CROPS 2030

A strategic plan to deliver environmental and economic sustainability for the Irish Crops Sector

A Report Compiled by the Teagasc Tillage Crop Stakeholder Consultative Group | August 2020

FOREWORD BY GROUP CHAIR

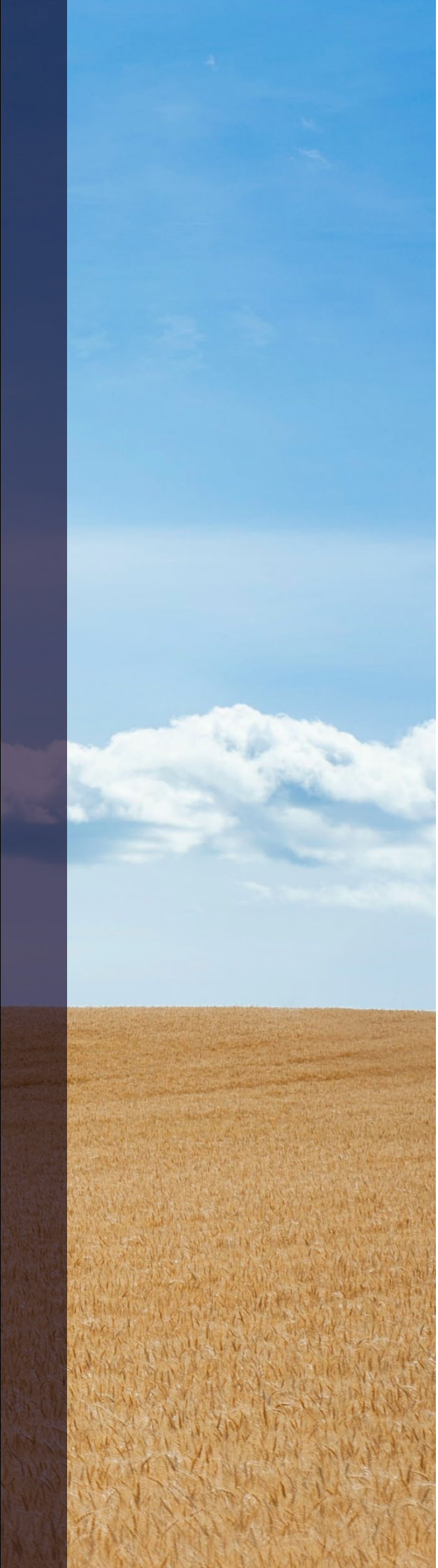
The Tillage Sector in Ireland is one with tremendous potential for future growth, especially when you consider the fast evolving environmental and sustainability targets that are being imposed on farmers and the food industry going forward. In addition, changing dietary habits and increasing consumer awareness of food provenance can create opportunities for greater diversification in our supply chains, whether they be in primary feed ingredients for our livestock sector or raw materials for the food and drinks industry.

This report aims to give some headline facts about the Irish Tillage Sector, along with some realistic targets and ambitions that could be met over the next 10 years. It has been spearheaded by the external representatives on the Teagasc Tillage Stakeholders Consultative Group. However, the group canvassed the views of key players in Ireland's tillage industry and these views are reflected in this plan. The broadly-based group that compiled this report wish to acknowledge the support provided by Teagasc experts in producing this plan.

We are confident the key policy makers, industry representatives, supply industry, research and farmer groups would use this document as a primary point of reference in making policy decision over the coming years. Our ultimate aim is to promote a more vibrant, profitable and sustainable tillage sector for all stakeholders with added ancillary benefits to the entire national agri-food economy as a result.

Donal Fitzgerald
Chairman, Tillage Stakeholders Group

Industry Stakeholder Representatives
Donal Fitzgerald (Chairperson)
Stephen Collins
Andy Doyle
Jonny Greene
Richard Hackett
John Keogh
Willie Masterson
Mariea O'Toole
Paddy O'Toole
Pat Ryan
Stuart Wallace
Ollie Whyte



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EXECUTIVE SUMMARY

Ireland's crop production underpins the agri-food industry through the provision of high-quality, low carbon footprint, traceable livestock feed for dairy, beef, horse, poultry and pig production, and raw material for processing into food and drink products. This supports approximately €13.7 billion in food and drink exports.

However the sector faces a number of challenges which currently restricts its development which include:

- Access to land, and high costs
- Loss of effective plant protection products
- Climate change challenges
- EU policy including 'Farm to Fork' and restrictions on plant breeding technologies
- Weak appreciation of the importance of the sector to agriculture and food

To allow this sector to develop, and to continue its support for food and drink production, a number of actions need to be taken to overcome these challenges but also to make the most of the sectors potential in areas of food, sustainability and other positive land uses. At stake is not only the relatively small crops sector at farm level, but other farm enterprises and their associated processing sectors, that are supported by the provision of low carbon, traceable produce of known provenance which underpins the 'Origin Green' brand for food products.

The environmental sustainability of the sector and its produce is strong, contributing significantly to the green credentials of Irish food production. Cropped land area produces less GHG emissions at 1.18 t/ha of CO_2 equivalent compared to dairy 8.7 t/ha, beef 4.4 t/ha or South American maize which emits 27 t/ha. Ireland's crop production is efficient in nutrient use achieving nitrogen use efficiencies of more than 60% compared to 25% for grass production. The nutrient and soil carbon status of Irish tillage soils makes them ideal sinks for organic matter, providing potential solutions for intensive livestock enterprises and other organic nutrient sources. However, the beneficial transfer of nutrients and organic material needs enabling actions.

The economic and social sustainability of the sector is also positive with tillage farmers next only to dairy farms in farm profit, even if the per hectare profitability differs considerably. While competitive within the EU, Irish crop production is less competitive against non-EU producers who are less regulated, have access to more breeding technologies, and may have high carbon footprints. While farm viability is good with only 18% deemed 'vulnerable', like all enterprises, the age profile of farmers is poor. To ensure continued production and to attract new entrants, the viability of the sector needs to be underpinned by rewarding producers for the environmental credentials of their produce and land use, which adds value to the consumer products that they become part of.

Ireland's reputation as a leading food exporter is primarily based on meat and dairy products. With concern about health and environment putting the focus on plant based foods, there is scope to build on the small but successful example of oats and cold-pressed rapeseed oil as Irish crop foods. Other food options, based on crops that grow well in our climate, need to be considered and developed. The traditional dominant supply chains, which can strangle indigenous producers, need to be disrupted to allow native food crop producers regain a foothold and displace imports from the UK and Europe.

Barley is the key ingredient for the Irish drinks industry which exported €1.4 billion worth of produce in 2018. There is scope to grow this further based on the provenance and potentially, the terroir, of our native grain. The multiple producers who continue to enter this market would benefit from the support of an innovation hub which, would help develop product based on traceable native sustainable feedstock, and provide a focus for the marketing of a suite of Irish produced drink products.

Animal feed remains the biggest market for Irish grains. Between 2014 and 2018, Ireland's self sufficiency in animal concentrate feeds has decreased from 41.6% to 21%, due to the animal sector's increasing dependence on imported feed, with an average of 3.4 million tonnes imported from 2014-2018. In the context of Origin Green and grass-fed brands, the use of significant proportions of imported feeds which are produced to different standards, in less regulated regions, risks damaging the authenticity of Irish food exports.

The substitution of imported animal feed with traceable, locally produced, material presents a significant opportunity for the crops sector, which has the capacity to expand production. To displace imports effectively, the development and adoption of new production technology such as precision breeding and more precise crop management is essential to remain competitive. Also the production of native feeds, which through the development of Irish Feed brand can support the marketing of beef and dairy products, needs to be rewarded through sustainability schemes or alternatives. Protein crop development needs continued support.

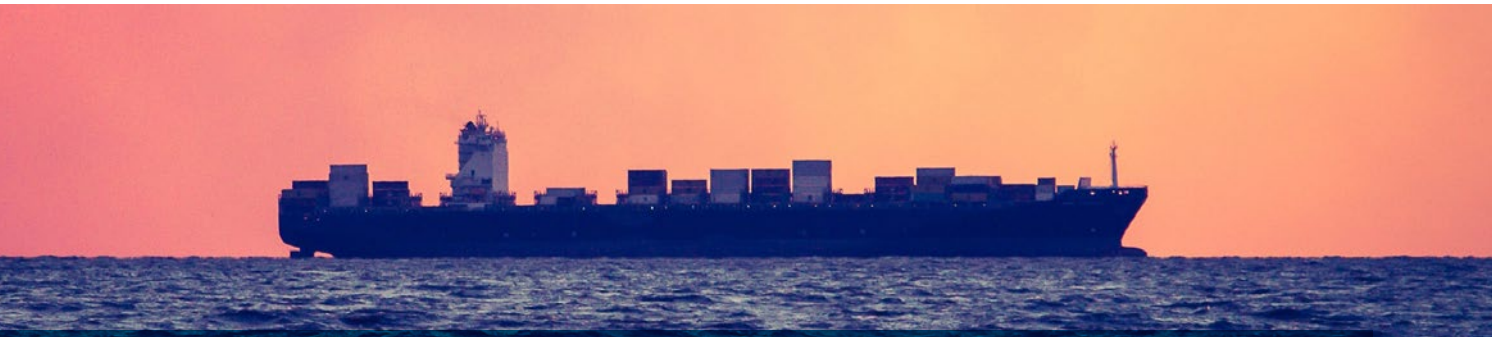
The non-food use potential of crops such as willow, miscanthus and hemp can contribute to GHG reduction in energy use and displace fossil-fuel-based building and manufacturing products with renewable fibre alternatives. The sector can also provide feedstock for anaerobic digesters and utilise the digestate as organic amendments to the soil. But none of these will be possible without well-thought-out support mechanisms.

The EU Farm to Fork strategy has as its core principal the development of a sustainable food system which many of the initiatives in Crops 2030 align with. The pesticide and fertiliser input reduction targets could be challenging for production in our climate depending on their implementation. The industry will need to be agile in its response, from research through to farm implementation, and newer technologies such as precision breeding and more precise targeting of all inputs will need to play an increasing role.

Crop production in Ireland has the scope to expand and develop, producing more food and drink products and underpinning the sustainability credentials of beef and dairy produce. Crops 2030 aims to support that development by outlining the potential of the sector and by identifying the actions necessary to achieve that potential. Although small in area use, the crops sector is important, technologically advanced, and ready to develop.

IMPORTS

Associated with the Crop Sector



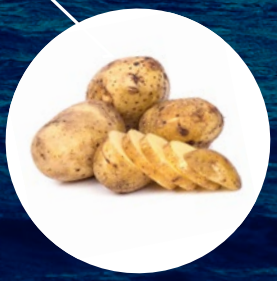
Import

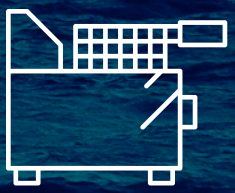
Average
last 5 years

3.42M
tonnes imported

(as part of total feed 5.7m tonnes)

Potatoes
80,000 tonnes





Food Grade Oil

Food service use 9,700,000 litres per year

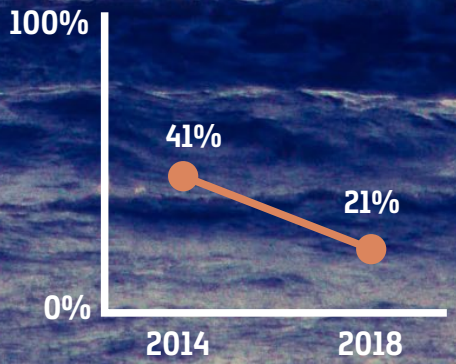
Flour
210,000 tonnes

Useful Information

(5 year average, 2014 to 2018)

Imports come from over **60 countries** with most coming from **Argentina, Brazil, Canada & USA**

Self sufficiency



EXPORTS

Associated with the Crop Sector

Grain/proteins and other products **support** exports of animal produce

Drinks
€1.4 BILLION*

Meat (beef/pig/poultry)
€3.5 BILLION

Dairy (milk/cheese/butter)
€4.4 BILLION

* Values are Bord Bia 2019 figures

SUSTAINABILITY OF THE CROPS SECTOR

True sustainability of any sector takes into consideration the economic, environmental and social impacts on a sector.

The tillage sector accounts for approximately 7% of the national land use, primarily in the eastern half of the country. Assorted tillage crops are distributed through the mainly grassland countryside providing product for the food and drink sector, while primarily underpinning the livestock sector with sustainably produced, traceable feed and providing circular economy opportunities in nutrient recycling capacity.

Tillage Farms emit
1.18 t CO_2 eq/ha

compared to

S. America Maize
27 t CO_2 eq/ha

Environmental Sustainability

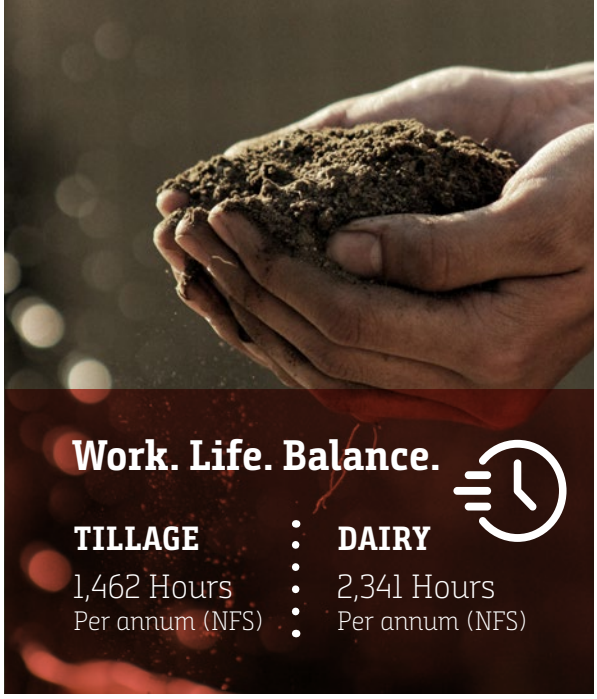
Crop production produces the lowest amount of GHG per unit area or unit of output of our main agricultural production systems. Irish specialist tillage farms produce 1.18 tonnes CO_2 equivalent per hectare (t CO_2 eq/ha) which is just 15% of that produced on dairy farms or 25% of that on beef farms. Irish grain production emits much lower GHG emissions than imported feeds; North American Maize produces 4.0 t CO_2 eq/ha and South American Maize producing 27 t CO_2 eq/ha. Other environmental sustainability indicators such as water quality and biodiversity can be positively impacted by having an integrated landscape of cropped and grassland areas.

Tillage soils in Ireland retain more carbon due to the wetter climate compared to soils in drier climates, and have the capacity to capture carbon from applied livestock manures. The single enterprise nature of today's farming systems effectively precludes the inclusion of grass leys in rotations and the resulting benefits this practice historically brought to soil quality and crop yield potential. Developing crop systems which retain more soil carbon would improve soil health and benefit: yield potential, water infiltration, water holding capacity and resilience during droughts. However, using low disturbance tillage systems in wetter climates to reduce carbon loss can lead to increased N_2O emissions thereby negating some benefits of carbon capture. Non-inversion tillage systems can also increase grass weed pressure. These tillage systems need further optimisation for Irish climatic conditions.

The suggested indicators of quantified fertiliser and pesticide reductions in the EU Farm to Fork policy document could present significant challenges depending on the details of their implementation. These policy changes indicate the need for an appropriate response at, research, knowledge transfer and farm practice level, to ensure all environmental targets are met while maintaining competitive production.

Financial Sustainability

The trend of reducing crop area and tillage farm numbers has continued until recently and is largely driven by land access problems, where the per-hectare profitability of dairy farming allows these farmers to out-compete tillage farmers for short- and long-term land leases. Crop producing farms are second only to dairy farms, when income per family farm unit is considered, and are well ahead of beef and sheep farming. When income is expressed in terms of the amount of labour deployed, specialist tillage family farms income per labour unit, averaging €41,000, over the last three years, compares well with dairy farming. Irish grain, on account of high yield potential, can be produced competitively compared to that of other EU grain producers but is less competitive against non-EU imported grains which are less regulated, have access to more technologies, and often have a larger carbon footprint. This is further compounded by the price cost squeeze at farm gate. Increasingly strict legislation will continue to challenge the



competitiveness and financial sustainability of Irish tillage farms. Technical issues also contribute to financial sustainability: increases in grass weeds; reduced soil carbon and the loss of disease control options, all impact negatively on financial sustainability, but conversely improvements in production technology can improve sustainability.

Social Sustainability

Economic analysis (NFS 2018) of farm viability suggests 62% of tillage farms are economically viable[1] with less than 18% classified as vulnerable. This is slightly less than dairy farms but well ahead of Irish farms generally, where only 32% of all farmers are ranked as viable. Working hours at 1,462 hours per year on tillage farms compares with a value of 2,341 hours on dairy farms, offering scope for a good work-life balance. While health and safety is of concern on all farms, the number of deaths and injuries on tillage farms are lower than other enterprises. The age profile of tillage farmers is similar to that of other farm enterprises, however there are fewer younger farmers entering the sector. The sector's role in Irish agricultural production needs to be recognised and supported, and the need for profitable production acknowledged, to ensure continued generational renewal.

Actions to achieve potential

- Establish a cross-society grouping to assess the requirements, including profitability, to attract new entrants and to guarantee the continuation of domestic food production.
- Assess the sectoral impact of the EU Farm to Fork measures, once clarified by the EU, and develop research, knowledge transfer and farm responses that minimise negative impacts on production.
- Develop and quantify the environmental credentials of Irish grain used in animal production systems to support the displacement of imports with poorer credentials.
- Further develop collaborative farming through partnerships, share farming and machinery sharing to optimise farm resources including labour.
- Improve our knowledge on the impact of tillage systems on carbon sequestration, soil health, weed challenges, crop resilience and biodiversity.

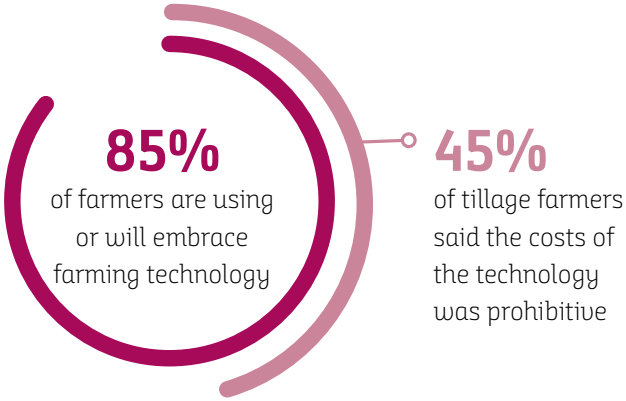
[1] The economic viability of a farm business is measured by a binary variable, where a farm is defined as viable if family labour is remunerated at greater than or equal to the minimum wage and there is sufficient income to provide an additional five per cent return on non-land based assets employed on the farm

NEW TECHNOLOGIES TO IMPROVE SUSTAINABILITY

Agriculture continues to develop at a pace allowing an increasing global population to be fed at a low cost. Continually developing technology in all areas of production including: plant breeding, crop nutrition, pest/disease control, soil management, mechanisation and cost control have contributed to efficient crop production. But today the challenges are changing with environmental constraints, along with increasing weed, disease and pest control challenges requiring a more targeted response. The response has largely been one of improving precision in all areas of production including: machine control, input application, disease prediction and now plant breeding, using newer technologies. The crops sector is quick to employ new on-farm technologies to improve efficiency. Recent examples include the use of GPS technologies for machine steering and yield mapping, more targeted application of fertilisers and plant protection products, and the application of molecular tools to deliver crop varieties with enhanced pest and disease resistance.

The crops sector is **quick to employ new on-farm technologies** to improve efficiency

The ability to capture and process increasing amounts of data from a variety of sensors and sources, across all aspects of agricultural production cycles, combined with newer analytical techniques, offers scope to improve crop management from disease prediction to more targeted application of all inputs. This has the potential to support integrated pest management, deliver more targeted and efficient use of nutrients, and impact positively on crop yield and quality. While both private and public organisations are involved in these developments, benefits form their adoption will only occur when the technologies are proven. Many challenges remain, from data ownership to the development of appropriate management responses to measured variation.



Progress is being made and tillage farmers are willing adopters. A recent survey indicates 85% of farmers are using or will embrace farming technology[2]. In the same survey 45% of tillage farmers said the costs of the technology was prohibitive whereas only 9% lacked confidence using technology on farms[2].

Where newer technologies result in improved crop varieties, these would be rapidly adopted if available on the market. While some lab-based genetic modification (GM) techniques have not been allowed in Europe, other molecular techniques such as marker assisted selection have speeded-up the breeding process. Newer precision breeding techniques involving gene editing, though not yet passed by the EU, offer scope to further improve breeding speed and accuracy.

[2] https://www.ifa.ie/wp-content/uploads/2019/11/Digital-Ag-Tech-Adoption-Attitudes.pdf

Precision Breeding

Breeding varieties with increased stress resilience to cope with pest and climate change challenges is particularly important for Irish production systems and will significantly contribute to national and EU sustainability goals. Conventional breeding still has a lot to offer in terms of increased yield and disease resistance, however precision breeding can add to this as it allows for the specific editing of DNA sequences in existing varieties, effectively enhancing their performance through a 'mutagenesis' approach which differs from traditional GMO techniques. This will deliver novel crop lines with enhanced traits that benefit the environment, the consumer and the farmer.

While mutagenesis as a breeding tool has been an accepted breeding technique since the 1950s, in 2018 the EU Court of Justice (ECJ) interpreted an existing law to rule that precision breeding was a GMO technique, contrary to overwhelming scientific evidence[3]. As it stands, the ECJ decision has effectively deprived EU breeders, farmers and consumers of novel varieties with the capacity to deliver the required sustainability goals of the EU Green Deal.

Analysis of precision breeding for the crops sector

To illustrate the potential impact of precision breeding, case studies were considered; based on published scientific reports. This analysis looked at the potential impact of a spring barley variety with enhanced nutrient use efficiency (NUE), reducing nitrogen requirement by 25%[4], and a potato variety bred with increased resistance to late blight allowing a reduced requirement for chemical plant protection products (PPP) by 80%[5]. Farm management gross margin data in these case studies indicate that a 10 to 20% increase in gross margin per hectare is possible which would equate to €5.8 million additional income annually, while at the same time exceeding the Farm to Fork targets for nutrient use reductions (decrease by 20%) and reduction in the use of plant protection products (decrease by 50%).

Actions to achieve potential

- The development and implementation of precision/smart technologies must be supported by validation in our climate and farming systems, to allow more precise management and improved efficiency in pesticide, fertiliser and other inputs.
- Further research is required on identifying breeding traits that can be effectively developed and integrated into crop management systems to enhance the sustainability of the sector.
- An open and objective discussion among all stakeholders is needed on the potential contribution of technologies to achieving the environmental goals of strategies such as Farm to Fork.

10 to 20% increase in gross margin per hectare is possible which would equate to

€5.8 Million additional income annually

There is potential to reduce PPP dependency with the correct tools

[3]https://easac.eu/fileadmin/PDF_s/reports_statements/Genome_Editing/EASAC_Report_31_on_Genome_Editing.pdf

[3]https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/scientific-support-eu-policies/group-chief-scientific-advisors/new-techniques-agricultural-biotechnology_en

[3]https://ec.europa.eu/info/news/commissions-chief-scientific-advisors-publish-statement-regulation-gene-editing-2018-nov-13_en

[4]Based on increased characterization of gene networks association with NUE ("https://www.frontiersin.org/articles/10.3389/fpls.2016.01587/full" Han et al. 2016) in barley and complementary work completed in alternative cereals ("https://onlinelibrary.wiley.com/doi/10.1111/pbi.12907" Lu et al. 2018)

[5]Based on analysis completed in "https://www.sciencedirect.com/science/article/pii/S1161030118300327" Kessel et al. (2018), which demonstrated that the introduction of late blight resistance with a specific IPM strategy will reduce the fungicide input by >80%.

SUSTAINABILITY

Social

11,000
directly employed

C. 3,000
FTE up-stream and down-stream connected to the tillage industry

Farm input & household expenditure

90%
stays within a 35km radius

Work. Life. Balance.

TILLAGE	DAIRY
1,462 Hours Per annum (NFS)	2,341 Hours Per annum (NFS)

Tillage (dark areas) recent footprint of Ireland

Environment

Irish Farm production (tonnes CO_2 eq per hectare)

GRAIN
1.18 T

DAIRY
8.7 T

BEEF
4.4 T

Imports from North America production (tonnes CO_2 eq per hectare)

MAIZE
4.0 T

SOYA
0.88 T

Imports from South America production (tonnes CO_2 eq per hectare)

MAIZE
27 T

SOYA
1.92 T
(up to 30 T)

IPPC methodology. Irish figures from NFS.

Traceability

IRISH FULLY TRACEABLE SYSTEM
from soil to consumer

Compared to

IMPORTED ANIMAL FEED

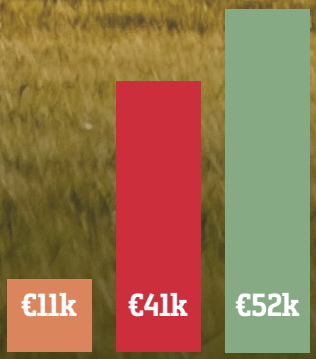
A FULLY TRACEABLE FOOD SYSTEM IS ESSENTIAL FOR CONSUMER CONFIDENCE

Financial

Income

Family Farm Income (FFI) per Farm

Family Farm Income (FFI) per Labour Unit

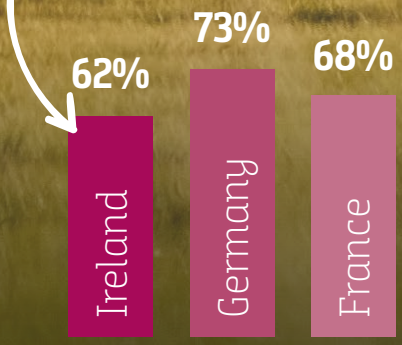


CATTLE TILLAGE DAIRY

(Teagasc National Farm Survey, 2016 - 2018)

Competitiveness

Ireland is more competitive compared to major EU countries



Cash costs as % of output

CHALLENGES FOR THE CROPS SECTOR

The crops sector is facing a number of challenges. Climate change, loss of critical agronomic tools, EU policy changes, an ageing workforce, access to land, and high production costs, all need to be considered in developing a response that ensures the competitive advantage which our yield potential brings, is maintained.

Climate Change

Climate change will demand changes in agronomy practice but will also require the development of resilient plant varieties to cope with water and temperature stresses, particularly when this is coupled with a loss of critical agronomic tools such as plant protection products. However, breeding advances are limited by EU restrictions currently in place on novel technologies.

Plant Protection Products

Loss of critical Plant Protection Products (PPP) is becoming acute in the tillage sector. The number of approved plant protection products continues to reduce and it is likely that 75 out of the total 400 substances currently available will be lost[6]. The principal driver of this reduction is the adoption of precautionary principles in assessment, but decision making is becoming more political as evidenced during the renewal of the registration of glyphosate in 2017. Withdrawn PPP products are not easily replaced. The cost of development (€250 million)[7] and the time required (approx. 11 years) to get a new active substance approved for the European market is stifling innovation. There were 70 new active substances awaiting EU approval in 2000. By 2012 that number had fallen to just 28[8].

The number of approved **plant protection products** continues to reduce

75 out of the total 400 substances currently available **will be lost.**

The EU Green Deal, Farm to Fork and Biodiversity strategies sets out to reduce use and risks from pesticides by 50% by 2030. The same strategy also advocates a reduction of fertiliser use by at least 20% by 2030, while at the same time increasing biodiversity; these targets will be challenging for the crops sector. The sector will rely heavily on Integrated Pest Management strategies to comply with new EU strategies; however IPM is limited. The losses of key PPP tools, will reduce yields in our main crops (barley, wheat and potatoes) by an average of 25%[9]. The decreased yields and increased risks may reduce profitability below the costs of production for many farmers. The development of IPM measures specific to our conditions is essential to combat crop pests/diseases.

FARM TO FORK PROPOSED

-50% **reduction in PPP**

-20% **reduction in fertilisers**

Scaling up of Organic Farming

The Farm to Fork strategy targets a 25% increase in land farmed organically by 2030. While there are some markets in Ireland any scaling up of production needs to be aligned with viable markets rather than informal farm to farm trading.

Land Availability

The average age of tillage farmer at 59 years is slightly older than that of other enterprises (NFS, 2019). Entry of young farmers is slow with only 20% of tillage farmers under the age of 50. Creating a sustainable income stream, coupled with good working conditions within tillage farms, will increase the numbers entering. New entrants, and existing farmers, need the support of education and knowledge transfer to allow them adopt newer technologies with confidence. Tillage

[6] Steward Redqueen Low Yield Cumulative impact of hazard-based legislation on crop protection in Europe
[7] Phillips McDougall, Agrochemical Research and Development: the cost of new product discovery, development and registration 2016
[8] Phillips McDougall, R&D trends for chemical crop protection products, Sept 2013
[9] Steward Redqueen: Low Yield Cumulative impact of hazard-based legislation on crop protection in Europe

farmers require a large land base to achieve the critical mass needed to compete with grain imports. Increasingly access to existing and new land through rental is challenged by competition from the dairy sector; and land is being lost to long term dairy leases of 15+ years. Co-operation between intensive livestock farmers and tillage farmers, e.g. share farming, partnerships, etc. could reduce the scramble for the same land base and bring efficiencies to both systems by providing solutions for nutrient recycling, fodder supply, machinery and labour sharing, etc. These arrangements must be encouraged through the AKIS (Agricultural Knowledge Innovation System).

Share Farming

"Share Farming has helped my business to open up new land access opportunities while at the same time reducing risks. It's now a valuable part of my business model"

Kildare Farmer

Actions to achieve potential

- Support the research driven development and demonstration of cropping systems including rotations and crop establishment, to meet the ambitious goals of Farm to Fork and hence deliver a tangible roadmap for the crops sector to counter the anticipated challenges.
- Develop and demonstrate new IPM tools to ensure decisions taken on farm minimise the impact on non-target species while also reducing the risks of crop failure and maximising output and grower profitability.
- Develop enhanced linkages and integration with the organic sector to help develop growth of sustainable markets for organic tillage products.
- Develop collaborative farming arrangements that will allow livestock and tillage farmers to optimise 'circular-economy' production methods, with crops and crop by-products being replaced by organic manures and access to land.

SECTOR REPORTS

Food Oats

48k Tonnes

+8%

Projected increase in domestic consumption of 8% between 2019 - 2025

EXPORTED

10k Tonnes

Potato Production

NATIVE

400k Tonnes

> 450 farmers producers

> €250m retail value per annum

IMPORTED

70 / 80k Tonnes

by 2030 >75% of imports can be grown domestically

Cold Pressed Rapeseed Oil

Current Irish yearly production **320,000 litres**

Market for 2,500,000 litres per year*

€5 Million
current retail value

€34.6 Million
potential retail value*

Milling Wheat / Flour

Small tonnage of native wheat milled

Imported Flour **210k Tonnes**

Food Grade Oil

Food service use
9,700,000
litres per year

*https://www.euromonitor.com/edible-oils-in-ireland/report

FOOD PRODUCTS

The Irish and international food consumer has increasingly diverse requirements from food, with taste, health objectives, provenance and food quality all of concern and these combined with price determining purchasing decisions. It is important, from a short and medium term food security perspective, to maximise the amount of food produced on this island for our own consumption. The impact of Covid-19 on market volatility, combined with Brexit market risks, highlight the need for greater food security.

Farmers and local companies continue to exploit available opportunities in potatoes, oats for human consumption, rapeseed oil, ancient grains and milling wheat. Markets exist for conventionally and organic grown produce, but mostly for the home market. Substantial export markets can be exploited but this requires support.

Demand/Market

Whilst Ireland has built up a solid reputation as a leading food exporter, this is dominated by exports of meat and dairy-based products. An increasing proportion of the other foods we consume are imported, primarily from the UK but also from mainland Europe through large supermarket multiples and the streamlining of the supply chains. As we approach 2030, the overarching themes of carbon emissions, biodiversity, water quality, plant-based diets, health and obesity, food provenance and water availability will impact on our scope to supply food for an increasing population with increasingly diverse requirements.

There is enormous potential to increase exports such as food oats and cold pressed oils but increased support is needed to market these products in overseas markets. Irish farmers have the ability to achieve substantial import substitution in the food sector in areas such as potatoes, protein sources, fruit & veg, and cereal based products but only if adequate supports are put in place for producers and if there is a concerted action by producers and retailers. There will also be more opportunities for organic foods, in line with the recently published EU 'Farm to Fork' policy, however an equal effort is needed to find markets for these food products.

Healthier plant based foods

With shifts in emphasis to healthier diets from sustainable produce there is an opportunity to develop and market plant-based food product based on crops that are suitable for our climate and preferably where we could develop a unique selling point.

Example: Irish Wholemeal Soda Bread

There is an association between refined white flour bread products, unhealthy diets and obesity. Conversely many wholemeal based products have a far better health profile with soda breads in particular being associated with high fibre and good gut health. Irish wheat, due to our climate, is more suitable for producing whole meal flours suitable for soda bread than for conventional white bread. There may be scope to build an overall brand around a variety of Irish wholemeal products based on a minimum content of Irish-produced wheat flour. Protected designation status may also be possible as international chefs already recognise the term 'Irish soda bread', further building the brand and opportunities.

Opportunities

- A ready market for food consumption in Ireland, as well as expanding potential for export into EU and non-EU markets (e.g. Asia[10]).
- Increasing interest and awareness in the provenance, environmental impact, carbon footprint and overall nutritional quality of food.
- Increasing consumer trends to plant-based diets will create opportunities for plant producers including the expansion of 'niche' crops to supply changing dietary demands.
- Ireland is seen as a safe place to grow and purchase food - consumer perception is already in the right place.
- Scope to build on the interest in plant-based diets by developing new food products based on the production of crops suitable for the Irish climate with guaranteed provenance.

Threats

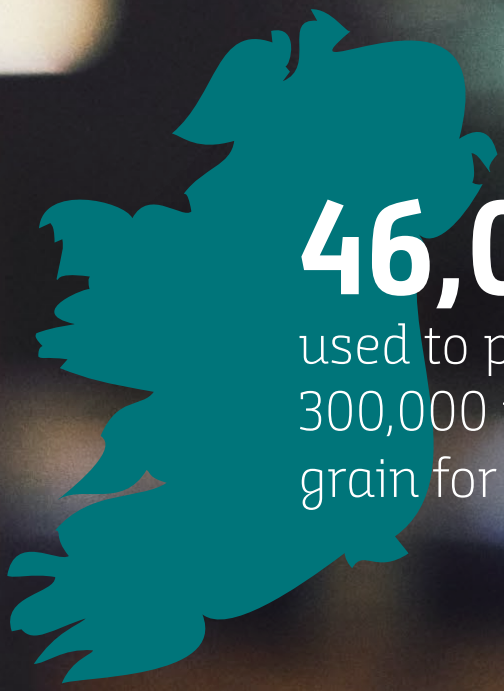
- Increasing dependence on imports from international markets, across Europe and the UK.
- Limited availability of knowledge for the production and marketing of specialist or niche products.
- Small scale production may not have the resources to break into/supply large multiples.
- Limited research capacity to help develop and scale consumer products derived from plants.

Actions to achieve potential

- The industry should work with Bord Bia and other stakeholders to develop a national approach (and support) to increase the use of Irish grown products (cereal foods, oats, cold pressed rape oil, etc.) and to develop novel plant-based products where the provenance and branding is based on Irish production, and to market these nationally and internationally.
- Support the diversification of mainstream and niche crops to generate novel, value added streams such as: food/nutritional ingredients; products to enhance gut microbiome and protein digestibility etc. to meet consumer-driven nutritional and health demands.
- Increase supports to develop products to displace food imports, achieving greater food sustainability and increasing national food security.

[10]Ireland's potential food export capacity: the strategic importance of Asia for Ireland's agri-food sector (KPMG report (2018) [https://home.kpmg/ie/en/home/insights/2018/12/irelands-potential-food-export-capacity.html

DRINKS INDUSTRY



46,000 ha
used to produce
300,000 tonnes of
grain for the industry

Each year the drinks industry purchases approximately...

220,000t of Barley

to produce 170,000t of malt

+

35,000t Feedstock Dried Barley

+

45,000t Roasted Barley


€2 Billion
projected value of exports in 2030
€1.4 Billion
value of exports in 2019
Supporting Irish whiskey tourism - seen as premium global tourism ambassador
year 2016
650k tourists
year 2025
1.4m tourists
Spending an estimated €1.9b
€200 Million
value of Irish whiskey exports in 2010
€600 Million
value of Irish whiskey exports in 2018

DRINKS INDUSTRY

In 2019 the Irish drinks industry, exported approximately €1.4 billion worth of drinks products to 140 markets, and supported 13,390 jobs in the local economy[11]. This industry is supported with grain production from more than 2,000 farmers producing approximately 300,000 tonnes of grain from approximately 45,000 hectares.

Barley is the main feed stock for the drinks industry. However, grain imports also play a part in the production of Irish whiskey. Although the craft beer sector is small, utilising less than 5% of the total malt production, it has increased consumer awareness of the brewing process including the source and type of raw material used in beer production.

Demand/Market

Malting barley growers generally deliver just over 70% of contracted grains to the required specification. Our variable climate impacts on farmers' ability to meet contracted protein, screening, germination and grain damage thresholds. Research could help to more precisely manage crop agronomic factors to allow farmers to align supply more closely with demand for different markets.

Ireland can produce wheat with the necessary high starch yields, and low protein levels for distilling. The inclusion of Irish produced wheat as the primary feedstock for existing and new distilleries will protect the industry's brand image and help build consumer loyalty based on provenance, traceability and sustainability, supporting Origin Green and distillers' efforts to promote products based on sustainable production.

13,390 jobs
in the local economy

[11] SUSTAINABLE GROWTH OF THE DRINKS INDUSTRY Ciaran Fitzgerald Agri-Food Economist, IBEC report 2019

Opportunities

- An increasing market for higher-value drinks (especially whiskey) and subsequent demand for malting barley.
- Exploiting the potential 'terroir' properties of Irish grain.
- To more precisely manage crops to more reliably meet the malsters specification.
- Increase farmer participation as part of the whiskey tourism product.
- Increase the use of Irish grown, high starch wheats in the whiskey industry.

Threats

- Sustainability and traceability claims are coming under increased scrutiny from consumers.
- Continuing price volatility and poor premiums over feed grains.
- Higher yielding feed production grains can be more profitable for farmers than malting markets.
- Lack of scale versus international competitors.
- Constraints on the use of new technologies, such as precision breeding techniques, need to be removed to sustain production with less use of PPP products.

Actions to achieve potential

» Develop a Beverage Innovation Hub to support new market innovation, to guide producer/supply chain and support the underpinning of sustainable, traceable production, based on locally grown feedstock.

» Increase research collaboration with breeders to deliver high yielding varieties with desirable quality, and disease/pest resistant traits.

» Develop and deploy more-precise crop production and quality prediction methods to help deliver grain within specification to different markets.

An **increasing market** for **higher-value drinks** (especially whiskey) and subsequent **demand for malting barley**

ANIMAL FEED AND FORAGES

Irish Grain used as Feed

BARLEY
0.99 Million Tonnes

WHEAT
0.77 Million Tonnes

PULSES
0.053 Million Tonnes

OATS
0.094 Million Tonnes

Other forages produce by the tillage sector for livestock

+

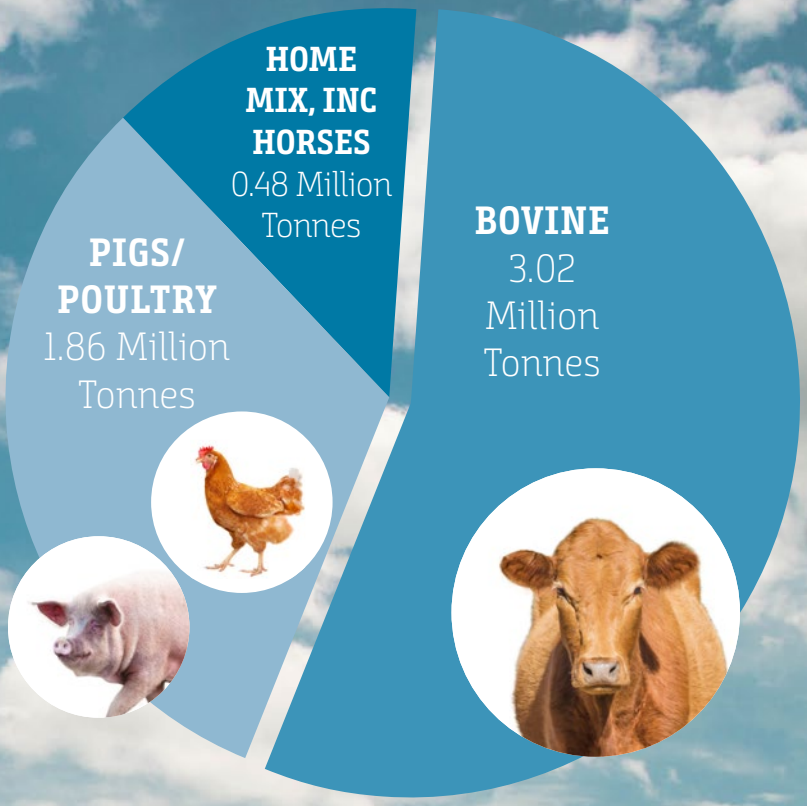
BEET & MAIZE
1.3 Million Tonnes

Ireland's self sufficiency was
21%
in animal concentrate feeds in 2018

Protein area increased by 100% over the past 5 years ... potential to increase by a further 100% within the existing tillage area

Total Concentrates

(2014-2018)



% of total imports

24% Maize
10% Soya Bean Meal
10% Distillers Grains
9% Soya Hulls
8% Maize Gluten
5% Wheat
5% Compound
5% Wheat Pollard
4% Rapeseed Cake
4% Beet Pulp
3% Barley
3% Molasses
3% Palm Kernel

Imports Grain & Protein

3.41 Million Tonnes

ANIMAL FEED AND FORAGES

The majority of cereal, oilseed rape and protein crops are used as feed for the livestock, pig and poultry sectors. There is also a significant amount of fodder produced from whole crop silage, arable silage, maize silage, fodder beet and catch crops. Between 2014 and 2018, Ireland's self-sufficiency in feed grain has decreased from 41% to 21%, due to the animal sector's increasing dependence on imported feed.

Imports

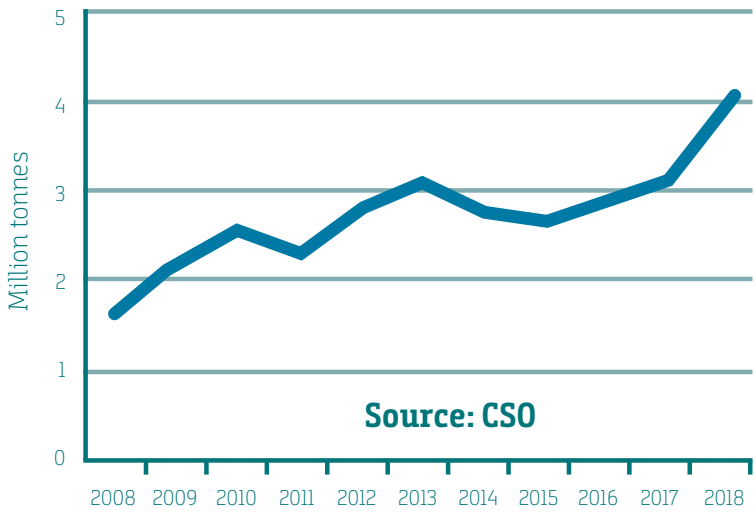
The average concentrate feed requirement was 5.3 million tonnes from 2014-2018 with a steady increase from 4.6 million tonnes in 2014 to 6.5 million tonnes in 2018 (a high demand year). Each year this equates to ~850,000 tonnes of protein per annum (or equivalent to ~3.1 million tonnes of faba bean). The level of feed imports has increased dramatically from 2 million tonnes in 2008 to over 4 million tonnes in 2018.

In the context of Origin Green, this deficit highlights a significant vulnerability concerning the authenticity of Irish food exports when such a large proportion of our animal feed is reliant on imports. At present, Ireland imports over 60 different animal feed products, many of which have production systems associated with high GHG emissions and negative impacts on biodiversity. For the Irish Crops Sector, this represents a significant opportunity for import substitution, with potential to produce both energy and protein crops for the feed market. There may be scope too to develop energy and high-protein forage markets, giving additional crop rotation opportunities and addressing some of the land constraint issues of intensive dairy farms.

Over 60
different animal feed products are
imported

Ireland's self sufficiency was **21%** in animal concentrate feeds in 2018

Figure 1. Total imports of designated animal feeds 2000-2018 (tonnes)



Opportunities

- To displace imports with traceable and transparent Irish-based supply.
- To support Origin Green credentials for animal produce by providing traceable animal feed with a low carbon footprint.
- To generate biodiversity in our landscape with a diverse cropping system.
- To supply a consistent and substantial livestock feed market with energy and protein concentrate feeds.
- To expand fodder supply opportunities including investigation of the potential for ensiled forage protein crops.
- To support livestock producers in the recycling of organic manures, which would decrease N fertiliser use in line with EU policy while supporting the circular economy.

Threats

- Loss of competitiveness caused by loss of plant protection products combined with the slow development of varietal resistance.
- The increasing prevalence of pesticide resistance in weeds, diseases and pests.
- Technology gaps that prohibit the rapid generation of disease resistant varieties through precision breeding.
- Lack of cost effectiveness in our small scale farms relative to international competitors.
- The continued pursuit of a cheap feed policy regardless of provenance, traceability or carbon footprint. Poor availability of suitable land at viable rental costs.

Actions to achieve potential

- Add value to native grown ingredients for product authenticity, through carbon or sustainability schemes.
- Develop managed grain marketing strategies by increasing EU supported Producer Organisations and collective marketing using pooling system to sell grains through the year (utilising averaged pricing mechanisms).
- Develop crop varieties with traits optimised to produce high yields with enhanced stress tolerance.
- Develop an Irish feed brand for indigenous grown crops which sets out specifications for the brand and how it will support Origin Green credentials.
- Develop ambitious targets for the inclusion of native cereals and proteins into existing meat and milk Quality Assurance schemes.
- Investigate the potential for development of alternative feed crops such as ensiled protein crops.

BIOENERGY AND INDUSTRIAL CROPS

ENERGY CROPS

Current area of Willow/ Miscanthus
2,600 hectares

POTENTIAL ENERGY CROPS

(displacing Grassland)

145,000 ha of energy crops if burned would contribute to

37.5%
of Ireland's **renewable heat target**

15,000 ha of willow has
281,000 tonnes

CO_2 -e Abatement Potential

CROP RESIDUES

Tillage Area (dark area) produces

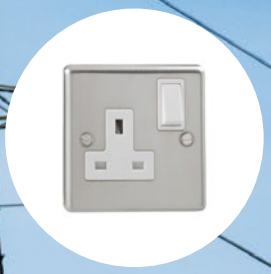
~800,000 tonnes

crop residues

(straw, stalks, leaves etc)

This is enough

energy to heat over 280,000 homes per year



100%

suitable for

heat / electricity

ANEROBIC DIGESTION

Slurry from 100 cows = **energy requirement for 25 houses** (@4,000kw/house)

Anerobic digestion can provide*:

- Electricity
- Heat
- Transport Fuel

1 tonne of **DRY MATTER MANURE** digested = **1.5** tonne of **GREEN HOUSE GAS** savings

* Government support is needed ~8 cents/KW

BIOENERGY AND INDUSTRIAL CROPS

The tillage sector can contribute to GHG energy targets and could also displace fossil fuel based building and manufacturing products with renewable fibre alternatives. However cohesive planning and viable support mechanisms are necessary to ensure growers have accessible and viable markets for energy and industrial crops. The sector can provide crop residue (straw) and can grow crops as renewable fuel sources, displacing carbon intensive fossil fuels, to produce heat, electricity or transport fuel.

- For direct heat or electricity, straw from all cereals and oilseed rape and purpose-grown energy crops such as willow, miscanthus and hemp, are all suitable.
- For biogas production for direct heat, injection to gas grid or use as transport fuel, anaerobic digesters can use a range of feedstocks including grass/red clover leys, food waste and animal manures.

Anaerobic Digestion

The tillage sector is well placed to provide feedstock for AD plants and also to utilise the nutrients and organic carbon from the digestion process to replenish tillage soils that could greatly benefit form organic additions.

The potential to contribute in the renewable fuel area has been recognised in many policy documents such as:

- SEAI identify the potential of 300,000 tonnes of straw as a bio-energy resource[12].
- SEAI state that 3.5% of the agricultural land base could produce 37.5% of the renewable heat target.
- 15,000 ha of bioenergy crops is included as an action on the Teagasc Marginal Abatement Cost Curve (MACC) for GHG reduction.

SEAI identify the potential of

300,000

tonnes of straw as a bio-energy resource

Other non-food uses for crops include fibre production where crops like hemp can be used to displace fossil fuel based products in industry. Similarly, plant sourced starch products can be used to produce bio-plastics.

Industrial Crops

Hemp offers potential as an industrial crop but others such as Borage, Camelina, flax, etc. can also be useful. Many parts of the hemp plant can be used including flowers, seeds, fibres and shivs. Uses include; paper pulp, insulation and building material, automotive industry and construction, and the oil has a high nutritional value. Challenges to production include; licencing, harvesting, processing and securing viable end markets. CO_2 is sequestered when hemp is used in textiles, paper, building, etc.

Many other plants have the potential for both food and non-food uses if a bio-refinery type approach was adopted. However the current commercial viability of these initiatives is limited.

Anaerobic Digestion

Anaerobic digestion is a renewable energy production system that offers scope to utilise organic manures, food wastes and particularly agricultural crops to produce bio-methane for injection onto the national gas grid or compression for use as an engine fuel or use on-site in a CHP for electricity and heat production. Many European countries support farm based anaerobic digestion as a means of increasing renewable energy production. In Ireland there is scope to utilise both high production grass/clover swards as energy sources. Development of AD is currently constrained by the lack of a development plan and a necessary support system.

[12]SEAI, Bioenergy Supply in Ireland 2015-2035

Opportunities

- To efficiently use our land base to contribute to essential GHG reductions and to reduce fossil fuel consumption.
- Growers have the land, expertise and flexibility to produce crops for alternative markets such as feedstocks for fibre, heat, electricity generation or transport fuel.
- Energy-dense crop residues such as straw are available within current crop production systems.
- Tillage farmers can provide a circular agriculture option for AD plants where they provide feedstock and utilise the digestate produced.

Threats

- Lack of clear policy and viable support mechanisms to enable the renewable energy sector to grow and contribute.
- Low fossil fuel prices mean subsidies will be required to make renewable sources viable.
- Public concern about switching land use from food to energy production.

Actions to achieve potential

- Establish a single entity to co-ordinate bio-energy industry policy.
- Provide support for pilot projects which demonstrate a viable model for the utilisation of bioenergy crops e.g. heating large municipal buildings, combustion to dry products e.g. milk, grain.
- Stronger government support (incentives and start up advice) is needed for on farm energy based production from renewable sources.
- Put in place viable feed-in tariff for bio-based fuels.

NUTRIENT RECYCLING

Tillage Utilisation of Organic Manures

Present Position

10% Pig Manure + 5% Cattle Manure + 70% Spent Mushroom Compost + 80% Poultry Manure =

174 k tonnes of organic material to supply tillage requirements

this would supply

- **5%** of crop needs of total NITROGEN
- **16%** of crop needs of total PHOSPHORUS
- **24%** of crop needs of total POTASSIUM

plus 64k tonnes of carbon added to the soil

RESULT

saving of

38,000t CO_2-e

through non-use of chemical fertiliser

Projected Potential

(in excess to requirements for grassland)

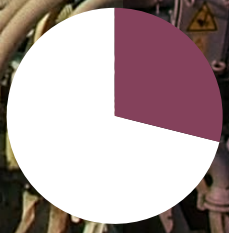
- 20% Pig Manure
- 10% Cattle Manure
- 90% Spent Mushroom Compost
- 90% Poultry Manure

=

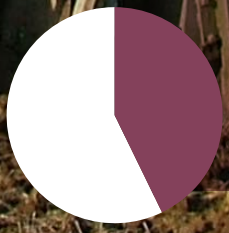
333 k tonnes of organic material to supply tillage requirements

this would supply

9% of crop needs of total **NITROGEN**



29% of crop needs of total **PHOSPHORUS**



43% of crop needs of total **POTASSIUM**

RESULT

saving of

71,000t CO_2-e

through non-use of chemical fertiliser

plus 106k tonnes of carbon added to the soil

NUTRIENT RECYCLING

The nutrient and soil carbon status of Irish tillage soils makes them ideal sinks for nutrients and organic matter, providing spread-land solutions for intensive livestock enterprises and other organic nutrient sources. The addition of these manures will improve soil quality, nutrient status and carbon sequestration in tillage soils. The challenge is to provide mechanisms to encourage appropriate nutrient and carbon movement to protect our water status and improve our soil quality.

Many tillage soils with lower soil nutrient and organic matter levels would provide a safer repository for organic manure nutrients, reducing leaching and overland-flow loss risks. Tillage soils tend to be dryer and less prone to N_2O loss also. While grassland soils can store carbon, the transfer of carbon to tillage soils would be much more beneficial as tillage soils have lower carbon levels. Additional carbon on tillage soils would add to the functionality and resilience of the soil by increasing nutrient availability and improving aggregate stability.

While substantial proportions of the organic manures from poultry and mushroom production at 80% and 70% respectively, are already utilised on tillage crops, manures from cattle and pigs at just 5% and 10% respectively, are used much less. Transport costs, logistics in storing, transport and application, incorrect N values attributed to some slurries and more challenging nutrient management currently restrict their use. Consequently the current transfer of nutrients is quite limited. There is scope to double the quantity of cattle and pig slurry which would add 106,000 tonnes of carbon to our tillage soils, in addition to supplying 9% of the N, 29% of the P and 43% of the K requirement for crop production. This would reduce the nutrient loading and pollution risk in intensive livestock areas, and ensure that GHG is reduced by 71,000 tonnes of CO_2-e.

There is scope to double the quantity of **cattle and pig slurry** which would add **106,000 tonnes of carbon** to our tillage soils

Soil Carbon

Soil carbon is an essential element for functional soils, impacting positively on soil biology, nutrient cycling/availability and aggregate formation/soil structure. Grass based production systems which have less disturbance tend to build up soil carbon to levels beyond which soils derive any functional benefit other than carbon storage. On the other hand, continuous tillage crop production, which involves more soil disturbance, will have soil carbon levels at a lower equilibrium value (frequently <2.5%) where function may be impacted. Traditional Irish rotations practised before the 1970s combined both crop and grass production (rotation) systems ensuring that soil carbon levels were never too low. While economics and logistics make a return to grass/tillage rotations challenging, there is scope to improve the situation by transferring organic manures from grassland to tillage soils. While the addition of carbon amendments in the form of manures and other sources (straw or cover crops) only has a small annual effect on total soil C stocks, the carbon that is added can benefit soil function.

Opportunities

- To achieve a win/win scenario where tillage soil resilience and fertility would be improved by the transfer of organic nutrients from high intensity animal production facilities, which need access to large spread areas.
- To improve the sustainability of both the supplier of the organic amendments and of those farms which receive it.
- To create a circular agriculture in animal feed, nutrient and carbon cycling.
- To integrate with energy production by using animal wastes and energy-rich crops in anaerobic digestion facilities, while still transferring the nutrients from intensive animal production systems to croplands.
- To reduce the requirement for imported N, P & K chemical fertilisers.

Threats

- The wetter organic manures such as cattle slurry are expensive to transport because of the low levels of nutrient per tonne of wet material.
- The current N value ascribed to cattle slurry in legislation (5kg N total or 2kg N available) is incorrect for most slurry and effectively prevents tillage farmers from using this slurry.
- Organic manures need to be applied in a timely fashion and incorporated to utilise the N fraction. This requires specific storage, transport and application infrastructure.
- Climate change may result in wetter winters and springs, leading to difficulties applying organic manures which could lead to increased soil compaction over time.

Actions to achieve potential

- Develop logistics and slurry/water separation practices that are suitable for Ireland to enhance manure movement from intensive livestock areas onto tillage soils.
- Research is needed into the long term benefits of organic manure use on soil health, carbon capture, soil water holding capacity, biodiversity, environment, etc.
- Analysis of other potential organic sources for tillage systems in terms of actual nutrient availability, quantities which can be applied, carbon capture and soil health effects is needed.
- Develop incentives to encourage the use of all organic manures from mushroom, pig and poultry production, and a proportion of other livestock manures, on tillage farms.

IMPLEMENTATION OF IDENTIFIED ACTIONS

Area/Sector	Action	Suggested Responsibility
Sustainability	Establish a cross-society grouping to assess the requirements, including profitability, to attract new entrants and to guarantee the continuation of domestic food production.	DAFM Industry Consumers
	Assess the sectoral impact of the EU Farm to Fork measures, once clarified by the EU, and develop research, knowledge transfer and farm responses that minimise negative impacts on production.	Teagasc Educational Institutions NGO's DAFM EPA
	Develop and quantify the environmental credentials of Irish grain used in animal production systems to support the displacement of imports with poorer credentials.	Teagasc Educational Institutions DAFM
	Further develop collaborative farming through partnerships, share farming and machinery sharing to optimise farm resources including labour.	Teagasc Social Scientists Educational Institutions
	Improve our knowledge on the impact of tillage systems on carbon sequestration, soil health, weed challenges, crop resilience and biodiversity.	Teagasc Educational Institutions DAFM EPA
Novel technologies	The development and implementation of precision/ smart technologies must be supported by validation in our climate and farming systems, to allow more precise management and improved efficiency in pesticide, fertiliser and other inputs.	Teagasc Educational Institutions DAFM
	Further research is required on identifying breeding traits that can be effectively developed and integrated into crop management systems to enhance the sustainability of the sector.	Teagasc Educational Institutions DAFM
	An open and objective discussion among all stakeholders is needed on the potential contribution of technologies to achieving the environmental goals of strategies such as Farm to Fork.	Teagasc Educational Institutions DAFM EPA

Area/Sector	Action	Suggested Responsibility
Sector Challenges	Support the research driven development and demonstration of cropping systems including rotations and crop establishment, to meet the ambitious goals of Farm to Fork and hence deliver a tangible roadmap for the crops sector to counter the anticipated challenges.	Teagasc Supply Industry End Users DAFM
	Develop and demonstrate new IPM tools to ensure decisions taken on farm minimise impact on non-target species while also reducing the risks of crop failure and maximising output and grower profitability.	Teagasc DAFM Supply Industry
	Develop enhanced linkages and integration with the organic sector to help develop growth of sustainable markets for organic tillage products.	Teagasc Educational Institutions DAFM EPA
	Develop collaborative farming arrangements that will allow livestock and tillage farmers to optimise 'circular-economy' production methods, with crops and crop by-products being replaced by organic manures and access to land.	Teagasc Farming Organisations DAFM
Food Products	The industry should work with Bord Bia and other stakeholders to develop a national approach (and support) to increase the use of Irish grown products (cereal foods, oats, cold pressed rape oil, etc.) and to develop markets nationally and internationally.	Farm Organisation Food Processors Bord Bia
	Support the diversification of mainstream and niche crops to generate novel, value added streams such increasing; such as: food/nutritional components ingredients, products to enhance gut microbiome and, protein digestibility, etc. to meet consumer-driven nutritional and health requirements demands.	Teagasc Food Processors Educational Institutions
	Increase supports to identify and produce/develop products to displace imports of food into Ireland, thereby food imports, achieving greater food sustainability and increasing national food security.	Bord Bia Teagasc Enterprise Ireland Industry

IMPLEMENTATION OF IDENTIFIED ACTIONS

Area/Sector	Action	Suggested Responsibility
Drink Products	Develop a Beverage Innovation Hub to support new market innovation, to guide producer/supply chain and support the underpinning of sustainable, traceable production, based on locally grown feedstock.	Teagasc DAFM Drinks industry
	Increase research collaboration with breeders to deliver high yielding varieties with desirable quality, and disease/pest resistant traits.	Breeders and Seed Trade Teagasc Drinks Industry
	Develop and deploy a more precise crop production and quality prediction methods to deliver grain within specification for different markets Teagasc.	Drinks industry Teagasc Educational institutions
Feed Industry	Develop crop varieties with traits optimised to produce high yields with enhanced stress tolerance.	Plant Breeders and Seed trade Teagasc DAFM
	Add value to native grown ingredients for product authenticity, through carbon or sustainability schemes.	Bord Bia Irish Grain and Feed Association Farmer Organisations Teagasc
	Develop managed grain marketing strategies by increasing EU supported Producer Organisations and collective marketing using pooling system to sell grains through the year (utilising averaged pricing mechanisms).	Farmer Organisations DAFM
	Develop an Irish feed brand for indigenous grown crops which sets out specifications for the brand and how it will support Origin Green credentials.	Bord Bia Irish Grain and Feed Association Supply Industry Animal Feed Industry Farmer Organisations Teagasc
	Develop ambitious targets for the inclusion of native cereals and proteins into existing meat and milk Quality Assurance schemes.	Bord Bia Irish Grain and Feed Association Supply Industry Animal Feed Industry Farmer Organisations Teagasc
	Investigate the potential for development of alternative feed crops such as ensiled protein crops.	Teagasc 3rd Level Institutions DAFM

Area/Sector	Action	Suggested Responsibility
Bio-energy and Industrial Crops	Establish a single entity to co-ordinate bio-energy/ industry policy.	DAFM Department of Finance Department of Public expenditure and Reform Department of Environment Department of Health SEAI
	Support pilot projects that demonstrate a viable model for bioenergy crop use e.g. heating large municipal buildings, heat source to dry products e.g. milk, grain, etc.	Enterprise Ireland SEAI EPA
	Stronger government support (incentives and start up advice) is needed for on farm energy based production from renewable sources.	SEAI DAFM
	Implement a viable feed-in tariff for bio-based fuels.	SEAI DAFM
Nutrient Recycling	Develop logistics and slurry/water separation practices that are suitable for Ireland to enhance manure movement from intensive livestock areas onto tillage soils.	DAFM Teagasc Farming Organisations EPA
	Research is needed into the long term benefits of organic manure use on soil health, carbon capture, soil water holding capacity, biodiversity, environment, etc.	Teagasc DAFM Education Institutions EPA
	Analysis of potential organic sources for tillage systems in terms of actual nutrient availability, quantities which can be applied, carbon capture and soil health effects.	Teagasc DAFM Education Institutions EPA
	Develop incentives to encourage the use of all organic manures from mushroom pig and poultry production, and a proportion of other livestock manures on tillage farms.	DAFM Industry EPA

APPENDIX 1

Barley

The average area of barley (winter and spring) is 180,000 hectares producing around 1.3 million tonnes each year. There has been a substantial shift from spring barley to winter barley, (higher yielding and higher profitability), in the past number of years. Ireland is not self-sufficient in barley with 372,000 tonnes imported in 2018, mostly for the ruminant feed market.

The barley crop supplies grain to the following:

- 76% to feed (estimated 20% home fed/milled, 80% sold for compounding).
- 23% to drinks industry (includes brewing distilling, roasted).
- The remaining small quantities to seed and other small markets.

SWOT Analysis

Strength

- Suitable for ruminant and mono-gastric feeds.
- Demand is likely to increase.
- Highly competent growers producing very high yielding crops.
- It can supply a number of premium markets such as malting, roasting, distilling and seed for both home and export.

Opportunities

- Increasing demand for malting, roasting and distilling.
- Use of animal manures and composts can decrease production cost.
- A higher winter barley area will provide increased opportunity to plant winter oilseed rape.
- New varieties are showing higher yield potential.
- Native barley has a fully traceable supply chain with a green image.
- Husbandry to increase protein levels in feed barley will help to replace protein imports.

Weakness

- High production costs.
- Crops are susceptible to abiotic stress.
- Vulnerable to losses caused by diseases, lodging and birds.
- Bulk of the crop must be dried with additional costs.
- Premium markets are volatile.
- Feed export opportunities are sporadic but the Northern Ireland market may prove more consistent.
- Lack of rotation can limit yields.

Threats

- Vulnerable to increasing input costs.
- Imports of cheaper grains and grain substitutes undermine price and profitability.
- Lack of efficiency in farm units due to land fragmentation, land availability and cost.
- Resistance developing to fungicides, herbicides and insecticides and the loss of Chlorothalonil and triazole actives all increase costs or decrease yield.
- Vulnerable to weather extremes.

Actions to achieve growth

» **A combination of plant breeders, Teagasc and DAFM to ensure continued development of disease resistant varieties and validation through the recommended lists.**

» **Intensive research and knowledge transfer to ensure growers can achieve the necessary protein and grain quality standards for malting and feed markets.**

» **Access to a broad spectrum of pesticide tools must be maintained to help combat increasing pathogen resistance problems.**

Wheat

The total average area under production of winter and spring wheat is approximately 65,000 hectares producing 0.65 million tonnes each year. Ireland is not self-sufficient in the production of wheat with 427,000 tonnes imported in 2018 mainly for the feed industry. A further 210,000 tonnes of milling wheat is imported as flour each year. Ireland can produce the highest average wheat yields in the world of high starch but low protein grain. These qualities make Irish wheat extremely suitable to supplying high yield alcohol to the distilling industry. In contrast, due to these high yields and variable weather at harvest Irish farmers have found it difficult to attain bread making quality wheats. Currently there are negligible amounts of Irish milling wheat produced with production now limited to supply of artisan bakeries.

SWOT Analysis

Strength

- Irish wheat ideally suited for ruminant and mono-gastric feeds and distilling.
- Winter wheat has high yield potential and produces the highest cereal output per ha in the world.
- Growers are technology receptive and quick to adopt ag-technologies.
- Wheat by-products used for mushroom compost, feed (preferred straw in mixed rations), bedding and energy production.
- It has full traceability with enhanced environmental credentials.

Opportunities

- Improving rotational positions for wheat can increase yield and simultaneously reduce carbon footprint.
- Exploiting the yield benefits of organic manures will help alleviate nutrient management difficulties on livestock farms.
- Crimping and whole cropping decrease processing costs for on-farm use.
- Cereal breeders are focused on wheat to produce varieties with higher disease resistance ratings.
- Potential market for energy generation.
- Can be used to meet over-winter green cover obligations as required under EU Green Deal.

Weakness

- High production costs (land, fertiliser, fuel, PPP, machinery, land fragmentation etc.).
- High risk from diseases like septoria and ear blight.
- Loss of fungicide options through resistance and regulation.
- Yield stagnation threat predominantly from reduced breeding gain, limited rotation options and soil organic matter decline.
- Planted area of winter wheat is heavily influenced by autumn weather which is increasingly unpredictable.
- Heavily reliant on the feed grain market (commodity price driven) with little premium outlets.

Threats

- Vulnerable to increasing input costs.
- Increasing levels of imports of maize and other grains undermine price and profitability.
- Lack of efficiency in machinery and fixed costs due to land fragmentation and land availability.
- Resistance development in all pesticide groups.
- Loss of pesticide active ingredients, in particular triazole fungicides, due to changes in pesticide regulation.
- Decreasing soil productivity arising from compaction, loss of organic matter and lack of rotation.
- Improved grassland management may decrease 'compound feed' requirement.

Actions to achieve growth

» **Need to actively promote native feed ingredients to protect the authenticity of Irish food exports.**

» **Increased research support into designing IPM strategies that support the use of high performing varieties, organic manures and enhanced disease diagnostics.**

» **Develop national micro-brewery/distilling infrastructure to research the use of domestic wheat stocks for distilling/brewery.**

» **Quantify the full socio-economic impact of EU pesticide legislation and policy drivers on Ireland's ability to control pests and diseases in the coming years (e.g. loss of glyphosate and specific disease protectants) in the absence of novel breeding technologies.**

APPENDIX 1

Oats

Oats are currently grown on 20-25,000 hectares to supply a market of 160,000 tonnes. While oats are primarily used as an equine and ruminant feed (70%), an increasing quantity is now milled for food use (30%). There is a growing appreciation of the health and nutritional benefits of oat grain consumption. While the benefits of a higher fibre content have been well known, the approval by the US Food and Drug Administration of a claim of reduced coronary disease where oats is eaten daily, has increased interest in oat consumption. Oats is also gluten-free and allowed in coeliac diets provided it is produced without admixture from other cereals. Additionally, there is a growing market for organic oats to supply further premium food markets. Irish oat millers are effectively exploiting all of these markets.

SWOT Analysis

Strength

- Oats is frequently discounted in the animal feed market despite proven equality to other cereals.
- Irish maritime climate suits Irish production, high yield potential.
- Lower input requirements.
- Good break crop that can easily slot into a rotation.
- Well established market outlets for porridge and gluten free oats.
- Recognised health benefits.
- Comprehensive production research programme.

Opportunities

- Potential to grow organic and gluten free markets.
- Potential for new products such as bakeries, oat drinks and yogurts, etc.
- Potential export and domestic demand due to health and nutritional benefits of oat consumption.
- Increased oat area improves cereal rotation with overall higher output/margins from other crops.
- Increase oats acceptance in animal feed markets to provide a better market floor.

Weakness

- Limit to production area as oats can only be grown one year in four to avoid build-up of oats mosaic virus.
- Lack of grass weed herbicides.
- Price is very sensitive to supply as the animal feed market discounts oats.
- Oat breeding activity is low compared to other cereals with negative impacts on yield gain and disease resistance.
- High quality markets are overly reliant on a small number of varieties.

Threats

- Currently on wave of positive health impacts and consumer sentiment could move.
- Supply/demand has a more acute impact on oat prices in any given year.
- Mycotoxin risks and changing EU limits.
- The spread of bromes, wild oats and grass weeds is a threat to current oat production and to expanded oat production.
- Loss of chemistry to control foliar diseases.

Actions to achieve growth

» **Capitalise on the quality of our oats and their nutritional/health advantages by promoting oat consumption and developing new food products.**

» **Research is needed to increase the incorporation of oats into food products.**

» **Enhanced breeding effort is necessary to find new varieties which combine good agronomic characteristics with grain quality.**

» **The value of oats in rotations and their proven value in animal feed rations needs to be promoted further.**

Potatoes

Traditionally Ireland had a high level of ware potato consumption which has stabilised after many years of contraction. Irish consumer's preference for a higher dry matter potato (comprising of few varieties) has been both a benefit but has also stagnated the development of this market. Production costs, grower and advisor expertise, finance for investment and volatile import levels are all challenges to increasing production area and meeting more of the home demand for potato products.

The potato market is made up of several broad supply chains; ware (washed mainly), direct sale, crisping, processing for the retail/restaurant market, salad potatoes, fresh chipping, and seed production. The other outlets are predominantly supplied by imported produce, mainly supplied from the UK but also continental Europe. There is little or no domestic production of frozen chips; all of this produce is imported. Seed potato production is at minimal levels and only sustains part of the domestic market. As the sector moves towards 2030, these areas present an enormous opportunity to displace imported produce.

SWOT Analysis

Strength

- Consumption levels steady and increasing consumer awareness of the nutritional benefits of potatoes.
- Land, climate and water availability suitable for production.
- Low base area allows for 'fresh' land available for potatoes.
- Mild maritime climate is ideal for potato production.
- Brand recognition of one variety, Rooster.
- Well established infrastructure for full year market access.
- Irish breeding program producing varieties specific to Irish conditions.

Opportunities

- Seed production (domestic and exports).
- Fresh chip production (to displace imports).
- Salad potato production (to displace imports).
- Crisp production has significant export potential.

Weakness

- Market dominated by a very small number of large supermarket outlets.
- Very small number of market intermediaries control the market.
- EU common market magnifies the impact of very small competitive advantages/disadvantages.
- Dominance of one variety in ware market.
- Increasing dependence on internal EU trade to - supply produce, especially from the UK.
- Production costs increasing.
- Over reliance of plant protection products to offset crop losses that will arise from late blight infection.

Threats

- Limited research and development into production systems which increase sustainability credentials.
- Number of growers in long term decline.
- Decreasing specialist knowledge to support specialist production.
- Availability of infrastructure to increase production, at micro and macro level.
- Availability of approved pesticides pose a long term risk to production.
- Emergence of fungicide resistant strains of late blight, the primary stressor of potato production.

Actions to achieve growth

» **Develop seed production for domestic and export markets to exploit Ireland's high grade seed potato area.**

» **Improved supports to develop the fresh chip market; capital support for on-farm quality assessments plus marketing supports to promote high value potential of sector.**

» **Increased research in both field and store management to increase marketable yields and sustainability.**

APPENDIX 1

Oilseed Rape

There is approximately 10,000 hectares of oilseed rape (OSR) which is a very effective break crop for crop production in Ireland. In rotations OSR brings additional yield and a reduction in N required in the subsequent crop. It also adds grass weed control options in cereal rotations and is by far the most effective crop to capture and efficiently utilise soil nitrogen in the autumn.

Variety improvements in recent years have seen advancements in yield potential and in yield protecting traits such as pod shatter resistance, disease resistance, and more recently TuYV resistance.

The use of reduced cultivation techniques, which can bring time saving and cost efficiencies during establishment are also becoming more popular.

Most of the OSR crop grown in Ireland is used directly for animal feed or exported for crushing for oil. Oilseed rape has a high energy and protein content and is of particular value for animal feed. A premium cold-pressed bottled cooking oil market has also evolved, based on the strong health profile of the oil and its promotion by high profile chefs. A number of cold pressing businesses supply premium branded product which effectively competes against other premium oils such as olive oil.

SWOT Analysis

Strength

- Ireland can produce high yields of OSR which are financially competitive with any other arable crop grown.
- There is a large market for cooking oils, including premium oils.
- Cold pressed Irish branded rapeseed oil is established in the market as a premium product.
- Ready market for high protein expeller cake.
- Crop has many agronomic benefits in rotations, and is also of benefit to pollinators.
- Potential to increase area which is still at a low base using the same machinery base but not clashing with cereal crops.

Opportunities

- Huge potential to grow more OSR in Ireland as it has a very beneficial role in production rotations.
- Ireland has a low incidence pests which are found elsewhere.
- Huge scope to increase the usage of OSR cake (by-product of OSR crush) which has a high protein content and would support the 'Origin Green' values of provenance, traceability and sustainability.
- Cooking oils market dominated by olive oil which can be substituted / replaced by rapeseed oil.
- Greater potential for seed production crops given the abundance of 'virgin land' to grow same.

Weakness

- Very poor native crush capacity, which means export of produce is only option for any increase in production / crop area.
- Market penetration has stabilised.
- While the main competitor is olive oil, suppliers are competing against one another for shelf space and a co-ordinated approach to domestic or export market.

Threats

- The loss of glyphosate could make harvest more difficult in wetter seasons and make growers less confident about production.
- The risk of CSFB attack and the lack of suitable seed treatments to control.
- Potential to increase area but there is a rotation limit (1 in 5) which limits oilseed rape production.
- Change to available pesticide chemistry can negatively impact on production.

Actions to achieve growth

- **Sustained support is needed to develop an umbrella Irish brand of cold pressed rape from Bord Bia, other state agencies and industry.**
- **Develop an understanding of enhanced health qualities of Irish grown cold pressed rape which can be used as a marketing advantage for growers.**
- **Research needed to investigate how oilseed can be better incorporated into animal diets - ruminant and monogastric.**
- **In order to incentivise growers to produce more WOSR, the crop should be included as an eligible 'green cover crop' under the new GLAS scheme.**

Protein Crops

There is a requirement for circa 900,000 tonnes of protein (or 3.1 million tonnes of faba bean equivalent) for animal feed which has continued to expand over the past number of years. Ireland as Europe generally, is protein deficient with animal feed protein imported as soya or maize distiller's grains or other feed sources. While grain protein crops (primarily beans) have increased from 4,000 hectares to 12,000 hectares producing between 50-70,000 tonnes, there is still a huge protein deficit. Many compounders now use beans in compound rations, but it is still not common place yet.

Protein crops are often considered more risky to grow than cereal crops, being more drought prone and 2018 illustrated the impact of drought at key parts of the growing season; however such yield impacts are relatively rare and also effect cereals. However growers are concerned about this risk and lower profitability compared to other crop choices. Therefore financial support (protein payment) has been essential. Their value in rotations is significant, bringing an estimated 10% - 15% extra yield to the following crop (often more), reducing N requirement and offering different weed control opportunities. As a legume they contribute to sustainability in GHG reduction.

SWOT Analysis

Strength

- Ireland and the EU are hugely deficient in protein sources thus ensuring high market potential and high prices.
- We can produce high (but variable) yields of good quality beans and other pulses whilst providing a good break crop in rotations.
- The ability of pulses to fix nitrogen decreases nitrogen requirement in the following crops.
- A native protein source that supports Origin Green image.
- Sustained demand for inclusion in coarse rations.
- Less influenced by fertiliser price increases than other tillage crops.

Opportunities

- Legumes are a more sustainable/traceable option particularly when grown in rotations, reducing N requirements and GHG emissions and consequently fitting in with the newer EU green agenda.
- Europe/Ireland is very deficient in feed protein with a high demand from the feed sector.
- There is potential to treble current production of pulse crops, exploit their break crop benefits and reduce anti-nutritional constraints.
- Beans are a non-GM protein source for specific market needs.
- There is scope to grow legumes for human consumption to support the move to a more plant based diet.

Weakness

- Variety development is slow compared to cereals, maize or soya.
- Limited research is available in areas such as post-harvest processing and their best use in feed rations.
- Perceived as more impacted by seasonal impact than cereals.
- Minority crops lack commitment throughout the industry, including research / technology support, merchants/feed industry etc.
- Feed industry is not well organised to handle small quantities of locally produced pulses.
- No quality market of consequence; feed market only.

Threats

- Fluctuating prices make it difficult for the industry to commit to long term development at every level from breeding to post harvest processing.
- Logistics in feed mills restrict potential inclusion.
- Lack of scale is an impediment to development.
- Lack of plant protection tools for growers to successfully produce these crops.
- Growers need to know that they will be profitable in rotations; this may be challenged without protein payment supports.

Actions to achieve growth

- **Research needed to establish the true value and nutritional constraints associated with these protein crops for ruminant and monogastric animals.**
- **Leverage labelling and quality assurance to utilise native protein sources in animal rations to protect Origin Green status.**
- **A transparent pricing system with forward-selling options is necessary.**
- **Continuing research needed to highlight protein crops value in the rotation and improved agronomic packages to improve profitability.**