. Duesberg et al. (2013) draws on Ruth Gasson's (1973) theory of farmers' goals to show "farmers exhibit complex, multiple and sometimes contradictory values in relation to farming". The values are following:

- instrumental - i.e. making the maximum income, making a satisfying income
- intrinsic - i.e. enjoyment of work tasks, preference for a farming lifestyle, purposeful activity, control over land
- social - i.e. farming for the sake of interpersonal relationships, continuing the family tradition.
- expressive - i.e. farming as a way of self-expression, meeting a challenge, exercising special abilities or aptitudes, pride of ownership

Regarding afforestation, Duesberg (2013: 18) find that less risk-averse farmers were more likely to plant, while farmers who put more weight on farming lifestyle or family tradition were less likely to consider afforestation. The result of the study show that farmers' profit goals did not significantly affect on their decision to afforest. These results demonstrate that farmers' profit goals are not primarily related to considerations about the comparative returns from farming and forestry. Farmers' decisions to afforest can be better influenced by addressing these evidence-informed factors:

- **Afforestation schemes are unsuccessful due to the opportunity costs of planting trees.** Howley et al. (2015) highlights a lack uptake despite financial incentives, partly because planting is irreversible and is seen to devalue land (Duesberg et al., 2013). Planting trees is seen as 'high-risk', while food production is low-risk as farmers can regain control of land easily (Howley et al. 2015: 186). Food production is also seen to be more valued by farmers than working the land for the environment (Inman et al. 2018).

- **Identity matters**: Cullen et al. (2020) found four different self-identities of farmers:
  - *Forward looking*,
  - *Productivist*,
  - *Conservative* and
  - *Optimistic caretaker*.

  In terms of AESs, farmers' perceptions split between *Benefits conscious* and *Drawbacks conscious*. While the study found that farmers' perceptions of the scheme are important, the relationship between farmers' self-identity and these perceptions also matters for farmers when they are making a decision regarding participation to the scheme. (Cullen et al., 2020.)

- **Participation is identity driven, most importantly where the farmer is of a *forward looking* disposition.** Farmers with a strong forward-looking identity are more likely to participate in an AES. Research has shown that these farmers see themselves as innovative and are looking forward to farming in the future. The relationship between this identity type and participation could be explained by their willingness to make necessary changes to participate to the schemes such as AES. (Barreiro-Hurlé et al., 2010; Willock et al., 1999). The relationship between farmers with other self-identities (*Productivist*, *Conservative*, *Optimistic caretaker*)

and their participation choice is influenced through their interaction with the farmers' opinions on the scheme characteristics. (Cullen et al., 2020.)

- **Risk averse farmers will not engage in afforestation.** "A negative value on the interaction between *Benefits conscious* and the *Conservative* self-identity may be due to the risk aversion of *Conservative* farmers and the slow reaction of conservative farmers to changing incentives, whereby there is a substantial delay between the introduction of schemes and their uptake by these farmers, and may not necessarily be related to insufficient benefits (Baur et al., 2016)." Cullen et al., 2020:6).

- **Famers that see themselves as businessmen will undertake afforestation if the net-present value is positive.** "The positive value of the *Productivist* self-identity interaction with *Benefits conscious* is likely to be due to the monetary benefits of participating in an AES, which some *Productivist* farmers would find enticing. As Sulemana and James (2014) suggest, productivist farmers see themselves as businessmen who act in a way that improves the situation of their business. So if a scheme financially net positive, or the scheme provides other benefits to them, they will choose to participate." (Cullen et al., 2020: 6)

- **Apathy about the environment will act as a strong disincentive. Internal motivations ultimately define action.** Reflected on those 'apathetic to environmental issues' as less likely to partake in farm forestry (Howley et al, 2015: 186) – this relates the extrinsic/intrinsic factors Russi et al. (2016)

Carol McCarthy finds that many of the problems with afforestation are a consequence of pat decisions that have cast a long shadow in the farming community. The inability to communicate to the farming community that "this is not your father's forestry" needs to be addressed if forestry is to be successful as an environmental policy solution.

> "…a lot of issues with forestry, I think, are legacy issues, the planning controls around forestry are a lot better at the moment, but it's the legacy forests that, I think, people still assume that that's the way things are done." (Carol McCarthy – LAWPRO)

Policy Recommendations:

- **Policymakers need to find methods to change behaviours and that begins with changing attitudes to the farmers towards the policy tool.** "The findings around the importance of attitudes and self-identity to the participation decision suggest multiple possible avenues for policymakers to improve or maintain the participation rate. One such avenue could be to changing farmers' attitudes towards schemes. Studies have investigated the possibility of non-fiscal and non-regulatory changes that can be made to alter farmers behaviour, known as 'nudges', that have had promising results in changing environmental attitudes and behaviour in experimental situations (Barnes et al., 2013; Czajkowski et al., 2019). Wilson and Hart (2000) found that the likelihood of acknowledgement of the benefit of AES measures increases with familiarity. Morris et al. (2000) argue that while mass media and generic literature are relevant, personal contact and demonstration are critical for the adoption process of measures. Other possible nudges to change attitudes and behaviour include changes to default policy, changes to the physical environment and use of social norms (Barnes et al., 2013). Changes in scheme design can also result in attitude changes, increasing the benefits and reducing the drawbacks for farms to participate while still meeting environmental and other goals. A farmer led design process may aid in this step in designing practical schemes that would work on their farms (Cullen et al., 2018)." (Cullen et al., 2020: 6)

- **Decisions are made at the margin. Appealing to business-minded farmers requires improvements in gross margin and long-term farms look for operational returns with long time horizons.** "a farmer who is a *Productivist* will be more likely to participate if there is a possible increase in the profitability of their farm. The monetary incentive already exists in AESs but demonstrating an improvement in their profit margins by implementing win-win measures such as optimising nutrient application, increasing pollinator numbers and improved slurry management, could also increase the likelihood of them participating. 'Win-win' measures may also increase participation of *Forward looking* farmers who are looking for ways to keep their farm running into the future." (Cullen et al., 2020: 6)
- **A value prospect, either in the form of improved leisure consumption or the transferal of assets to subsequent generations needs to be illustrated.** "To encourage more farmers to plant, those values need to be taken into account in policy development. For example, to get 'lifestyle farmers' interested in planting they would need to be shown how farmers can get involved in interesting work tasks around establishing and managing a forest. Addressing those farmers for whom family tradition is important could focus on the future value of a forest for their successors." (Duesberg, 2013: 18) "Identifying the range of motivational profiles of farmers may assist extension officers in their dealings with them. For example, recognising a farmer as generally motivated by the lifestyle benefits associated with farming rather than purely economic motives may assist in targeting of appropriate advisory services to that individual. Outside of explaining farm–forestry participation, ac- counting for different farming motivations and values may help explain farmers' behaviour in relation to a variety of activities. There is perhaps a need, therefore, for a greater integration of both farming motivations and financial factors in economic models concerned with understanding and predicting farmers' response to policy changes." (Howley et al., 2015: 193)

7.4 Previous experience and the influence of others: neighbours and social networks

The farmers' decision to participate to AES is also influenced by their positive experiences, with are a strong reinforcement mechanism for a farmer, and their peers' perception of their actions. Research shows that previous experiences of an AES positively affect farmers' likelihood to participate in an AES. Farmers may be more likely to trust in a familiar policy instrument or be more confident that they can play the system and profit from the associated payments. This is significant because of the finding that neighbouring farmers' experiences and opinions about AES influence farmers' behaviour. (Lastra-Bravo et al., 2015: 8.)

Duesberg et al. (2013:18) found that positive experiences of planting trees were passed on by word-of-mouth by neighbouring farmers, which they suggest could explain why farmers living in counties with above-average forest cover were more likely to participate in afforestry themselves. Likewise, in their recent study Cullen et al. (2020) found that neighbouring farmers' viewpoints have significant and positive impact on participation. Lastra-Bravo et al. (2015:8) suggest that "The social capital of rural areas could be enhanced if farmers were required to work together in AESs at a landscape scale that would also benefit biodiversity".

Also these interviewees noted the importance of the role of farming community and farmers' social networks:

> "The general feedback I get from this is that the knowledge exchange, people who attend the knowledge exchange various different services, or the discussion groups that are facilitated through the coops, where they can learn through their peers, have a much higher level of, 1. Engagement and 2. Enaction of the measures, than those who do not engage with these kind of discussion groups." (Alison Graham – ICOS)

> "So if you can get it embedded in a community – I think that's the best way you're going to get long term improvements in water, in environmental issues and so on.**"** (Noel Meehan - ASSAP)

Policy Recommendations:

- **Bootstrap peer-to-peer information sharing networks.** In their meta-analysis, Skaalsveen et al. (2020: 1-2) found that farmer networks (both peer to peer and with other actors) are more influential in sharing in- formation than other more established factors, such as farmers' age and farm size (Ramirez, 2013; Baumgart-Getz et al., 2012; Prokopy et al., 2008)." Which could provide a useful avenue for knowledge-sharing. As Lastra-Bravo et al. (2015) suggest, policy makers could take advantage of the farmers who have prior experience with AESs, to act as advocates for or champions of the benefits of the AES participation (Lastra-Bravo et al., 2015: 8).

- **Reinforce good will via knowledge exchange mechanisms that support AES practices.** Lastra-Bravo et al. (2015: 8) state that "a positive attitude towards the environment can be reinforced through the introduction of measures such as improved knowledge exchange mechanisms, which succeed in demonstrating the links between good management and the delivery of ecosystem services. In this way, future generations of farmers could be encouraged into a greater willingness to adopt the practices promoted under AESs. In addition, active participation by farmers who are more deeply committed to delivering the management outcomes promoted by schemes should further improve the effectiveness of agri-environment measures."

- **Positively bootstrap peer pressure to encourage farmer participation as peer opinion is held in high regard. Achieving participation requires the participation of the peer network.** "Another particularly interesting result from the analysis is the evidence of the strong impact that neighbours' viewpoints have on decisions made by farmers. This confirmation of the importance of social influences is important in the current policy environment with in-creasing support for locally-led, participatory schemes that involve farmers in scheme design and implementation processes (such as European Innovation Partnerships (EIP)). If social norms or other factors induce a farmer to join neighbouring farmers in an AES it means that the creation of locally-led schemes will be less challenging once the first influential farmer initiates the idea (Lastra-Bravo et al., 2015)." (Cullen et al., 2020: 6)

- **Tailoring policies to specific regional conditions is crucial to success**. "From a rural development, but also from a forestry perspective, it would be necessary to outline regions and farm enterprises that future afforestation policies should focus on. Such planning could ensure that resources are concentrated on areas where the natural conditions would be most suitable for forestry and where local economies would benefit most from a strong forest sector." (Duesberg et al., 2013: 19)

- **Include local knowledge via farmers and agents in the tailoring of policies to achieve ownership and participation.** "Whittingham (2011), in a review of 13 papers evaluating the environmental performance of AESs, reported that there are signs that management options targeted spatially within the landscape and implemented with careful advice can deliver substantial biodiversity benefits. In terms of good practice, Whittingham goes on to argue that in order to ensure that schemes are effective, it is crucial that farmers and land managers are included in the design of the schemes to ensure the better participation and engagement of

farmers. He provides the example of the unpopularity among farmers of AES options in England that require them to manage land within the crop itself (Whittingham, 2011)." (Lastra-Bravo et al., 2015:8)

- "A key observation from our research is that expecting farmers to adopt mitigation measures spontaneously in response to existing incentives, advice and regulatory stimuli is unrealistic. Proactive and sustained engagement is needed, facilitated by appropriate policy support. In particular, it is likely that the scale of change needed will only be enabled by engaging the farming community in deliberative discussion over the role and purpose of food production within the wider rural landscape and the multi-functionality society increasingly requires from that landscape. Running in parallel with this process is a need for expert and trusted advice, delivered on a one-to-one basis at the individual farm level. It is only through equipping farmers with a will to change behaviour, and the confidence and ability to do so, that systemic shifts in mitigation option adoption will become manifest. In addition, compliance with environmental legislation is likely to be far higher where farmers buy-in to what they are being asked to carry out. This can only be achieved through mutual understanding which re- quires dialogue over an extended period of time; both at a farming network and individual farmer level. An argument exists, therefore, for policy makers to invest resources in a properly equipped extension service with the necessary technical and social skills to engage effectively with the agricultural sector. In a time of limited public sector budgets, it is difficult to envisage such resource being forthcoming. It is worth speculating, therefore, whether resources could be made available from actors within the food supply chain, all of which ultimately depend on a sustainable land management system for their continued existence… Engaging with rank and file members of the farming community respectfully and with sensitivity regarding the future design of agri-environmental policy will be key; an aspect policy makers and environmentalists ignore at their peril." (Inman et al., 2018: 24)

- "Recent research confirms that sustainable agriculture is best advanced by multi-actor knowledge networks where different stakeholders with their various kinds of knowledge meet and negotiate and institutionalise new meanings and new farming practices (Moschitz et al., 2015; Tisenkopfs et al., 2015a; Wood et al., 2014; De los Ríos et al., 2011; Knickel et al., 2009). Knowledge networks make explicit the interactive and participatory character of knowledge generation and learning with the farmers being active partners and knowledge co-producers rather than passive receivers. In reality 'local farmers' knowledge' is often an amalgamation of different knowledge sources (Beckford and Barker, 2007), but farmers need to adapt this 'foreign' knowledge to their specific settings to make it useful (Stuiver et al., 2004). This reemphasises farmers' active role in knowledge generation and, in particular, in assuring its practical applicability." (Šūmane et al., 2018: 235)

7.5 Impact of other policies

The internal contradictions of CAP can work against participation in AES programmes. It has been noted that other CAP policies may be themselves be deterring farmers from participating in AESs. A study on coefficiency found that:

> "the effects of policy measures in favour of young farmers could be neutralized by still high incentives to remain in agriculture provided by the same policy. As regards intervention in favour of sustainability, the green payment could produce much lower environmental benefits than expected and could be ineffective in territorial contexts where there is high presence of small farms. In addition, rural development measures are still activated on a voluntary basis

and this can sterilize the positive and potential effects induced by agri-environmental schemes." Bonfiglio et al. (2017: 124)

In their research examining afforestation, Duesberg et al. (2013) note that the Rural Environmental Protection Scheme (REPS) was detrimental to planting because it offered an alternative to farmers that was more appealing (because of attitudes towards planting on 'good' land).

Policy Recommendations:

Resource targeting towards younger farmers and complimented by green regulatory frameworks can achieve environmental goals in the face of policy contradictions. Bonfiglio et al. (2017) suggest that these drawbacks could be avoided if the current policy framework was changed to favour young farmers and greening with higher and more targeted resources and more stringent rules, respectively.

7.6 Farmer characteristics: age

AES schemes do appeal to older famers. McGurk et al. (2020) found that in Ireland, older and younger farmers were least likely to participate, suggesting that older farmers are more conservative and reluctant to change farming practices so close to retirement, while younger farmers are more likely to work highly productive and profitable farms, which were found to be less likely to employ AES (McGurk et al., 2020: 7).

- **Older farmers will not seek to impose opportunity costs on the next generation and will shy away from AES programmes with long time horizons.** Lastra-Bravo et al. (2015: 7) found that the presence of a successor farmer (who is not the primary farmer) had a negative effect on farmers' willingness to adopt an AES – because of the length of the contract extending beyond their period of stewardship for the farm. (So, evidence of thinking about the future, but wanting to enable the successor to control that future)

- **Middle-aged farmers will accept long-term schemes if they generate an asset of value to transfer to the next generation.** In their study looking at factors influencing Irish farmers afforestation, Duesberg et al. (2014a: 19) found that of farmers who had already planted, those aged between 45 and 64, who were married and had children were more likely to change their minds in favour of planting trees. "From our previous study, we know that the most important reason for planting, for those who already had planted, was generating an asset for their successors." (2014:19)

- **Life-cycle position matters for environmental impact decisions. Young farmers embrace eco-efficiency. Established farmers will seek to maximize return on investment.** In their research on 'eco-efficiency', Bonfiglio et al. (2017) found that younger farmers were more eco-efficient, and that older farmers are less concerned closer to retirement. (Older statement in keeping with McGurk – younger contrasts slightly, though is measuring different thing – eco-efficiency not same as AES). Bonfiglio et al. (2017: 122) also found that family aged farmers try to extract as much profit from the land as possible, which leads to higher intensity farming: "While an agricultural holding is more eco-efficient if it is led by a young farmer, a farm with sons or daughters engaged in the agricultural activity shows lower levels of eco-efficiency. In other words, the possibility of generation renewal is associated with a greater pressure on the environment. This can be due to the objective of ensuring a higher income to family, which leads farmers to increase the level of intensification." Bonfiglio found that eco-efficiency depends on the presence of a young farmer if they are the farm owner and are adhering to environmental schemes. This is perhaps more important consideration for Ireland where majority are family-run farms.

Policy Recommendation:

- **Improved succession planning will temper these age and life cycle effects.** Policy makers could encourage "a greater involvement of the successor in the decision-making process or to design new policies where the contracts could be modified or withdrawn in the case of a change of management. This added flexibility could encourage farmers to participate in schemes that offer longer contract lengths which otherwise might be less attractive to them." (Lastra-Bravo et al. 2015: 7)

- **Capital improvement grants at generational transition could set farms on eco-efficient pathways.** "Policies oriented to favour generational renewal could be helpful in reducing environmental pressure exerted by arable farms" (Bonfiglio et al., 2017: 124)

7.7 Farm Structure: Dairy & Tillage

Dairy farmers are intensive, profitable and least likely to engage in an AES programme. Dairy farming is the most intensive and profitable element of Irish farming (McGurk et al., 2020).

- **Dairy farmers and intensive livestock farmers are the least likely to participate in an AES.** In their study exploring results-based agri-measures for species-rich grasslands, Russi et al. (2016: 73) found that dairy farmers and those with intensive livestock systems were less likely to participate. They give a financial rationale for this, as does not give substantial motivation to change: "All our non-participating interviewees carry out cattle husbandry in their land, and for them MEKA B-4 does not represent a sufficient motivation to switch to extensive grassland management. In their case, the payment would need to be much higher than D 60/ha to represent enough external motivation to make them change their farm management strategies."

- **Dairy farmers are the least likely to engage in afforestation.** Duesberg et al. (2013:18) found that dairy farmers were less inclined towards planting trees. Suggesting that this is to do with the high profitability of dairy farms, the investment put into it through machinery and technical equipment, which are often financed by loans. Another rationale given was due to their operating on 'good' agricultural land and how farmers are reluctant to plant such land. "Dairy farming in the past has been the most profitable farm enterprise in Ireland (Hennessy et al., 2011). It is a highly specialised business that needs a high level of investment in machinery and technical equipment, which is typically financed by loans (Hennessy et al., 2011). Such sunk costs determine the course of the farm business for many years into the future, also termed as 'path dependency' by economists. Another explanation for dairy farmers being less likely to join the afforestation scheme could be that they typically operate on fertile or 'good' agricultural land (see above). As our previous re- search and other studies have shown, farmers in general are reluctant to plant such land. While dairy farmers might be less likely to plant, it is questionable whether such a group should be targeted when designing policy tools to encourage farm afforestation and whether it makes sense from a rural development perspective to offer alternative income streams to viable farm business such as dairy farms." (Duesberg et al., 2013: 18)

- **Profitable (market-orientated) farmers are driven not to engage by lack of return, less market-orientated/profitable farmers will be discouraged by cultural factors.** Duesberg (2014) also found that tillage farmers were less likely to plant. If the incentives were too low, tillage and dairy farmers were less likely to plant. Drystock farmers' (cattle, sheep, mixed cattle and sheep) decision to not to plant was influenced by their lifestyle and tradition. Mixed tillage

and grazing farmers' decision to not to plant was influenced by both low incentives and traditions. They were more likely to not to plant because of tradition compared to tillage and dairy farmers but more likely not to plant because of incentives than drystock farmers. (Duesberg 2014.)

- **Farmers remain price sensitive, either to spot prices or the cost associated with leverage, and this matters to the AES decision-making processes of farmers.** "On the other hand, tillage farmers were not significantly disinclined to plant, despite them also typically, being viable businesses and operating on fertile land (CSO, 2012; Hennessy et al., 2011). One reason might be that fewer tillage farms run their businesses with loans compared to dairy farming (Hennessy et al., 2011). Also profit margins on tillage farms have been decreasing in the past due to the continuous increase in fertilizer and fuel prices. Another possible explanation could be a number of unusually wet summers and cold winters in Ireland. From personal communication with for- esters in Ireland, we know that the interest in planting by tillage farmers rises after extreme weather situations. This is confirmed by findings of Sutherland et al. (2012) according to which farmers are more likely to make major changes in farm management after trigger events. While other farm enterprises, too, suffer from bad weather the effect can be more devastating to tillage farmers, as crops can be irreplaceably destroyed by a single extreme weather event. An- other reason for tillage farmers being less opposed to forestry might be that growing trees is closer to their understanding of an agricultural product than is the case for dairy farmers. As the average size of a tillage farm is 56 ha, which is significantly greater than the national average of 33 ha (CSO, 2012), and larger farms are more likely to be planted, targeting tillage farmers with afforestation campaigns could prove successful, especially after trigger events. Tillage farms typically operate on fertile soils, which would make them particularly interesting as sites for establishing forests of high nature value. Ireland offers a specific support scheme to create such forests. This scheme should be promoted when encouraging tillage farmers to afforest. As concluded above, however, the farm size big enough for planting could be flexible between enterprises. Thus a tillage farmer could consider 56 ha as being not big enough for planting." (Duesberg et al., 2013: 19)

Policy Recommendations:

To change dairy farmer behaviour will require larger financial incentives that offer higher return on investment prospects than currently deployed. Research has shown that dairy farming is the most intensive and profitable element of Irish farming. Proportionally larger incentives might be required by dairy farmers to engage them with AES. (McGurk et al., 2020) Duesberg et al. (2013: 18) suggest that: "While dairy farmers might be less likely to plant, it is questionable whether such a group should be targeted when designing policy tools to encourage farm afforestation and whether it makes sense from a rural development perspective to offer alternative income streams to viable farm business such as dairy farms."

7.8 Farm Structure: size & quality of land

Farm size and quality of farming land matter in terms of AES participation. It is easier to obtain AES participation from large, low capacity or marginal land farms. Larger farms may find it easier to participate in an AES due to the fact that it is easier for them to adapt different measures. (Lastra-Bravo et al. 2015)

Low capacity farms and those located on poor quality land will participate in an AES as part of a risk mitigation strategy. Farms that are located in areas that have lower agricultural capacity are more likely to participate in an AES as they are seen as compensating for the low capacity of the land and

offset risk associated with this. (Lastra-Bravo et al. 2015: 7) Similarly, Russi et al. (2016:72) found that poor quality land was an incentive to get involved in AESs and it reduced the potential for farmland abandonment or intensification: "For some of our interviewees, MEKA-B4's incentive component played a key role in avoiding land abandonment or intensification. This is the case for example of some of the farmers with land in difficult conditions, like upland farmers. Additionality can be high for them, as the payment may ensure the economic sustainability of their farming practices." (Russi et al., 2016: 74)

Farm size and land quality plays a key role in afforestation decision-making. "Irish farmers in this study on average planted forests if their farm size was at least 56 ha"..."An average farm size could be assessed as 'big enough' for planting if it is above the local average. As there is con- siderable difference in farm sizes within Ireland, a farm size 'big enough' for planting could change between counties. The fact that there is regional flexibility in the farm sizes deemed big enough for planting raises the question if there also is a temporal and sectoral flexibility. Average farm sizes have continually in- creased in the past; in Ireland average farm size grew from 22 ha in the 1980s (the decade where the first afforestation programmes were launched) to 33 ha in 2010. Thus the average farm size reckoned big enough for planting could have risen over the years, too. Also farm sizes differ between enterprises with tillage farms averaging 56 ha and specialist beef farms averaging 28 ha (CSO, 2012); thus farm sizes big enough for planting could also be varying between enterprise types. As the farm size plays a pivotal role in the decision-making with regard to farm afforestation the regional, temporal and sectoral flexibilities in average farm sizes might have to be considered when developing strategies to encourage more farmers to plant." (Duesberg et al., 2013: 18) Howley et al. (2015: 186) also found that farms with poorer quality of land were more likely to take up planting. Duesberg et al. (2013) highlight the reasons for planting trees as: - land is not fit to graze, - difficult to get to, - farmer does not have enough time to farm it, - has lots of land elsewhere to farm (big plot). Note that these are often supported by financial incentives. Highlights why not to plant: - farmers unaware of details of subsidy, - belief that the land isn't 'bad enough', - farming more appealing because 'produces food', 'quick use of land' and 'regain control of land'. This tells us that reasons to take up a particular scheme of afforestation is due to issues relating to quality of land – or perceiving there being 'too much' land to be productive with. The reasons to not plant are more value and knowledge based.

Policy Recommendations:

Farm size is important to the decision to engage in AES programmes like afforestation. When developing strategies to encourage more farmer to plant, an average farm size might have to be considered as it plays a pivotal role in the farmer's decision to afforest. Also, there are regional, temporal and sectoral flexibilities in average farm size, which are important to take into consideration when designing policies. (Duesberg et al., 2013)

7.9 Farm Structure: Full/Part time working

Part-time farmers are more likely to participate in AES programmes. Alternatively, farmers that rely upon their farm as part of family income will be less likely participate in an AES programme. Duesberg et al. (2013: 18) found that like dairy farmers, full time farmers were less likely to participate in afforestation. (to do with risk to profit?) Russi et al. (2016: 72) found that part time farmers were more likely to participate in agri-environment measures (in their case species-rich grassland): "In general, they tend to be less dependent on their agricultural income than full-time farmers and for this reason they are more likely to maintain species-rich grassland, as they are ready to accept a lower productivity and the resulting lower profits. Their motivation is thus mainly intrinsic." Those who are more

dependent on farm income and family labour were less likely to participate in AES. (Lastra-Bravo et al. 2015: 7)

Policy Recommendations:

Farmers are still income sensitive. More farms could be nudged to participate in AES if their dependence on on-farm income was reduced by policies. (Lastra-Bravo et al. 2015:7.) According to Mettepenningen et al. (2013), farmers were less unlikely to participate in AES if they had to bid for payments.

8. Economic Policy Options

8.1 Introduction to Natural Capital Valuation

A method of analysis that can provide an insight is the development of a natural capital valuation. It should be understood that this is an initial and not complete approach to natural capital valuation and has been performed to indicate the usefulness of the approach. The EPA has commissioned Professor Stephen Kinsella of the University of Limerick and Professor Jane Stout of Trinity College Dublin to undertake a comprehensive analysis and calculation of natural capital for Ireland.

By way of introduction, the natural capital model follows that of Helm (2015), which seeks to create an asset value for the natural environment and remove the link between the asset value of agricultural land as being found exclusively in the capitalization of CAP payments. If the land and environment have a value and if the subsidy structure is changed to reduce activities that socially harmful then the CAP structure can be used to achieve environmental objectives as opposed to work against them. The challenge is to develop an economic value on what is either a function of the CAP system's subsidies or suffers from a tragedy of the commons, where a lack of property rights results in the destruction of common resources in water and biodiversity.

As Helm (2016) states:

> Just removing the direct production subsidies would not lead to optimal production. There would still be overproduction because the private costs of farming do not reflect the full social costs. Farmers can avoid costs, by passing on their wastes to others to clean up. Thus fertilisers, pesticides and herbicides can flow into the water supply, for water companies to clean up – and for the water companies to charge their customers accordingly. Slurry and agricultural effluents can leach into the water systems. Land is drained to force off flood waters for others to cope with. Carbon is emitted from the soils without paying a carbon price. Overuse of antibiotics drives up the costs to health care as antibiotic resistance builds up. Crop plants escape into the wider landscape. More generally, biodiversity has been reduced without consequences to the farmers who have caused it.
>
> …
>
> Farmers have an interest in protecting their natural capital in so far as it maximises profits. To take an example, removing a hedgerow increases field size, and therefore the ability to use large machinery. The destruction of British hedgerows has been a rational commercial response. Similarly applying fertilisers, pesticides and herbicides is commercially rational, given that the full costs of doing so fall on others, and not the farmers. It is not part of their profit maximising calculations.

> The challenge then is to internalise these external costs, so farmers make their profit maximising decisions in the context of their full costs of production. They should internalise the externalities. Policy should ensure that they face these full costs.
>
> …
>
> With these initial steps in place, and the bulk of the subsidies going in effect to Pillar Two farmers, the next transitional step is to sort out what public goods we want from the land, notably in those areas where farming is not economically efficient, and start diverting Pillar Two subsidies into direct payments for specific activities. As noted, the total value of the outputs of these marginal farms, properly managed to include the maintenance and enhancement of natural capital, is much greater than represented by focussing narrowly on their agricultural production. The framework would be the 25-year plan for the natural environment: working out which parts of natural capital have the greatest benefits and hence which to enhance, and which are in most danger of going below sustainable thresholds. (Helm, 2016: http://www.dieterhelm.co.uk/natural-capital/environment/agricultural-policy-after-brexit/)

As we continue our empirical work, we will be following the "UK natural capital: Ecosystem service accounts, 1997 to 2015" to create a valuation for Ireland and most importantly Ireland's watercourses. The data requirements for the natural capital asset valuation are:

1. Timber
2. Minerals
3. Fishing
4. Pollution removal
5. Water
6. Total renewables
7. Agriculture
8. Regulating services, producing benefits such as water purification, climate regulation, pollution and flood hazard reduction
9. Carbon sequestration
10. Air pollution removed by vegetation
11. Oil and gas
12. Cultural services: recreation

8.2 Natural Capital Valuation

This background section provides an estimation for the natural capital asset value for Ireland using data in 2015. The value for natural capital of Ireland is estimated to be roughly **€4,401.5 million** in 2015 (Table 6). The valuation provides a useful tool for understanding the current natural capital stock in Ireland and taking the natural resource depletion into account. The natural capital asset valuation for Ireland is calculated by combining two different methods, the UK natural capital accounts methodology and the net resource rent method by Horlings et al. (2020). The estimation is not perfect due to breaks in data series and unavailability of the data. However, the results suggest a rough idea on the natural capital asset value for Ireland.

According to Natural Capital Coalition (2016), natural capital is the "stock of renewable and non-renewable resources that combine to yield a flow of benefits to people". In economics, these stocks of flows are called as assets. Natural capital assets, such as plants, animals, forest, water and minerals

Table 6: Natural capital asset valuation.

Natural capital asset valuation				
Unit	**quantity**	**price**	**value**	**year**
Minerals			-€281,000,000.00	2015
Timber			€103,292,000.00	2015
Fishing			€667,338,000.00	2015
pollution removal				2015
water abstraction			€123,000,000.00	2015
agricultural biomass			€924,000,000.00	2015
Regulating services, producing benefits such as water purification, climate regulation, pollution and flood hazard reduction			€18,671.81*	2015
carbon sequestration			€397,200,000.00	2015
cultural series: recreation			€1,500,000,000.00	2015
noise mitigation	no data	165000 (subsidies)	€165,000.00	2015
urban cooling	no data	86508000 (subsidies)	€86,508,000.00	2015
energy generation			€881,000,000.00	2015
Natural capital asset value			**€ 4,401,521,672.81**	2015

* Note: the value represented for regulating services is calculated from a currency conversion from pound sterling and discounted for 2015 with long term interest rate 2015.

are under global pressure, and affecting to the livelihood of humans and the planet. For example, Chao (2012) estimates that the livelihoods of 1.6 billion people are dependent on forests, and Constanzela et al. (2007) evaluated that the forests are worth of $4.7 trillion per year. As Guerry et al. (2015) mention, the understanding of ecosystems is rapidly advancing. Similarly, governments have become more interested in measuring natural capital as the recognition of the economic value of nature has increased. Measurement of natural capital can help with understanding the provision and resilience of ecosystem services and protecting them. (Guerry et al. 2015.)

The natural capital asset valuation may also provide a different perspective to measuring the prosperity of the society. The Gross Domestic Product (GDP) measures only one part of economic performance, market production, which does not provide the full image of the economy's performance. For example, the economy may earn income by deploying non-renewable natural resources, such as fossil fuels, which would decrease its natural capital assets. As Joseph Stiglitz, Amartya Sen and Jean Paul-Sitoussi mention in their recent book, "Mismeasuring our lives: why GDP doesn't up" (2010), gross measures, such as the GDP, do not take into account depreciation of capital goods or degradation in quality of natural environment.

8.2.1 UK natural capital accounts methodology

The natural capital asset value for Ireland covers 13 annual asset flows: minerals, timber, fishing, pollution removal, water abstraction, agricultural biomass, regulating services producing benefits for the nature, carbon sequestration, fossil fuels, recreation of cultural services, noise mitigation, urban cooling and energy generation. The natural capital asset value for Ireland is calculated following closely the UK natural capital accounts methodological guide: October 2019 and the principles of United Nations (UN) System of Environmental-Economic Accounting Central Framework and System of Environmental-Economic Accounting Experimental Ecosystem Accounting principles. Instead of using the resource rent method by the UK natural capital accounts methodological guide, a net

resource method by Horlings et al. (2020) is used. As noted by the Adam Dutton and Max Engledew from the British Office of National Statistics, the UK natural capital accounting methodology remains

under development and it is not perfect. Nonetheless, it provides the most comprehensive and the clearest guidelines for natural capital accounting.

Following the UK natural capital accounts methodological guide, two types of approaches are used to value annual flows in general. The value for timber and carbon sequestration, the asset value is calculated by multiplying physical quantity by a market price. The asset value for fishing is collected from BIM Ireland's seafood agency's natural capital asset valuation for the Irish marine environment in 2019. For minerals, agricultural biomass, water abstraction and electricity generation (includes renewables), the "resource rent approach" is used in the similar vein to the UK natural capital accounts methodology guide: October 2019. For noise mitigation and urban cooling, the asset value is estimated to be the value of government subsidies for noise and vibration management and energy saving and management. For the asset value of regulating services, the asset value for regulating services in Northern Ireland is used.

According to the UK natural capital accounts methodological guide (2019) by the Office of National Statistics, the resource rent is "the annual return for stemming directly from the natural capital asset itself". However, as mentioned in the methodology guide (2019), the method may use very small or negative resource rents. Obst, Hein and Edens (2015) argue "resource rent type approaches are inappropriate in cases where market structures do not permit the observed market price to incorporate a reasonable exchange value for the relevant ecosystem service".

For Ireland, the steps for calculating the resource rent are given in Table 7.

Table 7: Steps for calculating resource rent

	Output
	Intermediate consumption
	Compensation of employees
Less	Other taxes on production
Equals	Gross operating surplus – SNA basis
Less	Specific subsidies on extraction PLUS subsidies on production
Plus	Specific taxes on extraction
Equals	Gross operating surplus – resource rent derivation
Less	User costs of produced assets (consumption of fixed capital and return to produced assets)
Equals	Resource rent

The formula is similar to the resource rent formula by UK natural capital accounts methodology guide: October 2019 with the exception of not including operating costs for practical reasons. There is no data available regarding operating costs for mineral production, production of agricultural biomass, water abstraction, production of renewables or electricity generation online. Besides output, same data is used to derive the resource rent for renewables and electricity generation due to gaps in data. In the contrast to the UK, the subsidies are also extracted from the output only once due to unavailability of data. The output for water abstraction is estimated by multiplying Eurostat Renewable freshwater resources - long-term annual: average by the average volumetric water service charge by the Irish Water.

Following the UK natural capital accounts methodology guide: October 2019, the return to produced asset estimates were calculated using industry-based net-capital stocks that are multiplied by the annual average of the long-term interest rate for Ireland by the European Central bank in 2015. As consequence, the interest rate is very conservative compared to market rates for these assets. The product is deflated using the gross domestic product (GDP) deflator in 2015 to produce the real yield. The drawback of the method is that GDP deflator time series has its base year in 2015. The steps for calculating the return to produced assets are given in Table 8.

Table 8: Steps for calculating the return to produced assets

	Total fixed assets
Multiplied by	ECB long-term interest rate for Ireland
Equals	**Product**
Multiplied by	The GDP deflator in 2015 (base=2015)
Equals	**Return on produced asset estimates**

The calculated return on produced asset estimates appears to be so large that it makes the resource rent negative. It seems that the value of total fixed assets on each industry is very high, which causes the resource rent and the natural capital value for Ireland to be strongly negative. As mentioned by Obs et al. (2015), the resource rent method may result negative resource rents for some countries. The main operators in each sector seem to have huge amounts of fixed assets in their balance sheets in Ireland. Thus, alternative methods for calculating the resource rent and the natural capital for Ireland are investigated below.

8.2.2 Alternative methods for calculating the resource rent

Net resource rent method

Alternative measures for the resource rent have been developed by Horlings et al. (2020) for Netherlands and by the World bank for measuring sustainable development. Horlings et al. (2020) suggest the following method for calculating the net resource rent (Table 9).

Table 9: Method for calculating net resource rent.

Output
less intermediate consumption
less compensation of employees
less other taxes on production
plus other subsidies on production
net subsidies
Equals gross operating surplus
less consumption of fixed capital (depreciation)
less return on produced assets
less labour of self-employed persons
Equals net resource rent

The net resource rent is calculated for mining sector, agriculture, water supply and management and electricity generation. Due to unavailability of Irish data, the method has been modified for the purposes of the natural capital asset valuation for Ireland. Instead of reporting other taxes on production and net subsidies separately, they are reported as net subsidies. As return on produces assets data is available only for agricultural sector, it is excluded from the calculation. Given the inaccuracy of the method used for calculating the net resource rent for Ireland, the natural capital asset value obtained can be only treated as a rough estimate rather than a precise one.

8.2.3 World Bank: total natural resources rent

The World Bank reports the total natural resources rent that are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. For some countries, earnings from natural resources account a sizable share of GDP. According to the World Bank (2017), much of these earnings come as economic rents, which are revenues above the cost of extracting resources. If the total natural resource rent is high, a country is using its natural resources to support its consumption, which can be considered as unsustainable. (World Bank 2020.)

The total natural resource rent is calculated as the difference between a price of an economic commodity and the average cost of producing it. The World Bank estimates that the total natural resource rent for Ireland has been 0.1% of the GDP for 2010-2017. The results suggest that the total natural resource rent has contributed only 0.1% for the formation of the gross domestic product each year. According to the World Bank, for example, the nominal total natural resource rent of Ireland was €255.8 million in 2015. (World Bank 2020; CSO 2015).

8.2.4 Conclusion

While this is a preliminary calculation that suffers from the Irish data limitations outlined above (including important missing timeseries data for water abstractions that may be of particular interest to the An Fóram Uisce) it does illustrate that Ireland's natural environment and ecosystem is providing a large economic role in Ireland. To put this in context, the presented estimation for Ireland is most likely underestimated due to the treatment of elements of capital stock related to energy production

and the high levels of energy imported into the country, but even with this low estimate, the natural capital of Ireland is more than twice the market capitalization of a high street multiple like Marks and Spencer.[31]

If public monies are to go towards public goods it is important to have a precise calculation of what the public good provided by Ireland's ecosystem at the present and over a time series. That can become the basis of calculations for biodiversity-orientated Pillar 1 payments and other results-based AES payments under Pillar 2.

8.3 Carbon Tax

The new Programme for Government presents a plan for directing a proportion of the proceeds of the carbon tax towards climate focused measures in the agri-food sector. In other words, the statement implies that the government is planning to imply the carbon tax into agri-food products to make the agricultural sector greener. Among economists, the carbon tax is considered as the most effective way to cut CO2 emissions (*Wall Street Journal*, 17/01/2019). Given the importance of Irish agriculture to the carbon footprint of Ireland and the changing policy landscape, it was considered important to include this note on a carbon tax, even if it did not directly relate to the conditions of water courses.

Recent literature on the effects of carbon tax suggests that existing local carbon pricing schemes have reduced total greenhouse gas emissions in the area. The idea of the Irish government is not novel as the taxation of the carbon emissions from the Irish agri-food sector has been a topic of public debate for over a decade.

Carbon tax has been introduced by few governments worldwide. A Canadian province British Columbia was among the first to begin tax carbon dioxide and other greenhouse gas emissions from the combustion of fossil fuels in 2008. The empirical evidence and the results from mathematical simulation suggest that the tax reform has, indeed, been successful, reducing greenhouse gas emissions by 5-15% by 2015 (Murray and Rivers 2015).

Macroeconomic implications of the carbon tax remain unclear. The British Columbia Ministry of Finance (2013) estimated that the carbon tax had had a small negative impact on the GDP of the province. In 2012, the government of British Columbia granted an exemption of the tax from certain agricultural sectors. An evaluation by Rivers and Schaufele (2014) suggests that the carbon tax did not have a statistically significant effect on agricultural trade or competitiveness compared to the period after exemption, 2012-2014. On the contrary, Tol et al. (2008) note that the carbon tax makes domestic enterprises less competitive in international markets as the tax increases the price of energy. This implies that the production costs of a firm would increase.

In 2019, the Canadian federal government implemented coordinated a nation-wide carbon price in 2019, facing lots of opposition by the farmers (Radio Canada International, 19/01/2020). Also, Australian government introduced the carbon tax scheme in 2012, although agricultural sector was exempted from the scheme (Meng 2015). New Zealand is planning to levy a carbon price on agricultural emissions in 2025. Agriculture is the most polluting sector in New Zealand, producing 48% of all greenhouse gas emissions of the economy in 2017. (Ministry for the Environment of New Zealand) In July 2020, the European Union Commission announced to launch public consultations on Energy Taxation Directive, regarding the taxation of energy, and a Carbon Border Adjustment Mechanism, which would prevent companies for sifting their production from EU to countries with less regulation on greenhouse gas emissions (European Commission, Daily News 23/07/2020).

In Ireland, the agricultural sector produces an unusually large share of greenhouse gas emissions compared to other EU countries (SEAI 2018). There is no data on productivity performance on agriculture available on the CSO or the Eurostat databases. In Figure 18, the agricultural sector's share

[31] https://markets.ft.com/data/equities/tearsheet/summary?s=MKS%3ALSE

of total CO2 emissions of Ireland is compared to Denmark, Ireland, Spain, France the United Kingdom in 2018. In Ireland, the share of greenhouse gas emissions from agriculture is more than 10 % higher than in other countries.

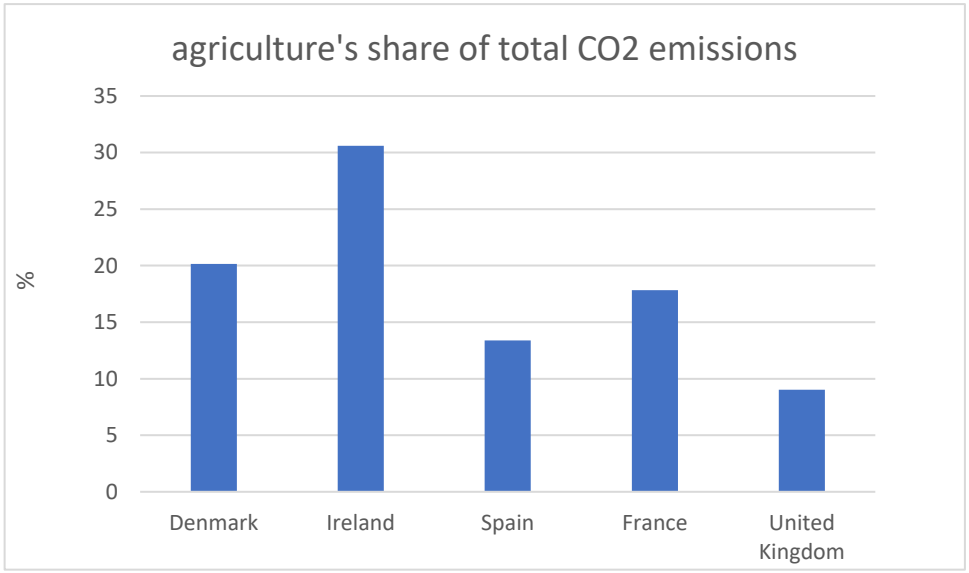


Figure 18: Agricultural sector's share of total greenhouse gas emissions in 2018. Source: Eurostat.

Agricultural sector was responsible for 33% of all greenhouse gas emissions in Ireland in 2018. Figure 19 presents the share of the annual greenhouse gas emissions of Ireland produced by a sector from 2006 to 2018.

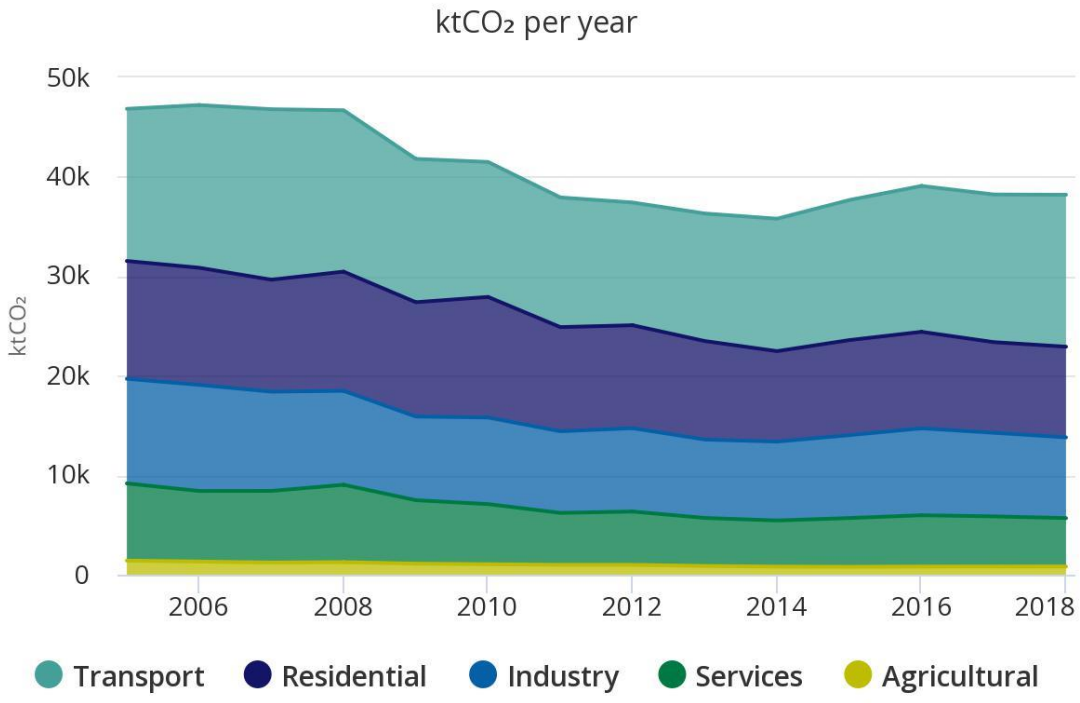
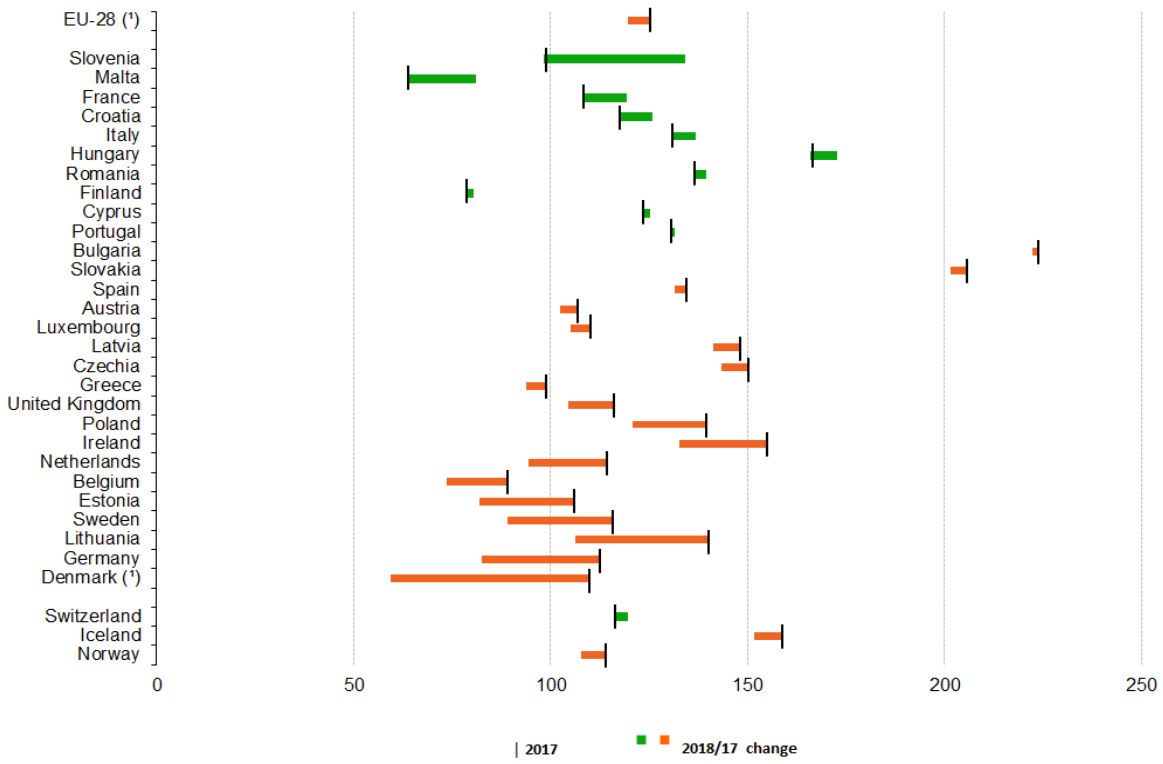


Figure 19: The greenhouse gas emissions by sector Source: SEAI

Literature on the effects of carbon tax on the Irish economy suggests that an increase in carbon taxation in Ireland would reduce its total greenhouse gas emissions. For example, Reaños and M. Lynch (2016) estimate the effects on carbon tax using Irish micro-level data. Their results suggest that total carbon emissions would decrease by 3.94% if carbon tax was increased for €30/tCO2 and by 10.24% if taxes were increased for €60/tCO2. As the agricultural sector is the biggest polluter in Ireland, the carbon tax scheme would very likely have a negative impact on agricultural production.

In addition, small-scale farming is predominant in Ireland and the productivity performance of the agricultural sector seems to be relatively low compared to other countries (Boyle 2002:177; Mathewws, Newmand and Thorne 2006). There is no updated data on total factor productivity (TFP) of the Irish agricultural sector are not provided by the CSO or Eurostat. Luckily, few studies have made an attempt to measure the productivity of Irish agriculture. Mathewws et al. (2006) estimate that the overall productivity performance of the Irish agricultural sector between 1984 and 2000 was very poor, growing just around 1% per annum. A study by Ball et al. (2001) suggests that Ireland's TFP was only 93% of the EU average in 1990.

An estimate for income created per annual work unit provides some information regarding the productivity of a sector. In other words, it measures the productivity per annual work unit. Figure 20 represents agricultural income created per annual unit of work in 28 European union members and Switzerland, Norway and Iceland in 2017-2018. The picture suggests that Ireland experienced a decrease in agricultural income created per annual work unit in agriculture, while the agricultural income created per annual work unit increased in, for example, France and Italy. This implies that the productivity (measured as income created) of Irish agricultural sector decreased while productivity of agricultural sector increased in France and Italy.



(¹) Estimate.

Figure 20: Agricultural income created per annual work unit 2017-2018 (2010=100). Source: Eurostat

In 2010, Breen, Clancy, Donnellan and Hanharan evaluated the possible cost of introducing a carbon tax for fuel used in agricultural production in Ireland. Their results suggest that farmers would experience an average €225 tax increase if the carbon tax scheme was implemented, ranging from €125 for average sheep farm to €467 for the average tillage farm. Similarly, Tol et al. (2008) estimate that an increase of carbon tax from €20/tCO2 to €38/tCO2 in 2020 would corresponds to an annual tax of €45 per dairy cow, rising to €86 in 2025; for beef cattle, this is €22/head rising to €43/head. The results suggest that the production costs in agriculture would almost double. Given that Ireland is a small open economy and agri-food products accounted 10.3% of total exports from Ireland in 2016, Irish farmers' income would decrease if other countries would not be taxed in the similar vein. (Tol et al. 2008; Government of Ireland 2018.)

8.4 Economic Policy Recommendations

At the core the voice of the famer needs to be part of the conversation and a move towards a more results-based ecosystem-system sustaining system of agricultural supports needs to be put in place.

To facilitate the aforementioned, we briefly discuss two results-based projects based in Ireland right now: the Burren Project and the Bride Project. These two projects are examples of how Ireland can make progress in a way that ensure a sustainable future environment but also gains crucial ownership and support from the farming community and delivers the objective that public monies will deliver public goods. The projects are presented based on two longer interview extracts, which can be found in Appendix 4.

The projects are both addressing environmental improvements from the point of view of removing the intensification of agriculture and seeking not to eliminate agricultural activity, which is essential to the natural landscape as it has been known for over 2,000 years, but to place it on a sustainable footing. These projects see agriculture as not an *exclusively economic* activity but one that has a deep attachment to the land. While inspiring in many ways, these projects would require careful analysis to see if they could be scaled up to the national level and be accompanied by close local management with a high degree of subsidiarity. Local considerations and subsidiarity are important for all approaches to agricultural policy reform.

9. High Level Recommendations:

9.1 Macro-scale – EU CAP:

1. **Reform Direct Payments in Pillar 1 CAP** to ensure that it values both biodiversity and production equally.

    - To receive direct payment, those who currently farm productive land must ensure that 25% of land is directly benefitting biodiversity, climate or water quality – so perhaps agro-forestry, agro-ecology. This is suggested as such land use can retain high productivity whilst benefitting biodiversity at same time.

    - For those who do not farm productively, this is not an issue – there is no requirement for productivity?

    - Farmers can also get eco-scheme top-up on this Pillar 1 payment that is results-based. In practice this could mean something like 50% of productive land is transformed to benefit both production and environment, while 50% is conventional production.

- This means that we are not favouring one over the other. Importantly, eco-schemes and farming that benefits biodiversity etc. will need to be tailored to the particular needs of farm/catchment – this will require national policies that offer an array of different interventions that require advisory input.

- Worst case scenario: potential problem with this would be that it may mean that there would be less food production and more importing from countries outside the EU who do not adhere to same standards and could lead to intensification/extensification of land that will damage biodiversity elsewhere, externalizing the problem globally. This is connected to the need for cheap food and how, for example, organic methods are predicted to reduce production by 40%.

2. **Food consumption changes**. Food imported from outside EU to meet environmental standards. All food produced on farms that adhere to standards of environmental compliance and to have a clear icon or chart visible to customer to show what they have added or given to the environment. This is to incentivize consumer to choose those options and to give a way of differentiating clearly from food with large or small ecological footprints. Directly address monopsony practices by major industrial food purchasers and supermarkets to place farmgate incomes on a more sustainable footing. This must be done while attempting to de-couple agricultural subsidies from immediate changes in food prices for households.

9.2 Meso-scale – National:

1. **Long-term investment in agri-environmental schemes that are results-based and tailored to the catchment/farm needs.**

    This would require proper investment from government. Would not be blanket programmes because of variations in conditions and needs across country (not just with

respect to water) – would look like an assortment of EIPs that would have basic model of working that would be applied. Would require proper monitoring and evaluation of conditions – either starting with the water or including proportion of water body within their farmland evaluation. Need to conduct baseline study, and then during and post to gauge whether agri-scheme actually had impact. This would require skilled farm advisors to help support and monitor through the programmes. These need to be co-designed or have feedback from farmers and other key stakeholders prior to implementation – need their buy-in to make them effective.

2. **Upskilling of farm advisors**

   All farm advisors need to be trained to be able to evaluate the environmental needs as well as productive needs of a farm. This would require set levels of training for advisors to hold certificate in agri-environmental practices and for each catchment there would need to be a specialist advisor to be able to support with more complex cases. Because there are private and Teagasc advisors this would need to be a national scheme that all advisors are required to take part in. Could be done online but would need to go hand in hand with development of rural broadband. Could be ASSAP programme, or similar initiatives, expanded across country and engaging with biodiversity, climate as well as water.

3. **Rural broadband**

   This needs to be improved across the country for a variety of reasons but is a necessary condition to support the uptake of new technologies and streamlined service with advisors.

4. **Development of alternative markets avenues such as energy crops.**

   Along with Pillar 1 reform and diversity around agri-environmental schemes that value biodiversity this would help to address the appeal of dairy farming. Would give farmers alternative ways of earning income. Would perhaps need to be developed by PPP with energy companies and government overseeing/monitoring to ensure security and avoid risk. As with results-based payments that incentivize the environment, the objective needs to be preventative – you can't stop the choice to become dairy farmer but can make other options more appealing financially and environmentally.

5. **Diversity around forestry schemes – cohesive with agri-environmental schemes**

   Reform the hectarage obligation and/or offer a variety of ways in which planting can be done that includes agro-forestry and native species to combat water, climate and biodiversity.

6. **National policy to get supermarkets to source food from smaller producers with shorter supply chains.**

   - This is from suggestion from Sustain input into UK National Food Strategy that 10% of all products in supermarkets be from non-multiples – not entirely sure of the impact this would have in Ireland but could go some way to support smaller suppliers and retain rural income.

   - Not necessarily in this way, but there should be something that tries to tackle supermarket power on a national scale. Not entirely sure of how they connect to processors/industry more broadly, but something needs to be addressed here at some point.

- Food Security: The UK National Food Strategy provides some potential avenues for change for Ireland and at worst offers an opportunity to observe a natural experiment in policy.[32] To ensure food security it is recommending diversification of food production.

- Adopt a Food Systems approach to reform. Change supply chains and food policies in Ireland. Shorten supply chains and encourage a policy of smaller producer purchase by multiples. Ultimately the decisions made with respect to CAP will be reflected in the food system but if the food system does not change it is not plausible to expect even a reformed CAP to achieve the aims and objectives outlined in Farm-to-Fork and Biodiversity Strategies. This is a matter of looking at the food system in Ireland in the round. Households in Ireland are in a price sensitive situation due to the wider income inequality issues in the Irish economy. In addition, reforms to CAP that are understood to be exclusively reforms for the purposes of biodiversity and the environment are incomplete. Complete reforms include changes to how the Irish population consumes food and has a real public health role, as reforms to CAP should work in concert to address Ireland's emerging obesity and Type II diabetes crises.

7. **The development of an asset-based approach to agricultural land management.** This will allow a depreciation framework to be developed that will allow Pillar 2 programmes to operate more effectively, directly purchasing public goods of biodiversity and also putting in place a structure for investment in a sinking fund that would counteract asset depreciation, such as declining air, biodiversity, soil, and water quality. Regulations and standards can also be deployed to state the acceptable levels of depreciation allowed at any one time and under what conditions.

9.3 Micro-scale – Farm:

1. **Farm advisors** support and facilitate development of farmer discussion groups across the country and ensure that these are not production focused but are spaces where environmental concerns and communications can be raised. Enabling a communication channel between farmers, regulators and the environmental community. Peer-learning networks. Use of pilot farms would be useful here because they could show the realities of certain agri-environmental schemes. Farm advisors need to be offering combined advice on production *and* environment. These could also be spaces where farmers are recognised for the good work they are doing. Important that advisors are networking with local groups/coops who also provide advice to ensure that they provide holistic and cohesive input.
2. **Better enforcement** of cross compliance in combination with better communication about impacts of certain practices. This needs to come from the advisors/coops/bridging actors/intermediaries. It would mean more inspections of farms to ensure accountability. If results-based payments come into effect this would also likely be done more.
3. **Uptake of technology** to better assess the needs of each field. This uptake would be done with support of advisors who are well trained.
4. **Better procurement and feed**

[32] https://www.nationalfoodstrategy.org/wp-content/uploads/2020/07/NFS-Part-One-DP.pdf

- Where is this being sourced? Could be Coops and industry investment level investment rather than individual farms because of likely rise in costs attached.

10. Conclusions

The original intention of this project was to look exclusively at the needs of reform in the Common Agricultural Policy to ensure that the River Basins Directive could be complied with by Ireland. Our investigations have brought us to the conclusion that this is a policy objective that can be achieved but not easily as there are significant institutional, structural, cultural and economic factors that preclude the use of easy policy solutions.

A more fundamental discussion of the aims and objectives of CAP within the wider food system is required.

Our agricultural system is neither healthy for ourselves nor our environment. We know this to be categorically and unequivocally true. We must change.

A useful first step has been taken with an acknowledgement by the farming community that public monies should be directed to public goods. In this paper we have attempted to look at that question of public goods from many different viewpoints, some economic, some scientific. At the core, changes in the system of Pillar 1 payments must take place and the farming community needs to be part of that policy co-production process. There are islands of expertise and promising pilot projects but more must be done to scale and adapt their principles to agriculture at large.

The other crucial reality is that of income surety. Farmers and non-farm households cannot live on grass or fresh air but need to have a stable economic foundation. Structural flaws in the Irish economy and the design of CAP have made rapid changes in policies potentially harmful to the most vulnerable of households. Care must be taken to ensure that transition periods are put in place and supports provided to enable these households to agree to changes politically and to support them in practice.

Culture is the final aspect that requires a change. Again, this is a systems issue as the productionist culture and the culture of farming under CAP needs to be modified at all levels of the food system. There is no such thing as "cheap" food, but policies put in place since the 1950s have attempted to generate such a fiction placing pressures with respect to value and cost at each point on the value chain. These mismatches between value and cost in the presence of artificial government budget constraints have made existing market failures worse. In order to make changes that ensure that farmgate prices reflect the full economic cost of food production, and that farmers fully understand the full economic cost of their externalities, the culture of the European food system must change at every point on the value chain.

Systems thinking will be the only solution to this complex problem. A siloed approach will result in unmet need and Pareto suboptimal solutions.[33]

For needs to be met – complimentary change needs to be made in other parts of the system too:

[33] A Pareto Optimal solution is a policy solution where all possible gains from trade have been exhausted and someone cannot be made better off without someone being made worse off. When Pareto Optimal solutions have been removed from the policy option set, persons will be made worse off by policy decisions and political economy solutions must be put in place to decide to either accept those outcomes or to compensate the welfare-reduced party in some fashion. This is the so-called "second best" world that most policies take place within. The objective of welfare economics is to drive policymakers towards Pareto Optimal solutions and to inform policymakers of the detail of suboptimal outcomes so normative political decisions can be informed prior to being taken.

"Converting these conflicts between goals into connections that yield co-benefits requires deeper change, in which the entire system is reoriented towards meeting health, environmental and economic goals together. This process of designing and managing food systems differently recognize that making changes in one part of the system will not necessarily have the intended outcome for diet- related health or other goals unless complementary changes are made in other parts of the system. Food systems could combine the goals related to diet-related health, environment and economy if they involved farmers, entrepreneurs, small- and medium-sized enterprises and big businesses generating jobs and creating equitably-shared wealth for themselves and local and national economies by producing, distributing, trading, processing, marketing and selling nutritious foods aligned with dietary guidelines to European citizens at affordable prices, using a skilled and decently paid workforce and environmentally-sustainable methods and processes that protect biodiversity, water, soils and air and minimize environmental health risks, food waste and greenhouse gas emissions, with high standards of animal welfare." (Parsons & Hawkes, 2018: 5-6)

The fundamental conclusion from analyses reviewed and elite interviews was that a consensus has formed around the principle of *public monies for public goods.*

Following on from that these key discussion topics will need to be addressed by An Fóram Uisce:

- What are our subsidies buying?
- Should subsidies be assessed on economic efficiency or by alternative criteria such as land utilization and environmental impact?
- What are our objectives for the environment and the maintenance of the rural economy?
- Can we move away from an agricultural/food chain approach that prioritizes yield?
- How do we ensure a constant level of renewable natural capital?
- How do we implement policy changes to ensure minimal disruption and greatest stakeholder engagement?
- How to change CAP so that it delivers on sustainability, food security and ensures the viability of farmer and consumer households?
- *How do we ensure that public monies buy public goods?*

These recommendations are not all encompassing but they hinge on the idea that financial sustainability goes hand-in-hand with environmental sustainability and that when the public purse is used to support or purchase goods and services, it should, as far as possible, direct those funds towards activities that improve the public good.

Further original research is needed an implementation plan for the above recommendations is necessary, but it constitutes the beginning of an engaged debate on what do we want from our agricultural system.

Crucially, the findings of our research highlight that a one-size-fits-all policy approach is dangerous and counterproductive. A solution needs to be found that will ensure that different consumer household and different type of farmers and different types of land are taken in account, which not breaking that essential link to maintaining the single market and the level playing field. Sustainability is about finding a balance through evidence-informed debate and consensus. It will be the role of An Fóram Uisce to navigate that compromise.

References:

Ball, E., Bureau, J.C., Butault, J.P. and Nehring, R. (2001). Levels of Farm Sector Productivity: An International Comparison. Journal of Productivity Analysis. Volume 15. Issue 1. https://www.researchgate.net/publication/43289826_Levels_of_Farm_Sector_Productivity_An_International_Comparison

Barends, E., Briner, R. M., & Rousseau, D. M. (Eds.). (2017). *CEBMa Guideline for Rapid Evidence Assessments in Management and Organizations*. Center for Evidence Based Management, Amsterdam. Retrieved from www.cebma.org/guidelines

Barreiro-Hurlé *et al*. (2010) "The Effects of Multiple Health and Nutrition Labels on Consumer Food Choices." *Journal of Agricultural Economics*. 61:2. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1477-9552.2010.00247.x

Bauer *et al*. (2016) "Significant atmospheric aerosol pollution caused by world food cultivation." *Geophysical Research Letters*. 43:10. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL068354

Bermejo, Ricardo, Heesch, Svenja, Mac Monagail, Michéal, O'Donnell, Moya, Daly, Eve, Wilkes, Robert J., Morrison, Liam. (2019) "Spatial and temporal variability of biomass and composition of green tides in Ireland." *Harmful Algae* 81: 94-105.

BIM. Ireland's seafood development agency. Welcome to the BIM Exploration of Natural Capital. Powerpoint presentation. http://bim.ie/media/bim/content/our-work/exploring-natural-capital-solution-seminar/BIM-Presentations-Exploring-Natural-Capital-in-our-shared-marine-environment-131119.pdf

Bonfiglio, Andrea., Arzeni, Andrea., & Bodini, Antonella. (2017) Assessing eco-efficiency of arable farms in rural areas. *Agricultural Systems*, 151, pp.114-125

Boylan, E.A., et al.,(2014) "The prevalence and trends in overweight and obesity in Irish adults between 1990 and 2011." *Public health nutrition*. **17**(11): p. 2389-2397.

Boyle, G. (2002). The Competitiveness of Irish Agriculture. Mimeo. Research Stimulus Fund Project Report, Department of Agriculture and Food.

Bradford, Anu. (2020) *The Brussels Effect: How the European Union Rules the World.* Oxford: OUP.

Breen, Clancy, Donnellan and Hanharan (2010). Cost Implications of a Carbon Tax on Fuel Used in Agricultural Production in Ireland. Teasgc Briefing note. No. 2010/1. https://www.teagasc.ie/media/website/publications/2010/11_Briefing_Note_Carbon_Tax_050510-Final.pdf

Buckley, Cathal., Carney, Patricia, (2013) The potential to reduce the risk of diffuse pollution from agriculture while improving economic performance at farm level. *Environmental Science & Policy*, 25, pp.118-126

Bukeviciute, Lina, Dierx, Adriaan and Ilzkovitz, Fabienne. (2009) The functioning of the food supply chain and its effect on food prices in the European Union. European Economy Occasional Paper 47. https://ec.europa.eu/economy_finance/publications/pages/publication15234_en.pdf.

Chao, Sophie Marie Hélène (2012). Forest peoples. Number across the world. Forest peoples programme. http://www.forestpeoples.org/sites/fpp/files/publication/2012/05/forest-peoples-numbers-across-world-final_0.pdf

Coillte (2017). https://www.coillte.ie/media/2017/06/ORP_Screen.pdf

CSO. (2016) *Farm Structure Survey*

Cullen, Paula, Ryan, Mary, O'Donoghue, Cathal, Hynes, Stephen, Ó hUallacháin, Daire, Sheridan, Helen. (2020) Impact of farmer self-identity and attitudes on participation in agri-environment schemes. *Land Use Policy,* 95 https://doi.org/10.1016/j.landusepol.2020.104660.

Da Silva, V., Van der Werf, H., Soares, S., Corson, M. (2014) "Environmental impacts of French and Brazilian broiler chicken production scenarios: An LCA approach" *Journal of Environmental Management*. 133: 222-231. https://doi.org/10.1016/j.jenvman.2013.12.011.

Department of Finance. (2020) *Stability Programme Update 2020.* 21 April 2020

Department of Food, Agriculture & the Marine (DFAM). (2020) Farm Incomes and Structures. https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/agri-foodandtheeconomy/publications/annualreviewandoutlook2019/chapter-2.html

DEFRA, Air Quality Pollutant Inventories for England, Scotland, Wales and Northern Ireland: 1990-2015 https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1710060932_DA_Air_Quality_Pollutant_Inventories_1990-2015_v01-01.pdf

Dingel, Jonathan and Brent Neiman. *How Many Jobs Can be Done at Home?* April 2020 https://bfi.uchicago.edu/wp-content/uploads/BFI_White-Paper_Dingel_Neiman_3.2020.pdf

Duesberg, Stefanie., O'Connor, Deirdre., & Dhubháin, Áine, Ní. (2013) To plant or not to plant - Irish farmers' goals and values with regard to afforestation. *Land Use Policy*, 32, pp.155-164

EPA (2019) *Water Quality in Ireland 2013-2018.* Dublin.

EPA. 2019. Ireland's Transboundary Gas Emissions 1990-2030

http://epa.ie/pubs/reports/air/airemissions/irelandsairpollutantemissions2017/Irelands%20Air%20Pollutant%20Emissions%202017.pdf
http://epa.ie/newsandevents/news/pressreleases2019/name,65883,en.html

Engle, Robert F. and C.W.J. Granger (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, Vol. 55, No. 2. pp. 251-276

European Commission. (2012) *Europeans' attitudes towards food security, food quality and the countryside. Special Eurobarometer 389 / Wave EB77.2 – TNS Opinion & Social*. Luxembourg: Publications Office of the European Union.

--. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.

--. (2019a) *Evaluation of the impact of the CAP on habitats, landscapes, biodiversity*. Luxembourg: Publications Office of the European Union.

--. (2019b) *Evaluation of the Impact of the CAP on Water*. Luxembourg: Publications Office of the European Union.

--. (2020) Daily News 23/07/2020. https://ec.europa.eu/commission/presscorner/detail/en/mex_20_1398

European Central Bank. https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/long_term_interest_rates/html/index.en.html

Eurostat (2020). Greenhouse gas emissions by source sector.

Eurostat (2020). Performance of the agricultural sector. https://ec.europa.eu/eurostat/statistics-explained/index.php/Performance_of_the_agricultural_sector#Resource_performance_of_the_agricultural_sector

FOAG (2012), "AP 14-17 Botschaft" [AP 14-17 Message], Federal Office for Agriculture, Bern, www.blw.admin.ch/blw/de/home/politik/agrarpolitik/ap-14-17/ap-14-17---botschaft.html.

FOAG (2015), "Biodiversity for food and agriculture in Switzerland", Abridged version and main findings of Switzerland's Country Report on the State of Biodiversity for Food and Agriculture, Federal Office for Agriculture, Bern.

Ghaly et al. 2015. Nitrogen Sources and Cycling in the Ecosystem and its Role in Air, Water and Soil Pollution: A Critical Review https://www.longdom.org/open-access/nitrogen-sources-and-cycling-in-the-ecosystem-and-its-role-in-air-waterand-soil-pollution-a-critical-review-2375-4397-1000136.pdf

Government of Ireland (2018). Fact Sheet on Irish Agriculture. January 2018. https://www.agriculture.gov.ie/media/migration/publications/2018/January2018Factsheet120118.pdf

Guerry, Anne D.; Stephen Polasky, Jane Lubchenco, Rebecca Chaplin-Kramer, Gretchen C. Daily, Robert Griffin, Mary Ruckelshaus, Ian J. Bateman, Anantha Duraiappah, Thomas Elmqvist, Marcus W. Feldman, Carl Folke, Jon Hoekstra, Peter M. Kareiva, Bonnie L. Keeler, Shuzhuo Li, Emily McKenzie, Zhiyun Ouyang, Belinda Reyers, Taylor H. Ricketts, Johan Rockström, Heather Tallis, and Bhaskar Vira (2015). Natural capital and ecosystem services informing decisions: From promise to practice. PNAS June 16, 2015 112 (24). https://doi.org/10.1073/pnas.1503751112.

Guthrie et al. The Royal Society. https://royalsociety.org/~/media/policy/projects/evidence-synthesis/Ammonia/Ammonia-report.pdf

Harrington, J., et al., (2008) "SLÁN 2007: survey of lifestyle, attitudes and nutrition in Ireland. Dietary habits of the Irish population." *Psychology Reports*.

Parsons, K. & Hawkes, C. (2018) *Policy Brief 31: Connecting food systems for co-benefits: How can food systems combine diet-related health with environmental and economic policy goals?* https://www.city.ac.uk/__data/assets/pdf_file/0008/446930/Connecting-food-systems-for-co-benefits-Hawkes-and-Parsons-Nov-2018.pdf

Helm, Dieter. (2015) *Natural Capital: Valuing the Planet.* London: Yale UP.

--. (2016) Agricultural Policy After Brexit. http://www.dieterhelm.co.uk/natural-capital/environment/agricultural-policy-after-brexit/

Horlings, Edwin; Sjoerd Schenau, Lars Hein, Marjolein Lof, Linda de Jongh and Michael Polder (2020). Experimental monetary valuation of ecosystem services and assets in the Netherlands. Technical background report. Wageningen University & Research.

House of Commons Library. (2020) *Agriculture Bill 2019-21.* https://commonslibrary.parliament.uk/research-briefings/cbp-8702/

Howley, Peter (2016) Subsidy streams versus a CAP bond: An assessment of farmers' preferences. *Land Use Policy*, 51,pp.184-190

Howley, Peter., Buckley, Cathal., O'Donoghue, Cathal., Ryan, Mary. (2015) Explaining the economic 'irrationality' of farmers' land use behaviour: The role of productivist attitudes and non-pecuniary benefits. *Ecological Economics*, 109, pp. 186-193

IBEC. (2020) *Reboot and Reimagine.* Dublin: IBEC.

IBEC (Gerald Barry). "Business in a Compressed Environment". COVID-19 Symposium for the Journal of the Social and Statistical Society of Ireland. 21 May 2020.

An Fóram Uisce. (2020) *Protecting and Enhancing Our Environment: A Framework for Integrated Land and Landscape Management.* Mimeo.

Inmen, Alex., Winter, Michael., Wheeler, Rebecca., Vrain, Emilie., & Cleasby, Will (2018) An exploration of individual, social and material factors influencing water pollution mitigation behaviours within the farming community. *Land Use Policy*, 70, pp.16-26

Lajoie, A. (2020) Exploring Household Debt in Ireland: The Burden of Non-Mortgage Debt & Opportunities to Support Low-Income Households. Dublin: TASC. https://www.tasc.ie/assets/files/pdf/household_dept_report_final_3320.pdf

Lang, T. (2020) *Feeding Britain: Our Food Problems and How to Fix Them.* London: Penguin.

Lastra-Bravo, Xavier.B., Hubbard, Carmen., Garrod, Guy., & Tolón-Becerra, Alfredo. (2015) What drives farmers' participation in EU agri-environmental schemes?: Results from a qualitative meta-analysis. *Environmental Science & Policy*, 54, pp.1-9

Leahy, S., et al., (2014) *Obesity in an ageing society: implications for health, physical function and health service utilisation.*

Logue , C. and Callan, T. (2016) Low Pay, Minimum Wages and Household Incomes: Evidence for Ireland. Dublin: ESRI. https://www.esri.ie/system/files?file=media/file-uploads/2016-06/BP201703.pdf

Matthews, Alan; Carol Newman and Fiona Thorne (2006). Productivity in Irish agriculture. Working Paper 06-WP-RE-1. Rural Economy Research Centre. https://www.researchgate.net/publication/242615088_Productivity_in_Irish_Agriculture

McDermot, Cathal. (2019) The Green, Low-carbon Agri-environment Scheme. IGEES Spending Review. Dublin: Department of Public Expenditure and Reform.

McGurk, Eoin., Hynes, Stephen., & Thorne, Fiona. (2020) Participation in agri-environmental scheme: A contingent valuation study of farmers in Ireland. *Journal of Environmental Management*, 262, https://doi-org.elib.tcd.ie/10.1016/j.jenvman.2020.110243

McSweeney, Ella. (2020) "'We've crossed a threshold': has industrial farming contributed to Ireland's water crisis?" *The Guardian.* https://www.theguardian.com/environment/2020/sep/28/weve-crossed-a-threshold-has-industrial-farming-contributed-to-irelands-water-crisis

Meng, Samuel (2015). Is the agricultural industry spared from the influence of the Australian carbon tax. Agricultural Economics. Volume 46. Issue 1. https://doi.org/10.1111/agec.12145

Mettepenningen, Evy., Vandermeulen, Valerie., Delaet, Katrien., Van Huylenbroeck, Guido., & Wailes, Eric.J. (2013) Investigating the influence of the institutional organisation of agri-environmental schemes on scheme adoption. *Land Use Policy*, 33, pp.20-30

Ministry of Environment of New Zealand. About the New Zealand Emissions Trading Scheme. Cited: August 6, 2020. https://www.mfe.govt.nz/climate-change/new-zealand-emissions-trading-scheme/about-nz-ets

Mooney, D., Richards, K., Danaher, M., Grant, J., Gill, L., Mellander, P.-E., Coxon, P.E. (2020) "An investigation of anticoccidial veterinary drugs as emerging organic contaminants in groundwater." *Science of the Total Environment.* 746: 141116.

Murray, Brian C. and Nicholas Rivers (2015). British Columbia's Revenue-Neutral Carbon Tax: A Review of the Latest "Grand Experiment" in Environmental Policy. NI WP 15-04. Durham, NC: Duke University. http://nicholasinstitute.duke.edu/publications.

National Atmospheric Emissions Inventory (UK) https://naei.beis.gov.uk/overview/pollutants?pollutant_id=21

Natural capital coalition (2016). The path towards the natural capital coalition – a primer for business. https://naturalcapitalcoalition.org/wp-content/uploads/2016/07/NCC_Primer_WEB_2016-07-08.pdf

Nieminen, M., Sarkkola, S., Tolvanen, A., Tervahauta, A., Saarimaa, M., Sallantaus, T. (2020) "Water quality management dilemma: Increased nutrient, carbon, and heavy metal exports from forestry-drained peatlands restored for use as wetland buffer areas" *Forest Ecology and Management.* 465: 118089. https://doi.org/10.1016/j.foreco.2020.118089.

Obst, Carl; Lars Hein and Bram Edens (2015). National Accounting and the Valuation of Ecosystem Assets and Their Services. Environmental and Resource Economics. Volume 64, p. 1.23. https://link.springer.com/article/10.1007/s10640-015-9921-1

O'Connor, N. and Staunton, C. (2015) Cherishing All Equally: Economic Inequality in Ireland. Dublin: TASC. https://www.tasc.ie/assets/files/pdf/tasc_cherishing_all_equally_web.pdf

OECD. (2000) Working Party on Agricultural Policies and Markets of the Committee for Agriculture Joint Working Party of the Committee for Agriculture and the Trade Committee *DECOUPLING : A CONCEPTUAL OVERVIEW.*

OECD (2017a). *The Political Economy of Biodiversity Policy Reform,* OECD Publishing, Paris, www.oecd.org/environment/the-political-economy-of-effective-biodiversitypolicy-reform-9789264269545-en.htm

OECD (2017b). *Reforming agricultural subsidies to support biodiversity in Switzerland*. https://www.oecd.org/environment/resources/Policy-Paper-Reforming-agricultural-subsidies-to-support-biodiversity-in-Switzerland.pdf

OECD library. Energy prices and taxes statistics. https://www.oecd-ilibrary.org/energy/data/iea-energy-prices-and-taxes-statistics_eneprice-data-en.

ONS. *Environmental Accounts*. https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/ecosystemserviceaccounts1997to2015

ONS. UK natural capital accounts methodology guide: October 2019. Office for National Statistics. Cited: 10/08/2020. Source: https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/uknaturalcapitalaccountsmethodologyguideoctober2019

Parliamentary Budget Office. (2018a) *An Overview of the Common Agricultural Policy (CAP) in Ireland and potential regional and sectoral implications of future reforms Briefing Paper 9 of 2018.* Dublin: Oireachtas Eireann.

--. (2018b) *The Multiannual Financial Framework of the EU PBO Note 3 of 2018*. Dublin: Oireachtas Eireann.

--. (2018c) *The Multiannual Financial Framework 2021-2027 of the EU – the European Commission's proposals PBO Note 14 of 2018*. Dublin: Oireachtas Eireann.

Radio Canada International. Canadian farmers continued concern about carbon tax. Cited August 5, 2020. https://www.rcinet.ca/en/2020/01/15/canadian-farmers-continued-concern-about-carbon-tax/

Reaños, M.A. Tovar and M. Lynch (2019). Carbon taxation in Ireland. Distributional effects of revenue recycling policies. ESRI QEC Special Article (June 2019). http://publicpolicy.ie/digest/carbon-taxation-in-ireland-distributional-effects-of-revenue-recycling-policies/

Rivers, Nicholas and Brandon Schaufele (2014). The Effect of British Columbia's Carbon Tax on Agricultural Trade. Pacific Institute for Climate Solutions. July 2014. https://pics.uvic.ca/sites/default/files/uploads/publications/Carbon%20Tax%20on%20Agricultural%20Trade_0.pdf

Roantree, Barra. "Understanding income inequality in Ireland." *Journal of the Social and Statistical Inquiry Society of Ireland*. 2020

Russi, Daniela., Margue, Hélène., Oppermann, Rainer., & Keenleyside, Clunie. (2016) Result-based agri-environment measures: market-based instruments, incentives or rewards? The case of Baden-Württemberg. *Land Use Policy*, 54, pp.69-77

SEAI (2019). Energy in Ireland 2019. https://www.seai.ie/publications/Energy-in-Ireland-2019-.pdf

SEAI (2020). CO2 emissions. Cited: August 6, 2020. https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/co2/#:~:text=Large%20share%20of%20agriculture&text=Ireland%20is%20unusual%20compared%20to,non%2DETS%20greenhouse%20gas%20emissions.

Sedjo, Roger A. and Brent Sohngen (2012). Carbon Sequestration in Forests and Soils. Annual Review of Resource Economics, Vol. 4, Issue 1, pp. 127-144. https://doi.org/10.1146/annurev-resource-083110-115941

Shah, N., Nisbet, T. (2019) "The effects of forest clearance for peatland restoration on water quality." *Science of The Total Environment.* 693: 133617. https://doi.org/10.1016/j.scitotenv.2019.133617.

Skaalsveen, Kamilla., Ingram, Julie., & Urquhart, Julie. (2020) The role of farmers' social networks in the implementation of no-till farming practices. *Agricultural Systems*, 181, https://doi.org/10.1016/j.agsy.2020.102824

Stiglitz, Joseph; Amartya Sen and Jean-Paul Fitoussi (2010). Mismeasuring Our Lives: Why GDP Doesn't Add Up. The New Press. ISBN-10: 9781595585196.

Šūmane, S., et al. (2018). Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *Journal of Rural Studies*, **59**, 232– 241.

Sweeney, R. (2020) The state we are in: inequality in Ireland today. Dublin: TASC. https://www.tasc.ie/assets/files/pdf/18457_inequality_in_irelandinnerfinalweb.pdf

Teagasc. (2017) *National Farm Survey Report*.

Teagasc. https://www.teagasc.ie/crops/forestry/advice/markets/timber-prices/

Tol, Richard S.J., Tim Callan, Thomas Conefrey, John D. Fitz Gerald, Seán Lyons, Laura Malaguzzi Valeri and Susan Scott. A Carbon Tax for Ireland. Economic and Social Research Institute. Working Paper No. 246. https://www.esri.ie/system/files?file=media/file-uploads/2015-07/WP246.pdf

UK Government. (2020) *Agriculture Bill.* https://services.parliament.uk/Bills/2019-21/agriculture.html

Wall Street Journal. Economists' Statement on Carbon Dividends. Thursday, January 19. 2019. Cited: August 5, 2020. https://clcouncil.org/economists-statement/

Williams, J., et al. (2009) *Growing up in Ireland national longitudinal study of children. The lives of 9 year olds.*

Willett, W. et al. (2019) "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems." *The Lancet.* 393 (10170): 447-492 https://doi.org/10.1016/S0140-6736(18)31788-4

Willock *et al.* (1999) "The Role of Attitudes and Objectives in Farmer Decision Making: Business and Environmentally-Oriented Behaviour in Scotland." *Journal of Agricultural Economics*. 50:2. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1477-9552.1999.tb00814.x

World Bank (2017). The changing wealth of nations. Library of Congress Cataloging-in-Publication Data. ISBN 978-0-8213-8554-8. http://documents1.worldbank.org/curated/en/630181468339656734/pdf/588470PUB0Weal101public10BOX353816B.pdf

World bank Database. Total natural resources rents (% of GDP). Cited 07/08/2020. https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS

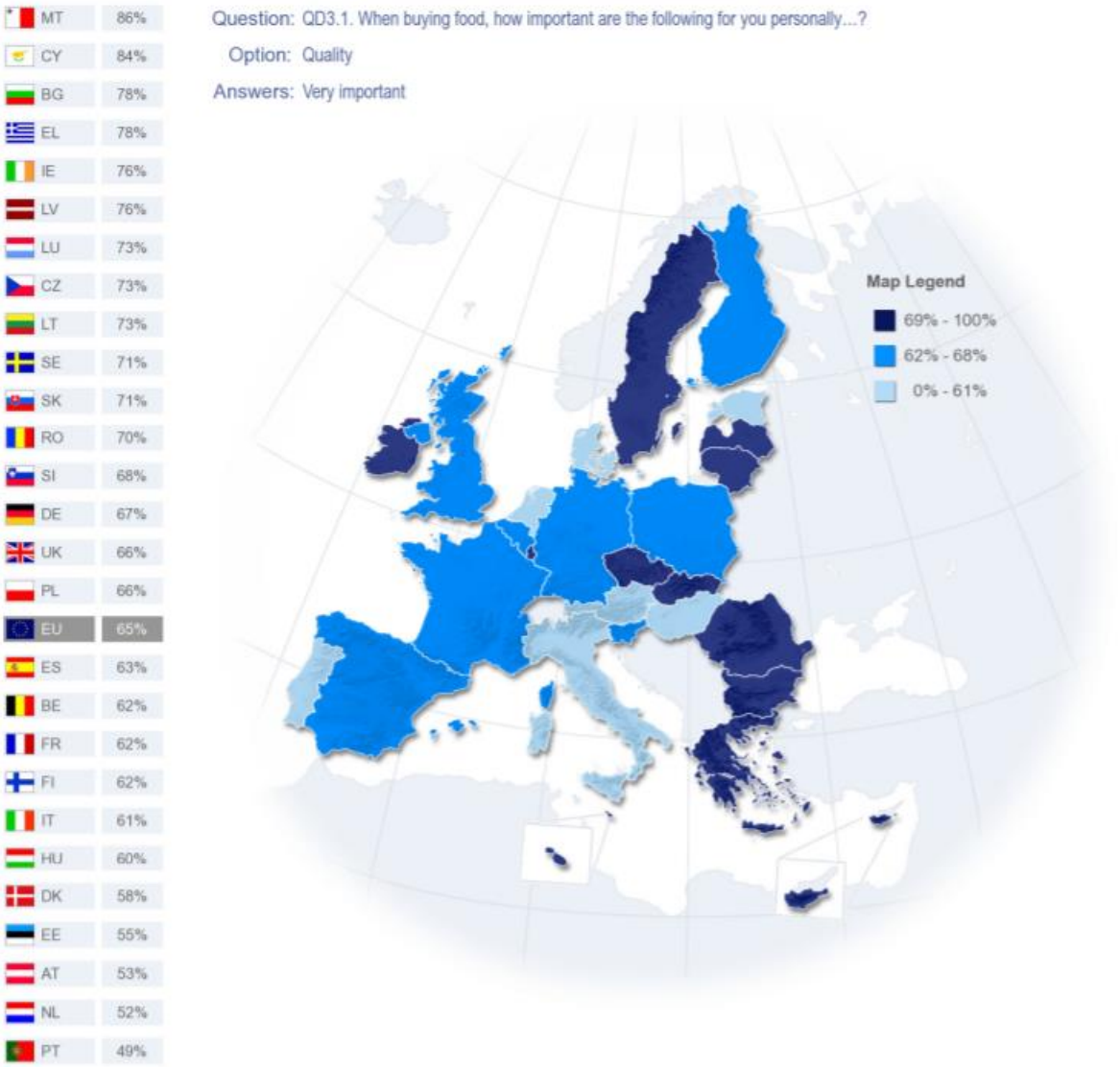
World bank database. https://data.worldbank.org/indicator/NY.GDP.DEFL.ZS?locations=IE

Appendix 1: Elite Interviews

A series of elite interviews were conducted over the months of June and July 2020. There interviewees were:

1. Jenny Deakin (EPA)
2. Brendan Dunford (Burren Project)
3. David Flynn (DHPLG
4. Alison Graham (ICOS)
5. Lee Ann Jackson (OECD)
6. Peter Linden (IFA)
7. Carol McCarthy (LAWPRO)
8. Noel Meehan (ASSAP)
9. Jack Nolan (DAFM)
10. Sinead O'Brien (SWAN)
11. Paul O'Brien (IFA)
12. Donal Sheehan (Bride Project)
13. Charles Stanley Smith (An Taisce)

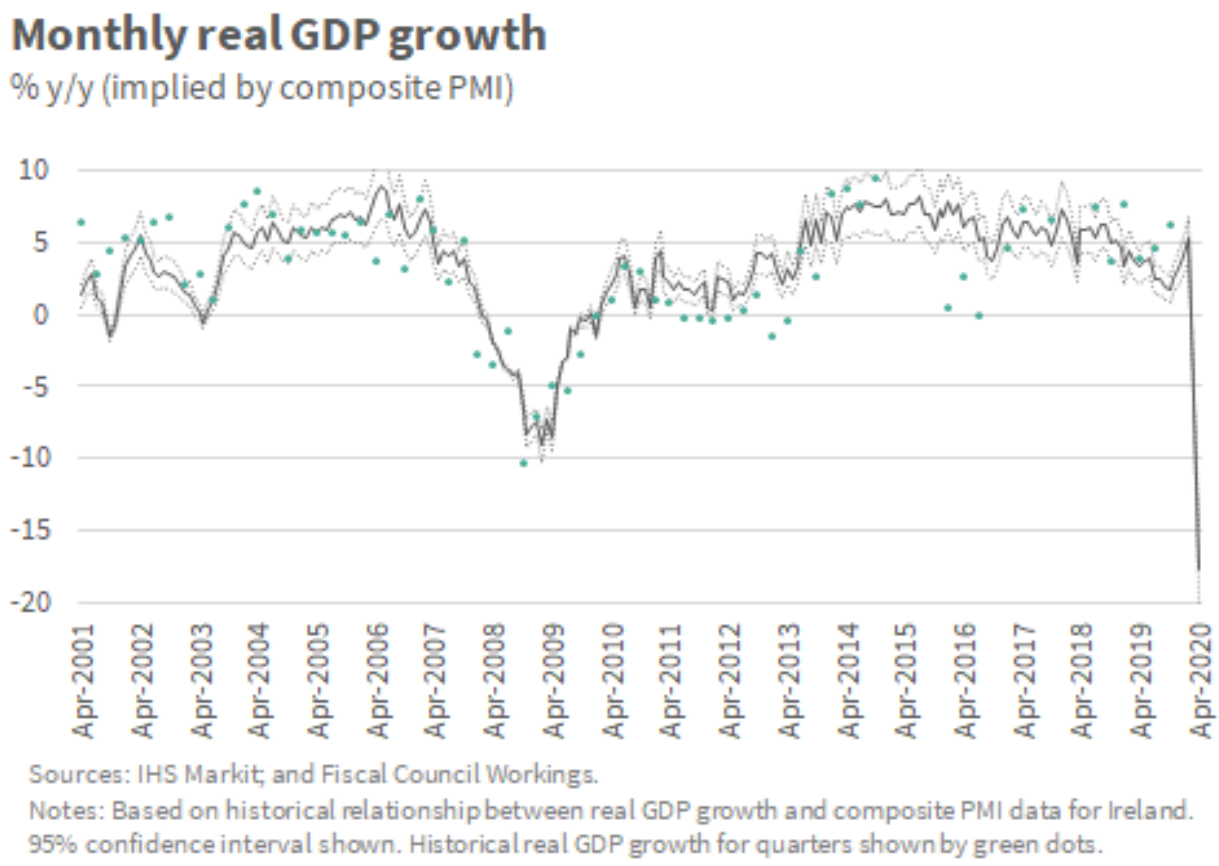
Appendix 2: Eurobarometer Analysis



Source: European Commission. (2012) *Europeans' attitudes towards food security, food quality and the countryside. Special Eurobarometer 389 / Wave EB77.2 – TNS Opinion & Social*. Luxembourg: Publications Office of the European Union.

Appendix 3: Additional Economic Graphs

Irish Fiscal Advisory Council Estimated GDP decline. Source: Irish Fiscal Advisory Council, 13 May 2020.



CSO statistical release, 25 August 2020, 11am

Labour Force Survey (LFS)

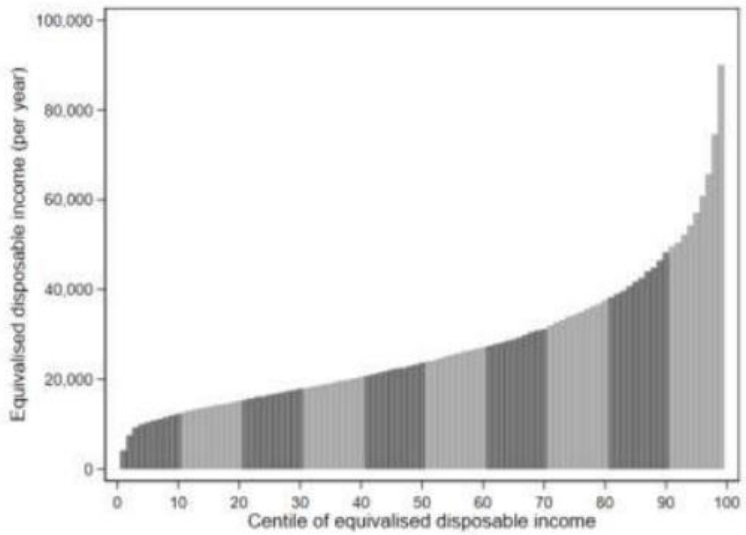
Quarter 2 2020

Indicator	Standard LFS Methodology (ILO) Q2 2020	COVID-19 Adjusted Estimates June 2020 (end of Q2 2020)
Employed persons aged 15 years and over	2,222,500	1,783,567
Employment rate for those aged 15-64 years	65.7%	52.2%
Unemployed persons aged 15-74 years	118,700	531,412
Unemployment rate for those aged 15-74 years	5.1%	23.1%
In labour force	2,341,200	-
Not in labour force	1,632,600	-

Source: https://www.cso.ie/en/releasesandpublications/er/lfs/labourforcesurveylfsquarter22020/

Proportion of the Irish population WITHOUT market income:

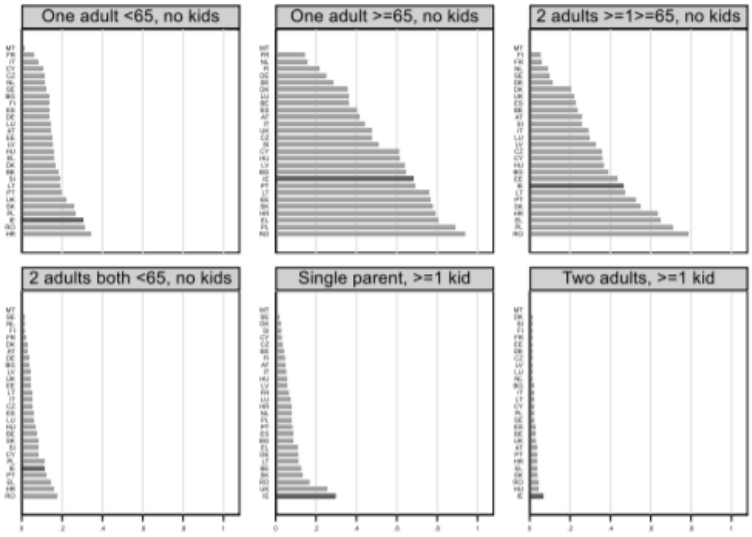
Figure 1: distribution of equivalised household disposable income, 2017



Source: Author's calculations using the 2017 EU Survey of Income and Living Conditions (EU-SILC).
Note: Figure shows the distribution of real equivalised household disposable income in January 2019 prices. Income is equivalised using the modified OECD scale with each member of the household included in the distribution, weighted by the Eurostat provided household weight (euroweight).

Source: Roantree, 2020.

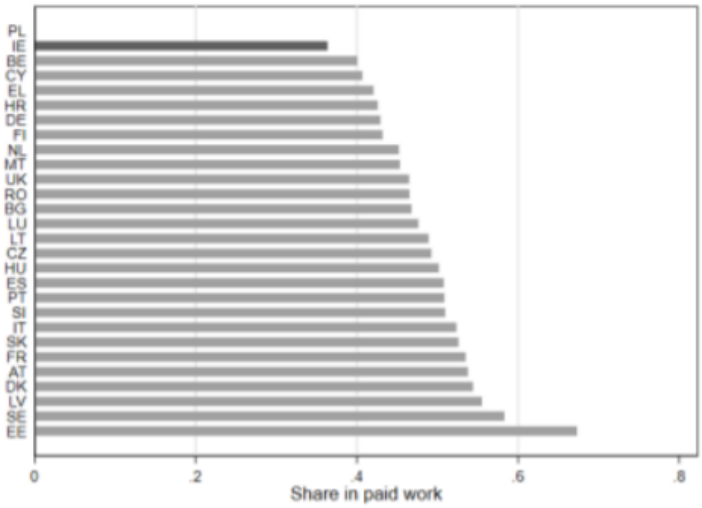
Figure 5: share without positive market income, by household type and country



Note: Author's calculations using the 2017 EU Survey of Income and Living Conditions, excluding households consisting of three or more adults and Malta, who censor household size. Market income defined as above.

Source: Roantree, 2020.

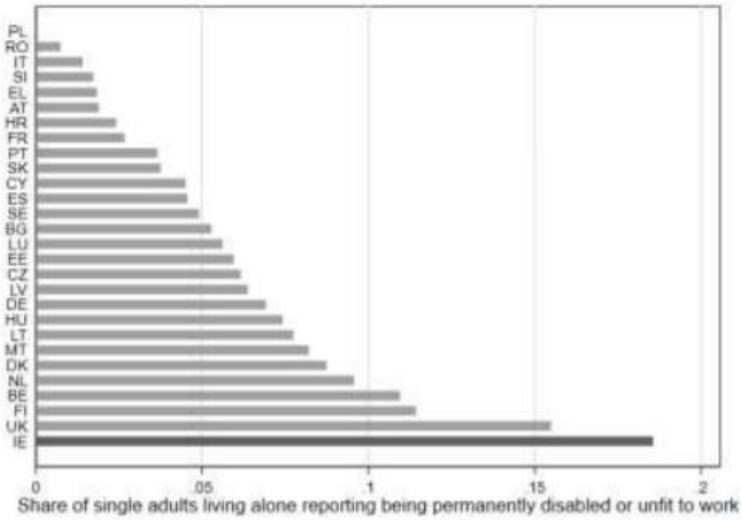
Figure A1: share of single parent households in paid work, by country



Note: Author's calculations using the 2017 EU Survey of Income and Living Conditions. Excludes Poland due to high share of missing observations. Single parent households defined as single parents living with dependent children and no other adult. Paid work derived from reported economic activity status PX050.

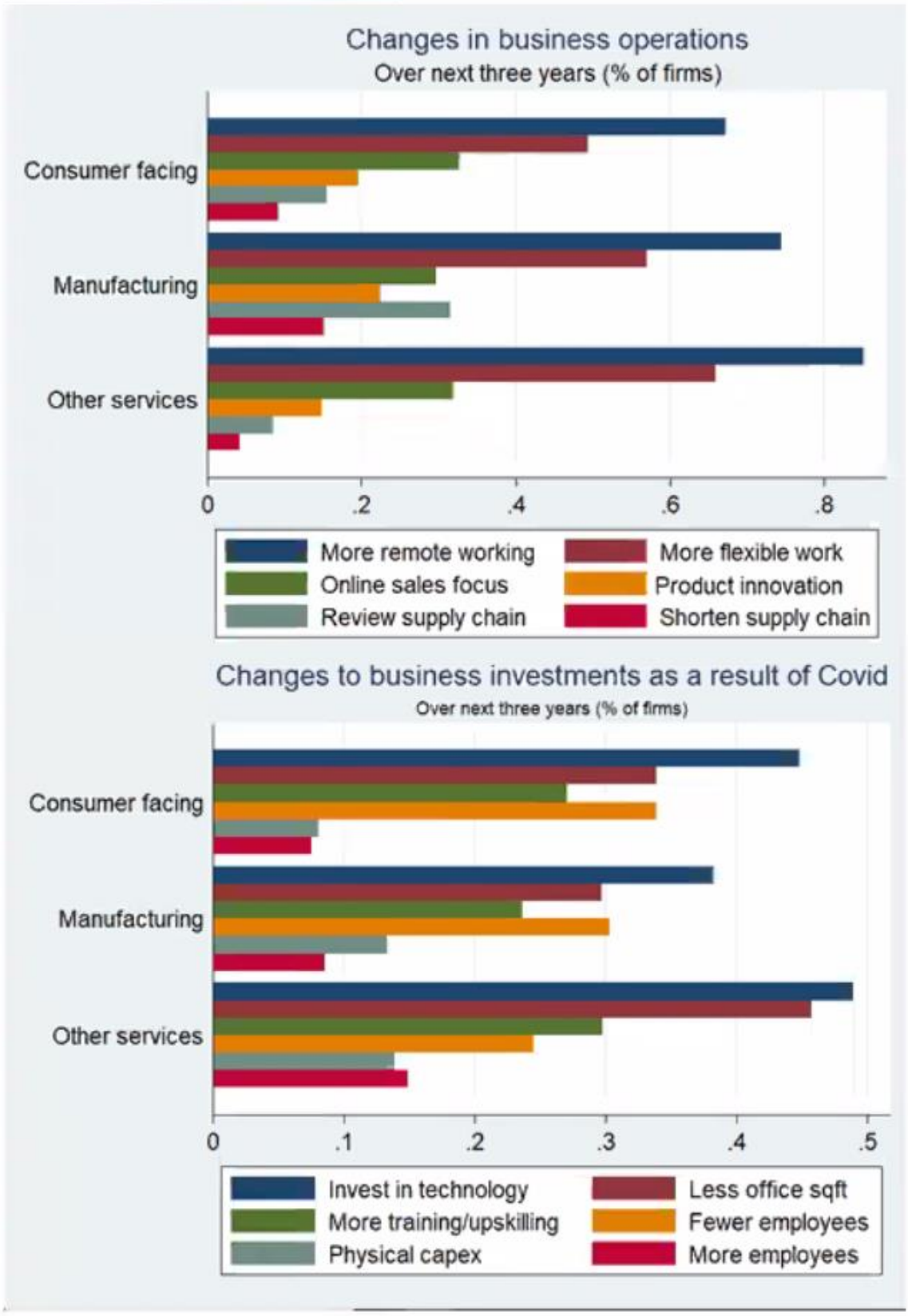
Source: Roantree, 2020.

Figure A2: share of working-age single adults living alone reporting being unable to work because a permanent disability and/or illness, by country



Note: Author's calculations using the 2017 EU Survey of Income and Living Conditions. Excludes Poland due to high share of missing observations Derived from self-reported economic status PL031.

Source: Roantree, 2020

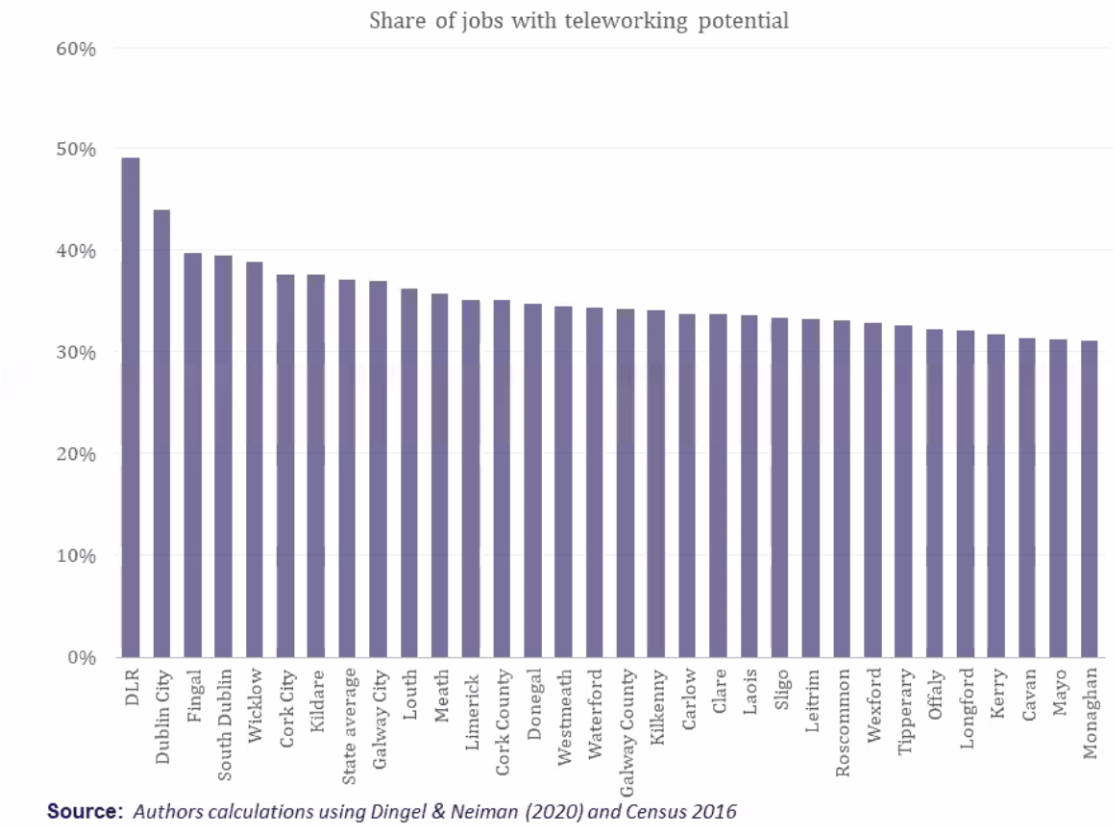


Source: IBEC, 2020

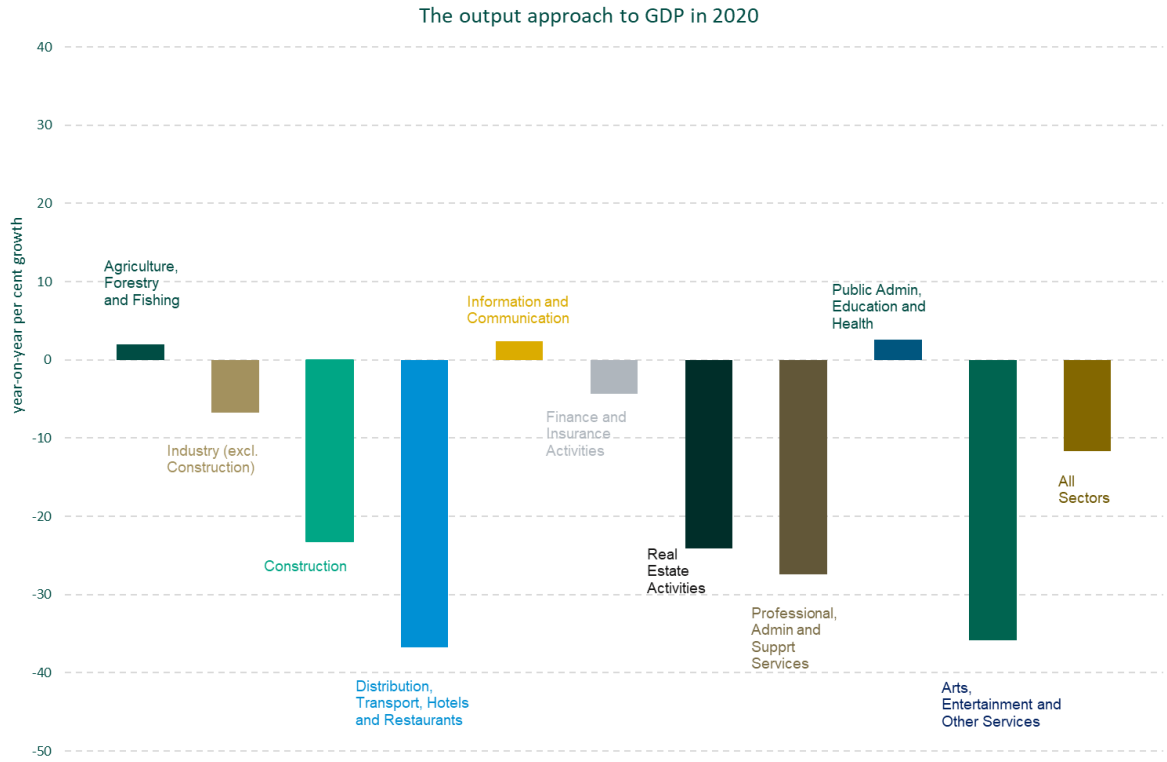
Table 3: Share of jobs that can be done at home, by occupation's major group

	Occupation	O*NET-derived baseline	Manual alternative
15	Computer and Mathematical Occupations	1.00	1.00
25	Education, Training, and Library Occupations	0.98	0.85
23	Legal Occupations	0.97	0.84
13	Business and Financial Operations Occupations	0.88	0.92
11	Management Occupations	0.87	0.84
27	Arts, Design, Entertainment, Sports, and Media Occupations	0.76	0.57
43	Office and Administrative Support Occupations	0.65	0.51
17	Architecture and Engineering Occupations	0.61	0.88
19	Life, Physical, and Social Science Occupations	0.54	0.36
21	Community and Social Service Occupations	0.37	0.50
41	Sales and Related Occupations	0.28	0.21
39	Personal Care and Service Occupations	0.26	0.00
33	Protective Service Occupations	0.06	0.00
29	Healthcare Practitioners and Technical Occupations	0.05	0.06
53	Transportation and Material Moving Occupations	0.03	0.00
31	Healthcare Support Occupations	0.02	0.00
45	Farming, Fishing, and Forestry Occupations	0.01	0.00
51	Production Occupations	0.01	0.00
49	Installation, Maintenance, and Repair Occupations	0.01	0.00
47	Construction and Extraction Occupations	0.00	0.00
35	Food Preparation and Serving Related Occupations	0.00	0.00
37	Building and Grounds Cleaning and Maintenance Occupations	0.00	0.00

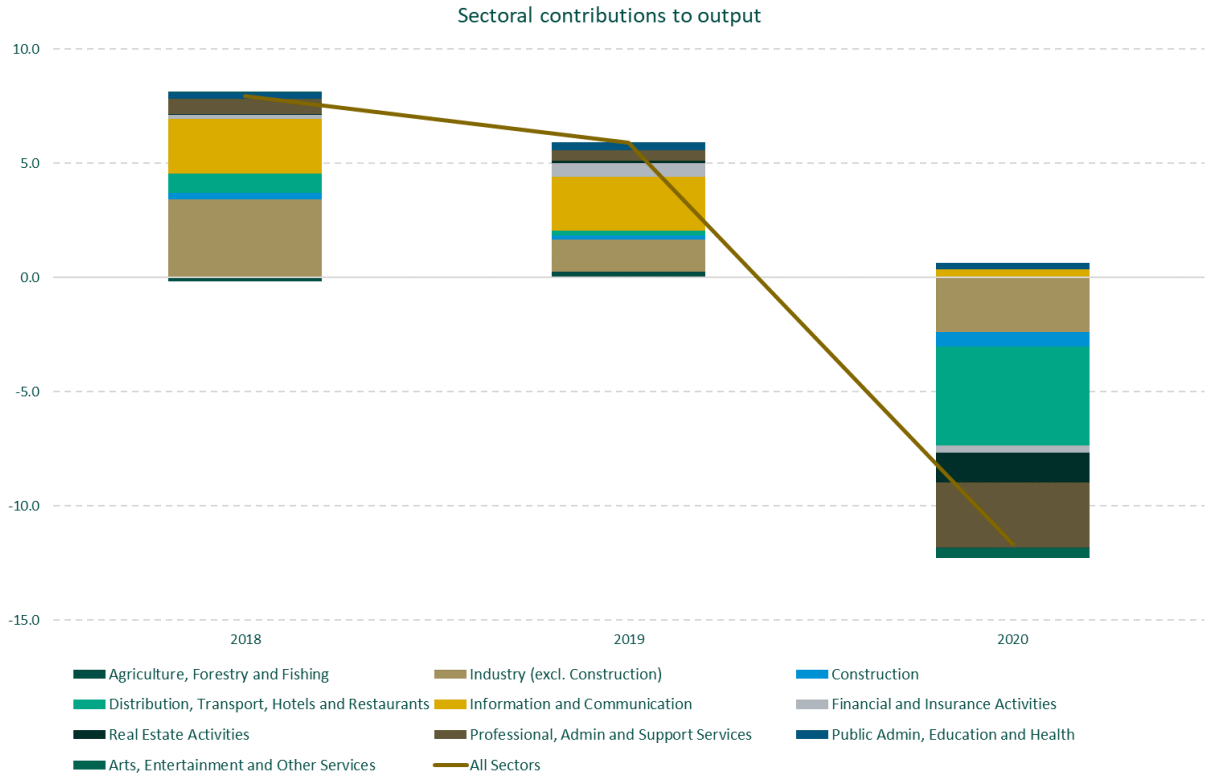
Source: Dingel & Neiman, 2020.



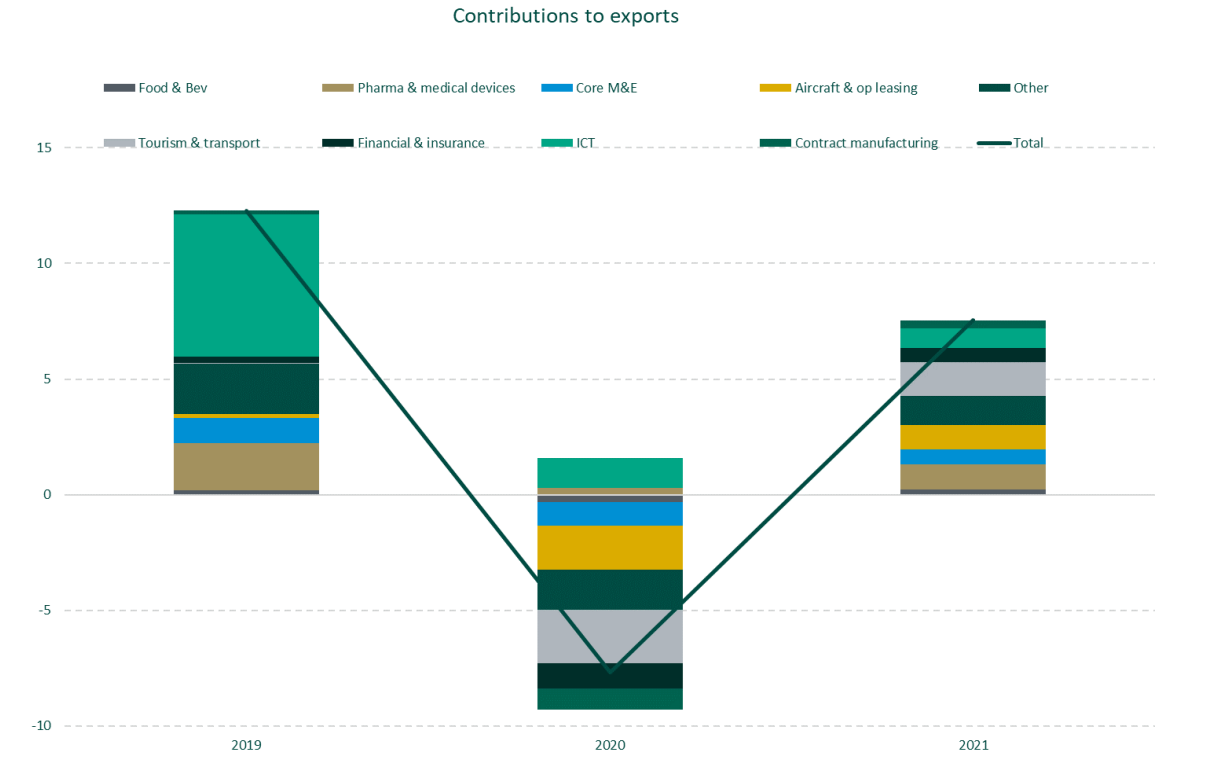
Source: IBEC, 2020



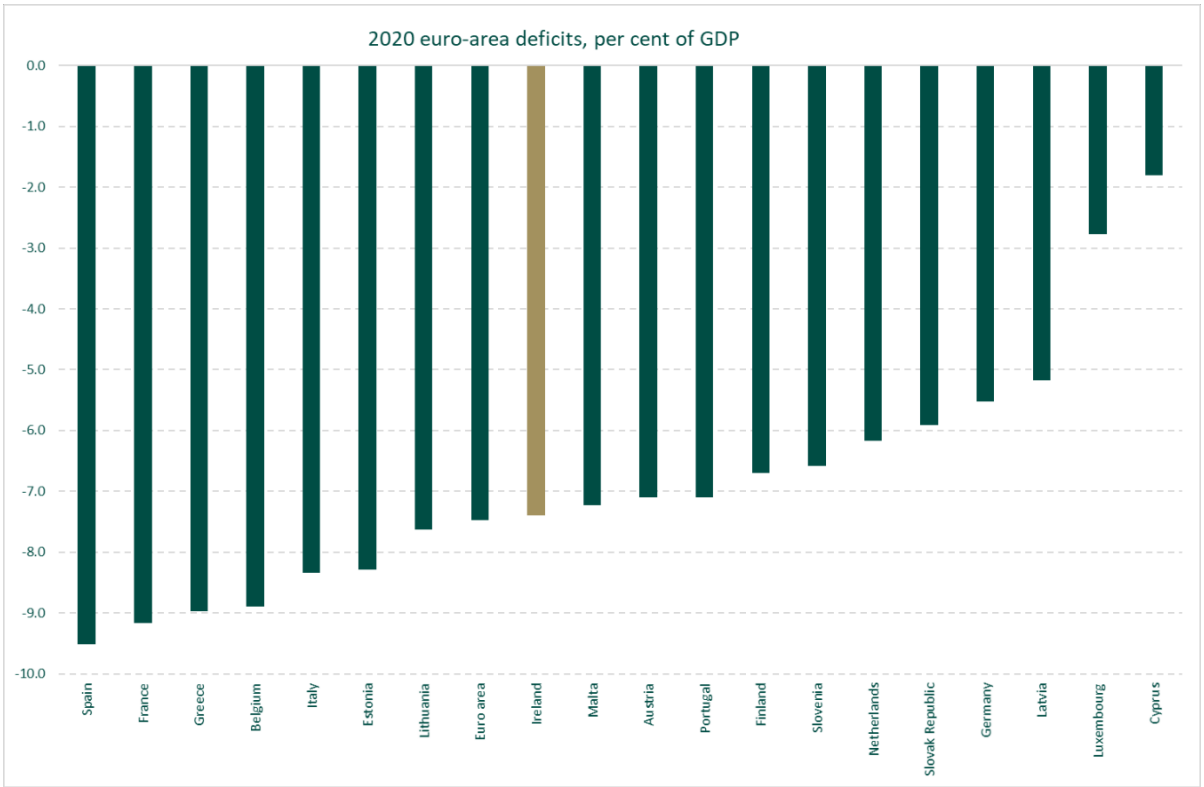
Source: Department of Finance. *Stability Programme Update 2020.* 21 April 2020



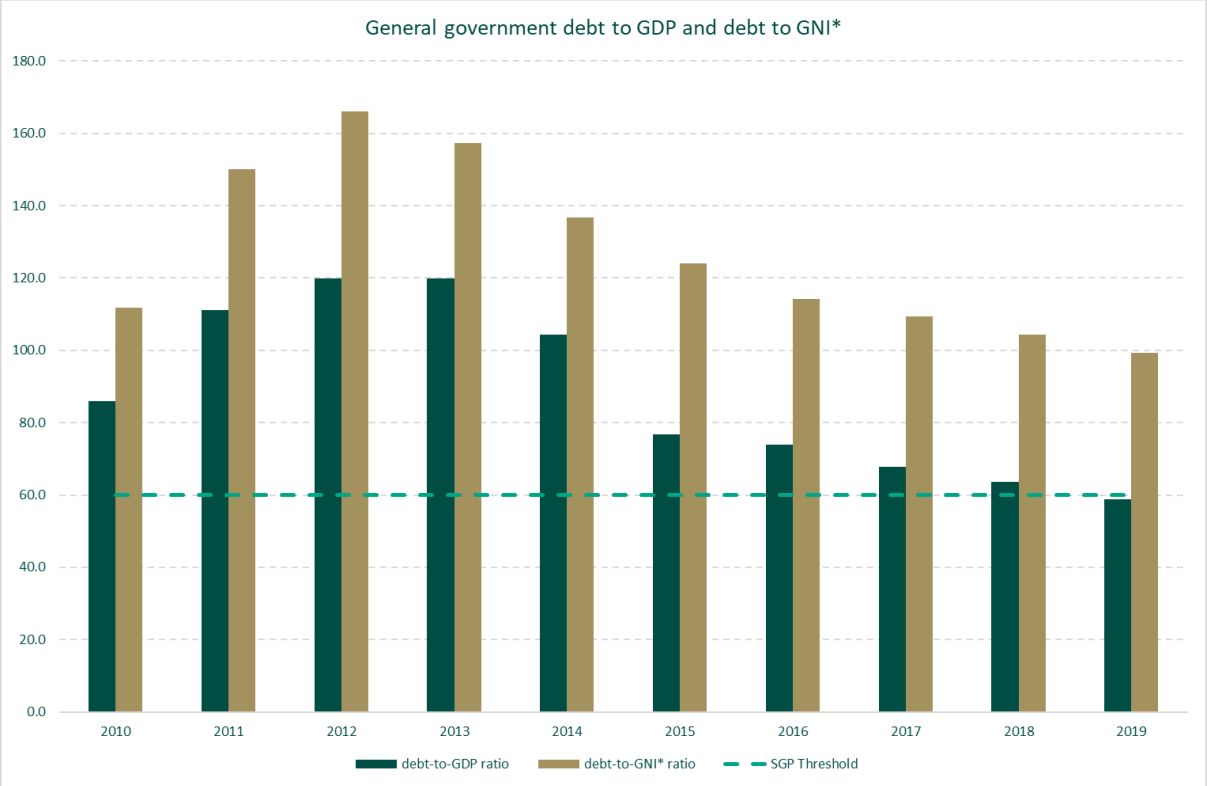
Source: Department of Finance. *Stability Programme Update 2020.* 21 April 2020



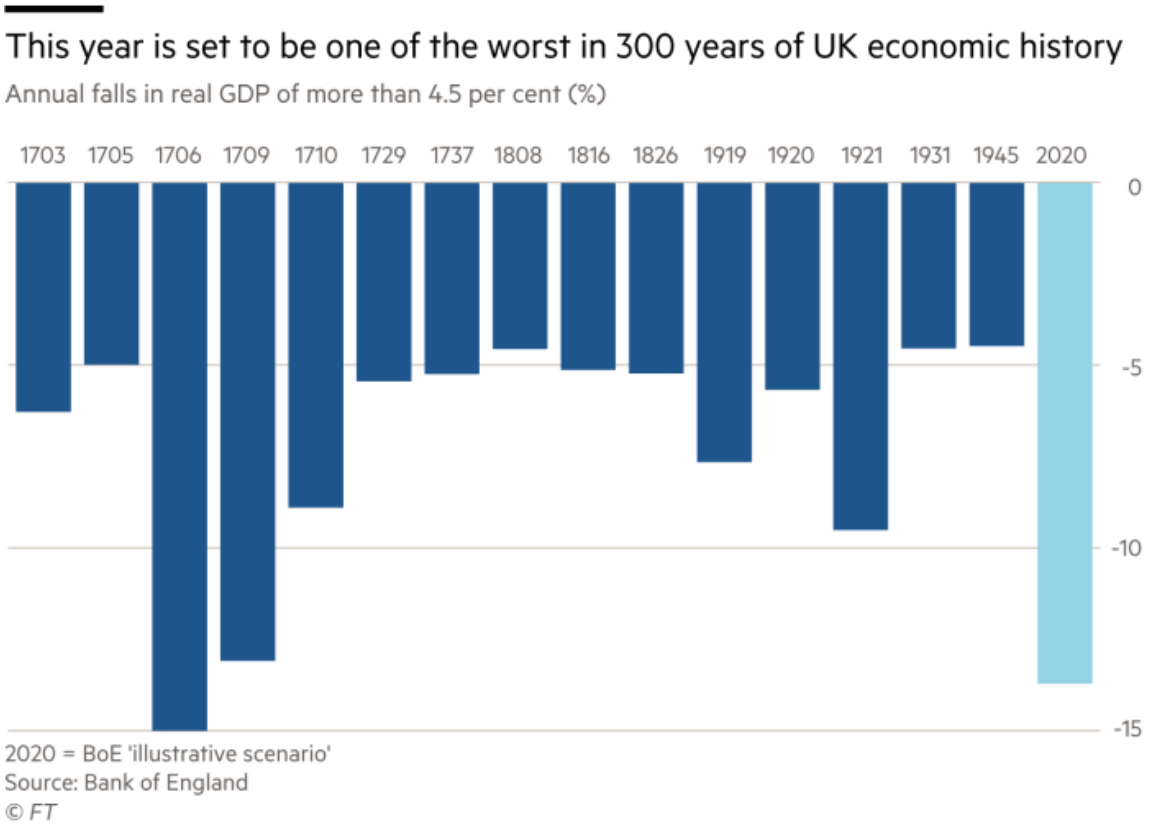
Source: Department of Finance. *Stability Programme Update 2020.* 21 April 2020



Source: Department of Finance. *Stability Programme Update 2020.* 21 April 2020

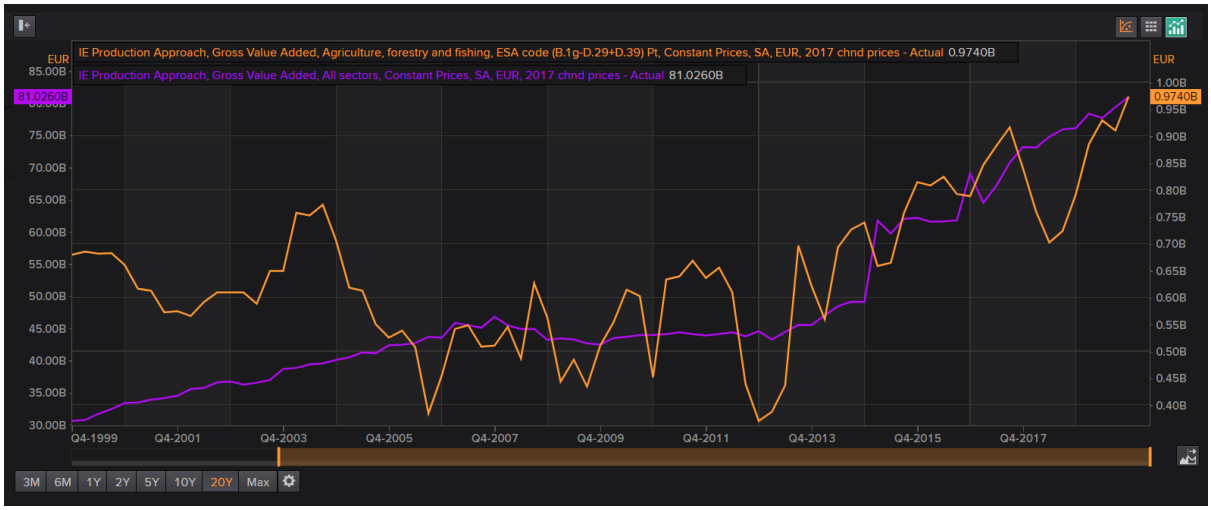


Source: Department of Finance. *Stability Programme Update 2020.* 21 April 2020



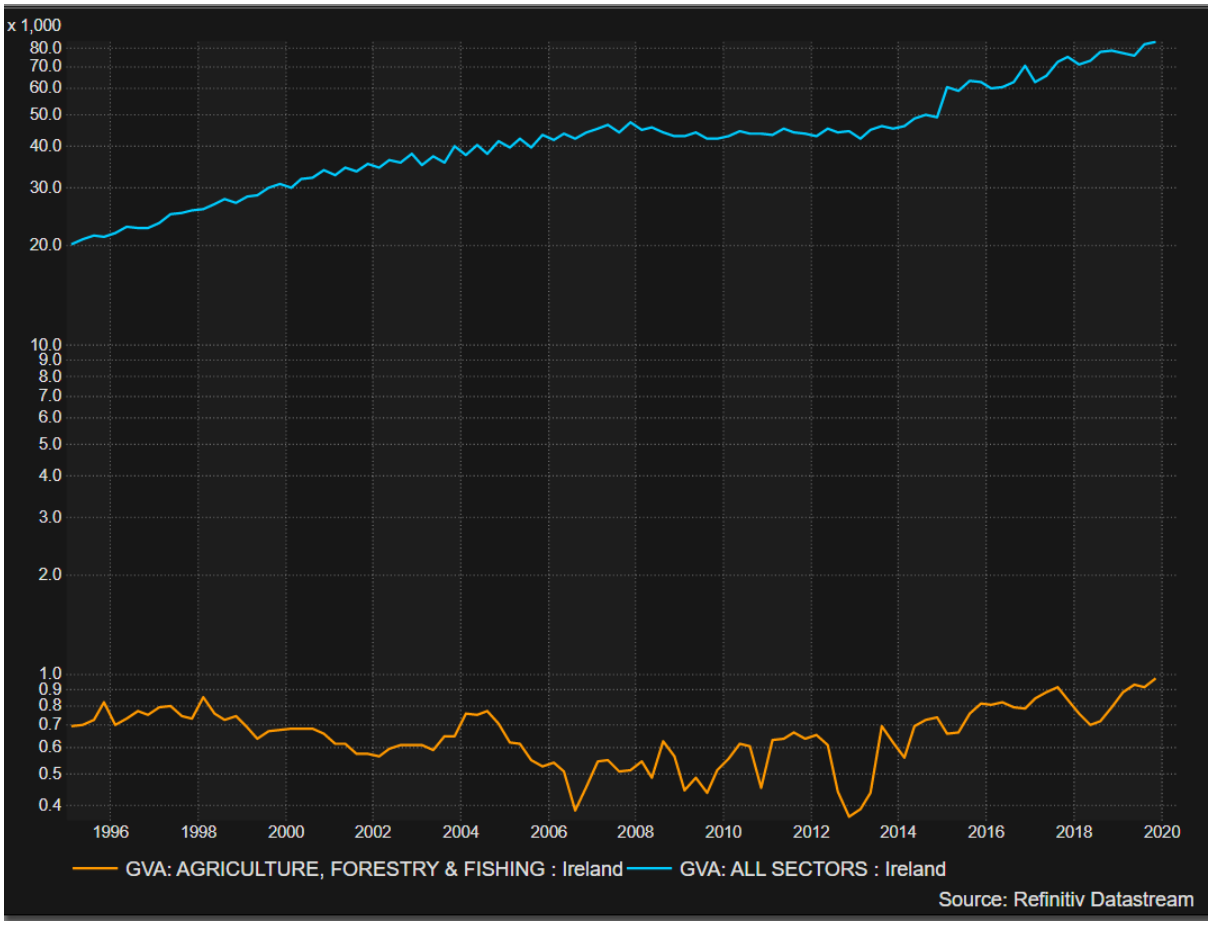
Source: https://www.ft.com/content/734e604b-93d9-43a6-a6ec-19e8b22dad3c

Ireland, Gross Value Added Agriculture (RHS), Gross Value Added All Sectors (LHS)

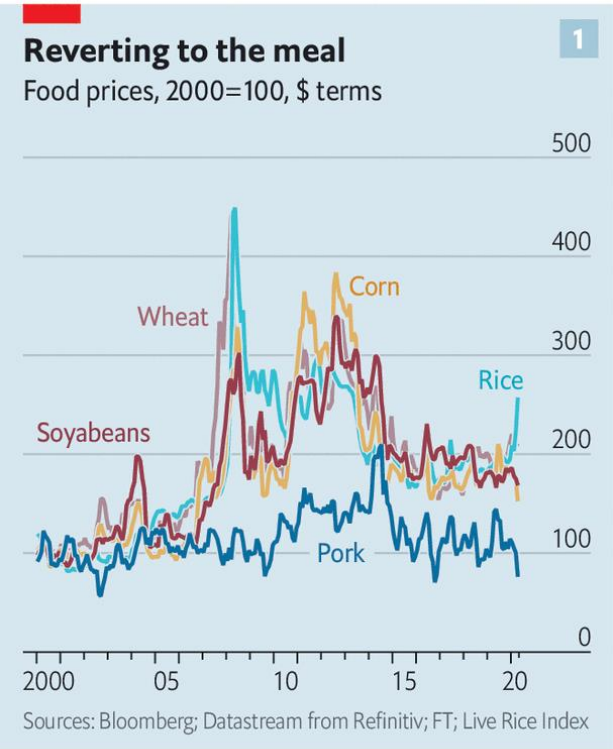


Source: Thomas Reuters Eikon.

Ireland, Gross Value Added Agriculture, Gross Value Added All Sectors (expressed in logarithmic scale)

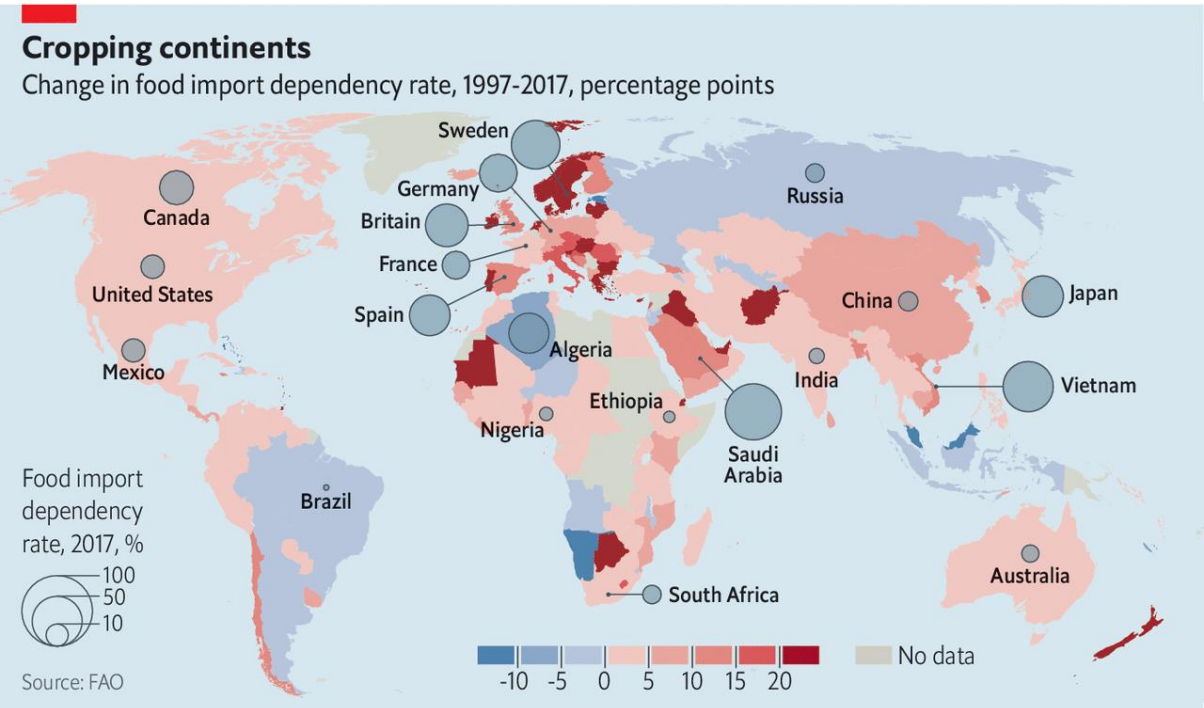


Source: Thomas Reuters Eikon.



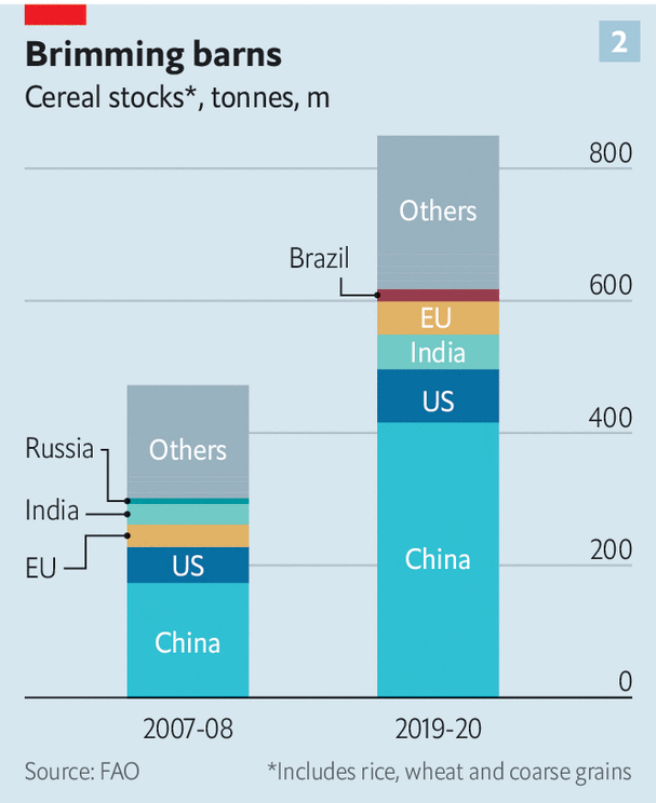
The Economist

Source: https://www.economist.com/briefing/2020/05/09/the-worlds-food-system-has-so-far-weathered-the-challenge-of-covid-19



The Economist

Source: https://www.economist.com/briefing/2020/05/09/the-worlds-food-system-has-so-far-weathered-the-challenge-of-covid-19



The Economist

Source: https://www.economist.com/briefing/2020/05/09/the-worlds-food-system-has-so-far-weathered-the-challenge-of-covid-19

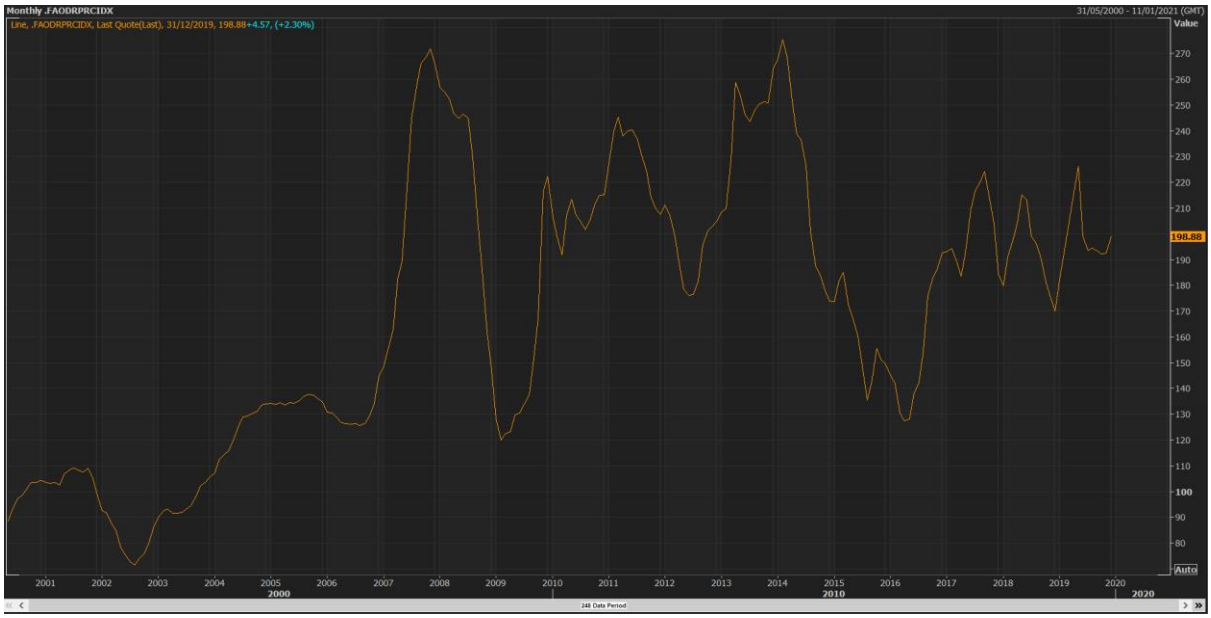
UN FAO Food Price Index (31 May 2000 – 12 May 2020)

Source: Thomas Reuters Eikon.

UN FAO Cereals Price Index (31 May 2000 – 12 May 2020)

Source: Thomas Reuters Eikon.

UN FAO Dairy Price Index (31 May 2000 – 12 May 2020)



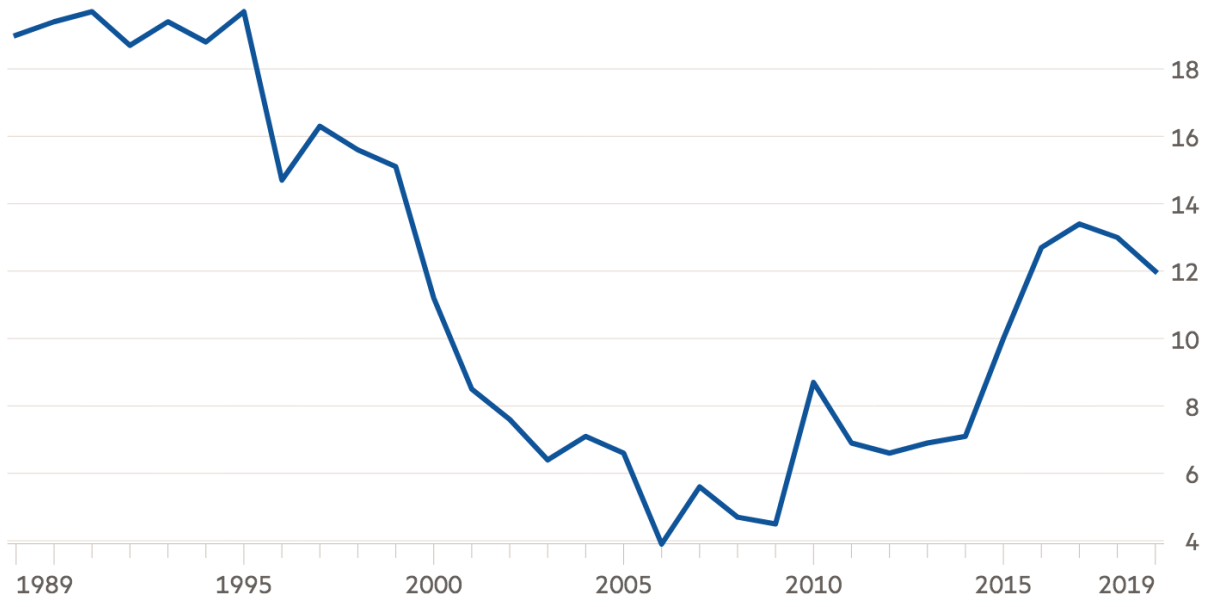
Source: Thomas Reuters Eikon.

UN FAO Meat Price Index (31 May 2000 – 12 May 2020)

Source: Thomas Reuters Eikon.

Meat grinding lower

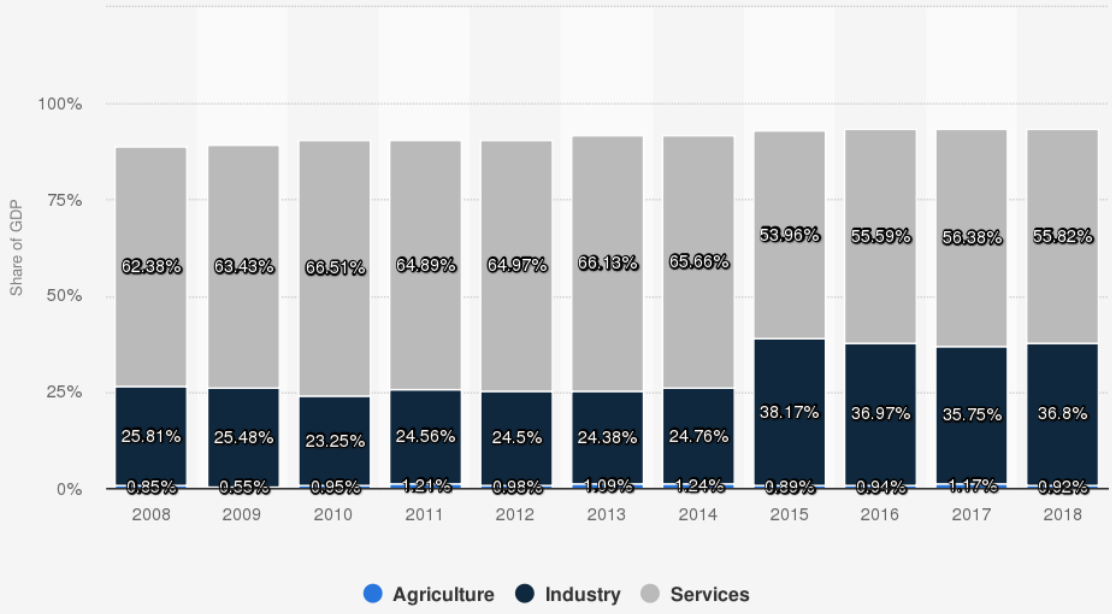
Tyson Foods' gross margin over the past thirty years (%)



Source: S&P Global
© FT

Source:https://ftalphaville.ft.com/2020/05/07/1588841222000/Beyond-Meat-s-profit-driven-pricing-power/

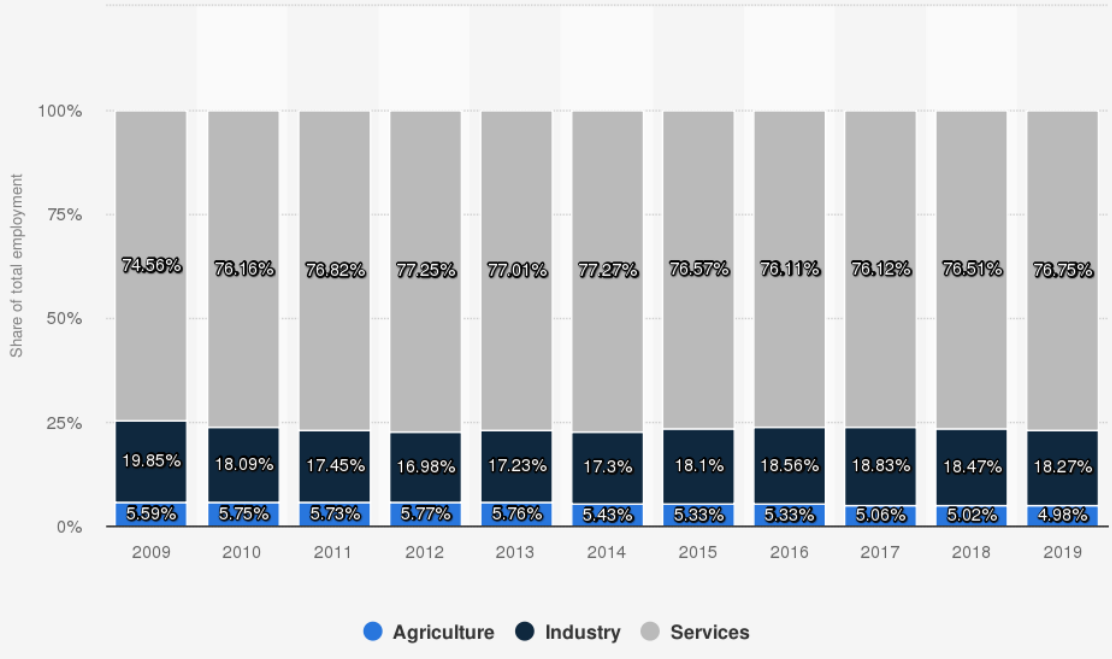
Ireland: Distribution of gross domestic product (GDP) across economic sectors from 2008 to 2018



Source
World Bank
© Statista 2020

Additional Information:
Ireland; World Bank; 2008 to 2018

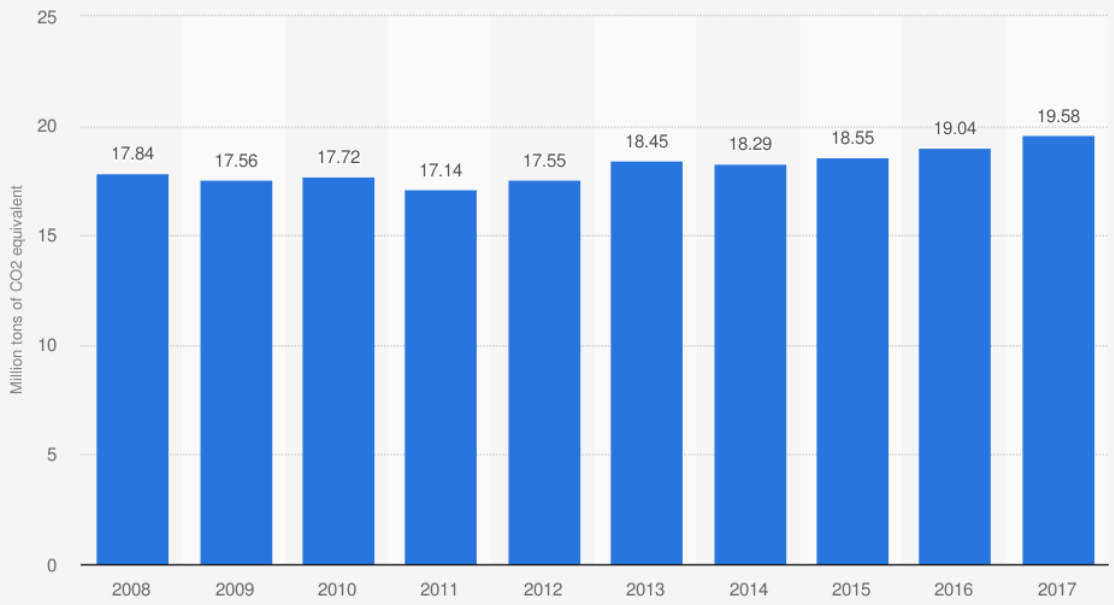
Ireland: Distribution of employment by economic sector from 2009 to 2019



Source
World Bank
© Statista 2020

Additional Information:
Ireland; World Bank

Annual greenhouse gas emissions from agriculture in Ireland from 2008 to 2017 (in million tons of CO2 equivalent)

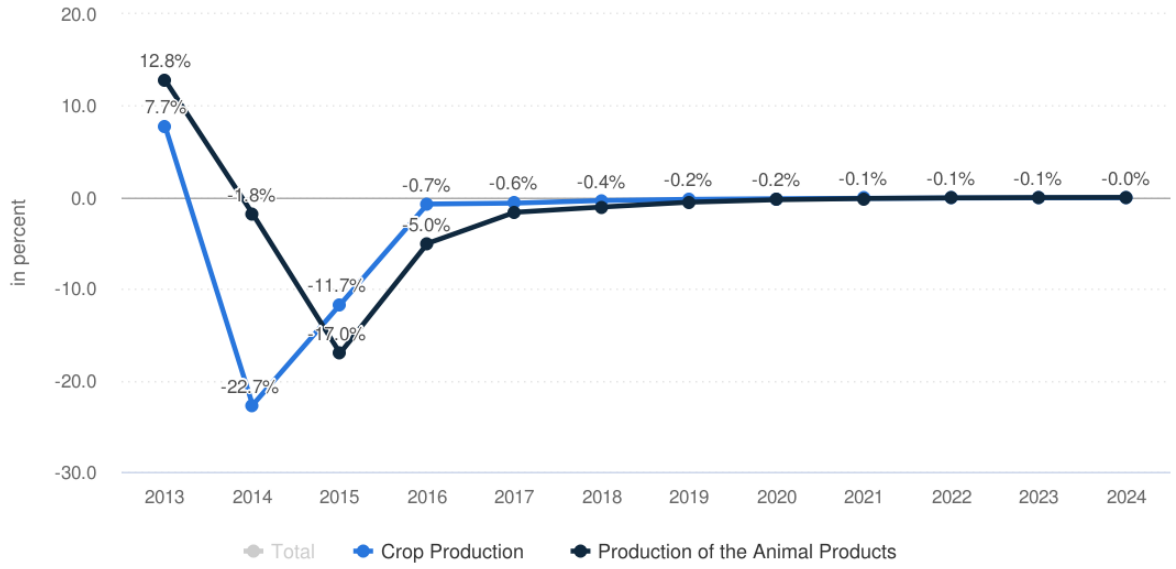


Sources
Eurostat; EEA
© Statista 2020

Additional Information:
Ireland; Eurostat; EEA; 2008 to 2017

Revenue growth in the Agriculture market

in percent (Ireland)

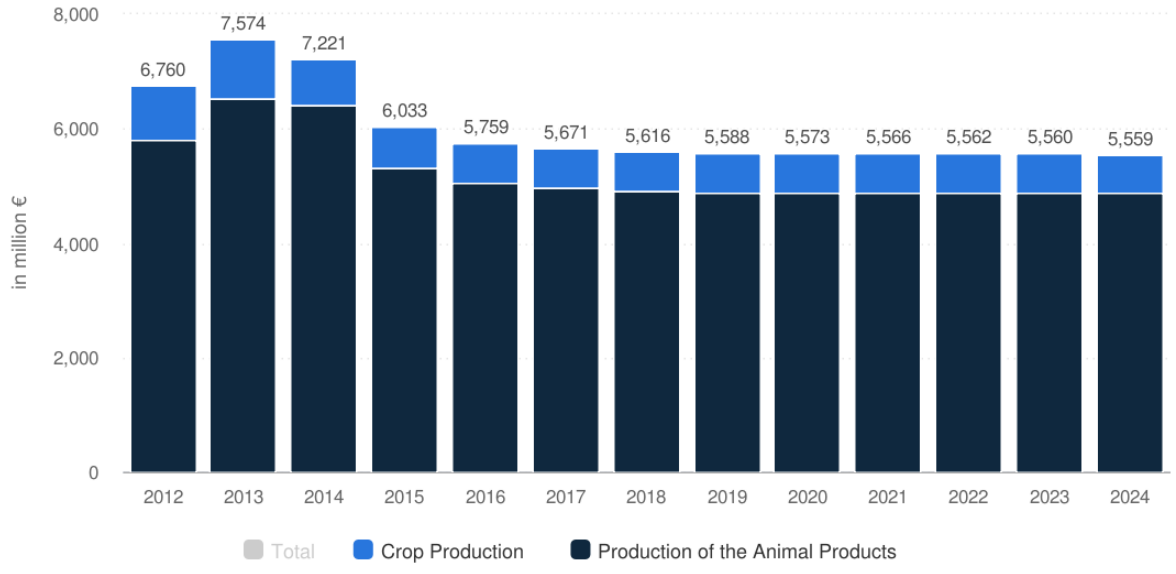


Source: Statista, Eurostat, U.S. Census Bureau (COVID-19 impact will be implemented Q2 2020), April 2020

statista

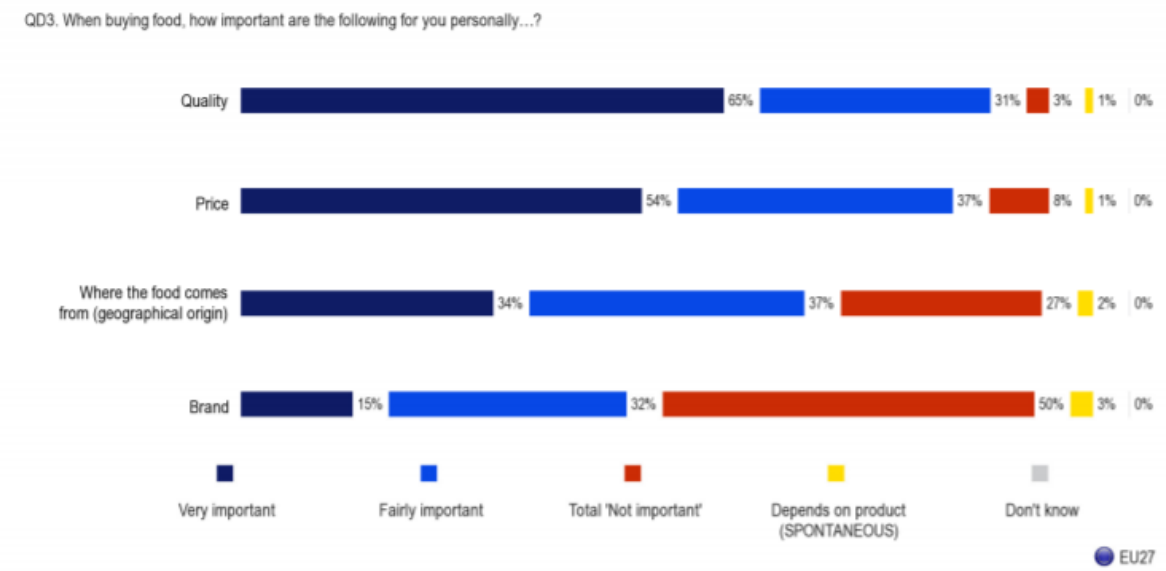
Revenue in the Agriculture market

in million € (Ireland)

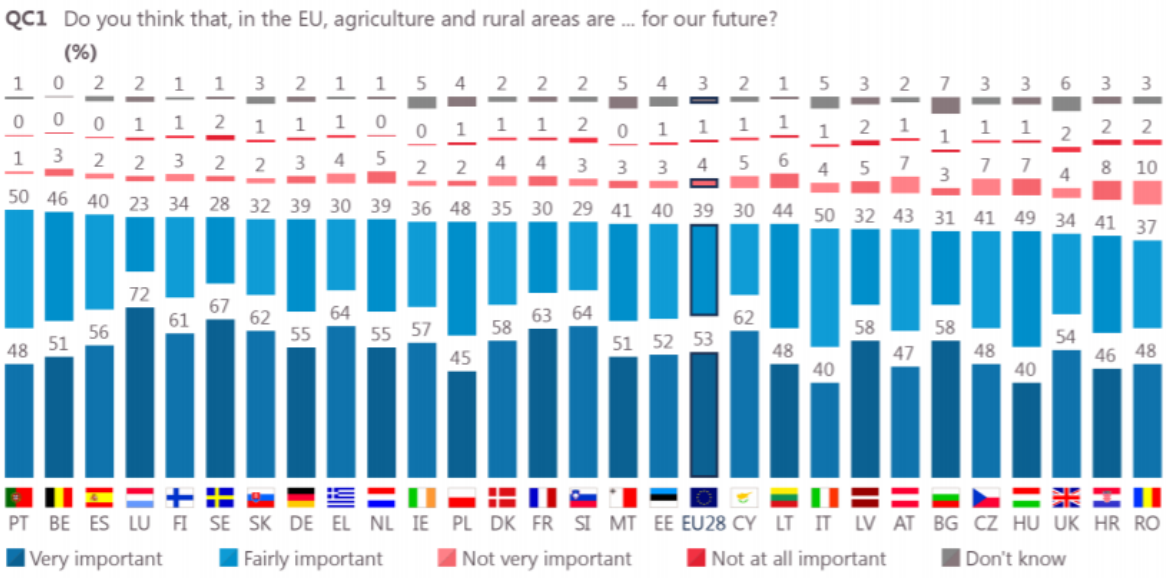


Source: Statista, Eurostat, U.S. Census Bureau (COVID-19 impact will be implemented Q2 2020), April 2020

statista



Source: European Commission. (2012) *Europeans' attitudes towards food security, food quality and the countryside. Special Eurobarometer 389 / Wave EB77.2 – TNS Opinion & Social*. Luxembourg: Publications Office of the European Union.

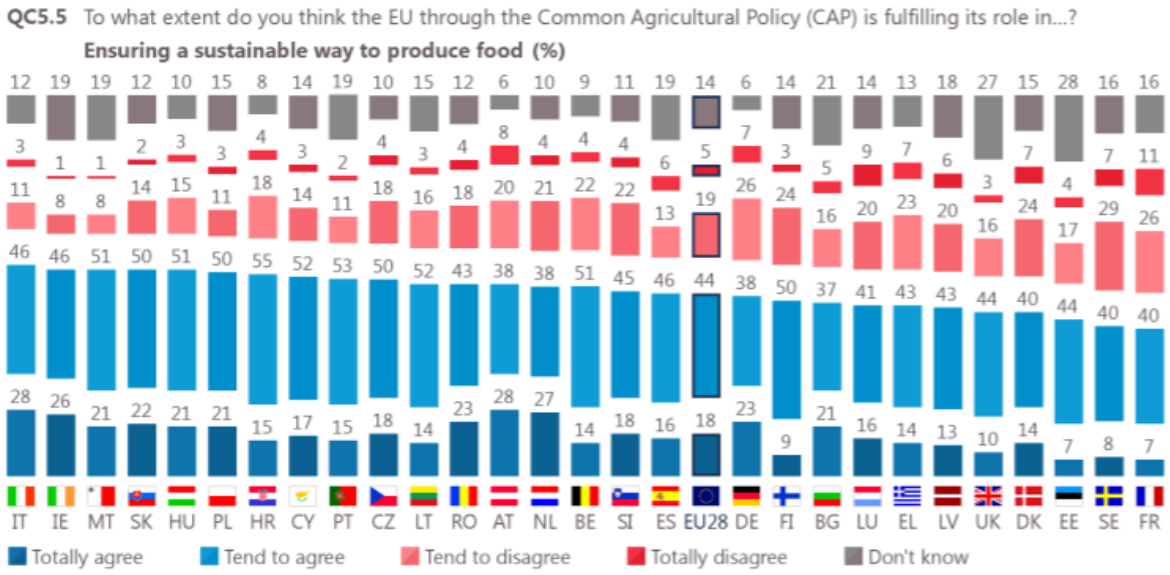


Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.

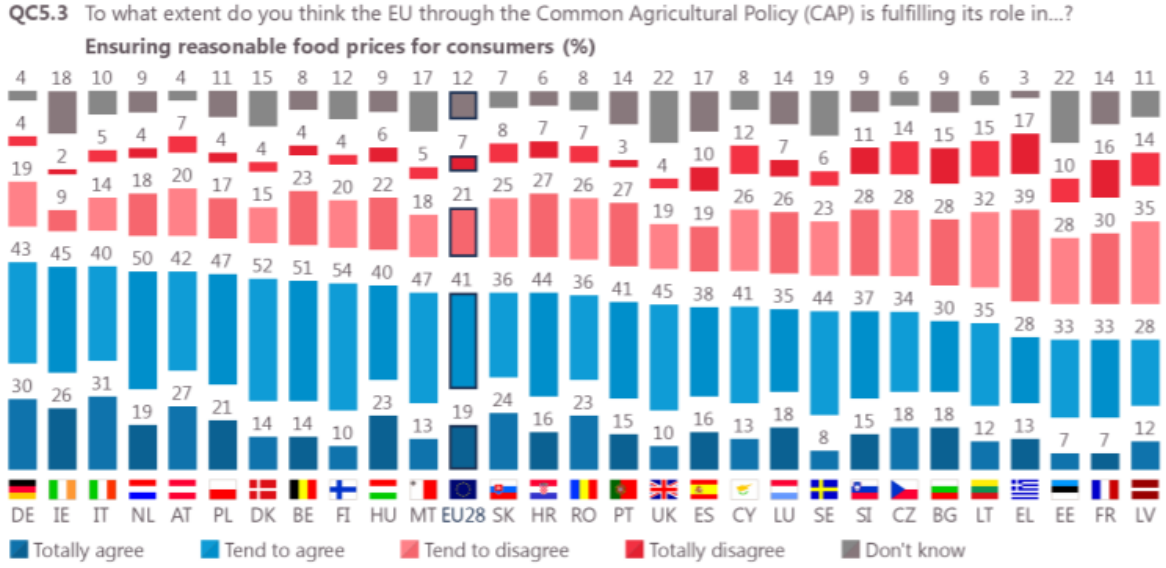
QC12 For each of the following issues related to agriculture and rural development policy, please tell me if in your opinion, it should be dealt with at the European level, the national level, or the regional or local level.
(% - EUROPEAN LEVEL)

	Ensuring that agricultural products are of good quality, healthy and safe		Securing food supply		Ensuring a fair standard of living for farmers		Ensuring reasonable food prices for consumers	
	2017	2017 - 2009	2017	2017 - 2009	2017	2017 - 2009	2017	2017 - 2009
EU28	51	=	48	▼ 5	44	▼ 1	42	=
BE	61	▼ 10	63	▼ 6	56	▼ 7	57	▼ 6
BG	52	▲ 3	40	▼ 32	50	▲ 2	40	▲ 8
CZ	51	▼ 8	39	▼ 3	41	▼ 6	38	▼ 3
DK	57	▲ 7	59	▲ 1	37	▼ 9	44	▼ 2
DE	66	▲ 3	62	▼ 13	56	▲ 3	53	▲ 1
EE	32	▼ 1	23	▼ 37	28	▼ 1	19	=
IE	55	▲ 10	53	▼ 7	48	▲ 7	48	▲ 9
EL	53	▼ 3	51	▼ 8	53	▼ 6	41	▼ 9
ES	63	▲ 15	62	▲ 13	63	▲ 16	58	▲ 12
FR	49	▼ 10	44	▼ 7	37	▼ 12	36	▼ 12
HR	38	*N.A*	38	*N.A*	37	*N.A*	34	N.A
IT	50	▲ 1	51	▼ 4	46	▼ 1	48	▲ 4
CY	68	▼ 5	60	▼ 21	63	▲ 6	50	▼ 5
LV	47	▲ 9	37	▲ 5	39	▲ 3	34	▲ 6
LT	53	▲ 11	44	▲ 8	44	▲ 2	40	▲ 11
LU	65	▼ 7	60	▼ 15	53	▼ 7	52	▼ 18
HU	41	▼ 11	37	▼ 7	37	▼ 5	32	▼ 1
MT	52	▲ 6	51	▼ 20	45	▲ 12	35	▲ 8
NL	75	▼ 3	73	▼ 2	49	▼ 12	51	▼ 13
AT	41	▼ 1	40	▲ 1	40	▼ 3	40	▲ 1
PL	37	▼ 4	33	▼ 3	35	▼ 3	33	▲ 2
PT	50	▼ 1	54	▲ 2	53	▲ 5	48	=
RO	34	▼ 10	30	▼ 30	36	▼ 1	33	▲ 4
SI	43	=	36	▼ 32	34	▼ 2	32	▼ 4
SK	42	▼ 17	36	▼ 12	39	▼ 15	34	▼ 11
FI	43	▲ 7	31	▼ 1	28	=	27	▼ 3
SE	62	▲ 7	49	▲ 1	29	▼ 10	27	▼ 6
UK	34	▲ 4	30	=	28	▲ 2	26	▲ 3

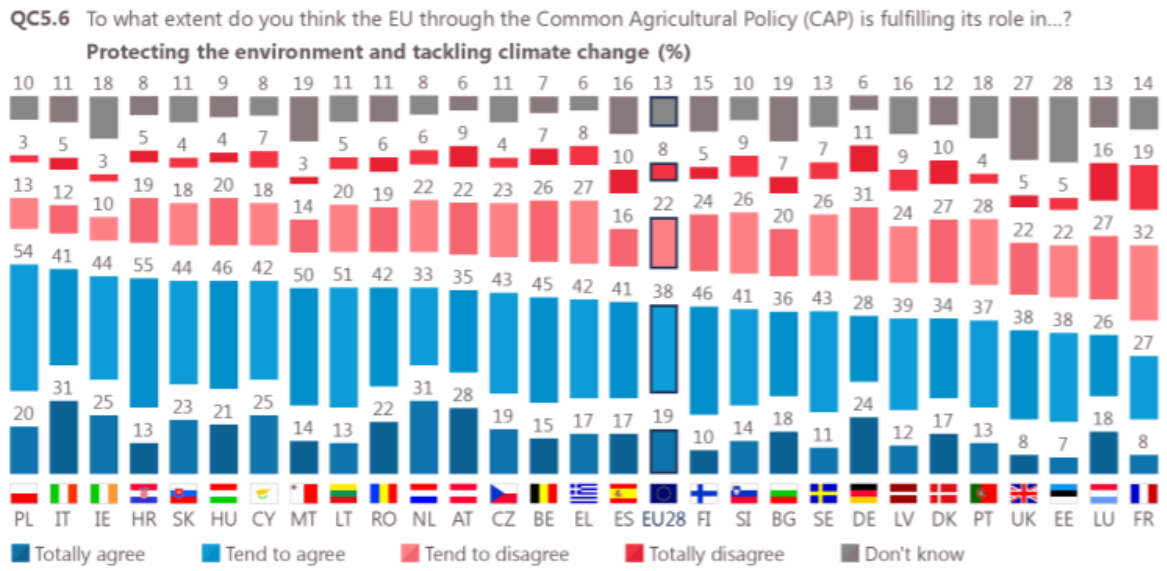
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



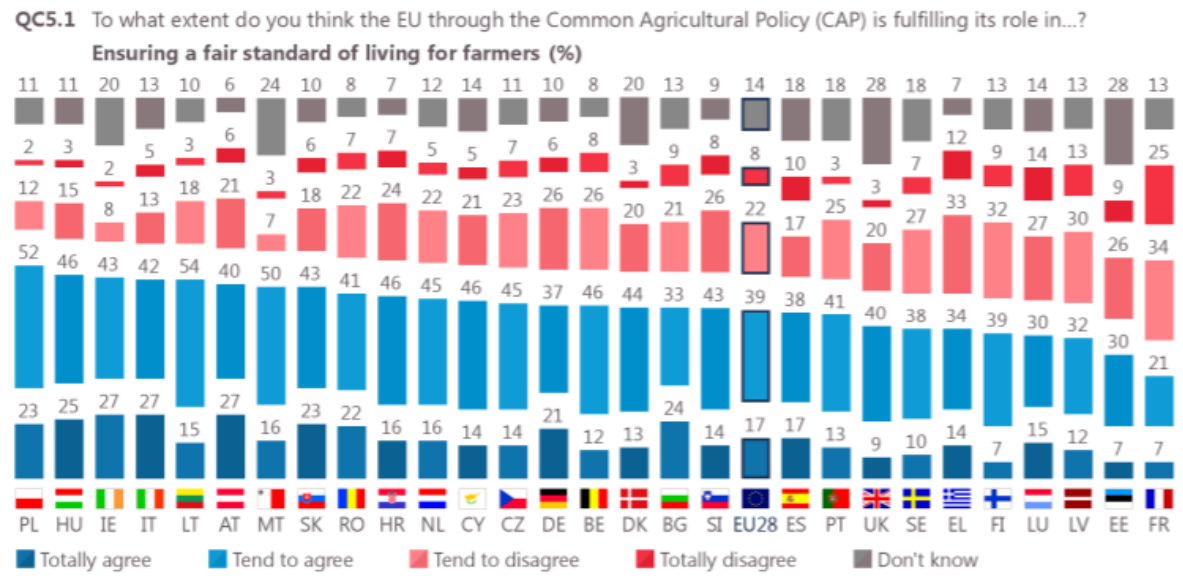
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



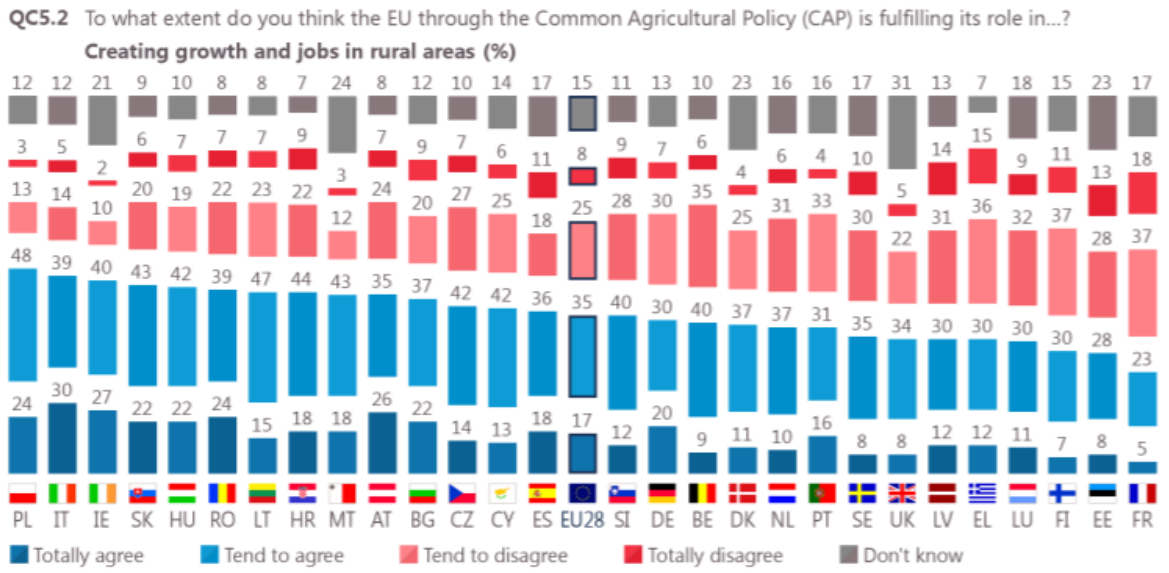
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



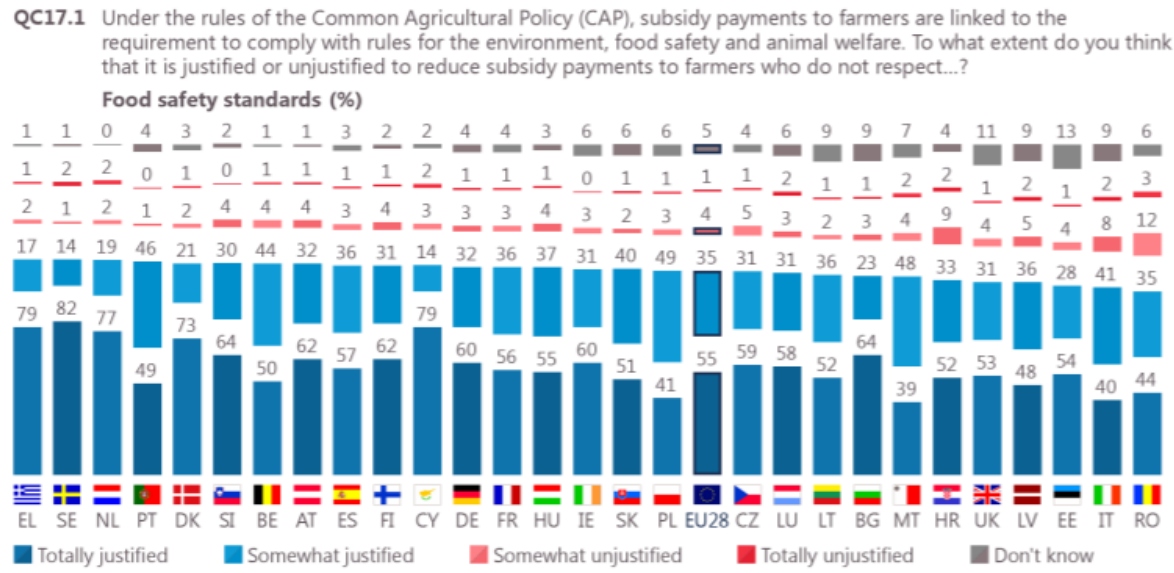
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



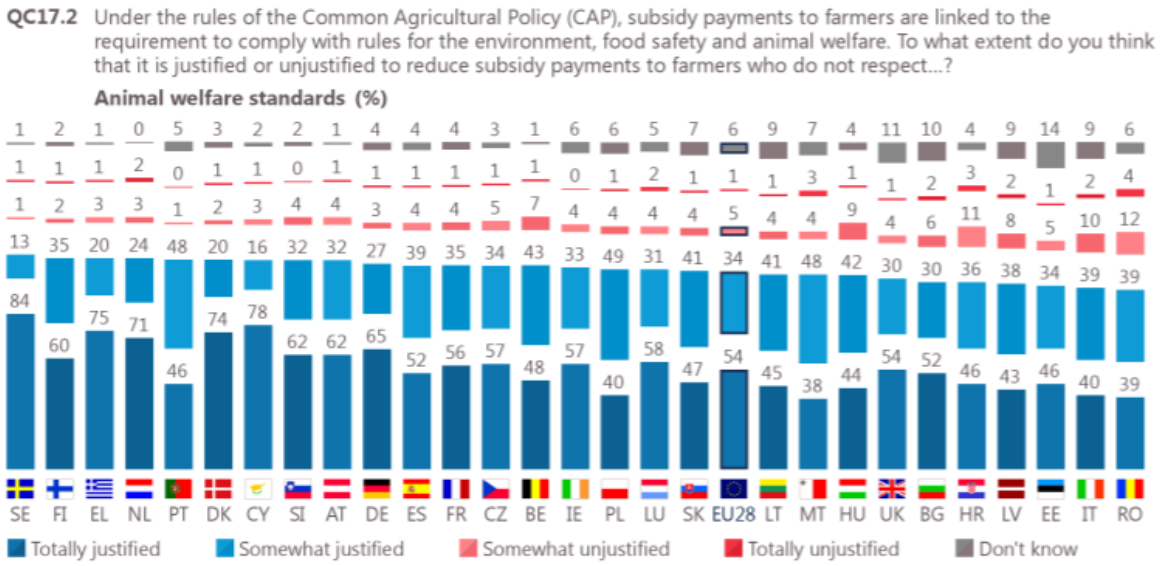
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



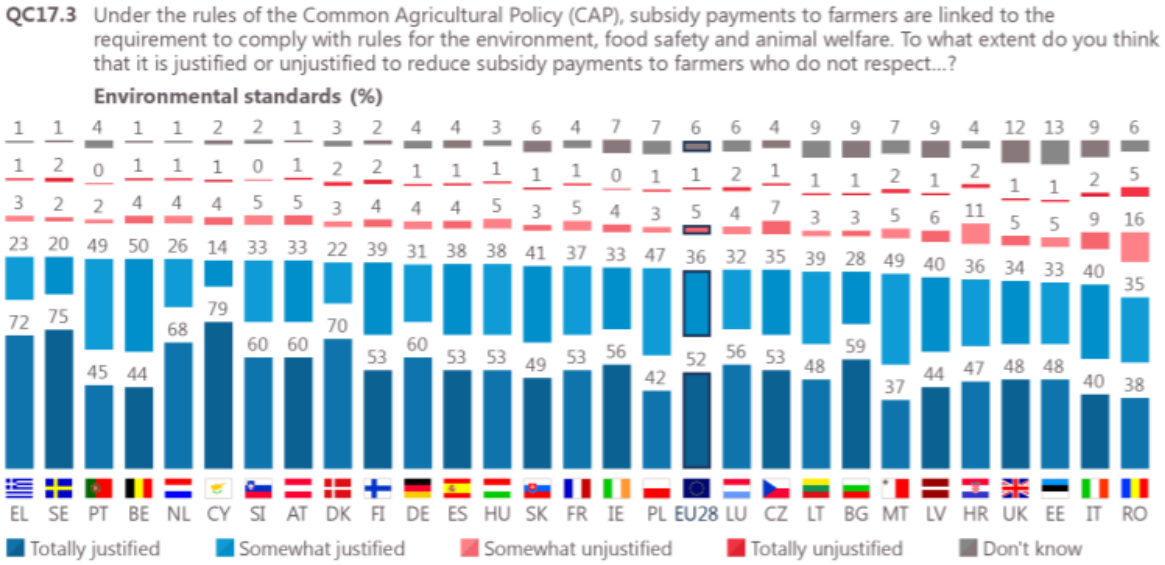
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



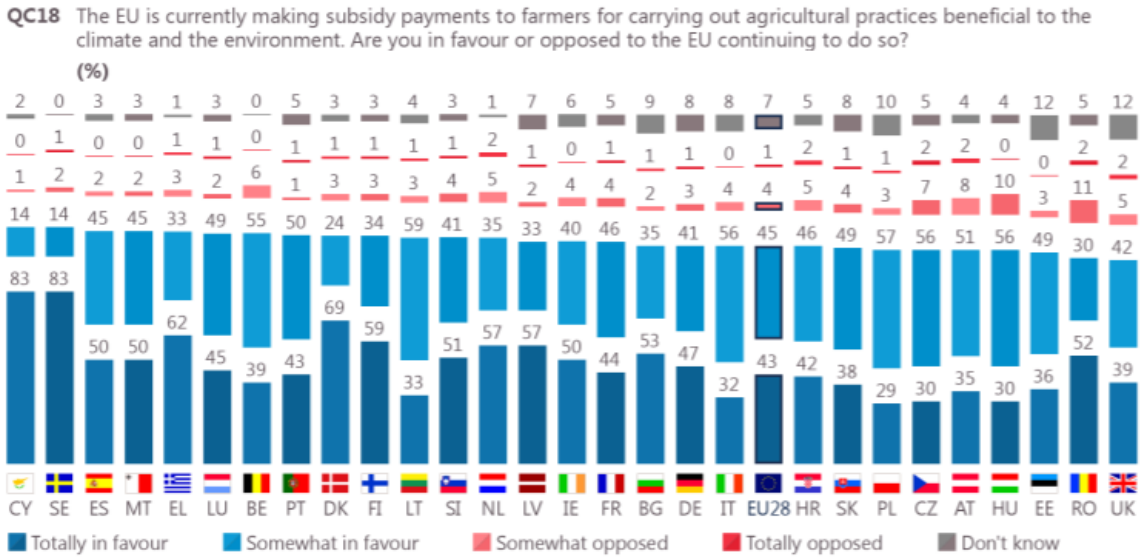
Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.



Source: European Commission. (2017) *Europeans, Agriculture and the CAP Special Eurobarometer 473 / Wave EB88.4 – TNS opinion & social*. Luxembourg: Publications Office of the European Union.

Appendix 4 Interviews with Brendan Dunford & Donal Sheehan

Brendan Dunford - Burren Project

"…for farmers, a big part of what they do, a big part of their value system, is their freedom to farm, so when they have restrictions imposed upon them which limits this freedom, it can build a lot of resentment and distrust and it breaks the connection between the authorities and the farmer on the ground. I think that designations and some schemes caused a big schism and continues to be a big gap between policy and practice."

"…I agree that small scale environmental incentives are of limited relevance here – maybe incentives provided by dairy coops would be a better approach. But these farmers depend a lot on Pillar 1 payments and any damaging environmental activities should in theory be covered under cross-compliance. For these farmers to get the single farm payment every year they need to follow baseline environmental conditions, but I think the enforcement of these conditions isn't always great. We all have heard the stories about habitat destruction, hedgerow removal, burning, hedge cutting during nesting season, slurry spreading during the closed season - these are contrary to environmental objectives and can't be allowed to happen, they will endanger not just the environment but our international reputation."

"It's more the abuse of chemicals than their use that's the problem. I think pricing has something to do with addressing this – helping to make sure these substances aren't abused - but I think, again, that enforcement and better education are needed. Farmers use these for a reason though and we need a better incentive to encourage farmers to limit their use – a result-based payment system can help do this, we regularly reduce payments for misuse of chemicals. We're too fond of penalising farmers for things that they feel they have to do as opposed to finding alternatives and rewarding them for positive management."

"By taking a peer-led approach. We set up 'farming for nature' project to identify farmers who are doing great things for nature and we try to say to other farmers – 'these are the role models, these are the guys who farm well, they're productive farmers, but they're also farming in harmony with nature'. These are the kind of role models that farmers will relate to, not policy makers or scientists. We need to give the environmental agenda back to farmers. With 'farming for nature' it's identifying, acknowledging and celebrating those farmers who do great things for nature, for water, biodiversity, soils, on their land. Having the farmers take ownership and share their story, that's what really works.

So I think what it would look like is you would have farmers in every part of Ireland with their own agri-environmental scheme for their own area, that they're actively participating in, that they're actively being rewarded as a consequence of their engagement and that they're viewed by their neighbours and their peers as being stewards of the landscape – in a real and meaningful way. The ones going out day on day making sure the water courses are kept clean, making sure that the habitats are protected and making sure that land is farmed in a sensitive way, producing great food and great heritage. I think the kind of model we're proposing would see gains for a lot of farmers – paid for by society. Because, as a society, if we want better environmental outcomes from farmland, we must pay for it – either through increased food prices and/or through environmental payments.

…

We need to begin by building trust and partnerships, ideally at a local level. Then moving on from that, it's developing a programme that fits your area…taking into account the landscape but also the environmental targets that you want to achieve there. Those programmes should be co-created by the farmers with the other parties together as partners. Then in terms of delivering those programmes, they have to be properly funded and have proper support with local office and payments made to farmers which relate to environmental outcomes achieved."

Donal Sheehan - Bride Project

"…GLAS and other agri-environment schemes were never targeted at the intensive farming sector, yet, this is where most of the environmental problems are occurring – high fertiliser use leading to poor water quality and a higher carbon footprint, habitat loss leading to declines in biodiversity

A lot of the agri-environment schemes, in my opinion, were income supplements. Whereas, what the Bride project tries to do, is, we actually pay for the environment first, rather than the farmer. Once you start paying for the environment, the farmer automatically gets paid, but it doesn't necessarily work the other way around. The payment is based on a result i.e. improving biodiversity."

"Farming has always been about working with your hands to produce food and getting paid for that. Farmers plant and harvest crops and look after livestock and milk cows. These are the occupations that keep rural Ireland alive. Planting monocultural Sitka Spruce has been forced on farmers who cannot make an income from the traditional methods of farming. When land use changes from farming to forestry, in essence this means there is no need for people to manage the land for the next 50 years. If you keep livestock, they have to be counted every day and checked for illness, with forestry the gate of the field is closed for good!

Wind farms are also a change of land use and the same result occurs – no need for farmers, leading to an exodus from the countryside and more urbanisation.

This policy has also led to a loss in biodiversity in the uplands. Hen Harriers and Curlew have declined to almost extinction because of loss of habitat. The visual landscape that the uplands provides also changes with a change of land use. Rolling hills and mountains with a patchwork quilt-type landscape of heather, all the different types of grassland, moorland, water features, give way to one landscape of continuous cover forestry. This impacts on tourism as the beauty of the landscape changes, again leading to rural degradation.

It is death by a thousand cuts.

Farmers in the uplands are providing different ecosystem benefits and need to be rewarded for these as they cannot survive on food production alone because of the difficulties compared with lowland farming."

"I'm a dairy farmer myself, my income comes from dairy farming. So, if I convert all my land to woodland or let it go wild, I'm not going to make a living from dairying. So it's a matter of marrying the two together and getting a balance whereby farmers are producing food but also delivering on all the other ecosystem services that their land can provide such as biodiversity, carbon sequestration and improved water quality.

Dairy farming has been very profitable but there needs to be higher sustainability accreditation so that those farmers who are delivering higher environmental standards are paid more. At present, farmers are paid solely on volume and yield e.g. the more milk I produce the more money I make, likewise for beef & sheep farmers and cereal growers. There is no environmental incentive in the pay cheque. Until this changes positive environmental improvements will not happen.

This needs to be taken on board by the food industry.

It's a matter of getting a balance between sustainable environmentally friendly food production and improving biodiversity and water quality at the same time.

Everybody drinks water, eats food and breathes the air, including the CEOs of all the large-scale food companies, yet there is no common strategy to ensure the quality of these are not comprised.

Cheap food comes at a high environmental cost and a poor environment leads to poor food and water quality, leading to poor health in our communities."

A farmers income is limited by the amount of land that they are managing. If a dairy farmer has 100 hectares, this means the farm can carry over 200 cows, whereas a farm of 50 hectares can only carry half that number, therefore only half the income can be made. In essence, more land = more profit. So there is an incentive to maximise the land to produce as much food as possible to increase your profit.

There is no income to be made from non-productive land such as hedgerows, trees, wetland, bogs, ponds etc. so the inclination is to remove or reclaim these landscape features to make the farm more productive.

The Basic Payment Scheme (BPS) is paid to farmers based on the productive area of the farm compounding further, the problem of biodiversity loss, carbon footprint and water quality as it does not allow these features to be included for payment. This gives another signal to the farmer that these same features have no value.

You put out more fertilisers, you take out more habitats. And it's all back down to utilising every square inch of land that you have."

"…what we're trying to do is we actually want to pay farmers based on their BMA (Biodiversity Managed Area – the non-productive area), and I think that would make a huge difference, because I would even go so far as to say that the single farm payment could be based on your BMA. So, if everyone is at 10% and they get 100 euros per Ha or 200 euros per Ha that can be decided, it puts a value on all of the other aspects of your farm, besides the cropping area… that means that every part of the river that the farm is on, and we include not just the length of riparian strip, but also a metre of the river itself to get that BMA. It puts a value, and actually a financial value on woodland, on riparian buffer strips, hedgerows, wetlands etc. etc. etc…. that's what we're trying to do."

RBP's - Results-based Payments

RBP's are a new way of administering environmental payments to farmers. Over the last 30 years or so, farmers were paid through traditional agri-environment schemes and the Basic Payment Scheme, and despite billions of euros of European taxpayers money being spent on improving the environment, biodiversity and water quality are still in decline.

RBP's are based on positive environmental quality results whereby farmers who have higher quality habitats are paid more than for poorer quality habitats.

The BRIDE Project is trialling this new system of payment whereby for the past month we have been scoring all the habitats on the Projects 42 farms. Based on the quality of these habitats, farmers will be rewarded for the previous year's management of these.

The cost of scoring versus the money spent on rewarding the farmer for environmental improvement needs to be weighted in favour of payment towards environmental improvement and to do this will mean an efficient scoring assessment with results that reflect the true quality of our farmland habitats. Specific BRIDE Habitat Scorecards have been developed so that scoring can be done quickly, without compromising on evaluating the environmental quality.

“The big problem with the CAP is the issue of eligible and non-eligible land, and it goes back to having a value on non-eligible land. If your only land that’s eligible for your single farm payment is the land you’re making money from already, the land where cows are grazing and the land where your crops are being harvested from – this is a duplicate payment.

If you have grassland and it becomes scrub, it could be a lot better for biodiversity than intensive grassland. Yet you’re penalised with your single farm payment as it (the scrub area) has to be removed from payment.

So, if you’re trying to improve biodiversity, the policy is going against you. This kind of good agricultural environmental condition, that’s contradictory in terms. Sometimes, what’s not in good agricultural condition can be very beneficial environmentally. So, it’s all about putting a value on every aspect of your land, and an equal value, because we know now how important biodiversity is because we’ve lost it, and we know how important water quality is because we have to treat it with chlorine. Yet, there are very few people putting their hands up and saying we really need to do something about this.

There needs to be change and it needs to happen at policy level. Farmers can do what they want, but most farmers are still driven by what they’ll make from the cheque in the post and the criteria that maximises this payment.

The signals need to be more positive for the environment.

We all suffer, farmers and non-farmers from a poor-quality environment.

Farmers are managing the land and they have the biggest say in the environmental benefits that can be accrued from it.

The way they manage it will determine whether we have good or poor water quality, high or declining biodiversity, a low carbon footprint or a high carbon footprint. The incentives need to be put in place to achieve this."

This page intentionally left blank