Cows eat grass, don't they?

Results of a social science project on the role of grass-based and higher-feed-input systems in the Irish dairy sector.

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Executive summary

This is a report for the project 'Cows eat grass, don't they?' which ran from 2018-2021 and looked at the future of grass-based, higher-feed-input and indoor dairy systems in the UK and Ireland. It was a social sciences project funded by the British Academy. Social sciences research on agriculture aims to understand how agricultural systems work and how change happens within agriculture. This involves analysing the opinions and values of those who work in agriculture as well as factors bigger than the individual such as culture, and the influence of policies and markets. This is a report on the research in Ireland, another report on the research in the UK can be found on the project website: www.docowseatgrass.org.

When I wrote the proposal in 2016, I was reading about the optimist visions from industry and government for a sustainable, profitable grass-based Irish dairy industry that provided good working lives for farmers and supported rural communities. The project was motivated by understanding the experiences of people working in the Irish dairy industry following the removal of EU milk quotas in 2015. In dairy sectors in industrialised countries there is a trend of decreasing importance of forage as cereals and other feeds are used to increase yields. Ireland is one of the exceptions to this rule and leading up to the removal of milk quotas farmers were encourage by industry, government and advisory services not to pursue yield increases through concentrate feed because the grass-based system is seen as more profitable and simpler. The emphasis in a grass-based system is on maximising milk from forage and keeping purchased concentrates to a minimum. Around this time I was also reading about how Ireland's unique grass-based system was more environmentally friendly, and could keep farmers on the land through providing a price premium because of the marketing advantages of grass-fed milk[1].

The research questions for the project were:

1. To what extent did farmers and key stakeholders in the Irish dairy industry endorse a low-cost grass-based system, as opposed to a higher-feed-input system?

And

2. What were farmer and stakeholder experiences of whether the low-cost grass-based system can realise a) environmentally sustainable production, that b) sustains smaller farms and c) provides a good working life for farmers?

This report is based on a survey with 396 dairy farmers in Ireland, and interviews with 18 key stakeholders and 20 dairy farmers.

Findings:

- **Support for grass-based over higher-feed-input systems** among the majority of key stakeholders and farmers who took part in the survey and interviews.
- **Relative unity around grass.** I did not find a strong divide between farming systems: farmers I engaged with during the research who fed more concentrate still focused on grass and had beliefs and networks that were not distinct from those operating a lower-feed-input grass-based system.
- **A 'good farmer' is a good grass farmer.** The success of the grass-based system was based on concerted advisory and research support that helped create a common definition of a 'good farmer' as someone who has grass management skills and produces high volumes of grass.
- **Good farming is intensive grass management.** This definition of a 'good farmer' included intensive production that aims to maximise grass yields using fertiliser inputs, which may conflict with current industry and government goals to lower the environmental footprint of the dairy sector.

1 IFA, "Towards a ' Milk Wise 2025 ' Strategy for Irish Produced Fresh Milk" (Dublin, 2015); DAFM, "Food Harvest Food Harvest 2020: A Vision for Irish Agro-Food and Fisherie," *Department of Agriculture, Fisheries and Food* (Dublin, 2010), https://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodharvest2020/2020FoodHarvestEng240810.pdf.

- **'The environment' is toxic.** Farmers I spoke to felt a connection to the natural world around them, enjoyed working outside and some took pride in their role as stewards of the land. However, they felt there was a big divide between them and the non-farming public on the issue and they felt blamed and vilified.
- **Alternatives to expansion?** Farmers I engaged with in the research had many positive views about post-quotas expansion but also felt social and systemic pressure to expand which could be at odds with other goals in their life including work life balance. Farmers who couldn't expand were worried about the future of their farm.

Recommendations for government/industry:

- **Redefining good farming.** In order to meet environmental targets, foster a definition of 'good farming' that includes environmental practices and values, and good work life balance as well as production and profitability.
- **Build on farmer's own beliefs and practices relating to the environment.** Farmers' own knowledge, experience and goals could be combined with research and policy objectives to define what 'good farming' should look like in a sustainable dairy sector. Farmer-led environmental goals could be identified through discussion fora.
- **Future without expansion?** If there is a desire to adhere to the statement in the Ag Climatise strategy and the draft agri-food strategy 2030 that the national herd cannot expand further, then measures need to support farms to make money through means other than expansion, or the dairy industry will undergo restructuring with fewer, bigger farms.
- **Supporting smaller farms.** If supporting smaller family farms and in turn rural communities is an objective of the industry and/or government, implement mechanisms to do so, such as strengthening alternative supply chains and paying farmers for the production of environmental goods

Introduction

The central question behind this project was 'can the Irish dairy sector beat the system?' I.e., can the Irish dairy sector provide a good living for farmers, workers and their families, produce environmentally sustainable milk, keep rural communities alive, all through a market-based system of exporting dairy produce? I've studied and researched agriculture for 12 years and the social science narrative is usually that agricultural markets left to themselves will weed out smaller farms, make remaining farmers bigger and more input intensive, environmentally damaging, often unpleasant places to work for people and animals and consolidate corporate control over inputs and land[2]. This can in short be called 'industrialisation'. When restrictions on production in the form of EU milk quotas were lifted in 2015, was it possible for the Irish dairy sector to avoid this fate?

The removal of milk quotas in 2015 prompted ambitious plans for expansion, with a government target of a 50% increase in milk production by 2020[3]. I wrote the proposal for this project in 2016 after I read a report by the dairy industry stakeholders Con Hurley and Mike Murphy called "Building a resilient, flourishing and internationally competitive dairy industry in Ireland"[4] and was struck by what I saw as its anti-industrial agriculture message. The report was a call to arms to keep the sector focused on grass, which the authors framed as a low-cost, environmentally friendly feedstuff that kept profits and control in farmers' hands. They compared a low-cost grass-based system to one based on increasing yields through increasing feed inputs, which they saw as higher cost, higher risk, more complicated and driven by corporate rather than farmer interests: "The greatest danger to realising this [grass-based] potential is that farmers will drift away from grazed grass as the foundation for low-cost, profitable milk production and sustainable, profitable farm family incomes."[5]

I wanted to know to what extent the Irish dairy sector's unique attributes made it structurally different to dairy sectors in other countries, meaning it wouldn't follow a process of industrialisation in coming decades. Ireland has a climate and land suited to grass production[6]; a co-operatised supply chain; a huge export market and positive marketing image. In Europe there is a trend over decades of dairy farming involving less grazing[7]. The dairy sector in Ireland is something of an exception to this rule with 95-100% of dairy farms grazing[8]. Most Irish dairy farms calf in spring[9]; Ireland's dairy sector exports 90% of produce in processed form which requires a high fat and protein content and is suited to a grass-based system[10].

Supplementing grass with purchased feed is a way to increase yield[11] and some in industry and research sectors in Ireland maintain that there is scope for farmers to profitably increase production through feeding more concentrate[12]. The limiting factor to expansion within the grass-based system is often access to land[13]. So, the

2 T. Marsden et al., "Towards a Political Economy of Capitalist Agriculture: A British Perspective.," *International Journal of Urban and Regional Research* 4 (1986): 498–521; Matthew Houser and Diana Stuart, "An Accelerating Treadmill and an Overlooked Contradiction in Industrial Agriculture: Climate Change and Nitrogen Fertilizer," *Journal of Agrarian Change* 20, no. 2 (2020): 215–37, https://doi.org/10.1111/joac.12341.

3 DAFM, "Food Harvest Food Harvest 2020: A Vision for Irish Agro-Food and Fisherie."

4 Con Hurley and Mike Murphy, "Building a Resilient, Flourishing, Internationally Competitive Dairy Industry in Ireland" (Dublin, 2015).

5 Hurley and Murphy, 2015

6 M. O'Donovan, E. Lewis, and P. O'Kiely, "Requirements of Future Grass-Based Ruminant Production Systems in Ireland," *Irish Journal of Agricultural and Food Research* 50 (2011): 1–21.

7 Agnes van den Pol-van Dasselaar, Deirdre Hennessy, and Johannes Isselstein, "Grazing of Dairy Cows in Europe-an in-Depth Analysis Based on the Perception of Grassland Experts," *Sustainability* 12, no. 3 (2020), https://doi.org/10.3390/su12031098.

8 van den Pol-van Dasselaar, Hennessy, and Isselstein.

9 IFA, "Towards a 'Milk Wise 2025' Strategy for Irish Produced Fresh Milk."

10 National Milk Agency, "Annual Report and Accounts 2016" (Dublin, 2016).

11 J. L. Hills et al., "Invited Review: An Evaluation of the Likely Effects of Individualized Feeding of Concentrate Supplements to Pasture-Based Dairy Cows," *Journal of Dairy Science* 98, no. 3 (2015): 1363–1401, https://doi.org/10.3168/jds.2014-8475.

12 Lyons Research Farm, "Lyons System Research Herd Notes" (Dublin, 2018); Mike Brady, "Analysis: Should We Put All Our Eggs in One Basket - or in One System of Milk Production?," *Irish Independent*, July 9, 2017, https://www.independent.ie/business/farming/dairy/analysis-should-we-put-all-our-eggs-in-one-basket-or-in-one-system-of-milk-production-35890269.html.

13 S. O'Donnell et al., "A Survey Analysis of Opportunities and Limitations of Irish Dairy Farmers," *Journal of Farm Management* 13, no. 6 (2008): 419–34, http://www.ingentaconnect.com/content/iagrm/jfm/2008/00000013/00000006/art00003; F. Thorne et al., "The Competitiveness of Irish Agriculture," *Allied Irish Banks and the Irish Farmers Journal* (Dublin, 2017); Cathal Geoghegan and Cathal O'Donoghue, "Socioeconomic Drivers of Land Mobility in Irish Agriculture," *International Journal of Agricultural Management* 7, no. 2 (2018): 26–34.

answer to a lack of land for expansion, fragmented farms and a lack of labour could be increasing yield per cow through the use of higher yielding breeds and more energy dense feed. Debates about the role of grass and feed continued to play out in the media after expansion[14].

I carried out the research in Ireland between 2018 and the beginning of 2020. During this period the industry continued to undergo expansion: milk production increased 40% between 2014 and 2019[15], and media and industry debate about environmental sustainability intensified. The 2010 government Food Harvest 2020 report[16] and its successor FoodWise 2025[17] both set out commitments to economic and environmental sustainability. Food Harvest 2020 described Ireland's grass-based livestock production system as inherently environmentally friendly:

> "Ireland's extensive, low-input grass-based production systems are the foundation of its green credentials […]"[18]

The Irish dairy system is seen as having lower greenhouse gas emissions per unit of produce than other countries: a European report showed Irish milk to have the lowest greenhouse gas (GHG) emission footprint in the EU[19]. Dairy farming is a source of a number of greenhouse gases: methane from enteric fermentation produced by the cow; carbon dioxide for embedded fossils fuels in feed, machinery use and loss of carbon from soils; and nitrous oxide from fertiliser and manure[20]. The carbon sequestered in grassland soils is seen as a factor making the Irish system more environmentally friendly than systems which buy in non-forage feeds, where soils tend to store less carbon or emit carbon[21].

The grass-based 'green' credentials of the Irish dairy sector were seen as a marketing advantage. Food Harvest 2020 states:

> "Ireland's historic association with the colour green is linked to our unspoilt agricultural landscape and our temperate climate. The modern use of 'green' to identify concern for the natural environment has, for some time, been recognised as representing a natural marketing opportunity for Irish agri-food to build on."[22]

Based on these claims a national Origin Green marketing strategy was developed through Bord Bia, the Irish Food Board[23].

However, after continued dairy expansion, the Environmental Protection Agency made a bleak assessment of the environmental situation in 2019 in a response to a consultation for the agri-food strategy 2030:

> "FoodWise 2025 has delivered the intensification and growth in production that it promised but has not delivered the environmental protection objectives envisaged – the natural environment has deteriorated during the strategy period with trends in water quality, greenhouse gasses, ammonia and biodiversity all going in the wrong direction. It is also clear from the evidence that agriculture and other land management practices are key drivers of these negative trends. These deteriorating trends in environmental quality present a significant threat to the reputation of the agri-food sector in Ireland which in turn depends on our reputation and marketing advantage as a food producing nation with strong environmental credentials."[24]

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14 Brady, "Analysis: Should We Put All Our Eggs in One Basket - or in One System of Milk Production?"; Claire McCormack, "Dairy Expansion: 'Alarm Bells Should Be Ringing Now,'" *Agriland*, February 13, 2018, http://www.agriland.ie/farming-news/dairy-expansion-alarm-bells-should-be-ringing-now/.

15 Laurence Shalloo et al., "An Analysis of the Irish Dairy Sector Post Quota" (Moorepark, 2020).

16 DAFM, "Food Harvest Food Harvest 2020: A Vision for Irish Agro-Food and Fisherie."

17 DAFM, "Foodwise 2025: A 10 Year Vision for the Irish Agri-Food Industry" (Dublin, 2015).

18 (DAFM 2010 p.5)

19 A. Leip et al., "Evaluation of the Livestock Sector ' s Contribution to the EU Greenhouse Gas Emissions (GGELS) - Final Report.," 2010.

20 FAO, "The State of Food and Agriculture: Livestock in the Balance" (Rome, 2009).

21 Leip et al., (2010)

22 (DAFM 2010 p.6)

23 Bord Bia, "Origin Green" (Dublin, 2019), https://www.origingreen.ie/.

24 EPA, "Submission on Proposed Strategy for the Irish Agri-Food Sector to 2030" (Wexford, 2019).

Several environmental government policies and initiatives were introduced after I chose documents for analysis, but which I will refer to in the report: a strategy for the development of the organic sector in 2019[25]; the government's Ag Climatise strategy to make agriculture carbon neutral by 2050 in 2020[26]; the Signpost programme to support climate action on Irish farms in 2021[27] and a government draft agri-food strategy for 2030 in 2021[28].

The draft agri-food strategy 2030 signalled that livestock production for export would remain the core of Ireland's agriculture sector, with goals to improve economic, environmental and social sustainability. The draft strategy was criticised as not fit to meet the challenge of making agriculture carbon neutral by 2050, and a continuation of a model of agricultural intensification[29]. The representative of the environmental group Environmental Pillar withdrew from the Strategy Committee prior to publication.

During the time I carried out the research, the survival of smaller farms post-expansion was also a topic in the media and industry, with fears restructuring would drive smaller farms out, with knock on effects on rural communities[30]. This came up as an interesting theme in the research, as did the overlap, or lack thereof between farmers' own aspirations and values and the cultural and values they perceived in the dairy industry around expansion and work life balance. These issues are included below in research question 2.

The research questions for this report are:

1. To what extent did farmers and key stakeholders in the Irish dairy industry endorse a low-cost grass-based system, as opposed to a higher-feed-input system?

And

2. What were farmer and stakeholder experiences of whether the low-cost grass-based system can realise a) environmentally sustainable production, that b) sustains smaller farms and c) provides a good working life for farmers?

This is a social science report, so it explores beliefs, values, practices and systemic forces. The report aims to produce findings and recommendations which are helpful in the climate of intense debate about the future of the dairy industry.

Methods

This report is based on a survey with 396 dairy farmers in Ireland, 18 interviews with key stakeholders and 20 interviews with dairy farmers.

Survey

A survey was disseminated to Irish dairy farmers in August 2018 which included questions about farmer demographic details, production practices and attitudes towards pasture-based, higher-feed-input and indoor production systems. An indoor system is one where cows do not graze, and is not common in Ireland[31]. To some extent an indoor system can be seen as an extension of the higher-feed-input system as farmers move production indoors to increase yield and farm size. Demographic details included gender, length of time

25 DAFM, "Review of Organic Food Sector and the Strategy for Its Development 2019-2025" (Dublin, 2019).
26 DAFM, "Ag Climatise: A Roadmap towards Carbon Neutrality" (Dublin, 2020).
27 Teagasc, "The Signpost Programme: Farmers for Climate Action" (Carlow, 2021).
28 DAFM, "Draft Agri-Food Strategy 2030" (Dublin, 2021).
29 Environmental Pillar, "The Environmental Pillar Withdraws from the Problematic 2030 Agri-Food Strategy Committee," 2021, https://environmentalpillar.ie/the-environmental-pillar-withdraws-from-the-problematic-2030-agri-food-strategy-committee/.
30 Conor Finnerty, "'You Can Make a Good Living Milking 80 Cows; Expansion Isn't Always Necessary,'" Agriland, 2018, http://www.agriland.ie/farming-news/you-can-make-a-good-living-milking-80-cows-expansion-isnt-always-necessary/; M.J. Doran, "Is There a Future for the 70-Cow Dairy Herd in Ireland?," Agriland, 2016, https://www.agriland.ie/farming-news/is-there-a-future-for-the-70-cow-dairy-herd-in-ireland/.
31 van den Pol-van Dasselaar, Hennessy, and Isselstein, "Grazing of Dairy Cows in Europe-an in-Depth Analysis Based on the Perception of Grassland Experts."

in farming, position in the business, and location. Farm system questions covered whether the farm was conventional or organic, number of cows, area of land farmed, average milk yield per cow, number of labour units on the farm, calving pattern, grazing and housing practices, reason for choosing an indoor system, use of zero grazing, age of buildings, expansion of milk production since 2015, plans to expand in future and the means of expansion. A small number of paper copies of the survey were also disseminated through personal contacts. A charitable donation of the euro equivalent of £2 was made to a charity supporting farmer wellbeing for every survey completed.

There were 10 attitudinal questions based on issues raised within debates about pasture-based, higher-feed-input and indoor systems using a Likert scale with strongly agree, agree, neither agree nor disagree, disagree or strongly agree options. Likert scale questions also assessed satisfaction with profitability and work life balance and a ranking question assessed views on challenges facing the dairy sector. There was an open question for respondents to leave any additional comments. Ethical approval for the study was gained from the James Hutton Institute research ethics committee. The survey was pilot tested with stakeholders in the Irish dairy sector.

Document analysis and interviews

Interviews, or 'qualitative research' involves asking someone in depth questions about what they do and what they believe. The aim is to get detailed information on the interviewee's experience and views on a particular topic. Qualitative interviewing involves carefully selecting a relatively small number of participants whose experiences are relevant to the research questions. The aim is not to generalise to a larger group of people e.g. 'all dairy farmers think or do x', but to look in detail at the reasons why people do what they do and draw conclusions based on their circumstances.

In 2018 and 2019 I carried out document analysis of key stakeholder documents, and interviews with key stakeholders in the Irish dairy sector. Documents from government, research organisations, non-governmental organisations (NGO) and agricultural industry organisations were collected through internet searches between February and October 2018. Documents that described an organisation's policy or position or research findings about the Irish dairy sector relevant to the research questions were chosen. A total of 26 documents were analysed: 6 industry; 3 NGO; 12 research; and 5 government. A list of documents analysed is given in appendix 1. Eighteen interviews were carried out: 10 from industry, 4 from academia, 1 from an NGO and 3 from government.

In the survey respondents were asked if they were willing to take part in a face-to-face interview. I contacted a small number of respondents for interview, based on their location: to interview people in a range of locations across Ireland, but also to keep the logistics manageable because I intended to do as many as possible in person. I contacted people who operated different kinds of production systems and had different views in order to access a variety of perspectives. I interviewed 20 farmers: 4 in the north east, 2 in the midlands and 14 in the south west. All but one interviewee was male, as there were few female respondents to the survey. I have anonymised the interview data by giving the interviewees a letter corresponding to their sector: G for government, N for NGO, I for industry, A for academia and F for farmer.

Results

Grass-based and higher-feed-input systems

Q1. To what extent did farmers and key stakeholders in the Irish dairy industry endorse a low-cost grass-based system, as opposed to a higher-feed-input system?

Farmer survey: Majority support for the grass-based system

A total of 396 surveys were completed by farmers in Ireland: 18 paper copies and 378 online. A charitable donation of €869.35 were made to the Mind Our Farm Families phoneline run by Pieta House and the Irish

Farmers Association in March 2019. The dataset is published on an open access repository[32]. More details of the responses to the Irish survey can be seen in appendix 2.

Respondents were asked questions about their views on the future of grass-based and higher-feed-input systems. The results are shown in figure 1. There was majority support from respondents for the low-cost grass-based system, as opposed to a higher-feed-input system. More respondents disagreed that there were advantages to a higher-feed-input system in Ireland than agreed. Unsurprisingly, the majority of respondents agreed cows should graze, as opposed to staying indoor year round.

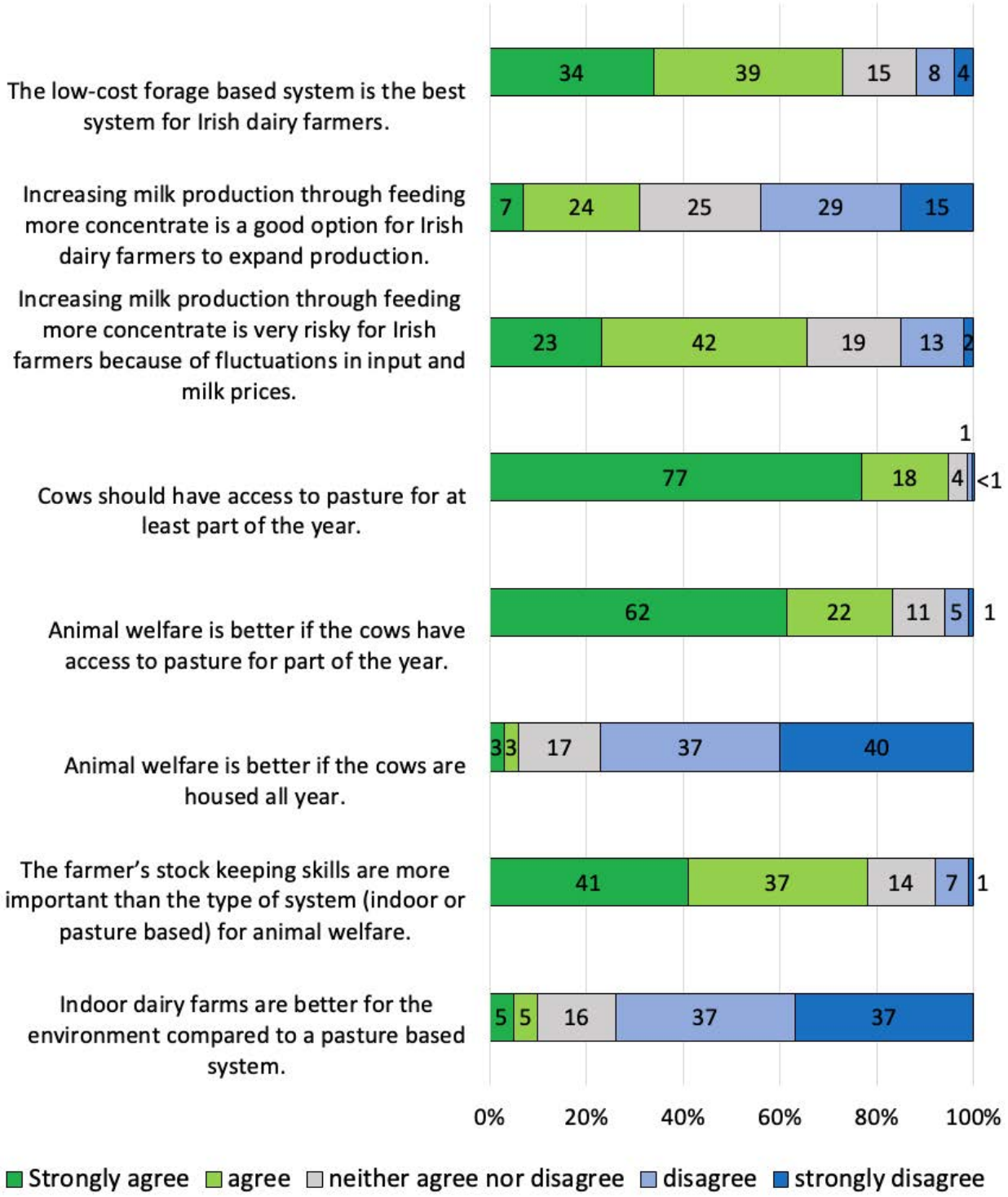


Figure 1 Responses to attitudinal questions

32 Orla Shortall, "Irish Dairy Farmers' Survey on Production Practices and Pasture Based, High Input and Indoor Systems 2018-2019" (Colchester, Essex: UK Data Service., 2020).

Respondents who answered questions supporting a grass-based or higher-feed-input system were asked to rank reasons for their views. The reasons are shown in figures 2 and 3 below.

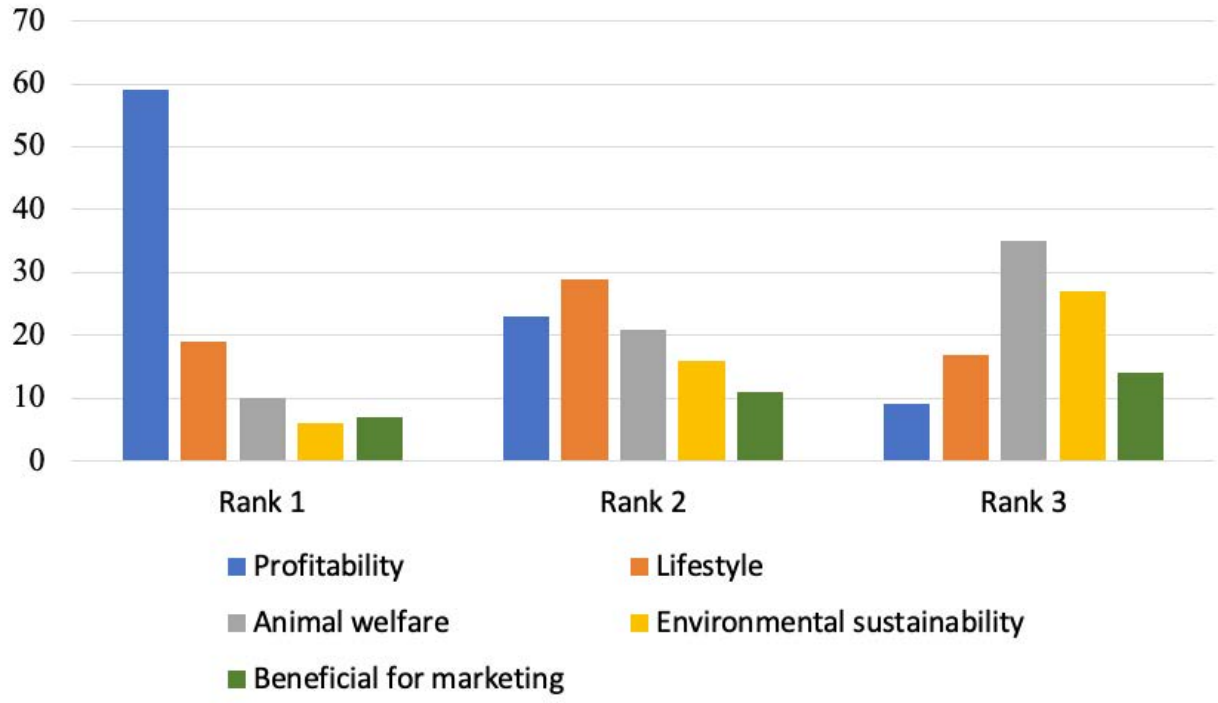


Figure 2 Reasons for agreeing with the statement 'The low-cost grass-based system is the best system for Irish farmers'.

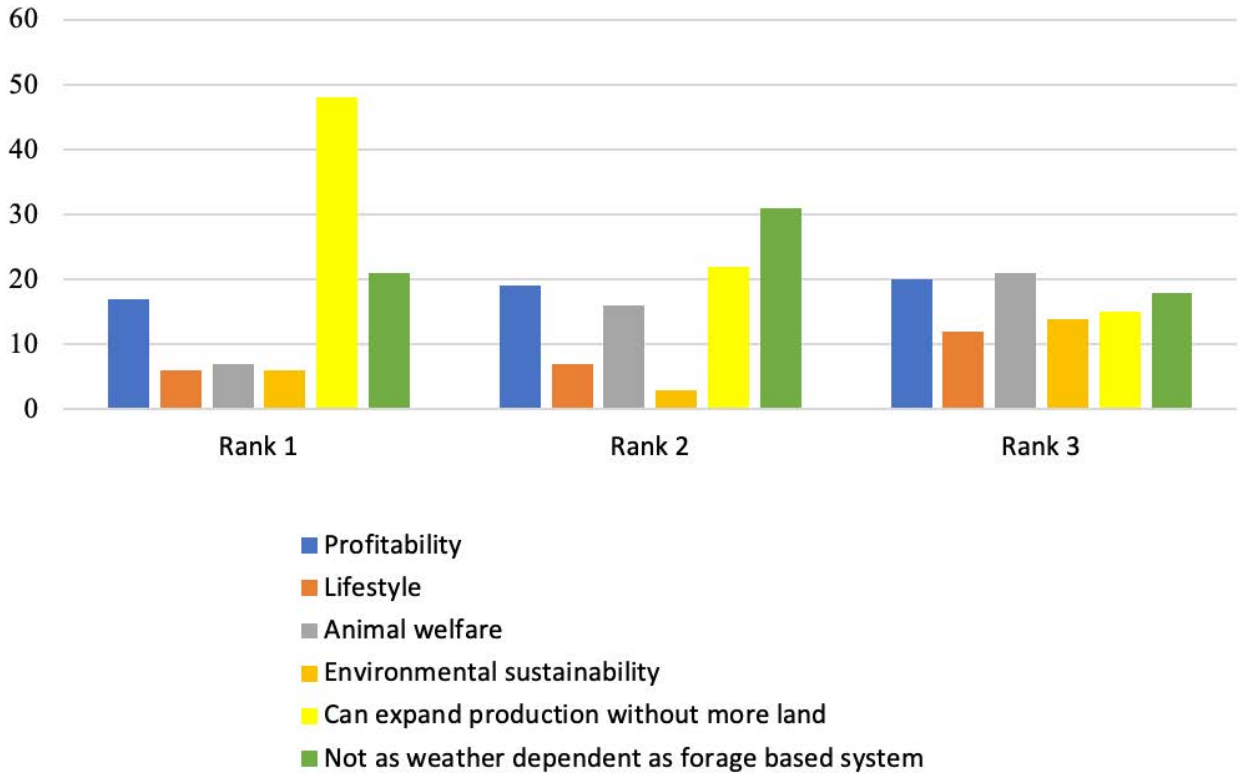


Figure 3 Reasons for agreeing with the statement 'Increasing milk yield through feeding more concentrate is a good option for Irish farmers to expand production'.

As can be seen from the graphs above, the reasons farmers chose for supporting a low-cost grass-based system and a higher-feed-input system were different. Respondents supported the grass-based system primarily because of profitability, lifestyle and animal welfare; and a higher-feed-input system because of lack of access to land and the weather dependency of the grass-based system.

Thus, there wasn't disagreement among farmer respondents about the merits of different systems, but respondents based their answers on different priorities and/or circumstances. This shows that the people who responded to the survey had views in line with the messages coming from the industry and media about different systems[33]. With the exception of environmental sustainability, which is part of industry debate about grass-based or higher-feed-input systems[34], but was not chosen as a significant reason by respondents.

52% of farmers indicated they planned to expand in the near future. Farmers might encounter difficulties accessing land or dealing with challenging weather when they expand which could lead them to diverge from a grass-based paradigm. Providing farmers who cannot expand within a grass-based system with other production options such as payments for environmental services, and access to higher value supply chains that do not require expansion in milk and/or grass production could help sustain farmers within the grass-based paradigm. Plans to strengthen alternative supply chains and environmental schemes are laid out in the Irish government's draft agri-food strategy 2030[35] and these results lend support to their realisation.

Grass production as 'good farming'

I'll use the concept of the 'good farmer' to explore values and culture around the role of grass-based and higher-feed input systems in Ireland, as well as values around expansion. The idea of the 'good farmer' was developed by social scientists to explore what values farmers hold themselves and their peers up to[36]. It was originally used to explain why farmers aimed to increase production, even when markets or government incentives steered them towards environmental initiatives or reducing production[37]. The good farming work showed that producing a lot is taken as a demonstration of skill: farmers will look into each other's fields to see how well cereal or grass crops are growing and appraise livestock at market. As long as other farmers value high production, farmers face a loss of status if they adopt practices that compromise production. In recent years social scientists have shown that farmers don't just get status among their peers from producing high volumes, but other values such as profitability and sustainability can be part of 'good farming'[38].

Interviewees talked about the legacy of the 1970s and 80s when policies incentivised milk production, and so producing more milk per cow was lodged in farmers' minds as the meaning of good farming. A farmer stated that milk yield had a 'subconscious' hold over farmers as an important indicator of success.

> F8: [milk] yield would still be a big one, subconsciously or whatever, people find it very hard to get away from yield. It takes a conscious decision to move away from it. In that a person has to openly acknowledge that almost as a caveat, that they are not focusing on yield when they're discussing or when they're being commented on, either in a formal or informal setting about the farming performance. So, it is the first parameter that people either talk about or judge by.

However, in keeping with the results of the survey, interviewees talked about the work that had been done for decades from government, research, advisory services, industry bodies to steer farmers away from thinking about milk production to thinking about grass production and grass management as indicators of 'good farming'. An industry stakeholder said:

33 Thia Hennessy, Brian Moran, and Fiona Thorne, "Why Dairying?," in *Teagasc Dairy Manual*, ed. Teagasc (Moorepark: Teagasc, 2016); Lyons Research Farm, "Lyons System Research Herd Notes."

34 Orla Shortall, "Cows Eat Grass, Don't They? Contrasting Sociotechnical Imaginaries of the Role of Grazing in the UK and Irish Dairy Sectors," *Journal of Rural Studies* 72, no. September (2019): 45–57, https://doi.org/10.1016/j.jrurstud.2019.10.004.

35 DAFM, "Draft Agri-Food Strategy 2030."

36 Rob J F Burton, "Seeing through the 'good Farmer's' Eyes: Towards Developing an Understanding of the Social Symbolic Value of 'Productivist' Behaviour," *Sociologia Ruralis* 44, no. 2 (2004): 195–215, https://doi.org/10.1111/j.1467-9523.2004.00270.x.

37 Burton.

38 George Cusworth, "Falling Short of Being the 'Good Farmer': Losses of Social and Cultural Capital Incurred through Environmental Mismanagement, and the Long-Term Impacts Agri-Environment Scheme Participation," *Journal of Rural Studies* 75, no. February (2020): 164–73, https://doi.org/10.1016/j.jrurstud.2020.01.021.

> I2: There's a general agreement between the advisory service, the researchers, the co-ops, the farming organisations, Farmers Journal, that, you know, the grass-based system is the way that we should go.

The consolidated nature of the Irish sector facilitated homogeneous advice to farmers about the grass-based system.

> A1: Like, if you go to France, you go to Holland, you've got a huge segmentation of, you know, you've got the dairy boards or the co-ops, you've got individual advisory outlets, you've got the milk marketing boards, it's very broken up, no coherence. And, we've a lot of coherence in the message of research, advisory to farmer.

A researcher describes the rejection of milk yield per cow as an indicator of success:

> A1: There's an old saying here, profit is sanity, you know, milk yield is vanity. And, it is true. They go down to the pub at night, they're talking milk yield. You know. What does that mean?

The farmer interviewees understood grass management and high levels of grass production as 'good farming' rather than milk production per cow. While I spoke to interested, motivated, engaged farmers because those are the people that are likely to fill in a survey and agree to be interviewed, this speaks to the wider culture in the industry as a whole. A farmer stated drifting towards a higher-feed-input system was a failure to be a good grass-based farmer.

> F7: Some farmers fall into high input systems, because maybe they can't manage grass. With a low input system, you need to have very high-quality grass. Some farmers are I suppose, refuse to be educated in grass measuring and that, that they just feed a lot of meal, and graze heavy covers during the summer, and cows milking well and they're happy. But it's non-profitable, it's not profitable.

Interestingly, one farmer notes that grass yield has replaced milk yield as a source of 'vanity'.

> F8: So now even, it's still going back to yield because people are still… I won't say blowing, but about their yields of grass. So, it's gone from yields of milk or yields of beef or whatever, to yields of grass. And people make plenty noise about how much grass they're growing now.

Another farmer makes the point that the metrics used in the grass-based system: low concentrate use, a long growing season, can be detached from the aim of profitability and become aims in their own right because they bestow status on farmers:

> F1: So, once you're are performing and you're farming for profit not for milk, or for ego in the grass system, the ego, what I'm saying is having cows out on the first of February, [laughter] feeding them no meal, and having them out on Christmas Day, there's ego that way just as much as there's ego in the high input system, to have ten or twelve thousand litre cows.

This farmer's comments are wry, and he intends to point out the folly of farming for 'ego': aiming to build status according the culture of the day, rather than for profitability. The 'good farming' concept describes a similar mechanism at play, farmers aim to build status and succeed within the rules of their peer group. The research showed that the principles of 'good grass farming' have successfully been established as the dominant culture of good farming among Irish dairy farmers.

Farmers operating higher-feed-input systems

As I described in the section on the survey, 31% of respondents strongly agreed or agreed that a higher-feed-input system was a good option for Irish farmers to expand production. The main reasons for supporting a higher-feed-input system were logistical rather than ideological: not enough land to expand and variable weather under a grass-based system. I interviewed some of the farmers who responded this way in the survey.

I asked farmer interviewees to define what a 'high-feed-input' system was in the Irish context and the answers most people gave were either over a tonne and a half or two tonnes of concentrate per cow per year. Among farmers I interviewed who used this amount of concentrate consistently year on year, or identified to some extent with a 'higher-feed-input system', there were a mixture of ideological and practical reasons why they

chose this system. Some interviewees described environmental, animal welfare and economic advantages of a higher-feed-input system. Farmers spoke about issues acquiring more land to expand through more cows and grazing, as highlighted in the survey. A farmer points out that the grass-based system is only low-cost as long as land is affordable:

> F6: You know, it's available land is the issue, if you've got available cheap land, it's [grass] probably the cheapest source of feed. But if the cheap land becomes scarce, you know what I mean, then, that's when the issue arises. That doesn't become cheap land anymore, it becomes expensive land, because of competition. You know, then, you'll say, well, might be cheaper to import feed and, your feed, a higher input feed will become more of a thing.

However, while there were interviewees who disagreed with, or moved away from the principles of the dominant grass-based vision, I did not find a unified idea of 'good farming' coalescing around being a higher-feed-input farmer in the same way I did around being a good grass farmer.

Interestingly, the farmers I interviewed who identified as operating a higher-feed-input system emphasised the importance of grass and weren't involved in separate social and information networks to farmers in the dominant grass-based system. The farmers I spoke to still went to farmer discussion groups because they found some of the content helpful and valued the social interaction. Thus, I didn't find evidence of clearly distinct 'camps' among Irish dairy farmers on the basis of their interest, or lack of interest, in grass and grazing. A liquid milk producer states that he's not replacing grass with meal, he's supplementing it:

> OS: And what made ye go down what you call the high input sort of route in the Irish context, you know that's high input for Ireland?
>
> F11: I suppose traditionally going back to the earlier discussion about the milk we were always in winter or liquid milk so we always had a high yielding cow, we always fed the cow well and looked after the cow as a priority. That's mainly it. Now I wouldn't feed excessively either to the extent that you're trying to replace forage with meal, you have to as I say back to profitability too there's no point in feeding a cow out there and she walking out in the field and lying on lovely grass either so there has to be a balance.

A farmer points out that within the grass-based system there may be a creep of increasing use of concentrate:

> F8: Now, I don't know what it was twenty years ago but the national farm survey, the average feed of Irish farmers is approximately a tonne a meal. […] Which is a lot higher than we would have thought. I won't say we'd have been led to believe but the conversation would have led us to believe most people wouldn't owning up to feeding a tonne a meal, they'd say they were feeding less. […] But then if the average is a tonne, if the average is a tonne it means there's a hell of a lot of 1.5 tonnes. So, I mean I would think that's really going into high input basis where your system will not survive without that level of input.

The phrase not 'owning up to feeding a tonne of meal' goes back to the previous section which showed being a good grass farmer meant keeping concentrate inputs low. Among the farmers I spoke to, some might feed more meal in a given year if the weather was poor for grass and/or if milk prices were higher.

Within the farmer survey and interviews I did not find a higher-feed-input 'counter-culture' with a different belief system and different information networks to the grass-based system. That's not to say it doesn't exist, I may have missed it in my research, and there are undoubtedly farmers in Ireland who are not interested in grass and get their information and inspiration from other countries with higher input systems. What I did find was that farmers who consider their system higher-feed-input, or would be considered by others as higher-feed-input, still put a large emphasis on grass. Farmers who saw themselves as operating within a grass-based system may move towards feeding more meal because of difficulty accessing land, or difficulty adhering to the principles of the grass-based system because of factors such as weather variability.

Q2 What were farmer and stakeholder experiences of whether the low-cost grass-based system can realise a) environmentally sustainable production, that b) sustains smaller farms and c) provides a good working life for farmers?

The environment

Good farming as intensive farming

As I described above, in farmer interviews a good farmer was someone skilled at grass management who produced a lot of grass. To this I can add that being an 'intensive' grass farmer: using inputs to produce a lot of output, was within the definition of good farming. This can shed light on attitudes among stakeholders and farmers to environmental challenges facing the Irish dairy industry.

I asked key stakeholder how they would define 'intensive' agriculture, and it was often defined in terms of stocking rate of cows per hectare.

> I10: I suppose, the intensive one is really the one that goes beyond, goes beyond three livestock units per hectare on the milking platform, that's fairly intense then at that stage.
>
> OS: Okay. And does that rely on extra concentrate feeding then above that level?
>
> I10: No, not necessarily.

So an 'intensive' farm is not necessarily a higher-feed-input farm, but this interviewee is talking about intensive grass-based farms.

> I10: There's some top class intensive dairy farmers out there at 3.8 livestock units per hectare on the milking platform but their eye, their vision, their sharpness has to be razor sharp as regards costs and management, to keep their allocations giving out and keep the cow, or to keep the grass growing behind them. They're your real top guys, that's some of them on hilly enough and marginal enough ground, throughout the country.

The quote shows that this interviewee approves of this type of system: it's operated by 'top guys' and they balance keeping costs down with growing enough grass for the cows.

Another interviewee also defined an intensive dairy farm as an efficient grass-based farm in the Irish context.

> A1: Intensive dairy farm? […] And my concept is, efficient dairy farm is, you know, a farm that's, where I stand now is probably is a well-managed grass-based system.

A farmer states:

> OS: And in your view what's a good dairy farmer?
>
> F10: […] you can say performance wise they must be hitting so many cows per hectare or so much milk solids per hectare, you know. But like look, they obviously have to be hitting within certain norms.

Intensive, highly stocked dairy farms require fertiliser inputs to produce a lot of grass and in turn produce a lot of manure per unit of land, both of which contribute to greenhouse gas emissions and water quality problems. A farmer who had some criticisms of Ireland's grass-based system on environmental grounds states that not maximising grass production using inputs was considered a 'low achievement':

> F8: Now, we've all gone, conventional agriculture has gone completely natural to an automatic high input system for forage structure. It's not considered on a low input basis because it's seen as a waste of resources or as low achievement.

This links use of inputs to good farming: not using inputs to maximise output from the land is not good farming.

Interestingly, while the dominant story told in Ireland that a higher-feed-input system is expensive, inefficient, dependent on inputs which increased farmer's running costs and capital costs; an intensive grass-based system using fertiliser to produce more grass was considered efficient 'good farming'. Research has shown that Ireland's grass-based system is more profitable than other European dairy countries because of the lower cost base[39]. So,

39 Shalloo et al., "An Analysis of the Irish Dairy Sector Post Quota."

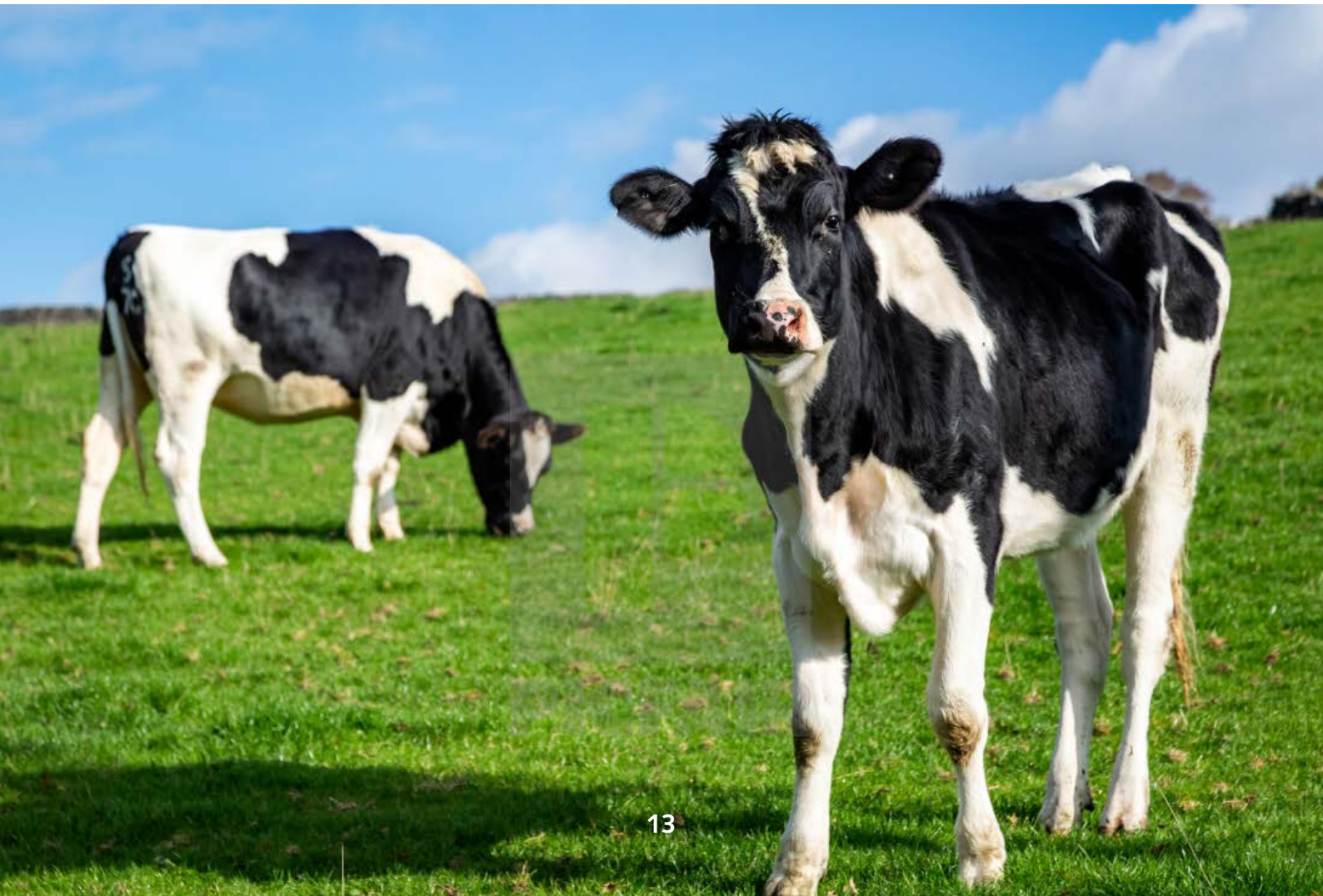
under current economic conditions, in the mainstream view in Ireland a system which relies on fertiliser inputs to drive production is seen as profitable, whereas a system which uses feed inputs to drive production is less so. Given that fertiliser inputs lead to greenhouse gas emissions and water pollution, a system which is seen by many interviewees as 'good farming', is also criticised on environmental grounds.

Responses to environmental criticisms

The farmers I interviewed generally acknowledged that changes needed to be made in the Irish dairy sector in relation to the environment. Within this recognition of the need for change farmers didn't want environmental regulation to disadvantage them financially, they wanted the benefits of carbon sequestered in grassland soil taken into account, and a recognition of how much food the Irish dairy sector produced.

Even though farmers recognised a need for environmental action, the farmers I spoke to often perceived an 'us and them' situation in relation the environment: farmers were being blamed by a miscomprehending public and their fate was in the hands of government who might impose punitive regulation.

> F12: The environmental regulations that are coming there from the EU are way over the top. They're expecting farmers to put up containers, you know, storage for slurry and effluent and that kind of thing costing absolutely bonkers money. And there's no way the returns in this industry could justify that. So, I've huge concerns where are people going to get money, where am I going to find the return from the dairy industry to justify me putting up those layouts?
>
> F4: In general, the politicians have gone urban orientated and have forgotten that there is a rural, all you have to do is look at the carbon thing. They've done nothing about carbon for fifteen years, and then they're blaming the farmers now. All of a sudden, just, purely just to get themselves off the hook. […] Of course, agriculture has a part to play, and I'd say no issue in playing it, but it's, "who we are going to blame? because it's not our fault".
>
> F5: That's not saying we shouldn't, for the environment, for example, we shouldn't not care about the environment, we should, like, but, it's, at the end of the day, it's all to benefit us all but, I feel, as a



farmer, it's been used as a stick to beat us more than to encourage us.

F6: Irish government probably just goes whatever is in vogue at the moment, it annoys me at times to see the politicians all jumping on the climate change bandwagon, because it sounds good and everything has to be seen to be doing something about the climate change, and agriculture is definitely getting the biggest hit for it.

A farmer points out that the government encouraged farmers to expand after quotas were removed and now the inevitable environmental consequences are being blamed on farmers themselves:

F17: It was just such a big push. Everything was expansion, expansion, expansion, whereas now they haven't thought of the consequences of some of that with the calves and the environmental and all those kind of things.

Farmer confusion and anger also makes sense in the context described above, where intensive production using fertiliser to produce a lot of grass is within an industry definition of 'good farming', but farmers feel blamed and vilified for operating this kind of system.

The results suggested a disconnect and lack of trust between farmer interviewees and those perceived to be making decision about the environment: the government, the public and experts. If parties don't trust how decisions are made or feel disconnected from the process, this can make them more difficult to implement as well as being less democratic and accountable[40]. Below I'll look at environmental values of the farmer interviewees I spoke to that could be built on going forward.

Farmer connection to the environment

While being a high producing farmer is part of 'good farming', recent research has also shown that farmers can value their role as environmental stewards[41]. This can be a building block for incorporating environmentally friendly practices into farmers' identity.

F13: Any farmer's ambition is to give the farm to the next generation better than what he got it, that's the most sustainable model that anyone could have in my book.

The farmers I spoke to also had a strong connection with the natural world on their farm and pride in being someone who worked outside. Building on these factors could be a way to break down the 'us and them' thinking around environmental goals. Farmers talked about observing wildlife when they were going about their job:

F5: It's a very nice lifestyle, you're outside in the air. […] being self-aware, to be able to, as you're walking down a field, someday, that you're actually "Oh, there's a bird singing" you know, you have to be aware of that stuff.

F11: Like there's plenty of good things to see around the place too like I go to the top of the farm over there I can see down on top of the water here and you look around the place it's all green, the trees and the hedgerows start growing and the bit of wildlife pop out and about too.

Farmer identified the grass-based system as environmentally friendly. While this could lead to a reluctance to change, pride in the Irish dairy sector could also be something to build on.

F4: But I think anybody that is grass based, you're cutting down your carbon footprint, to be honest. Most of the trials that was done early on that was carbon neutral was, because of the grass, rather than tillage.

The Signpost programme involves measuring carbon sequestration on a number of dairy farms, which will help address farmer concerns that this was not included in carbon calculations[42].

40 Maarten Hajer, "Policy without Polity Policy Analysis and the Institutional Void," *Policy Sciences*, 2003, 175–95, https://doi.org/10.1023/A:1024834510939.

41 Fred P. Saunders, "Complex Shades of Green: Gradually Changing Notions of the 'Good Farmer' in a Swedish Context," *Sociologia Ruralis* 56, no. 3 (2016): 391–407, https://doi.org/10.1111/soru.12115; Rebecca Wheeler et al., "'The Good Guys Are Doing It Anyway': The Accommodation of Environmental Concern among English and Welsh Farmers," *Environment and Planning E: Nature and Space* 1, no. 4 (2018): 664–87, https://doi.org/10.1177/2514848618817487.

42 Teagasc, "The Signpost Programme: Farmers for Climate Action."

Part of the farmer interviewees' identity, enjoyment and pride in their job is working outside in a natural environment, with animals. In non-farming populations connection with nature can be a source of environmental concerns and actions[43]. Currently, the research suggests farmers feel somewhat disconnected from an environmental agenda and see it as something challenging imposed from outside. Future environmental initiatives could work with and build on farmers' existing connection with their own farm environment. In addition, if there were a mechanism in policy making to elicit farmers' views on the environment and incorporate their expertise in the design of environmental initiatives, this could make them more robust and more likely to be taken on board. Research has shown involvement in environmental schemes can foster more positive feelings in farmers towards environmental practices[44].

Survival without expansion?

The future survival of smaller farms: farms below the average herd size, in the long term emerged as a concern in the farmer and key stakeholder interviews. The difficulty of surviving without the potential to expand may affect farms of all sizes given that the Ag Climatise government strategy clearly stated that environmental goals cannot be met with the continuing expansion of the national herd[45], which was reiterated in the draft agri-food strategy 2030[46].

The need to expand is because of the long term trend in agricultural markets that prices farmers receive stagnate or decline in real terms while costs increase so farms need to expand production to stay profitable[47].

> F14: Everyone has expanded, yeah. You have to, because if you don't expand, you're going backwards. There's no such thing as standing still. You have to put an extra 1 or 2% every year, just to keep your income the same, so there's pressure from that point of view as well. […] The cost goes up by twice the outgoing prices, that's generally the way it seems to me, that there's a constant squeeze there.

In social science, this dynamic is called the 'treadmill of production' or the 'technological treadmill'[48]. Farm expansion was encouraged in government and industry documents to make the industry more economically robust and viable. Most of the farmers I spoke to, and 82% of those who responded to the survey, had expanded production since quotas were removed. When I asked farmers why they expanded milk production they said to make more money; because they were advised to do so; because their farm was under capacity during quotas and because everyone else was. Going back to the idea of good farming as high production, a farmer expresses the idea that progress in farming equates to expansion:

> OS: Why do you think farmers will keep expanding?
> F10: Sure, it's in their nature. In most of them it's kind of, there's a sense of progression that if you're not expanding, you're not making progress.

Some interviewees expressed concern about smaller farms leaving the sector instead of expanding, which could contribute to rural depopulation:

> G2: So I'd imagine there'll be less farmers, bigger farms. But that'll contribute to the rural depopulation as well so, it's bigger than just the dairy sector, like, it's the agricultural sector, what do you want for the agricultural sector in Ireland?

Farmers who couldn't expand were worried about the future of their farm:

> F17: A lot of competition around here for land and people paying crazy prices for land just to expand and you'd be wondering what it's all for. I suppose we felt a little bit left behind maybe in a way. In a

43 E. Kals, D. Schumacher, and L Montada, "Emotional Affinity toward Nature as a Motivational Basis to Protect Nature," *Environment and Behaviour* 31, no. 2 (1999): 178–202.

44 Wheeler et al., "'The Good Guys Are Doing It Anyway': The Accommodation of Environmental Concern among English and Welsh Farmers"; Emma Thomas, Mark Riley, and Jack Spees, "Good Farming beyond Farmland – Riparian Environments and the Concept of the 'Good Farmer,'" *Journal of Rural Studies* 67, no. December 2018 (2019): 111–19, https://doi.org/10.1016/j.jrurstud.2019.02.015.

45 DAFM, "Ag Climatise: A Roadmap towards Carbon Neutrality."

46 DAFM, "Draft Agri-Food Strategy 2030."

47 M Winter et al., "Is There a Future for the Small Family Farm in the UK?" (London, 2016).

48 A Schnaiberg, *The Environment: From Surplus to Scarcity* (Oxford: Oxford University Press, 1980).

way, everybody was expanding and we weren't.

F20: Well, we had no option.

During the document analysis and stakeholder interviews I came across the idea that a 'price premium' for Irish dairy produce based on its unique grass-based credentials could secure the future of smaller farms. In a submission to the 2015 Agri-food strategy the Irish Farmers' Union states:

> […] there must be a renewed focus in the new strategy on successfully marketing the competitive advantage of Ireland's sustainable food production to deliver a price premium throughout the supply chain for Irish products and ingredients.[49]

One stakeholder describes a price premium as a way to insulate farmers from the 'treadmill of production' and the need to expand:

> I9: And they [farmers] can stand back and say, "I don't need to have five hundred cows. Because I can have a hundred cows here, and get a damned good price for that hundred cows because my milk is produced in such a way that it can be marketed in such a way that gives me enough of a premium to be able to pay my way, fund the kids in college, give me a standard of living that, call it sustainable," you know?

According to interviewees, the price premium based on Ireland's unique production system hadn't materialised in the post-quotas era.

> F14: There is no sign of the premium. We're saying, they're selling our product for a premium price because they're talking about the environment and the cows on grass and everything else, but we're not getting any portion of that premium.

Research has shown in the last few years Irish farmers, have received among the lowest milk prices in Europe, though analysis points out that profits in Irish co-ops have been reinvested in production facilities rather than being paid in the form of milk price, which will benefit the industry in the long run.[50]

If there is a desire to adhere to the statement in the Ag Climatise strategy and the draft agri-food strategy 2030 that the national herd cannot expand further then either there will be a restructuring of the sector with a smaller number of farms expanding and the industry staying static, and farms leaving the industry, or measures need to support currently operating farms to make money through means other than expansion. The draft agri-food strategy 2030 states that there is a place for small, medium and larger farms in the Irish agriculture sector. Goal 4 of Mission 3 includes an aim to help small producers make money through direct markets[51]. And Mission 1 describes paying farmers for public goods and environmental services. These measures could be assessed to ensure that it is possible for farmers of all sizes to adopt them and benefit from them and that they can provide a sustainable livelihood.

Expansion and a good working life

Pressure to expand did not only affect smaller farms, but farmers I interviewed of different sizes described conflicts between the need to expand, the need to work long hours to keep their business operating, and their own personal goals. In the survey 57% of respondents indicated they were very satisfied (18%) or satisfied (39%) with their work life balance, 12% were neither satisfied nor dissatisfied and 34% were either dissatisfied (26%) or very dissatisfied (8%). While this shows more satisfaction than dissatisfaction, 34% of respondents who were dissatisfied with their work life balance is not insignificant. A farmer said that his generation work long hours but the next generation might not be willing to:

> F4: No, well, one man, or one unit, one man, one woman, one unit, can only handle a certain amount, no matter what. And even if they're working above their means, which my age group are, we're probably doing seventy, eighty hours a week, ninety hours a week, and that's okay, but the next generation won't do that. You know what I mean. So, you've, someone's going to have to address it

49 IFA, "Towards a ' Milk Wise 2025 ' Strategy for Irish Produced Fresh Milk."

50 Shalloo et al., "An Analysis of the Irish Dairy Sector Post Quota."

51 DAFM, "Draft Agri-Food Strategy 2030."

> down the line, I don't know, maybe it's our fault, but it's just, it's an issue that's going to have to be dealt with at some stage, you know.

This farmer's workload had increased when he expanded. Though expansion did not necessarily mean a worse work life balance. Several interviewees stated their work life balance had improved after they increased their herd size because they could afford to employ more people on the farm. But interviewees wanted to be able to prioritise work life balance in their decision making. Interviewees stated that being a good farmer included having a good work life balance:

> F18: From what I see now, fellas I would classify as a good farmer they have them three qualities. They mightn't be the biggest or they mightn't be making the most money but sure you could be making the most money and your daughter or your son says to you, 'I don't want that farm at all sure you're working like a dog that's why you're making money'.

> F11: What's a good dairy farmer for me? I suppose a person that's profitable, a person that's happy, manages their animals well and looks after the farm and the environment well, that's basically it. And have time for people, there's no point in being a busy fool either. Yeah you need a bit of lifestyle as well.

A farmer states that traditionally farmers valued hard work and judged others they saw as not working hard enough.

> F7: I see a lot of good dairy farmers […] that they drop their kids to school, they come back and they do their jobs, what has to be done. […] Some people then on the other hand wouldn't like to be seen collecting the kids from school, because they feel then that people around the school are saying, 'Ah sure he's not busy'. That happens also, and it's a fright to even see that.

> F9: I'm happy doing as little as possible for the maximum output. It is that simple, like, but most fellas don't get that. I don't know why like, we'll say, but sure, look, that's their problem.

There was a perception that work life balance was not talked about enough in the industry.

> F8: I suppose some of the other KPIs that aren't being included are hours worked, and the pressure some people are under as well. That's the thing in fact that isn't talked about enough in comparison to all other businesses and other workplaces.

In the interviews a work life balance was related to skill, personal priories, and a shared farming 'culture'. Work life balance was also something that's to some extent beyond the control of individual farmers because of difficulties getting and keeping labour and difficult economic conditions. Skills, farming culture and economic conditions are areas that industry and government can influence to enhance the 'social sustainability' of the dairy sector.

Conclusion

I found broad support for the grass-based system among stakeholder and farmer interviewees and in the farmer survey. In the survey farmers who supported a higher-feed-input system did so for different reasons to the grass-based system: lack of land to expand and weather variability. And in the interviews I did not find a clear divide among farmers in terms of the interest or lack of interest in grass.

The expansion of the grass-based system was however causing problems that are usually caused by increasing production: environment damage, small farms being left behind, and the need to continually expand production trumping other values. The environmental question has become polarised between farmers and non-farmers. Farmers feel vilified and threatened by the prospect of stringent environmental regulations. This makes sense in a context where farmers were told to expand by government and industry, and that 'good farming' is intensive grass-production. But they are also told that they are not environmentally sustainable, and they need to change.

It is a good time to consider goals and values in the dairy sector. The farmers I spoke to wanted to enjoy their work, make money, feel valued in society, worry less about environmental issues and have time for things outside of work. Current government proposals to tackle environmental issues through strengthening alternative value chains and incentivising farmers to carry out environmentally friendly practices could provide ways around the expansion imperative. In addition, eliciting farmers' views on the environment and incorporating their expertise into the design of environmental initiatives, through for example focus groups or other participatory governance mechanisms, could make them more robust and more likely to lead to successful outcomes.

Appendix 1

Documents analysed

I searched for documents to analyse from April to July 2018. I looked for documents from government, NGO and agricultural organisations and individuals from 2010 onwards which expressed the organisation or individual's policy, position or research findings relevant to the research questions. There were a small number of documents pre-2010 which I included because they were of relevance to the research questions.

Government	Climate Change Advisory Council (2018) *Annual Review 2018*. Dublin.
	DAFM (2010) *Food Harvest Food Harvest 2020: A vision for Irish agro-food and fisherie*. *Department of Agriculture, Fisheries and Food*. Dublin. Available at: https://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodharvest2020/2020FoodHarvestEng240810.pdf.
	DAFM (2015) *Foodwise 2025: A 10 year vision for the Irish agri-food industry*. Dulbin.
	Department of communication climate action and environment (2017) *National Mitigation Plan*. Dublin.
	Environmental Protection Agency (2012) *Consultation on Environmental Analysis of Food Harvest 2020 : Response of the Environmental Protection Agency*. Dublin.
Industry	AIB and IFA (2013) *Outlook: AIB's Series of Sectoral Research Reports Dairy*. Dublin.
	Hurley C and Murphy M (2015) *Building a Resilient, Flourishing, Internationally Competitive Dairy Industry in Ireland*. Dublin.
	IFA (2015a) *Farm Profitability Key to Agri-Food Growth: IFA Submission to Agri-Strategy 2025*. Dublin.
	IFA (2015b) *Towards a ' Milk Wise 2025 ' Strategy for Irish Produced Fresh Milk*. Dublin.
	IFA (n.d.) *Liquid Milk Handbook*. Dublin.
	Promar International Limited (2003) *Strategic Development Plan for the Irish Dairy Processing Sector*. London.
NGO	Environmental Pillar (2012) *Environmental Pillar Submission on the Environmental Analysis of Scenarios Related to Implementation of Recommendations in Food Harvest 2020 (FH2020)*. Dublin.
	Friends of the Irish Environment (2012) *Requirement for Assessment of Food Harvest 2020*. Cork.
	Irish Climate Justice (2012) *Irish Climate Justice Group Submission to the Department of Agriculture Public Consultation on Harvest 2020*. Dublin.
Research	Boyle L, Marchewka J, Berry D, et al. (2017) ProWelCow – dairy cow welfare. *TResearch* 12(3). Cork: 12–13.
	Delaney M (2015) *Sustainability – the Climate Change Challenge for Irish Dairying Farming Scholarships*. Thurles.
	Dillon E, Moran B and Donnellan T (2017) *Teagasc National Farm Survey 2016 Reults*. Athenry. Available at: http://www.teagasc.ie/publications/2015/3596/TeagascNFSPrelimResults2014_final.pdf.
	Farrelly P, Crosse DS, O'Donoghue DP, et al. (2014) *Food Harvest 2020 - Environmental Analysis Report*. Dublin. Available at: http://www.agriculture.gov.ie/media/migration/agri-foodindustry/agri-foodindustry publications/2020Foodharvest190710.pdf.
	Fitzgerald JB, Brereton AJ and Holden NM (2009) Assessment of the adaptation potential of grass-based dairy systems to climate change in Ireland — The maximised production scenario. *Agriculture and Forestry Meterology* 149: 244–255. DOI: 10.1016/j.agrformet.2008.08.006.
	Hennessy T, Buckley C and Dillon E (2013) *Measuring Farm Level Sustainability with the Teagasc National Farm Survey*. Athenry.
	Hennessy T, Moran B and Thorne F (2016) Why dairying? In: Teagasc (ed.) *Teagasc Dairy Manual*. Moorepark: Teagasc.
	Lyons Research Farm (2018) *Lyons System Research Herd Notes*. Dublin.
	Murphy P, Keena C, Hyde T, et al. (2016) Key Environment Issues Issues for Dairy Farmers Key Environment Issues. In: *Teagasc Dairy Manual*. Fermoy: Teagasc, pp. 163–174.
	O'Donoghue C, Creamer R, Crosson P, et al. (2015) *Drivers of agricultural land use change in Ireland to 2025*.
	Schulte RPO, Donnellan T, Black KG, et al. (2013) *Carbon-Neutrality as a horizon point for Irish Agriculture - A qualitative appraisal of potential pathways to 2050*. Oak Park.
	Thorne F, Gillespie PR, Donnellan T, et al. (2017) *The Competitiveness of Irish Agriculture*. *Allied Irish Banks and the Irish Farmers Journal*. Dublin.

Appendix 2

Table 1: Respondent descriptive statistics							
Responses (n)	**Gender (%)**		**Time in farming (%)**				
	Male	**Female**	**<10 years**	**10-20**	**20-30**	**>30**	
396	96	3	25	23	25	27	
Education (%)							
Junior certificate equivalent	**Leaving certificate equivalent**	**Certificate**	**Diploma**	**Degree**	**Postgraduate degree**		
8	7	33	20	25	8		
Ownership structure (%)							
Owner	**Manager**	**Employee**	**Family**	**Partner**	**Other**		
84	8	5	2	2	0.25		
Location (%)							
South West	**South East**	**North West**	**North East**	**Midlands**			
32	32	7	10	20			
Full time labour units							
Organic (%)	**Conventional (%)**	**Median**	**Max**	**Min**	**Interquartile range (IQR)**		
1	99	1.5	8	0.25	2-1		
Land owned							
(n)	**Median (ha)**	**Max (ha)**	**Min (ha)**	**IQR (ha)**			
371	54	243	12	80-40			
Land other (e.g. partnership)							
(n)	**Median (ha)**	**Max (ha)**	**Min (ha)**	**IQR (ha)**			
30	30	230	5	52.6-12			
Land rented							
(n)	**Median (ha)**	**Max (ha)**	**Min (ha)**	**IQR (ha)**			
280	29	400	1	55-12			
Total land							
(n)	**Median (ha)**	**Max (ha)**	**Min (ha)**	**IQR (ha)**			
378	80	440	18	120-53.8			
Expanded since 2015 (%)	**Plan to expand in future (%)**	**Yield/cow/year (litres)**					
		Median	**Max**	**Min**	**IQR**		
81	52	6000	11500	3000	7000-5500		
Means of expansion since 2015							
More land	**More cows**	**More concentrate**	**Different breeds**	**Change calving**	**Change grass management**	**Improve health/ fertility**	**Partnership**
38	94	22	8	10	33	37	4
Means of future expansion							
40	80	18	7	8	24	38	7

Calving pattern (%)					
Spring calving	**Autumn calving**	**Spring and autumn**	**Other**		
74	2	20	4		
Housing and grazing system (%)					
Year-round grazing	**Summer grazing, winter housing with minimal additional feed**	**Summer grazing, winter housing with additional feed**	**Year-round housing some lactating cows**	**Year-round housing all lactating cows**	**Year-round housing all cows (including followers)**
11	58	29	1	1	<1

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