Education Programme

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Agriculture and Food Development Authority

Education Programme

Teagasc Education Vision
- meeting future needs

Agriculture and Food Development Authority

Teagasc – the Agriculture and Food Development Authority – is the national body providing integrated research, advisory and training services to the agriculture and food industry and rural communities.

Foreword

Teagasc has a unique mandate to create and impart knowledge to the Irish agri-food sector. Education and training lies at the heart of Teagasc's mission to support science-based innovation and to underpin profitability, competitiveness and sustainability.

The Teagasc Education Vision exercise has canvassed educationalists and stakeholders both nationally and internationally to make recommendations regarding future agricultural education needs of the land sector. The Vision recommendations have been guided and informed by national, EU and international reports and policies, notably the national vision for the agri-food sector, *Food Wise 2025,* the EU communication *The Future of Farming and Food* and the Teagasc Foresight exercise, *Teagasc Technology Foresight 2035.*

The Teagasc Vision exercise noted that Teagasc's existing education programme was fundamentally sound and that it had notable strengths. Research has shown a high rate of return to Teagasc education at individual farm level with a substantial multiplier effect accruing throughout the supply chain. A key strength of Teagasc's education programme is its blend of classroom and practical instruction, combined with experiential learning on commercial host farms and land sector businesses. The Vision exercise concluded, however, that the educational needs of future generations of land sector entrants will be more challenging in terms of knowledge, skills and capability requirements.

Environment and climate change challenges mean that the ability to farm sustainably will be a key competence in the 21st century. The public good role of the land sector in maintaining and enhancing the environment will be important. A key capability will be to integrate rapid advances in farm husbandry and technologies in a manner that enhances rather than compromises environmental management and sustainability. Sustainability concepts will extend far beyond the land sector. The principle of a circular low carbon bioeconomy founded on renewable and recyclable resources will become central both nationally and globally in the coming decades.

There is a broad consensus that the land sector will be one of the key pillars of a successful bioeconomy. In addition to being food producers, farmers will have a greater role as producers of biomass for the energy, bioprocessing and pharmaceutical sectors. The bioeconomy will stimulate innovation in our agriculture, forestry, aquaculture, bio-processing, biotechnology and pharmaceutical industries. The shift towards a bioeconomy, coupled with the projected increase in the world population to about nine billion by 2050, will provide increased opportunities for the land sector and help underpin demand for its produce and services.

The impact of both consumer and policy trends on the food chain can also be expected to intensify. The policy emphasis on food security, safety and traceability, animal and plant health protection, anti-microbial resistance, biosecurity, health and safety, animal welfare, carbon footprints and food miles will work its way through the food chain creating new demands at farm level. Consumer attitudes and behaviour relating to lifestyle, nutrition and wellbeing and perceptions of ethical farming issues will determine food consumption and market specifications. It will be imperative that future generations of farmers can apply management and husbandry practices that will meet continually evolving food demands.

At farm level, the pressure to be efficient, competitive and business oriented will intensify. Future farmers will need to be proficient in business planning, financial management, governance and compliance. People management skills will be more important on larger farms. The next generation will need to break with traditional views and conventional wisdom to fully maximise and leverage the potential of their farm resources. An entrepreneurial mindset will be essential to fostering fresh thinking and new approaches.

The digital revolution will transform society as we know it in the coming decades and it will have its impact also on the agrifood sector. It will demand new skills and capabilities across existing occupations, replacing some occupations and creating new ones. The land sector will not be exempt. Smart farming, precision farming, sensor technology, automation and robotics will increasingly encroach on mainstream farming activities. Future farmers will need to be digitally literate to exploit this technology to the maximum.

The next three decades will mark a breakpoint from farming as we currently know it, toward an integrated 'smart', environmentally sustainable, market focussed sector. The Teagasc Education Vision exercise concluded that future Teagasc education pathways and curricula content will have to evolve to meet the substantial transformation facing the land sector. Teagasc graduates, by and large, become farm owners or operators at some point. Teagasc's challenge is to equip future farmers with the capabilities that will allow them to maximise their land resources whilst meeting and complying with broader food chain and societal needs. This challenge will exist regardless of whether future graduates take up full-time or part-time farming. Similar capability challenges will arise across the horticultural, equine and farm forestry sectors.

A number of overarching themes arise from the Vision exercise with regard to the education of future land sector entrants. First, it will be necessary to extend current education pathways to enable future entrants to attain the qualifications which their occupation as farm business owners will demand. Secondly, innovative teaching and learning approaches will be necessary to foster all round personal capabilities. An understanding of the fundamental principles and science of farming must remain embedded in Teagasc education. But 21st century education is shifting from a focus on content delivery to building 'learning to learn' capability. A holistic education philosophy is needed to foster transversal skills such as problem solving, goal setting, critical and reflective thinking, teamwork, communication and an entrepreneurial spirit. Active learner engagement is crucial to learner personal development. Teagasc learners are generally well grounded in the real life context of farming. Problem based learning (PBL) approaches offer the potential to harness learners' existing knowledge and insights to provide a fulfilling and engaged learning experience that builds all-round personal development rather than knowledge absorption alone.

The final overarching theme from the Vision exercise is of the imperative for lifelong learning through Continuous Professional Development (CPD) routes. It was recognised that entrant education programmes cannot equip learners with all of the knowledge, skills and capabilities they might need for their future occupation. In an era of change and transformation, the breadth and depth of knowledge and capability requirements will continually evolve. The need for continuous learning will be more evident. Equally the Vision exercise recognised that effective learning is best connected to real life experience. In a farm management context, advanced skills and capabilities such as business and financial management may be more readily understood and applied when a sufficient bank of farming experience has been acquired. The Vision exercise recommended that Teagasc establish more clearly defined and accessible CPD routes for the land sector.

Other important issues must not be overlooked including: the relatively low level of female participation in land sector occupations in Ireland, the age distribution in farming, the likely substantial decline in farm numbers over the long term and land sector labour supply deficits. A 'hard' Brexit scenario poses profound trade and competitive challenges that could significantly impact on farm viability. These issues will require across-the-board stakeholder action.

The opportunities and threats point to agricultural education being a core investment for a dynamic land sector.

Professor Gerry Boyle
Director, Teagasc

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Executive Summary

Teagasc is the leading provider of accredited further (vocational) education for the land sector.

Teagasc has a statutory remit to provide and procure education and training and is the predominant agricultural educator of landowners in Ireland. Teagasc is the leading provider of accredited further (vocational) education for the land sector. Teagasc also has a major input into higher education and postgraduate education delivery through its extensive partnership with the higher education sector. In 2017, more than 7,000 learners participated in Teagasc school leaver and adult vocational education and training programmes. This total included Teagasc-linked higher education programmes. Teagasc also provides short duration courses and professional development events for the wider agri-food sector.

A Teagasc research study, *The Economic Returns to Formal Agricultural Education (*Teagasc, 2014), highlighted the very positive returns to Teagasc education for the individual farmer and to the national economy as summarised below:

- 9% private rate of return to the individual farmer (consistently higher farm income per hectare).
- 14% social rate of return arising from improved farm productivity across all types of farm.
- 25% social rate of return from the supply chain multiplier impact of higher on-farm productivity.

Global, EU and Irish reports foresee transformative change for agriculture and food in the coming decades. An OECD (2016) scenario analysis, *Alternative Futures for Global Food and Agriculture* envisages global food prices and farm incomes rising in the period to 2050, and the global population potentially increasing to over nine billion. The OECD analysis highlights that the environment will be 'under increasing strain' in many global regions. Food safety and bio-security issues will continue to remain a global threat.

The recent EU communication, *The Future of Food and Farming,* (European Commission, 2017); foresees generational renewal and the future up-skilling of the land sector as priorities for future EU policy frameworks. The EU Standing Committee on Agricultural Research (EU-SCAR, 2017) policy brief, *New approaches on Agricultural Education Systems,* proposes a new paradigm for agricultural education that involves 'future-proofing' agriculture at three levels.

These levels are: developing the talents and skills of individuals; focusing on entrepreneurship and innovation to meet the labour market requirements; and addressing connectivity, sustainability and green goals to meet social requirements. The EU report on *Precision agriculture and the future of farming in Europe* (European Parliamentary Service, 2016) envisages digital technologies transforming farming of the future, aiding more sustainable farming approaches and enhancing food safety. It suggests that precision agriculture may fundamentally alter future farm business models and work practices. The *Precision Agriculture* report emphasises the need for new technical, environmental and managerial skills.

Nationally, the *Food Wise 2025 Vision* (DAFM, 2015) identifies human capital as an essential pillar for the future development of the Irish agri-food sector. This ten year vision highlights the need for the agri-food sector to attract 'ambitious, educated and motivated people'. Food Wise 2025 and other reports emphasise the critical importance of education in developing 21st century workforce skillsets.

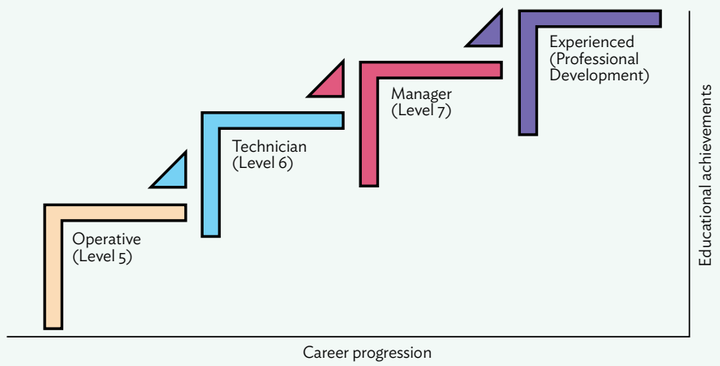
The *Teagasc Technology Foresight 2035 Report* (Teagasc, 2016) concludes that the land sector and the wider agri-food sector 'is on the verge of a revolution in the application of powerful new technologies'. Rapid advances in digital and biotechnologies have the potential to transform the sector in the years ahead. Future farmers will operate in an age where smart farming technologies have the potential to transform farming. The imperative for sustainable, secure but productive farming systems will drive the advancement of a circular bioeconomy that maximises the value, renewal and regeneration of products and finite resources. This transformation will necessitate harnessing existing and new technologies and knowledge. The *Teagasc Technology Foresight 2035* Report envisages the need for an 'innovation-ready' population of farmers; and that agricultural education will play a key role in enabling farmers to become multi-skilled and adaptive to new technologies and new practices.

The overall consensus is that 21st century farming will require more advanced skillsets to enable farmers to meet fundamental changes occurring at many levels. Key areas include entrepreneurship, transversal (personal), sustainable farming and digital technology skillsets. An entrepreneurial mindset is needed to stimulate farmers and land-based businesses to fully exploit the opportunities that their resources offer. Skills such as problem solving, critical thinking and communication are seen as crucial future skills in most industries. The land sector will be no exception.

Agricultural education and continuous professional development have a crucial role in enabling future farmers to keep pace with technological and policy change. The challenge for Teagasc education is to provide the education pathways, curriculum content, pedagogical approaches and continuous up-skilling opportunities that the land sector will require.

Both part-time and full-time family farms will continue to be dominant features of Irish farming. On larger farms occupational role profiles will become more defined. This differentiation will likely be most evident on farms that employ people. In turn the education and qualification requirements for the various farm occupational roles are also likely to further differentiate over time.

Figure 1: Education and career stepping stones guide



Box 1: Farm occupational roles and recommended education qualifications

The future is likely to see more clearly defined farm and land sector occupation roles that can be generically categorised as follows:

- ***operative:*** carry out defined duties adequately and competently
- ***technician:*** lead and supervise key enterprise (e.g. dairy herd) activities
- ***manager:*** determine and lead more complex management and business activities

The following qualifications are recommended for the future:

- ***farm operative:*** a QQI Level 5 Certificate in Agriculture (or equivalent), facilitating future education and career progression. At a minimum, operatives should receive industry recognised training that is customised to their role.
- ***farm technician:*** a QQI Level 6 Advanced Certificate in Agriculture (or equivalent), facilitating future education and career progression.
- ***farm manager:*** Level 7 Degree in Farm Management* through an apprenticeship route or equivalent.*

Experienced farmer: Qualified experienced farmers will need to pursue continuous professional development (CPD) in a structured manner that enables them to adapt to continuing challenges and opportunities.

*(*While the proposed qualification level for a future farm owner is a Level 7 Degree in Farm Management or equivalent, it is recognised that the Level 6 Advanced Certificate in Agriculture may be a more appropriate minimum qualification for small scale and/or part-time farm owners).*

The *Teagasc People in Dairy Project* report (Teagasc, 2017) highlights imminent workforce and skills deficits in the dairy sector. The proportion of Irish farmers under 35 years of age fell from about 13% in 1990 to less than 6% in recent years. The proportion is closer to 5% for dairy farms, even though dairying is the sector mostly likely to sustain farming as a full-time occupation. Up to 6,000 additional full time person equivalents will be required to sustain dairy herd expansion over the coming decade. Generation renewal will account for about two thirds of this requirement.

Central Statistics Office (CSO) data indicate that about two thirds of the existing Irish farm holders do not have 'full agricultural training', though this is improving with each successive generation. For the future, the land sector requires a higher rate of agricultural education uptake to ensure a capable and adaptive workforce.

Box 2: Challenges from an improving economy

The national economy is moving towards full employment. The land sector will need to provide attractive conditions and career progression opportunities to compete in a tighter labour market. Perceptions of career opportunities in the land sector will be an important determinant of future education choices.

Strength in the other areas of the economy has led to considerable volatility in full-time agricultural college enrolments in the past. Sustaining full-time agricultural college enrolments will prove more challenging in the years ahead. When the overall economy is buoyant school leavers are more likely to defer their agricultural education. Accordingly demand for Teagasc adult vocational programmes is likely to remain robust for the foreseeable future. Demand for Teagasc-linked higher education programmes is also likely to remain relatively stable in the medium term.

Teagasc Education Vision core recommendations

The Teagasc Education Vision project was conducted between March 2016 and March 2017 and was chaired by Professor Seamus Smyth. It involved extensive consultation with stakeholders, a review of relevant national and international reports and an appraisal of peer agricultural education systems in a number of EU countries. The details of the Vision project are outlined in Appendix 1. The following high level recommendations emerged from this process:

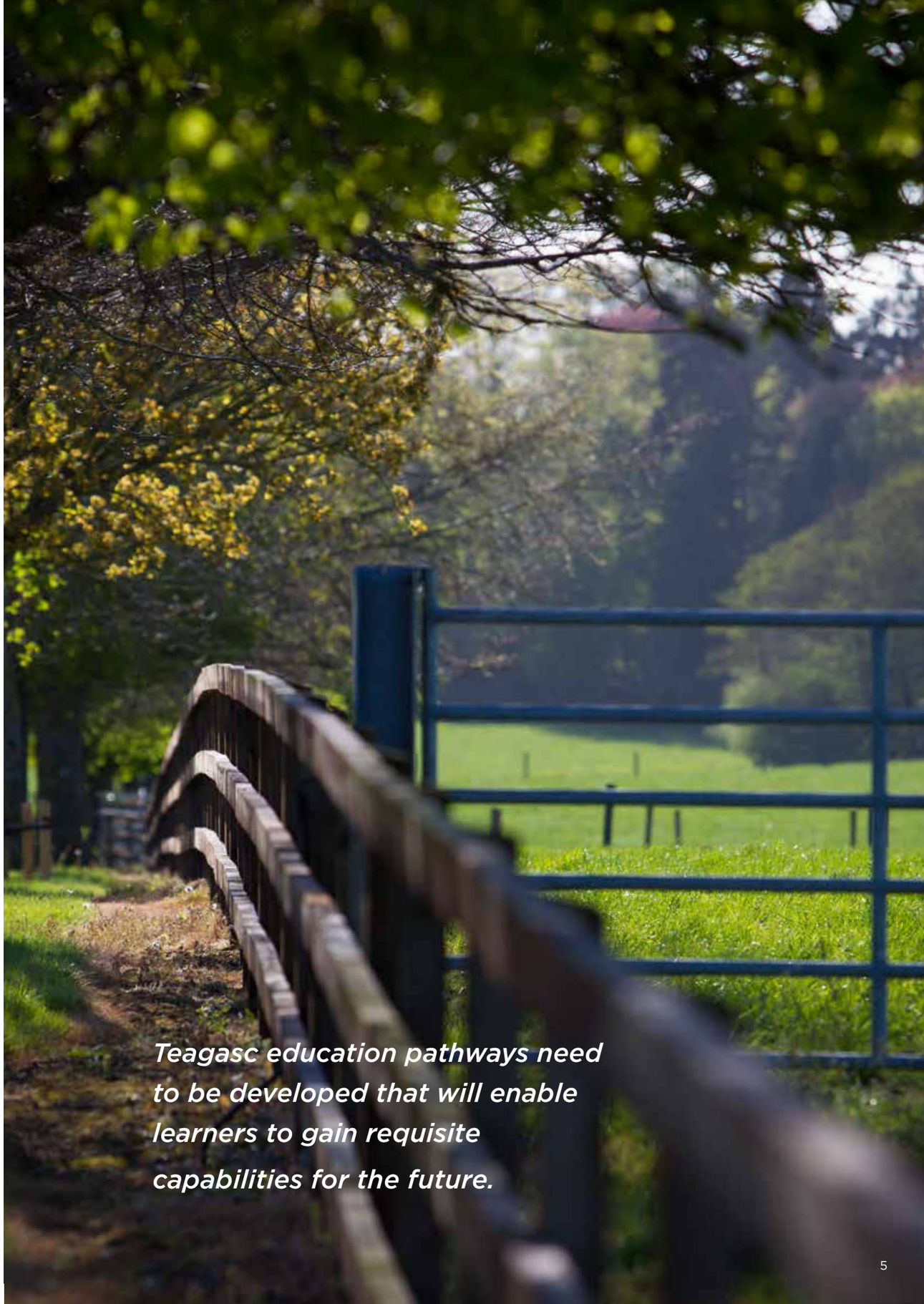
- Viable land sector career opportunities need to be strongly promoted to attract new entrants.
- Gender pro-activeness is required in promoting agricultural education programmes and careers.
- Entrepreneurial and transversal skills need to be cultivated in Teagasc education programmes.
- Capability requirements at farm level regarding sustainable farming and environmental management; governance, health and safety; market requirements; and 'smart' farming applications will increase in addition to core technical and business capabilities.
- Teagasc education pathways need to be developed that will enable learners to gain requisite capabilities for the future. Apprenticeships should be developed where there is an identified need and adequate industry support for such proposals.
- Joint initiatives by industry stakeholders and Teagasc are required to address specific skills training and workforce deficits that are emerging. An immediate priority is the need to increase the supply of trained dairy employees. Similar efforts may be required in other sectors. The following Teagasc education pathways are recommended as per Box 3:

Box 3: Proposed Teagasc education pathways for the farming sector[1]

Farm Manager	**Farm Technician**	**Farm Operative**
Degree in Farm Management (Level 7 apprenticeship)	QQI Advanced Certificate in Agriculture (Level 6)	QQI Certificate in Agriculture (Level 5) (or at a minimum, sector customised training programmes).

[1]Equivalent roles and qualification requirements may apply across the broader land sector.

- Workplace learning outcomes need to be strengthened to ensure that learners obtain appropriate learning and mentoring experiences from workplace learning hosts.
- Recognised professional development routes should be provided by Teagasc for experienced farmers, who wish to further deepen their farm business, people management and technical capabilities.
- An alumni support programme should be developed for Teagasc graduates who take up farming.
- Innovative teaching and learning approaches such as problem based learning (PBL) should be adopted by Teagasc to develop learners' critical thinking and personal skills and to enhance the ability of graduates to adapt to change.
- Online learning platforms and digital technologies need to be further developed by Teagasc to support teaching and learning and flexible delivery.
- Supports and resources for learners with diverse learning needs and disabilities must continue to to be developed.
- Training and continuing professional development in teaching and learning must be prioritised for Teagasc education staff.



Since 1990 there has been a dramatic increase in the share of Irish farm managers with some agricultural training.

Teagasc Education Vision

1 Land Sector Trends

1.0 Land sector trends

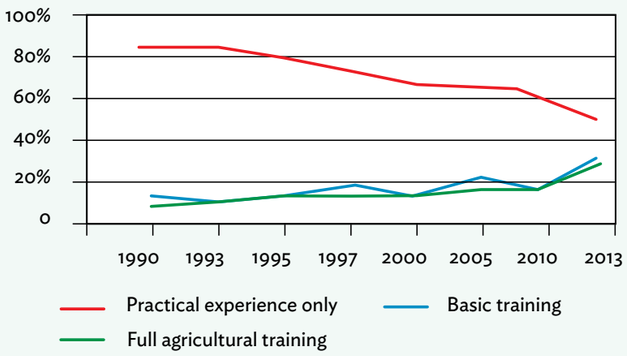
Key drivers including demographics, structures, economic factors and policy direction need to be considered in assessing future Teagasc enrolment trends. Key aspects are summarised below.

1.1 Agricultural education uptake

Since 1990 there has been a dramatic increase in the percentage of Irish farm managers with some agricultural training. The share of farmers relying on 'practical experience only' declined from about 90% in 1990 to approximately 50% by 2013 *(Figure 2)*.

Correspondingly, the share of farmers in Ireland with 'full agricultural training' and 'basic training' increased substantially. In 2013 the proportions of farmers with full agricultural training and basic levels of agricultural training were approximately equal. Shifts in agricultural education penetration across the farming population in the period 2005 to 2013 are detailed in Figure 2.

Figure 2: Trends in the agricultural training of Irish farm managers 1990–2013



Source: Eurostat dataset ef_mptrainman] *Datapoints are not intended to be chronologically equidistant*

Table 1: Trends regarding the level of training of farm managers (2005-2013)

Year	Full agricultural training (%)[1]	Basic training (%)[1]	Practical experience only (%)[1]
2005	14	17	69
2010	16	15	69
2013	24	26	50

[1] percentages rounded for presentation purposes.

Box 4: EU Categorisation of farm manager agricultural training

The EU categorises farm manager (owner) training under three headings for comparative purposes as follows:

Practical experience only: experience acquired through practical work on an agricultural holding.

Basic agricultural training: any training courses completed at a general agricultural college and/or an institution specialising in certain subjects.

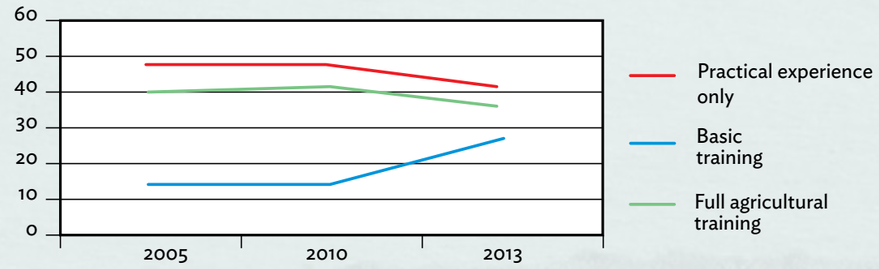
Full agricultural training: any training course continuing for the equivalent of at least two years training after the end of compulsory education and completed at an agricultural college, university or other institute of higher education in agriculture or equivalent.

In 2013 the share of young farmers (>35 years of age) with either 'basic' or 'full' agricultural training approached 60% *(Figure 3).* The overall agricultural education penetration among the under 35 cohort improved in the period 2005 to 2013. Surprisingly, the proportion of young farmers with 'full agricultural training' contracted somewhat *(Figure 3).* This contraction in 'full agricultural training' among young farmers appears to contradict the long term trend of substantial improvement in education penetration. The slowdown potentially reflects the collapse in agricultural education enrolments in the late 1990's and early 2000's.

Many future land-holders deferred their agricultural education at the height of the 'Celtic Tiger' era. The overall rebound in agricultural education enrolments over the last decade, combined with the exceptional level of adult farmer enrolments which has occurred in very recent years, should lead to a significant upswing in education penetration among young farmers in the years ahead.

Teagasc has a statutory remit to provide and procure education and training and is the predominant agricultural educator of landowners in Ireland.

Figure 3: Trends in the agricultural training of Irish farm managers <35 years of age (2005-2013)



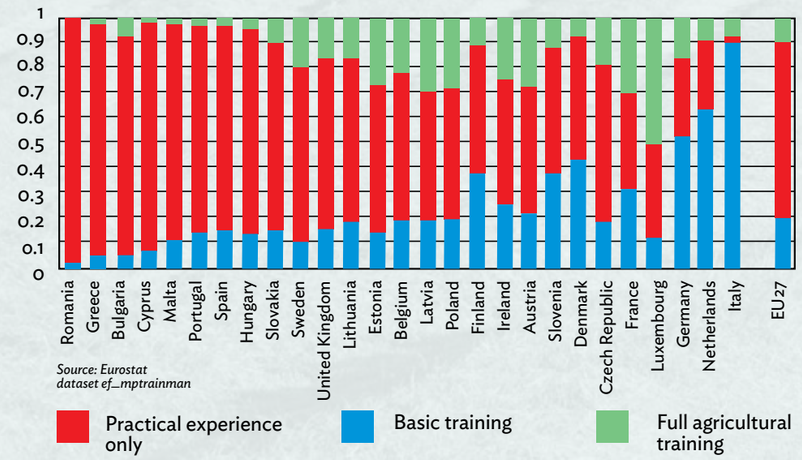
Source: Eurostat data set [ef_mptrainman]

Datapoints are not intended to be chronologically equidistant

The Teagasc study, *The Economic Returns to Formal Agricultural Education* (Teagasc, 2014) indicated a correlation between farm size and formal agricultural education participation. The average farm size of farmers with no formal agricultural education was about 30 hectares, increasing to about 50 hectares where farmers had a formal agricultural education. The Teagasc study also indicated that farmer agricultural education qualifications were predominantly acquired through Teagasc vocational programmes and Teagasc-linked higher education programmes.

European data *(Figure 4)* indicate that (in 2013) about 70% of EU farmers had practical experience only (i.e. no formal training), 21% had basic agricultural training and less than 9% had 'full agricultural training'. The highest proportion for 'full agricultural training' was in Luxembourg, where half of all farm managers had such training. It was followed by the Czech Republic, France, Latvia, Poland, Austria and Estonia, all of which had proportions higher than 25%. Ireland ranked 8th among EU member states, for farm managers with 'full agricultural training'.

Figure 4: EU agricultural training levels of farm managers in 2013



Theoretically, in the region of 3,500 entrants per year would be required to maintain the current Irish farm holder population of circa 139,000. This assumes a 40 year generational cycle and all other factors being equal. CSO data indicate that the agricultural education penetration rate for 'full' agricultural training for young land holders (<35 years) is about 40%.

This suggests in theory that about 1,400 of young entrant land holders pursue 'full' agricultural training annually. Equally it suggests that a significant cohort of young entrant land holders do not pursue 'full' agricultural training. There may be a range of justifiable reasons for entrant land holders not pursuing 'full' training including very small holdings, farm viability issues, personal or family circumstances.

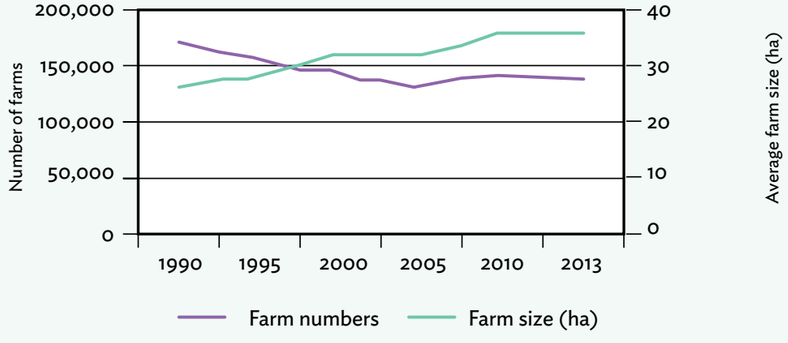
1.2 Farm numbers

Over time structural change in Irish agriculture will affect the long term demand for agricultural education. Contraction in farm numbers will see fewer young people becoming farm owners, all other factors being equal. A decline in farm numbers is likely to be associated with a concomitant increase in the area farmed. In Figure 5, the recent trends in Irish farm numbers and the average size of farms are presented.

The decline in farm numbers evident between 1990 and 2005 effectively stopped as a result of the macroeconomic crisis in Ireland that began in 2007. Farm numbers remained relatively unchanged between 2010 and 2013 with average farm size remaining constant. With the Irish economy now experiencing strong growth and unemployment rates declining as the economy approaches full employment, the push and pull factors that could facilitate further structural change in Irish agriculture are again evident. It is likely that over time renewed contraction in the number of farms will occur, resulting in average farm size increasing.

Recent data, *Census 2016,* (CSO, 2017) [where respondents were asked to identify their principal occupation] point to a modest decline in the number of people of over 15 whose occupation was within the agriculture, forestry or fishing sector. This decline amounted to 2.6% between 2011 and 2016 (equivalent to an annualised rate of change of -0.53% per annum). Farm numbers have been declining more quickly in the EU than Ireland. The total number of farms in the EU-28 (excluding Croatia) fell by 26%, equivalent to an average decline of 3.7% per annum between 2005 and 2013. Farm numbers in Ireland remained very stable in this period (Eurostat, 2016).

Figure 5: Changing Farm Structures 1990–2013: *Number of Farms and Average Farm Size (UAA)*[1]



Source: CSO (2000, 2010 and 2013). [1]*Utilisable Agricultural Area* *Datapoints are not intended to be chronologically equidistant*

For the purposes of the Teagasc Education Vision project, three scenarios were projected from 2013 to 2050 on the basis of previous rates of decline in farm numbers:

- Stable numbers: farm numbers would decline at a similar rate as for the years 2000 to 2010.
- Significant decline: farm numbers decline at a similar rate as for the years 1991 to 2010.
- Substantial decline: farm numbers decline at a similar rate as for the years 1991 to 2000.

Table 2: Projections on Farm Numbers in 2050 based on Previous Decline Patterns

Decline Scenarios	Projected Farm Numbers to 2050[1]	% Decline	Extrapolated Farm Size (ha)[1]
Baseline Position 2013 (CSO)	139,600	-	32
1. Stable: decline as per 2000 to 2010 period (0.13% p.a.)	133,000	4.7%	34
2. Significant: decline as per 1991 to 2010 period	92,000	34.1% (0.9% p.a.)	49
3. Substantial: decline as per 1991 to 2000 period	61,000	56.3% (1.55% p.a.)	74

[1]*Scenario projections conducted for the Teagasc Education Vision (Dr K Hanrahan, Teagasc Agricultural Economics and Farm Surveys Department, February 2017)*

A significant to substantial decline in farm numbers is the more likely scenario over the long term. By 2050 farm numbers could fall by one third to one half over current numbers. Average farm size could potentially double. This assumes that total agricultural area does not significantly change through land abandonment or loss to urbanisation.

Box 5: Declining farm numbers v Increasing agricultural education penetration scenario

Should the 'substantial' contraction in farm numbers scenario occur by 2050, a farm population of circa 60,000 would require 1,500 entrants per year for generational renewal purposes (assuming a 40 year generational cycle). The on-going trend towards increasing agricultural education uptake by entrants must also be considered. Increasing farm size leading to more complex farm businesses should favour a higher rate of education uptake among future young farmers.

If by 2050, the agricultural education uptake by young farmers increased to 90%, there would be no substantial difference in the numbers pursuing full agricultural training relative to the current position. Larger farms are also likely to create requirements for additional fully trained employed farm technicians and farm managers. The agricultural education qualification levels for future farmers will also likely shift upwards. Many variables may qualify the above assumptions not least the level of qualification future young farmers will pursue.

1.3 Farming workforce

Data from the *CSO Agricultural Labour Input* (2000 & 2010) and CSO *Farm Structure Survey* (2013) and Eurostat data indicated the following:

Table 3: Trends in Farm Demographic Characteristics

Age profile	The % of farm holders under 35 years of age fell from 13% in 1991 to 5.9% in 2013. The EU average was 6% in 2013. The proportion of farm holders under 35 years of age was lowest on dairy farms at 5.1%. In the region of 50% of land owners are aged 55 years or over.
Female participation	Eurostat (2017) data indicate that women on average account for about 28% of farm managers/holders in the EU. Ireland (12%) ranked sixth lowest of EU-27 countries for the percentage of female farm managers/holders (Croatian data not available).
Farming as sole occupation	The percentage of farm holders indicating that farming is their sole occupation has remained relatively stable at 50%. Specialised dairy farms had the highest share (80%) of farm holders describing farming as their sole occupation. The percentage for specialised beef and sheep farms was 47% and 43% respectively.

Source: Eurostat dataset ef_mptrainman]
Source: Derived from CSO Agricultural Labour Input reports (2000 & 2010) & Farm Structure Survey (2013)

From a demographic perspective the ageing profile of the farming population is of particular concern. Without change, the on-going deficit in young farmer numbers will act as a constraint to future output growth and dynamism. The age imbalance in dairy farming warrants attention as it is the sector most likely to sustain farming as a sole occupation and it has capacity for significant expansion. Relative to other EU countries, the proportion of women farm managers/holders in the Irish agricultural workforce is quite low. The EU Future of Food and Farming communication identifies the demographic challenges facing the land sector as a key policy issue for the future.

Emerging dairy workforce deficits

The *Teagasc People in Dairy Project* (Teagasc, 2017) on future dairy workforce requirements suggests that labour availability will likely pose a constraint to sustaining future dairy herd expansion. Key points from the report include:

- Average herd size has increased from 54 cows in 2005 to 76 cows in 2016. Milk supply increased by 35% in the period 2010 to 2016. Though dairy farmer numbers have remained relatively static since 2010, the proportion of herds with greater than 100 cows increased from 13% in 2005 to 47% in 2016. The number of dairy herds with greater than 100 cows exceeded 4,200 versus 1,080 in 2005.

- From 2017 until 2025, it is estimated that the dairy sector will require an additional 6,000 or more full time person equivalents (FTEs). Over 60% (~4,000 FTEs) of this additional requirement will be necessary to facilitate normal generational turnover as existing herd owners retire. An additional 2,300 or so new FTEs will be necessary to meet increased workforce requirements as herds expand.

These new FTEs will include full-time, part-time and casual labour requirements. There will also be a need for employed herd manager and farm manager positions.

The *Teagasc People in Dairy Project* report highlights the need for industry stakeholders to promote dairy farming as an attractive career and to provide education and career pathways for operatives, herd managers and farm managers.

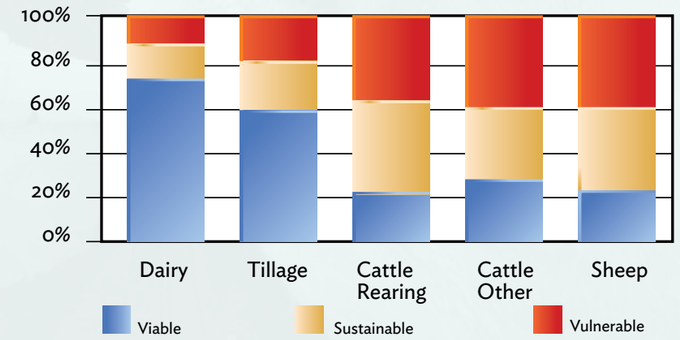
1.4 Farm Viability

A Teagasc study *'The viability of the Irish farming sector in 2015'* (Teagasc, 2015) indicated that just 37% of Irish farms were economically viable in their own right. For this study farms were categorised as viable, sustainable or vulnerable as follows:

Economically viable: the farm being able to remunerate family labour at the minimum agricultural wage and provide a 5% return on the capital invested in non-land assets.
Economically sustainable: the farm not being viable; but the household is sustainable through off-farm income (of the holder or spouse or both).
Economically vulnerable: the farm not being viable and the holder or spouse does not have off-farm income sources.

Viability issues were most acute on cattle and sheep farms. Three in four dairy farms were perceived as economically viable. When the presence of an off-farm income of the farm holder and spouse/partner were factored in, about two thirds of farming households were considered to be viable or sustainable in income terms.

Figure 6: Viability of Irish farming by farm system



Source: 'The viability of the Irish farming sector' (Teagasc, 2015)

Part-time farming is an important feature of the Irish land sector. Many entrants to part-time farming are likely to pursue an agricultural education at some point for a combination of reasons including:

- Improving capability to farm more efficiently.

- Fulfilling the agricultural education requirement for farm schemes and incentives aimed at young farmers.

- Increasing off-farm employability prospects in wider agri-food sector.

1.5 Policy drivers

Over recent decades, national policy has prioritised 'young trained farmers' for various farm schemes and incentives. The minimum qualification for a 'young trained farmer' is a recognised QQI Level 6 agricultural qualification or equivalent. Measures and schemes where a young trained farmer qualification is required for, or prioritises a young trained farmer, include:

- National Reserve Scheme – Young Farmer Category.
- Young Farmer Capital Investment Scheme under the Targeted Agricultural Modernisation Schemes (TAMS)
- Registered Farm Partnerships/ Collaborative Farming Grant Scheme.
- Stamp Duty Exemption on Transfers of Land to Young Trained Farmers.
- Capital Acquisitions Tax Relief.
- Stock Relief on Income Tax for Certain Young Trained Farmers.

1.6 External trends

The overall performance of the national economy is likely to impact on the agricultural workforce supply and enrolments to Teagasc education. CSO data (2018) indicate that the economy is moving closer to full employment with unemployment rates in the region of 6.0% in late 2017. An ESRI economic commentary (2017) forecasts robust expansion of the labour market, with unemployment expected to average 6.2% in 2017 and 5.4% through 2018. Unemployment rates were in the region of 15% in 2012. The wider economy can increasingly provide alternative opportunities to those who would otherwise be considering an agricultural education and career.

Box 6: Brexit implications

Brexit is foreseen as having potentially serious implications for the Irish agri-food industry. A 'hard' Brexit would increase the viability threat to Irish farms and adversely affect future farm numbers and farming career uptake. It can be argued that dedicated investment in education, innovation and technology advances right across the agri-food industry down to farm level will be required to mitigate the unprecedented competitiveness shock posed by a 'hard' Brexit.

1.7 Factors impacting on Teagasc enrolments

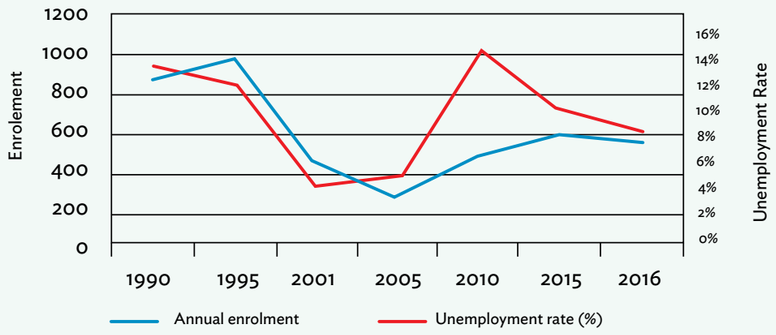
Entry level enrolments for full-time vocational education courses (Level 5 equivalent) at agricultural colleges have shown considerable volatility since 1990. Enrolments increased in the early 1990's but fell in the late 1990's. In the early 2000's there was a very marked dip in enrolments followed by a significant upswing from 2008. This upswing plateaued in the period 2011 to 2015. Since 2015, Level 5 enrolments have declined by about 14%. (Note: there were 11 agricultural colleges in the period 1990 to 1998, compared to six since the early 2000's)

The strength (or weakness) of the wider Irish economy, as reflected in GDP growth rates and rates of unemployment, has an impact on agricultural college full time entry level enrolments. During periods of weak economic growth and high unemployment and fewer non-farm employment opportunities, enrolment in agricultural colleges is likely to expand. School leavers defer entry to the labour market and remain in education.

During periods of strong economic growth, and associated low levels of unemployment; enrolments in full-time agricultural college courses contract. Potential agricultural college entrants avail of employment opportunities in the non-farm economy. Figure 7 highlights the extent to which historic enrolments to agricultural colleges have correlated with developments in the rate of unemployment in the wider Irish economy. Experience to date suggests that a dip in demand for full-time agricultural college courses may represent a deferral by school leavers of their agricultural education. This deferred demand may re-emerge at a later point for Teagasc adult 'Green Cert' education.

The sensitivity of agricultural college full-time enrolments to the wider economy and in particular labour market conditions is also reflected in variations in demand for higher (university) agricultural education. The CAO points required for the Bachelor of Agricultural Science degree at University College Dublin have varied considerably over recent macroeconomic cycles. The CAO points stood at 310 to 320 points in the period 2004-2007, rose to 375 in 2008, and reached 470 points in 2015.

Figure 7: Full-time entry level further vocational enrolments to agricultural colleges 1990–2016 and the national unemployment rate



Source: Teagasc and Eurostat

Datapoints are not intended to be chronologically equidistant

Enrolment trends part-time and distance education - adult farmers

Demand and enrolments for Teagasc adult 'Green Cert' programmes have also shown considerable volatility. For the period 1990-1997, total annual enrolments for the then adult 'Green Cert' programmes at Teagasc county education centres averaged circa 500. Adult enrolments accelerated with the introduction of '180 hour' courses with a surge in enrolments in the 2004 to 2008 period peaking at over 1,500 enrolments annually. The '180 hour' [Special Purpose Certificates in Production (100 hours) and Farm Management (80 hours)] courses qualified non-agricultural award holders as young trained farmers for the purposes of Revenue reliefs and certain farm schemes.

The peak '180 hour' course enrolments in this period were artificially boosted by then pending changes to the educational qualification requirements that led to the '180 hour' courses no longer fulfilling the young trained farmer education requirements for tax reliefs and other schemes from 2008 onwards. After 2008, 'Green Cert' adult enrolments averaged at about 500 enrolments annually

From 2014 an exceptional level of both demand and enrolment for Teagasc adult farmer part-time and distance education programmes materialised arising from the young farmer oriented provisions of the *Common Agricultural Policy* (CAP) review leading to the implementation of the CAP *Rural Development Plan.* Combined enrolments to Teagasc adult farmer part-time and distance education programmes reached 6,000 for the years 2014, 2015 and 2016 and 2017; averaging about three times the annual enrolment level of the preceding years.

Higher Education Enrolments in Agriculture

Enrolments in Teagasc-linked higher education programmes increased over three fold in the period 2001 to 2015, with the greatest acceleration occurring in the period 2011 to 2015. More recently, Central Applications Office (CAO) data indicates volatility in demand for land sector higher education courses. First preference applications fell by approximately 20% in 2015 and by 25% in 2016. There was some recovery in 2017 with an increase of 17% on 2016 first preference levels. For 2018, first preference applications for agricultural Level 8 courses increased by 6%.

First preferences declined by 13% for Level 6/7 higher education courses (CAO, 2018). The data suggest shifts within first preference towards Level 8 courses, but an overall decline in combined first preferences. The recent volatility in first preference applications has not yet impacted on total agricultural higher education enrolments. The trends may however be indicative of some shrinkage in overall demand against a background of an increasing number of higher education providers and the potential over-provision of higher education courses.

1.8 Future Teagasc education enrolments

Factors likely to push future Teagasc full-time agricultural college enrolments include:

- The underlying trend towards a higher rate of agricultural education uptake among farmers.
- The underlying trend towards increasing farm size as a driver of education uptake.
- The wider and deeper skillsets that will be required by future generations of farmers.
- The need for on-going generational renewal of the farming population.
- The potential creation of additional or new roles such as farm technician and farm manager roles in farm sectors (e.g. the dairy sector) and employment opportunities in the wider agri-food sector.
- Existing and future National and EU policies to incentivize young farmer entrants and encourage land mobility.
- Increase in the overall school leaver population in the period 2017 to 2025 (Dept. Education and Skills, 2015).

Factors likely to pull against future Teagasc full time agricultural enrolments are likely to include:

- Economic recovery and falling unemployment providing alternative career opportunities.
- Long term underlying trend towards falling farm numbers.
- Overall farm viability challenges.
- Competition from higher education providers and further education providers.

Box 7: Future enrolment trends

Long term agricultural education trends will be significantly influenced by the degree to which an increasing rate of agricultural education uptake will offset a potential decline in farm numbers. Equally important will be the education choices future young farmers make regarding the type of education qualification level they seek.

Increasing employment opportunities negatively impact on school leaver enrolments at agricultural colleges. Based on historic indicators a decline of 30% in full-time vocational enrolments could occur. This would see agricultural college Level 5 Certificate in Agriculture enrolments declining from the most recent peak of circa 635 to under 450 over the coming years. This enrolment decline may not occur uniformly across colleges and could create difficulties for individual colleges. Individual colleges may need to explore alternative opportunities in agri-food education.

Previous trends suggest that a decline in full-time vocational enrolments due to an improving economy, are in the main a deferral effect rather than a permanent effect. This displacement, combined with continuing support measures for young farmers, will underpin a robust demand for Teagasc adult vocational programmes in the medium term.

Enrolments in Teagasc-linked higher education programmes are expected to remain relatively stable in the medium term. Given the increasing proliferation of agricultural higher education however, courses providers may find themselves competing for enrolment share.

Agriculture, in particular, faces significant challenges in the coming decades, not only in Ireland, but in Europe and elsewhere around the world.

2.0 Future issues for land sector education

2.0 Future issues for land sector education

The overall agri-food sector continues to play an integral part in Ireland's economic activity; accounting for 8.6% of total employment and 24% of manufacturing industry gross output, and contributing 7.8% of gross national income. It is our largest indigenous industry, generating 10.3% of merchandise exports (DAFM, 2018). Irish food, beverage and horticultural exports reached €12.6 billion in 2017 (Bord Bia, 2018) representing growth of almost 60% or €4.7bn since 2010. The target is to reach €19 billion by 2025.

Its long term competitiveness and sustainability are a priority concern for national policy. In 2015, the Department of Agriculture, Food and the Marine launched a new industry-led national strategy- *Food Wise 2025.* This strategy outlines an ambitious vision for 2025 and highlights a range of actions needed to ensure that the industry realises the many opportunities in expanding global markets while also addressing difficult challenges, particularly that of sustainability.

2.1 Land sector challenges and opportunities

The global context for Irish agriculture and bioeconomy is changing rapidly, introducing both challenges and opportunities for an industry that seeks to strengthen its global reach and become a leader in sustainable food production and processing.

Agriculture, in particular, faces significant challenges in the coming decades, not only in Ireland, but in Europe and elsewhere around the world. On one hand, it must produce more food for a growing, increasingly affluent global population that requires a more diverse, protein-rich diet.

But it must also compete for lucrative new markets, while vying for access to increasingly scarce natural resources, preserving biodiversity, water and soil quality, restoring fragile ecosystems and mitigating its impacts on climate change.

Agriculture will also have to adapt to direct consequences of climate change such as higher average temperatures, more extreme weather events and increased incidences of flooding and crop loss, as well as new plant and animal disease threats. The latter challenge is compounded by the increasing scarcity of appropriate control measures against consistently evolving pathogens and pests.

Another major challenge arises from the fact that the Irish agri-food sector is particularly exposed to the impact of Brexit, given the sector's disproportionate reliance on the UK market compared to other sectors of the Irish economy. Short term challenges for the sector mainly arise from the impact of the significant drop in the value of Sterling against the Euro, which has created difficulties for those most exposed to the UK market, especially the horticulture sector. Medium term challenges arise from potential Brexit changes to the EU-UK trading relationship, changes to regulations and standards, border controls and certification, and the related areas of veterinary and health certifications.

While there are challenges ahead, global megatrends at play will also present major new opportunities for Ireland. The underlying trends in population growth, expansion of the middle-class in emerging markets and increasing urbanisation will continue to underpin the expansion in global food demand well into the future. At the same time, the abolition of dairy quotas and the continued widening of market access for our beef industry have dispelled some of the constraints that have restricted our industry's capacity to exploit the opportunities generated by expanding export markets. Major opportunities are being created for Irish agri-food businesses which are capable of expanding and innovating to service the demands of consumers who value quality, taste and origin of their food.

Dairy farming remains Ireland's most profitable farming system. Notwithstanding the extreme price volatility witnessed in recent years, Irish dairy farmers are among the most economically competitive and carbon efficient farmers globally. While dairy farmers are well set to exploit the opportunities arising from quota removal, this is in contrast to the other farm sectors. The beef farm sector continues to be characterised by very large numbers of small producers, some part-time, with comparatively low farm incomes and a very high reliance on direct payments as a source of income.

Innovation and technology adoption rates remain low on many small and part-time farms with little incentive to innovate given the high-reliance on direct payments. Improving the productivity and profitability of these farms will be a persistent challenge for both research and knowledge transfer over the next ten to twenty years. Following a number of years of contraction of sheep flock numbers across Europe and Ireland, the economic situation on sheep farms has recently improved. Like the beef sector, the reliance on direct payments is still very high.

While tillage farms in Ireland are large (in area) relative to beef and sheep farms, they are small by international standards. They have been particularly exposed to price volatility in recent years with a number of very difficult years of low-to-negative margins.

New opportunities for the Irish agri-food sector will not be just confined to food production. In addition, the development of new technologies for the use and transformation of bio-materials has opened up a wide range of potential new economic opportunities for rural areas. Markets for new bio-based products, for biofuels, green chemicals and biomaterials are projected to grow. They have a real contribution to make to the rural economy in terms of skilled jobs, rural sustainability and competitiveness and sustainable rural economies and providing new markets.

To realise this potential, investment will be required in new technologies, new business models, new models for the organisation of supply chains and value chains, as well as new policies and infrastructures.

Moreover, agri-food and forestry have an important impact on the provision of public goods. Those involved in the sector have opportunities to increase the provision of environmental goods and services by reducing the impact of their own activities on the environment, as well as by off-setting the impact of other economic factors.

The development of new tools for monitoring the environment based on satellites, sensor networks, smart connected farm machinery and drones, suggests that it will become increasingly possible to monitor the environment and quantify the provision of public goods to the extent that it will be possible for farmers to charge fees for the public goods provided.

If real markets for agriculture-sourced carbon and other environmental goods are developed over the coming decades, such measurement systems will become indispensable. It is possible to foresee a future where farmers, foresters and other actors will generate significant revenues from the provision of increasingly sophisticated environmental goods and services, on the basis of objectively quantified, auditable data.

2.2 Transformation on the horizon

Dealing with the foregoing challenges and taking advantage of new opportunities requires the development of a knowledge-based, sustainable, and secure food system, embracing social, environmental, health and economic goals, as well as new policies, systems and procedures, and the evidence base to support marketing strategies. economic goals, as well as new policies, systems and procedures, and the evidence base to support marketing strategies.

Irish farming will need to transform as it faces up to the challenges and risks associated with climate change mitigation and adaptation, broader environmental sustainability challenges, and increasing weed, pest and disease resistance to herbicides, pesticides and antibiotics. Policy makers and scientists are in broad agreement that the world cannot adopt a business-as-usual approach to producing the additional food needed by a growing and wealthier world population.

Ireland will have to focus on options for increasing the efficiency of farm-level output and use of our natural capital. Actors all along the agri-food and bioeconomy value chain will need to play their role in improving the efficiency of both the quantity and quality of outputs, enhancing the protection of natural capital and reducing waste. To achieve this, two things are essential:

- The development of new technologies to increase productivity, increase sustainability and enable superior management practices.

- The widespread adoption of existing and new practices by the greatest number of producers and agri-food actors.

The *2016 Teagasc Foresight* project concluded that the development and application of innovative new technologies will drive exponential change in our agri-food sector and help it to address the 'Grand Challenges' discussed above and to take advantage of new opportunities in the non-food sector of the bioeconomy. A key conclusion of the *Teagasc Foresight* project is that: *'the agri-food industry is on the verge of a revolution in the application of powerful new technologies. Increasingly rapid advances in ICT and molecular biology, in particular, have the potential to transform the sector in the coming years. It is essential for the success of the Irish agri-food and related industries that Ireland is a central player in this revolution.*

Investment in new and existing technologies will play a decisive role in enabling the sector to sustainably intensify production and to grow output, exports and jobs, while respecting the environment. 'Harnessing this transformation will not only enable ambitious increases in the export of world-class agricultural produce, but will also drive the completion of a dynamic circular bioeconomy creating new jobs and new opportunities. It will help to increase profitability throughout agri-food value chains. It will drive exports of smart knowledge-based data-driven services, developed by Irish service providers, to markets in Europe, and across the globe'.

The supply chains and value chains of the agri-food industry and bio economy in the coming decades will be very different from those we know today. They will be much more knowledge-intensive involving the trading or exchange of vast quantities of data to drive more productive resource-efficient operations and services. They will reorganise based on principles of the circular economy, the dominant growth paradigm at EU level for sustainable industrial and economic development. They will employ economic and business models very different from those employed today. Enabled by low cost digitally connected sensors they will make more use of technology. They will avail of a larger range of knowledge-intensive services. Many will enjoy new sources of revenue.

Practices such as collaborative farming and leasing are likely to be more widespread and more sophisticated in approach. New actors will emerge focused on the processing of biomass and organic waste, not only from agri-food production and processing but also from forestry, paper, food retail, food service and domestic consumption. They will produce a wide range of products, biofuels and green chemicals, composts, animal feeds and food additives, as well as high-value molecules for food, Pharma and cosmetics.

2.3 New capabilities and skillsets

In summary, a range of reports (as referenced in Appendix 2) have informed the Teagasc Education Vision process with regard to the challenges and opportunities outlined facing the land and agri-food sector. The core themes arising from a future agricultural education perspective include:

- Attracting and developing 'human capital' in the land sector and promoting the sector as a career path of choice.
- Understanding the complex and interconnected challenges in relation to climate change, sustainable farming systems, the bio-economy, bio-security, food security and related issues.
- Recognising the role of farmers as producers of environmental and wider bio-economy goods and services
- Promoting sustainable farming in its widest context, not alone ecological and environment sustainability, but also economic and social sustainability.
- Applying new technologies and practices arising from advances in plant and animal genomics and related technologies.
- Identifying new skillsets that will be required in the land sector including technical skills, environmental skills and managerial skills.

A strategy of 'business-as-usual' cannot be entertained in the face of deep transformation over the coming decades. Over the coming decades, Teagasc programmes must support a more knowledge-intensive land sector. It will be essential to develop farmers' capability to manage agricultural land for higher productivity and natural resource and input efficiency and to avail of new opportunities in the flourishing bioeconomy and circular economy.

Future farmers will have sophisticated tools to support decision making. Farming will be less about muscle power and more about brain power. Improving the level of technology skills of farm managers and operatives Future farmers will have sophisticated tools to support decision making.

Farming will be less about muscle power and more about brain power. Improving the level of technology skills of farm managers and operatives will be important in increasing the uptake and application of these smart technologies.

The adoption of new technology and management systems by Irish farmers has traditionally been variable. New technologies and farming systems will only contribute adequately to a globally sustainable Irish agri-food and bioeconomy sector if adoption rates are improved. This calls for an increased emphasis on education and extension services to help increase the skills and knowledge base of farmers and food producers. Future expertise and specialist knowledge requirements call for new capabilities and skillsets for teachers and farmers to fully capture the benefits that digital communication and other technologies can deliver. For example, ecosystem services provision, agro-ecological practices and utilisation of digitally dependent precision farming applications, are just a few of the anticipated innovations that farmers are expected to adopt in future. This development will require our students, future farmers, teachers and advisors to be fully informed and conversant with the latest developments as well as having an appreciation of social contexts and drivers for change. The need for innovative agricultural curricula approaches will become more pronounced in the 21st century.

2.4 New thinking on teaching and learning

Recent EU Presidencies have called for a modernisation of education with a focus on 'transversal skills' (Council of the European Union, 2017). The need to prioritise 'skills for the future' through more effective links between education, skills and labour market needs is reiterated under the *Modernising education – youth initiative* and the *New skills agenda for Europe* (CEDEFOP, 2018). Various other national and international reports relating to future education and skills strategies (Appendix 2) have also informed the Teagasc Education Vision process with key themes summarised below.

Future importance of transversal skills

Transversal skills (also often referred to as 'transferable skills' , 'soft skills', 'generic skills', 'life skills', 'non-academic or non-cognitive skills' or '21st Century Skills') encompass both life oriented skills and work oriented skills. Transversal skills broadly encompass:

- critical and innovative thinking skills (e.g. problem solving, reasoned decision making, reflective thinking, entrepreneurship, learning to learn)
- interpersonal skills (e.g. communication, teamwork)
- intrapersonal skills (e.g. perseverance, initiative, self -motivation)
- lifestyle skills (wellbeing, health and safety).

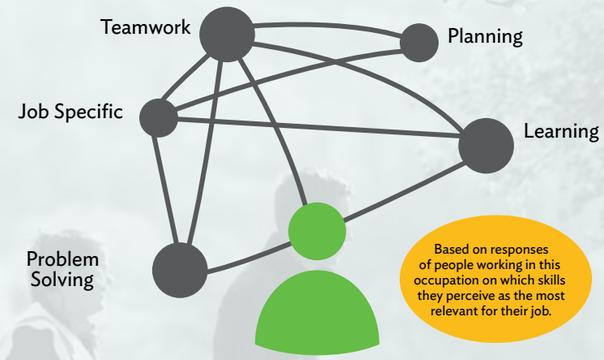
The *Europe 2020 initiative on Skills, Competencies and Occupations* (ESCO) refers to transversal skills as 'skills and competencies that are relevant to a broad range of jobs and occupations'. The *Ireland's National Skills Strategy 2025* (DES, 2016) report refers to transversal skills and competencies as the building blocks for the development of the 'hard skills' and competencies required to succeed in the labour market.

CEDEFOP - European Centre for the Development of Vocational Training (2016) posits that future jobs, including agricultural occupations, 'could be surprisingly different than those of today'. In this scenario 'soft skills' become at least as critical as job-specific technical skills. According to CEDEFOP surveys; those working in agricultural, forestry and fisheries occupations identified problem solving, teamwork, learning, planning and job specific skills as the five key skillsets currently required. CEDEFOP notes that these five skills will be important to tackling future challenges in agriculture and related occupations.

Initiative and entrepreneurship

While initiative and entrepreneurship are regarded as transversal skills, EU policy separately identifies them as a specific area for action in education and training. Developing and promoting entrepreneurship is a key education EU policy objective (Eurydice, 2012).

Figure 8: Most important skills for skilled agricultural, forestry and fisheries workers

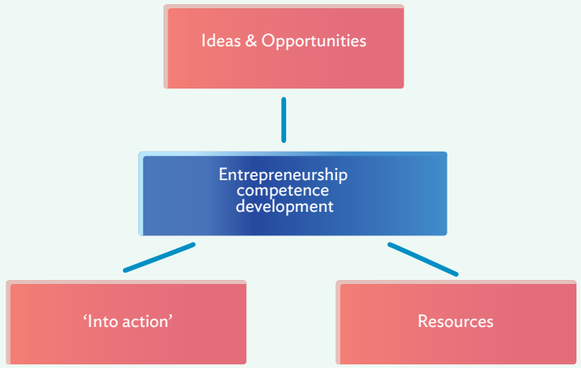


CEDEFOP (2016)

The *EU Entrepreneurship 2020 Action Plan* prioritises the role of education in developing entrepreneurial mindsets and advocates that entrepreneurship development be embedded in education systems. Initiative and entrepreneurship is described as 'an individual's ability to turn ideas into action and is characterised by creativity, innovation and risk-taking pro-activity.'

Entrepreneurship competence can be developed around three core interrelated concepts: '*Ideas and opportunities', 'Resources'* and '[Putting] *Into action'.*

Figure 9: Developing Learners' Entrepreneurship Competence



The EU emphasis on entrepreneurship in education is also reflected in the national *Action Plan for Education 2016-2019* (Department of Education and Skills, 2016). The plan sets out a number of proposed actions in regard to entrepreneurship, creativity and innovation.

The World Economic Forum's (2009) definition of entrepreneurship as being 'the pursuit of opportunities beyond the resources you currently control' is particularly relevant to the land sector. The Forum report *(Educating the Next Wave of Entrepreneur, 2009)* called for a transformation of education so that entrepreneurship is at the core of the way education operates. It should be deeply embedded in the curriculum as a key competency for young people to become more self-confident, creative and innovative; and to think outside of the box.

A paper developed for the Teagasc Education Vision project, *An Alternative View on Agricultural Education for the 21st* Century (Bradley, September 2016), argued that traditional education cultures driven by academic instruction and theoretical knowledge can be the enemy of innovation and the development of an entrepreneurial spirit. Rather than being handed information and knowledge, students can learn more effectively by exploring topics in 'a problem solving milieu'.

Box 8: Potential for problem based learning (PBL) approaches in agricultural education

Problem-based learning (PBL) is a learner-centred approach in which students learn by engaging with real problems and experiences. It has been defined as the: 'learning that results from the process of working towards the understanding of a resolution of a problem'. (Barrows and Tamblyn, 1980). Learners are motivated to gain new knowledge through independent study and through working together (Barrett, 2017). PBL is a learning paradigm rather than a teaching paradigm. It represents a significant cultural shift for educators. It redefines the role of the teacher as a facilitator of knowledge transfer, exchange and development and of synergistic peer to peer learning (Aalborg University, 2010).

PBL represents a shift from traditional classroom approaches that are often lecture-based. The focus is not on solving problems *per se*, but on learners acquiring desirable skills and attributes through critical thinking, communication and collaboration. The PBL process enables learners to develop overall capabilities that will equip them for their future occupations.

PBL poses significant challenges in its application. Extensive use of PBL in programme delivery may be more resource demanding as it relies on significant use of facilitated group work. It needs to be adapted to the education level, capabilities and context of learners. For some students, learning and integration of learning can be more difficult than in more conventional education approaches. PBL may pose issues for novice learners who may find it difficult to process large amounts of information through a PBL format. It presents significant challenges regarding curriculum design and teacher professional development.

McKinsey & Company (2017) reports that a combination of teacher-directed learning and inquiry based learning has optimized student learning in science subjects. McKinsey & Co note that inquiry based delivery is more challenging to deliver and that teachers will struggle without sufficient training and support. However it can provide a more fulfilling learning experience for students if utilised in the right context.

Despite the caveats, appropriate and correct use of a PBL approach is perceived to stimulate learner engagement and 'cognitive workouts' and moves teaching and learning from a focus of 'what' questions to 'why' and 'how' questions. In summary PBL presents opportunities to develop learner competence in a more holistic way.

Workplace learning and apprenticeships

The Action Plan to Expand Apprenticeship and Traineeship in Ireland 2016 -2020, (Dept. Education and Skills, 2016) recognises that there is a need for alternative education and workplace experience routes to develop hands-on capabilities. Traditional education routes may not always deliver these outcomes. The Action Plan seeks a substantial increase in the number of apprenticeship and traineeships with a target of over 120 Apprenticeship and Traineeship Schemes and 50,000 apprenticeship and traineeship registrations to be in place by 2020. The Action Plan calls for new Apprenticeship proposals.

The effectiveness of apprenticeship schemes in bringing young people into work is recognised by the EU Commission. *The European Framework for Quality and Effective Apprenticeships* (EU Commission, 2017) initiative to boost apprenticeships forms part of the EU *New Skills Agenda for Europe,* adopted by the Commission in 2016. The Commission view apprenticeships as strengthening 'the link between education and the labour market' and providing the 'combination of technical, transversal and soft skills that employers are looking for.'

The development of 'new' apprenticeship programmes and awards in Ireland is governed by the requirements set out by the Apprenticeship Council in conjunction with SOLAS, the Higher Education Authority and QQI ('new' refers to apprenticeships developed since 2016). Apprenticeship is defined as a programme of structured education and training which formally combines and alternates learning in the workplace with learning in an education or training centre. It is a dual system of on-the-job training and off-the-job training. Key requirements for new national apprenticeships are that they:

- are industry led
- are of at least two years' duration
- contain a minimum of 50% on the job training
- prepare apprentices to work autonomously and competently in a specific occupation
- involve a Contract of Apprenticeship
- provide a salary for the duration of the apprenticeship (on-the-job and off-the-job).

Box 9: Farm apprenticeships in Ireland

The Farm Apprenticeship Board (FAB) was established in 1964 to administer the Farm Apprenticeship Scheme. The FAB apprenticeships filled a major and very well recognised role in farm management training. Following on from recommendations of the report of the Taskforce on Agricultural Education and Training (DAFM, 2000) the Farm Apprenticeship Scheme was incorporated into Teagasc education structures.

Overall enrolments in agricultural education plummeted in the early years of the 2000's. Enrolments to the Farm Apprenticeship Scheme were particularly affected to the extent that the programme became unviable and was discontinued. The FAB schemes were outside of the national craft apprenticeship system and were not governed by the 1967 Industrial Training Act pertaining to statutory apprenticeships. The creation of an 'Industrial Training Order' under the 1967 Act is a key step in the development of national apprenticeships and would be required for future farm apprenticeships.

2.5 Learner support

The national action plan, *Literacy and Numeracy for Learning and Life* (DES, 2011) advocates a broader view of literacy and numeracy than 'reading, writing and arithmetic'. In today's world literacy includes understanding verbal, printed and digital communication, while numeracy requires the ability to problem solve and operate in every day settings. Learner diversity is a feature of Teagasc education programmes.

Currently, close to 20% of Teagasc full-time further education entrants require some learner support. A similar or higher incidence arises for Teagasc adult part-time courses. Of those learners requiring support, 85% or more relates to specific learning difficulties arising from literacy/numeracy difficulties, dyslexia, attention deficit disorder or other conditions or a combination of conditions. The remaining 10-15% of support provided typically relates to physical disabilities.

Data for the higher education sector (HEA, 2017) indicated that circa 9% of students entering higher education in 2016 had a disability, with specific learning difficulties again being the predominant condition. It is generally accepted that the incidence of learning disability is greater in the further education sector relative to the higher education sector. Addressing specific learning disabilities presents a more significant challenge to Teagasc than for the higher education sector.

2.6 Recognising prior learning

EU policy views the 'recognition of prior learning' (RPL) as an essential step to widening access to education programmes and qualifications. This is underpinned in national education legislation with providers being required to implement 'recognition of prior learning' policies. RPL relates directly to priority goals under the *EU Education and Training 2020* strategic framework.

Mobility of learners and workers is more prevalent than heretofore. There is a need for education and training providers to find ways of assessing and validating relevant prior learning achievements (formal, non-formal and informal) regardless of where the learning has taken place. The recent report *Recognition of Prior Learning in Irish Further Education and Training* (QQI and ETBI, 2017) underscores both the importance of effective and consistent RPL implementation and the challenges involved for providers.

2.7 Lifelong learning

The *National Skills Strategy 2025* emphasizes the importance of lifelong learning and continuous training for workforce up-skilling in the context of overall economic competitiveness.

Adult learning is also seen as a vital component of the European Commission's lifelong learning policy *(The Renewed European Agenda for Adult Learning 2011,* EU, 2011). EU Commission policy advocates adult learning systems that are characterized by flexibility, high quality excellent teaching with the full involvement of all relevant actors. Adult learning and lifelong learning opportunities are important for the land sector.

Fundamental changes are occurring at many levels including environmental and sustainable farming pressures; economic viability challenges on some farms to expansion challenges on other farms; the increasing need for financial, business management and governance up-skilling; changing husbandry practices; and the accelerating and the likely pervasive impact of digital and smart technologies on farming. As previously discussed the majority of the current farming population do not have (or have a limited) formal agricultural education. Appropriately focussed adult learning opportunities will be essential to enabling the wider farm population better cope with an accelerating pace of change.

2.8 Role of digital technologies in education

The National Forum for the Enhancement of Teaching and Learning in Higher Education, A Roadmap for Enhancement in a Digital World 2015-2017, outlines a number of objectives including:

- Embracing digital learning and digital innovation.
- Utilising digital platforms, resources and tools to enhance teaching and learning.
- Developing and embedding digital skills for teaching and learning.
- Providing student access to technological supports and resources to enhance their learning to enable them to become lifelong learners in a digital world.
- Enabling educators to fully use digital technology to enhance student learning.

Digital technologies can potentially improve delivery efficiency and learning outcomes if properly exploited. Delivery efficiencies include: improved communication channels, use of online assessments and the provision of learning materials online. Used appropriately digital technologies may stimulate deeper learner engagement but research findings to date appear uneven. Advantages highlighted include: the potential for personalised learning experiences, access to learning resources 'anywhere-anytime', interactive learning experiences and the opportunity to embed formative assessment.

Disadvantages highlighted in regard to digital technologies include: the challenges for tutors, digital literacy issues for learners, learner 'cognitive overload', use of less credible online learning resources and challenges regarding authentic assessment. The use of digital technologies does not imply that net resource savings will occur. The development of a coherent digital education strategy and enabling tutors to leverage digital technologies to enhance student learning outcomes appear central to effective institutional deployment.

Salmon (2004) proposed that successful online learning depends on teachers acquiring new competencies and becoming aware of the potential of online learning. McKinsey & Company (2017) report mixed outcomes from digital technology use during the school day. A positive impact or neutral impact must not always be assumed and student-based classroom technologies such as laptops, tablets and e-book readers can potentially hurt performance. McKinsey & Co reports that the best results from technology use inside the school comes 'when technology is placed in the hands of the teacher'.

The use of digital technologies to enhance education delivery and learning by Teagasc is uneven. Individual tutors very capably utilise a range of digital technologies and online platforms to enhance delivery and learning. However Teagasc lacks an overall strategic and systemic approach to harnessing digital technologies for the enhancement of teaching and learning. A strategic approach needs to be prioritised.

Box 10: Teagasc – UCD studies regarding digital technology use for Teagasc agricultural education

A number of postgraduate studies under the Teagasc/UCD Masters in Agricultural Innovation Support (MAIS) programme have looked at the role of digital technologies in agricultural education. A PhD study (Deegan, 2016) concluded that blended learning using digital technologies could be used to enhance practical skills instruction and allow students to take greater charge of their own learning. The utilisation of tablet-PCs in agricultural education was also explored (Deegan, 2014). Overall a positive attitude by students outweighed perceived negatives to the use of tablet-PCs.

A further study exploring the potential for the use of digital technologies in Teagasc horticultural education (Doran, 2016) concluded that there were opportunities to develop and deliver distance education short courses in horticulture utilising digital technologies.

An evaluation of the current Teagasc Distance Education programme for non-agricultural award-holders (O'Donoghue, 2014) indicated the Teagasc distance education programme provided an appealing model of blended learning for non- agricultural graduates wishing to pursue a formal 'young trained farmer' qualification. The study highlighted the need for greater design awareness regarding the online component to ensure learner expectations were met.

A recurring theme in the studies were the barriers to successful technology uptake arising from ICT infrastructural issues, the lack of available support to teachers in dealing with technical difficulties and the need for teacher up-skilling in regard to the use of digital technologies for teaching and learning.

2.9 The 'student voice'

In education, the 'student voice' refers to the values, opinions and perspectives of individual students and groups of students in a school, and to instructional approaches and techniques that are based on student choices, interests, passions, and ambitions. The concept of the student voice in education has grown increasingly popular in recent decades. Fleming (2013) highlighted the student voice as essential to the development of active citizenship, and learning and pedagogy. It represents an alternative to more hierarchical forms of governance in which educators may make unilateral decisions with little or no input from students. Recognising the student voice is predicated on the belief that teachers will become more effective and professionally fulfilled and that students will learn and achieve more. Recognising the student voice can occur through providing:

- Formal and informal channels for students to have their voice heard.
- Opportunities for student involvement in regard to teaching and learning approaches.
- Engaging students in evaluation of and providing feedback on education programmes.

Teagasc education pathways need to be developed that will enable learners to gain requisite capabilities for the future.

3.0 Overview of agricultural education

3

3.0 Overview of agricultural education

This section summarises land sector education in Ireland and reviews selected European land sector models.

3.1 Quality and Qualifications Ireland (QQI)

QQI is a state agency established with statutory functions in regard to awards and standards, programme validation, quality assurance and the National Framework of Qualifications (NFQ).

All Teagasc further education programmes are validated by QQI and lead to QQI awards. Quality and Qualifications Ireland has responsibility for the development and review of awards and standards in further education and training. Teagasc under the auspices of QQI has had a key role in the development and review of further education land sector award standards.

The *Quality Assurance and Qualifications (Education and Training) Act 2012,* specifically makes provision for the delegation of awarding authority by QQI to bodies such as Teagasc subject to meeting the criteria set by QQI. The implementation plan for the *Food Wise 2025* strategic vision for the Irish agri-food sector recommends that Teagasc pursue awarding functions as an important enabler to future human capital development.

3.2 Agricultural education at second level

Unlike many European countries Ireland does not have a specific second level vocational agricultural stream. In Ireland, second level learners may choose to complete agricultural science as an academic subject with some practical assignments at senior second cycle. About 7,500 students sat the agricultural science examination for the Leaving Certificate in 2017 representing 14% of the total student population sitting the Leaving Certificate (Agriland, 2017).

3.3 Further agricultural education and training

Teagasc is by far the dominant provider of specialised agricultural education major award programmes at Levels 5 and 6. Teagasc is one of many providers of horticultural education. Teagasc's involvement in applied horticultural research and knowledge transfer and its substantial hands-on teaching facilities bring a depth of expertise to its horticultural programmes. A number of providers offer equine programmes. Teagasc's Level 5 and Level 6 horsemanship and equine breeding programmes are well recognised within the equine sport horse sector. Teagasc is the only provider for the QQI Levels 5 and 6 major awards in forestry.

Teagasc is also the only provider of QQI accredited specialised programmes to the pig sector delivered jointly by the Teagasc pig husbandry knowledge transfer department and selected colleges. It is Teagasc's intention to introduce similar specialised programmes for the poultry sector subject to demand. A poultry resource person has been appointed to facilitate this. Teagasc also offers accredited short duration courses relating to organic production. Teagasc provides a suite of other accredited and non-accredited short duration courses and continuous professional development events addressing many food and land sector topics.

3.4 Recognised apprenticeships

There are no Apprenticeship Council recognised apprenticeships in place in agriculture other than a long-established craft apprenticeship in agricultural mechanics. National policy advocates the creation of new apprenticeships. In response to the most recent call for new apprenticeship proposals in September 2017, Teagasc on behalf of the relevant sectors submitted five apprenticeship proposals for agriculture, horticulture and equine apprenticeships. These proposals have been approved by the Apprenticeship Council to proceed to the next stage of development contingent on the active participation of industry stakeholders in the development process.

3.5 Agricultural education at higher education levels

Higher education participation in Ireland is high by European standards. It is projected that by 2020, close to two-thirds of 30-34 year olds in Ireland will have higher level qualifications compared with the expected EU average of 40% (*Skills Forecast Country Report - Ireland,* (CEDEFOP, 2015)).

Teagasc has a long established partnership with many Institutes of Technology (regarding land sector programmes). Teagasc also has a partnership with University College Dublin (UCD) regarding the BAgrSc Dairy Business degree and UCD is the awarding body for the Teagasc Professional Diploma in Dairy Farm Management programme. Teagasc's links with the higher education sector provide its students with a valuable progression ladder to higher agricultural education.

Teagasc, through its higher education sector links, plays a key role in postgraduate education for the agri-food sector. Typically there are up to 250 postgraduates (mainly PhD students) conducting research studies at Teagasc centres annually.

3.6 Gender balance in agricultural education

Quality and Qualifications Ireland data *(Annual Statistics Report - 2014 key data)* indicate that nationally, 51% of recipients of all QQI further education awards were female. In contrast about 11% of the 14,588 QQI further education awards made for Teagasc programmes in the period 2012-2016, were to female graduates. Female participation in agricultural higher education is observed to be greater, in the range of 40% for some university degree programmes. By contrast, female participation in veterinary education in Ireland is much higher and can range from 70% to 80%.

Data from Scotland, *(National Strategy for Land Based Education,* SRUC, 2015), indicate that Scotland has a corresponding pattern of female participation in agriculture-specific courses as Ireland.

A research report, *Women in farming and the agriculture sector* (Scottish Government, 2017), highlights that the 'remarkably stubborn and persistent gender divide [in agricultural education and farming careers] is problematic'. The report cites research indicating that 'women themselves often view [agricultural] training groups and programmes as being for men and [that they] feel 'unwelcome and conspicuous in this space'. The report concludes that 'the cultural norm of sons inheriting farms is very resistant to change'.

Research by Shortall (1996) revealed that low levels of female participation in agricultural education were mainly attributed to how women and men enter into farming. Typically men inherit the farm and women enter farming through marriage.

Research on female participation in agricultural education and farming careers suggests key influencers include: mothers, schools, and overall perceptions of farming as a career. The influence of mothers on family education and career choices has been detailed by O'Hara (1997, 1998). According to O'Hara, mothers assume the major responsibility for the education of farm children. Historically, farm children have had a significant level of participation in full-time and higher education compared with any other social group.

More farm daughters go to college than sons. O'Hara posits that this conscious emphasis on education is to maximise daughters' occupational opportunities given that they are less likely to inherit the farm. Media portrayal can reinforce farming as a male profession. Brandth (1995) highlights how tractor and machinery advertisements tended to stereotype farming as a male profession.

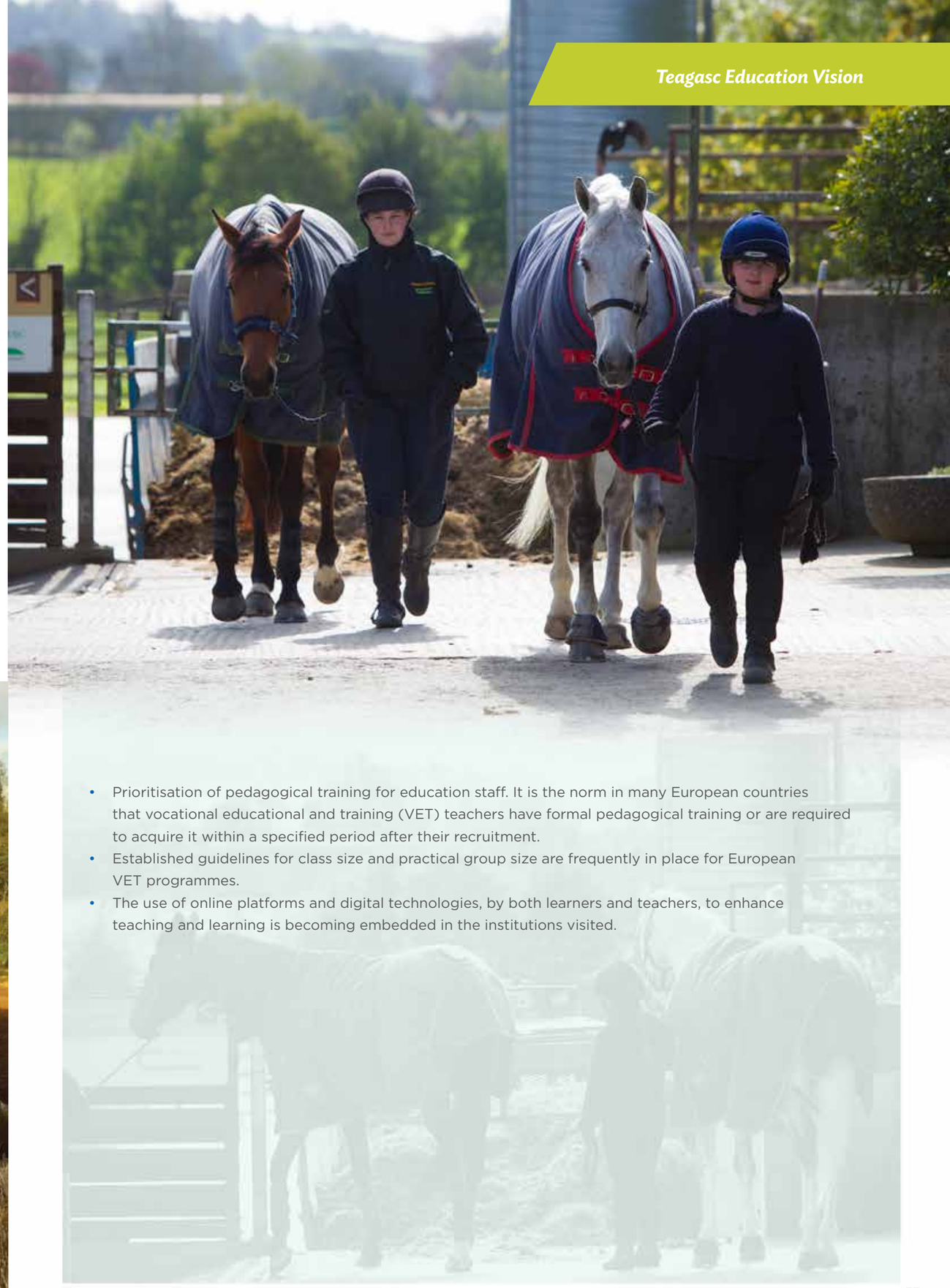
3.7 Overseas agricultural education models

Agricultural education institutions in Northern Ireland, Scotland, Denmark and the Netherlands were examined in the context of the Education Vision process and a number of study visits were undertaken. The structure of second level education in many European countries is quite different from that in Ireland. In Ireland second level education is usually of six years' duration (given that in excess of 60% of second level students complete the transition year cycle).

Irish second level school leavers are typically 18 or 19 years of age entering post Leaving Certificate education. In many European countries school leavers are younger (around 16 years of age) when entering vocational education and training. In some countries it is usual for second level students to choose at an early age (e.g. 12 years old) between an academic or a pre-vocational path. On completing the pre-vocational pathway learners may enter vocational education or an apprenticeship route depending on their wishes and aptitude.

The following education approaches from individual countries, or from across countries, were considered to be of particular relevance to the Teagasc Education Vision process:

- Emphasis on the importance of workplace learning and availability of apprenticeship programmes including the development of modern apprenticeships (e.g. Scotland).
- Fostering of problem solving ability and peer to peer learning.
- End of programme occupational capability assessment. (In both the Dutch and Danish colleges visited there was an emphasis on end-of-course competency tests to determine if learners had developed the capabilities necessary for their intended occupation).



- Prioritisation of pedagogical training for education staff. It is the norm in many European countries that vocational educational and training (VET) teachers have formal pedagogical training or are required to acquire it within a specified period after their recruitment.
- Established guidelines for class size and practical group size are frequently in place for European VET programmes.
- The use of online platforms and digital technologies, by both learners and teachers, to enhance teaching and learning is becoming embedded in the institutions visited.

Teagasc's mission is to support science-based innovation in the agri-food sector and wider bioeconomy so as to underpin profitability, competitiveness and sustainability.

4.0 Teagasc education delivery

4

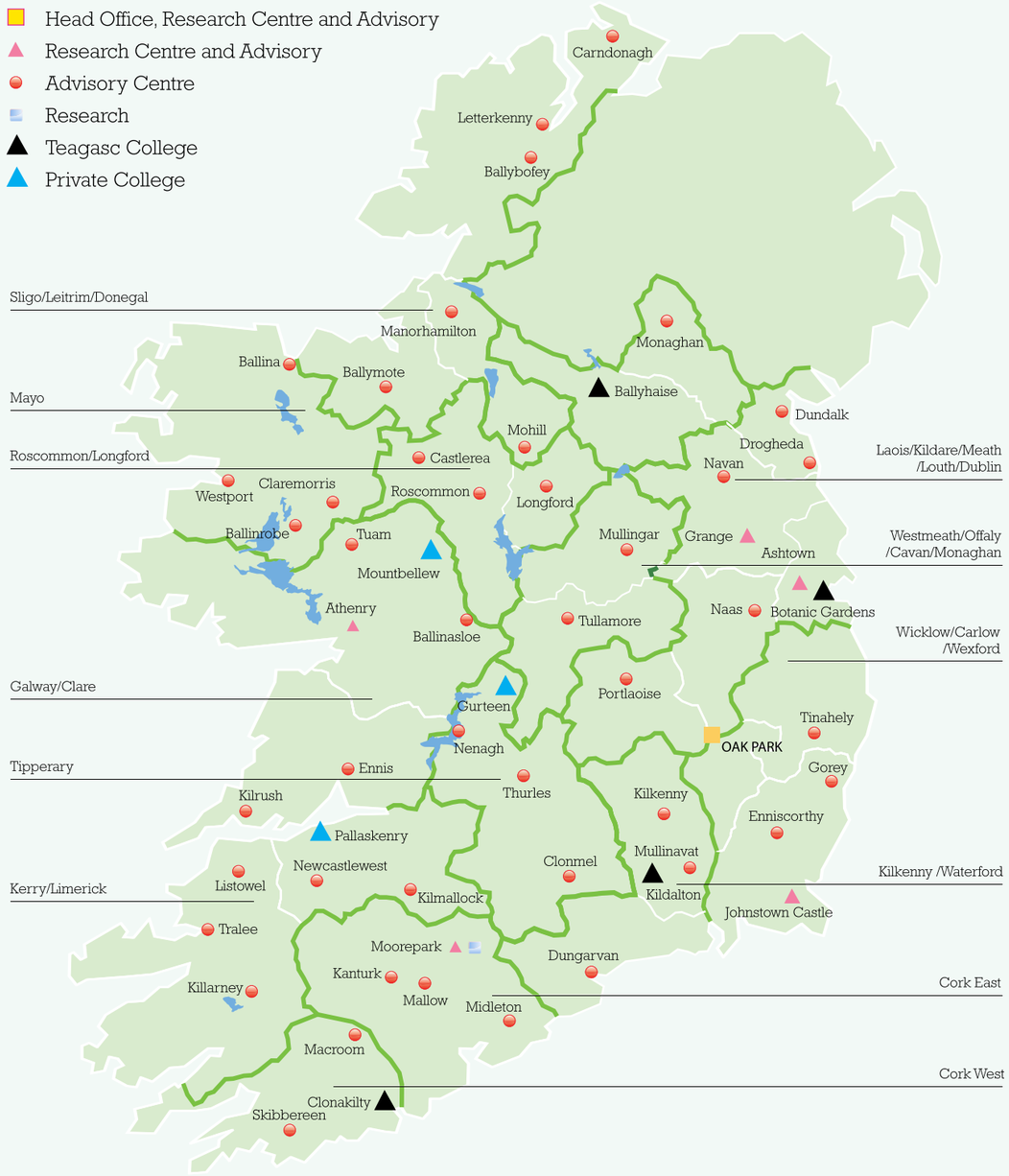
4.0 Teagasc education delivery

Teagasc (the Irish Agriculture and Food Development Authority) is a state body established under the Agriculture (Research, Training and Advice) Act of 1988. It employs approximately 1,200 full time staff equivalents at 51 locations throughout Ireland with an annual operating budget in excess of €160 million. Teagasc operates in partnership with all sectors of the agriculture and food industry and with rural development agencies. It has developed close alliances with research, advisory and training agencies throughout the world.

Teagasc's mission is to support science-based innovation in the agri-food sector and wider bioeconomy so as to underpin profitability, competitiveness and sustainability. Teagasc incorporates research, knowledge dissemination and education and training functions.

The organisation is structured into three directorates (Research, Knowledge Transfer and Operations) reporting to the Teagasc Director who in turn reports to the government appointed Teagasc Authority. The Department of Agriculture, Food and the Marine is the 'parent' government department for Teagasc.

Figure 10: Teagasc locations



4.1 Teagasc education remit

Teagasc has a statutory remit under the 1988 Teagasc establishment Act, Agriculture (Research, Training and Advice) Act to provide and procure the provision of 'educational training and advisory services in agriculture'. The Act requires Teagasc to '...have particular regard to the need for, and the importance of, agricultural training and education for young persons...'

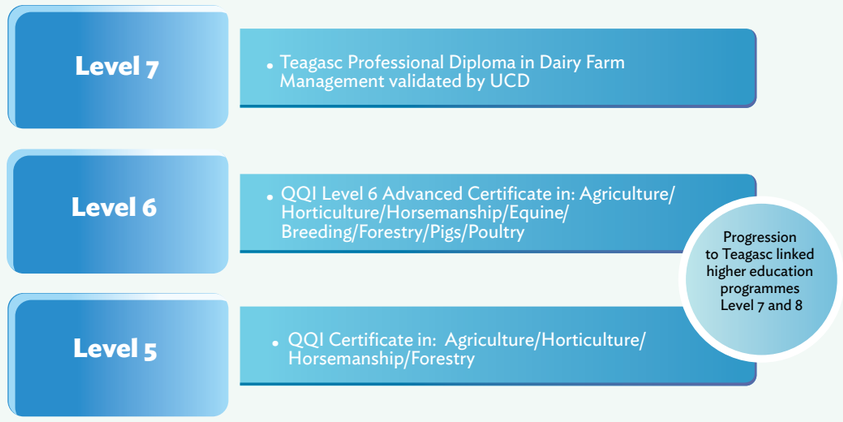
Teagasc is the primary provider of accredited further (vocational) education and training at Levels 5 and 6 on the Irish National Framework of Qualifications (NFQ) for the land sector. Teagasc, through its partnership with the higher education sector, has a substantial input into higher education delivery at NFQ Levels 7 and 8. Teagasc also has a substantial collaborative involvement in postgraduate education studies at Level 9 (Masters) and even more extensively at Level 10 (PhD) with about 250 postgraduates participating annually.

Teagasc education, advisory and research services also have a substantial involvement in both accredited and non-accredited short duration training courses and continuous professional development for adult farmers, operatives and professionals operating across the land and food sectors.

4.2 Teagasc education pathways

Levels 5 and 6 QQI accredited programmes are the primary education pathways offered by Teagasc for school leavers and for adults owning, or intending to own, a farm or to work in the land sector. Progression pathways are available to Level 7 and 8 programmes offered by other providers. Teagasc also provides a Level 7 Professional Diploma in Dairy Farm Management programme that is validated by University College Dublin.

Figure 11: Teagasc full-time education programmes Levels 5, 6 and 7.



Box 11: Full-time agricultural college route for school leavers enrolling in September 2018

Agriculture

Two year option incorporating:

- Year 1: Level 5 Certificate in Agriculture (QQI award)
- Year 2: Level 6 Advanced Certificate in Agriculture (QQI award)

In year 1, mandatory course content will include principles of agriculture, farm safety, safe use of pesticides, farm assurance, soils and environment, farm business and technology and a personal development oriented module in addition to production and elective modules.

In year 2, Level 6 specialised programmes will be offered in both dairy herd management and drystock management. Level 6 crops/machinery and agricultural mechanisation programmes will also be offered at designated colleges. Mandatory content will include farm management and business planning, sustainable farming, an integrating capstone module and a personal development oriented module in addition to specialised production and elective modules.

Practical learning periods on approved host farms are required in both Year 1 and Year 2.

Teagasc Professional Diploma in Dairy Farm Management

The Professional Diploma in Dairy Farm Management offers a progression option from the Level 6 Advanced Certificate in Agriculture or other appropriate routes. It involves two-year farm based professional work experience on commercial dairy farms (part of the work experience may be undertaken abroad e.g. New Zealand). The programme also incorporates a block release period delivered by Teagasc dairy researchers, knowledge transfer specialists and educators.
Teagasc proposes that the Professional Diploma be redeveloped under the umbrella of a National Apprenticeship Scheme for farm managers.

Horticulture

Level 5 Certificate in Horticulture and Level 6 Advanced Certificate in Horticulture programmes are offered leading to QQI Awards. The Level 6 advanced programmes include fruit and vegetable production, nursery stock production, landscape construction & maintenance and sports turf.

Equine

Level 5 and Level 6 programmes in horsemanship and stud management leading to a QQI award.

Forestry

Level 5 and Level 6 programmes in forestry leading to a QQI award.

Pigs and Poultry

Full-time and part-time Level 5 Courses in pig husbandry are offered subject to demand. Currently Level 6 programmes are not offered in pig management, but the intention is to do so, subject to demand. Short duration QQI accredited courses are offered in poultry husbandry. Teagasc intends to offer full-time and part-time Level 5 and 6 courses in poultry husbandry subject to demand.

Adult part-time & distance education 'Green Cert' programmes

The Level 5 Certificate in Agriculture and the Level 6 Specific Purpose Certificate in Farming programmes are also offered to adult farmers as a part-time course or as a distance education option. The distance education format is offered to adults who already hold a major non-agricultural award at Level 6 or higher. Both the part-time and distance options are offered through agricultural colleges and Teagasc regional education centres.

The part-time option involves face-to-face delivery. The distance education option involves considerably less face-to-face contact. It places a substantially greater onus for self-directed learning on the learner. Accordingly, distance education enrolees are required to have already achieved, at a minimum, a Level 6 major award qualification.

Box 12: Profile of Teagasc learners – Level 5 and 6 agricultural programmes

School leavers: full-time

- Typically 17-18 years of age.
- Most (90%+) complete second level.
- Most are male (90% or more)
- Most are from or connected to a farm (typically 90%).
- Primarily from drystock farms (~50%) and dairy farms (~30 to 40%). About 10-15% from tillage farms.
- Most (~90%) become engaged in farming after graduation or later.

Adult: part-time

- Mature students, early twenties to mid-thirties.
- Majority have completed second level cycle, but some participants may not.
- Typically 85% are male.
- Majority part-time farming.
- Predominantly from drystock but some from dairy farms.
- High level of involvement and frequently the owner or co-manager of the farm.

Adult: distance education

- Mature students, early to mid-thirties.
- Already hold a major non-agricultural qualification (at Level 6 or higher).
- Most are male (typically 85%).
- Part-time farming combined with a non-farming profession/occupation.
- Drystock farms, but significant cohort from dairy farms.
- Variable levels of involvement in active farming. Most will inherit land at some point.

Special Agricultural Award

Teagasc provides supports on a 'reasonable accommodation basis' to those learners having learning difficulties and disabilities but who are capable of undertaking the requirements and fulfilling the standards of the course. Additionally Teagasc makes provision for learners with specific learning challenges to complete an adapted programme of learning, provided that these learners are in a position to fulfil the adapted programme requirements. This Special Agricultural Award programme is recognised by DAFM and Revenue for the purposes of young farmer schemes and incentives.

4.3 Participation levels

In the region of 7,000 learners participated across Teagasc further education (full-time, part-time and distance education) and Teagasc-linked higher education programmes in 2017.

Table 4: Student numbers at agricultural colleges and Teagasc regional centres – 2016/17

Full-time courses[1] + Adult part-time and distance education courses[2]

Teagasc Colleges	**Gross**	**Full-time Equivalent**
Ballyhaise	1,209	585
College of Amenity Horticulture Botanics	327	196
Clonakilty	648	379
Kildalton	1,179	716
Private Colleges		
Gurteen	740	427
Mountbellew	883	584
Salesian Pallaskenry	587	356
Teagasc Regional Education	1,639	1,071
Total Participation	**7,212**	**4,314**

**Notes: [1] Inclusive of Teagasc-linked higher education courses. [2]Peak participation, adult part-time and distance educationcourses commence and complete on a rolling basis.*

Teagasc also delivers a range of accredited and non-accredited short duration courses and continuous professional development opportunities to farmers and others in the wider land and food sector. Typically about 3,000 to 4,000 adults attend such courses annually, though this may be considerably higher in a given year. Additionally Teagasc operates and facilitates a national network of over 800 discussion groups/ knowledge groups.

4.4 Teagasc education resources

The Teagasc education programme is delivered through its network of seven colleges (four Teagasc colleges and three linked private colleges) and Teagasc's 12 Advisory Regions. There are circa 176 permanent education staff located at colleges and advisory regions, of these, 115 are college teachers, technicians and regional education officers. Due to the exceptional demand for Teagasc Green Cert courses arising from the national Rural Development Plan (RDP), Teagasc received sanction to recruit temporary education officers and some temporary administration staff.

In 2017 the temporary education officer complement amounted to approximately 30 FTE's. It is expected that the RDP temporary education staff complement will reduce to almost zero by late 2019. Teagasc also engages external contactors to support various aspects of its education programme delivery and this has been equivalent to circa 15 staff units in recent years.

Practical learning hosts

Teagasc has circa 1,100 active host farms and host units (not all are active) that provide in-situ practical learning periods (placement) for Teagasc learners. A further 50 commercial farms known as 'Education Benchmark Farms' are utilised for learner benchmarking exercises and learner discussion group visits.

Curriculum Development and Standards Unit

The Teagasc Curriculum Development and Standards Unit (CDSU) is the quality assurance and education knowledge transfer unit for Teagasc education staff and education management. The unit has internal Teagasc responsibility for quality assurance and quality standards, programme and module development, course validation and results verification. It also oversees development and innovation in teaching and learning approaches, education staff training and support; the development of staff and learner education resources and course materials (e.g. workbooks, skills DVDs, online resources); and the promotion of ICT technologies in teaching and learning.

4.5 Agricultural college farms and research linkages

Teagasc colleges and the private colleges have substantial land and physical resources for practical instruction and demonstration of commercial farm practice across further education (full-time/part-time distance education) and higher education. The total combined area farmed at colleges amounts to just over 1,000 hectares and includes over 800 dairy cows, almost 300 suckler (beef) cows, 1,200 ewes and close to 70 hectares of tillage.

Colleges also have an extensive range of farm equipment, workshops and computer labs for teaching purposes. There are also specialised resources and facilities at both Teagasc horticultural colleges to enable hands-on learning for horticultural learners and likewise for the equine programme at Teagasc Kildalton College. Forestry teaching resources at Teagasc Ballyhaise include state-of-the-art simulator teaching facilities.

Table 5: Farm Enterprise Profiles – Agricultural Colleges (2017)

	Teagasc Colleges			Private Colleges			
Farm Profile	Ballyhaise	Clonakilty	Kildalton	Gurteen	Pallaskenry	Mountbellew	Total
Ha farmed	147	118	169	276	245	145	1,100
Dairy cows	120	195	112	180	250	91	948
Suckler cows	60	35	65	70	30	45	305
Other cattle systems (LU)	39	-	22	100	60	33	254
Ewes	200	55	180	600	130	200	1,365
Tillage crops (ha)	-	-	34	35	-	-	69

LU= Livestock units

Note: Excludes areas of forestry, biomass, equine and horticulture. Colleges not having a tillage enterprise may sow small areas of crops and catch crops for teaching and learning purposes. Area farmed includes leased and rented land.

Teagasc dairy research programmes have been established at Teagasc Clonakilty and Ballyhaise Colleges. Teagasc, with support from Glanbia, has established an open source sustainable farming project at Kildalton College. Kildalton is also a significant base for Teagasc and Dept. of Agriculture, Food and the Marine crop variety trials, for Teagasc research crop trials and for some Teagasc horticultural observation trials. A joint horticultural research and teaching facility has also been established at Teagasc Ashtown, Dublin.

4.6 Teagasc education evaluation and stakeholder consultation

The Teagasc Education and Training Forum is one of Teagasc's longest established stakeholder consultative groups. The Forum includes representatives from education and farming organisations and key agencies. The Forum has provided valuable feedback and guidance to Teagasc education over many years. Teagasc considers a range of quantitative and qualitative indicators in monitoring and assessing the performance and impact of its education programme including: enrolment levels, retention rates, learner outcomes, student to staff ratios, contact hours, and learner satisfaction surveys.

Teagasc conducts a 'look back' survey among its further education Level 6 graduates five years after they graduate. The aggregated findings from those responding suggest a:

- Very high level of graduate active involvement in farming post-graduation (90%+).
- Substantial involvement at management level in the home or owned farm.
- Increased levels of farming activity and on farm investment by graduates.
- A positive view of how their Teagasc education prepared them for a farming career.
- A high level of endorsement of their Teagasc course to others (~90%).

4.7 Research on Teagasc education impact

Teagasc completed a major agricultural education impact study *(The Economic Returns to Formal Agricultural Education)* in 2014. The study highlighted the high rates of return to Teagasc education both at farm level and at a national level. The main data source was the Teagasc National Farm Survey (NFS) annual sample of 1,100 farms. The NFS data was reviewed for the period 2001 to 2011. Family farm income per hectare was consistently between 1.3 and 1.9 times greater for those with a formal education as opposed to no formal education.

There was also a very high 'social' rate of return to agricultural education. The study assumptions model indicated a 'social' return in the order of 25% when the wider food supply chain effects of improved agricultural productivity were factored in.

Box 13: Teagasc – UCD MAgrSc (Innovation) Studies on Teagasc Education

In recent years Teagasc initiated a MAgrSc (Innovation Support) programme in collaboration with University College Dublin. These post-graduate studies are a catalyst to encourage innovation and/or to refine existing methodologies. Conclusions and insights from education studies completed to date highlight:

- The importance of on-farm placement and practical instruction as enablers of student learning.
- Opportunities to harness digital technologies more effectively for delivery and learning.
- The scope to use social media to communicate with learners.
- The need to integrate sustainable and environmental best practice with husbandry practice.
- The need for greater pedagogical training opportunities and support for Teagasc educators.
- The strong technical performance of recent graduates of the Teagasc Level 6 Dairy Herd Management programme but also their need for further up-skilling in regard to business and financial management post-graduation.

Studies currently in progress include: learner engagement strategies; learning supports for Teagasc learners; horticultural workforce skills needs; future role of host farmers; agricultural education splanning on dairy farms to succession needs.

Teagasc education pathways need to be developed that will enable learners to gain requisite capabilities for the future.

5

5.0 Future partners for Teagasc education

5.0 Future partners for Teagasc education

The principal future education partners of Teagasc are outlined below.

5.1 Farm owners

Teagasc's primary education activity will continue to be the education and training of farmers, irrespective of farm size and type of farming. Teagasc's formal education programmes for farmers will continue to include full-time programmes for school leavers and part-time/distance education programmes for adult farmers. Teagasc will also continue to partner with higher education institutions in the delivery of relevant programmes. The provision of lifelong learning opportunities and a continuous professional development programme for active farmers will be a key element of Teagasc's future knowledge exchange activities.

Box 14: Future agricultural education needs for part-time farmers

The education needs of full-time and part-time farmers are likely to diverge over the long term. Teagasc education pathways will need to reflect this divergence. Future part-time farmers will need to farm efficiently from an economic, labour and safety perspective. It is likely that a requirement to provide 'public goods and services' will be a key component of future EU farm payments. Such payments will be particularly crucial for less viable holdings. Sustainable farming compliance will be equally relevant to both part-time and full-time farmers.

In addition to technical competence, inheritors of economically less viable farms will also need to think 'out of the box' in regard to their resources and career goals. For some, the emphasis will be on improving farm viability by growing the business, or engaging in collaborative farming models or diversifying farm activities. For others, creation of external business activities or developing skillsets that will enhance their off-farm employment opportunities will be very relevant. Where economic viability and opportunities are particularly challenging the economically best option may be to lease the farm to others.

Other considerations including lifestyle and family circumstances will influence choices made in a given situation. In summary, Teagasc must remain equally mindful of the changing education needs for both full-time and part-time farmers.

5.2 Farm employees and agri-food-sector employees

Teagasc traditionally has had a dual role in providing for the education of farm families to pursue career opportunities both inside and outside the farm gate. Teagasc full-time further education programmes and Teagasc-linked higher education programmes will continue to be education routes for roles such as operative, technician, manager and also for roles across the wider agri-food sector.

Customised operative training may also be necessary in some sectors, the dairy sector being an example. This may include accredited training, non-accredited training or a combination of both. In some sectors operative training may include training of foreign nationals. Overall, Teagasc will seek to broaden the diversity of its student body.

5.3 Other sectors

Horticulture

The combined output value of the horticultural produce and the amenity sector is estimated to exceed €1.1bn. The farm gate value of horticultural food produce and nursery stock is about €430m, the fourth highest commodity sector output after beef, dairy and pigs. The *Labour Review of Horticulture in Ireland in 2016* (Bord Bia, 2016) indicates that farm gate employment in horticulture amounts to 6,600 staff with a further 11,000 employed in added value and downstream horticulture related activities.

The Bord Bia Review identifies a need for up-skilling both within and beyond the farm gate. Key areas for growers include workplace standards, innovation through new and smart technologies. The Review also identifies areas such as green-keeping/turf management as offering employment growth in the next five years. It recommends that flexible education and training programmes be available to employees.

The recent report, *Horticulture Industry Vision,* (Horticulture Industry Forum, 2017) identifies significant opportunities for the Irish Horticultural sector in terms of growth and import substitution. Education and training is identified as one of the requisites for a dynamic horticultural sector. Key sector requirements include professional development, up-skilling, apprenticeships and more commercially oriented vocational training programmes. It identifies the need for horticultural education providers to have capacity and capability both at knowledge and infrastructural levels. The report identifies the need for Teagasc to have adequate resources to meet the sector's needs.

Equine - sport horse sector

The sport horse breeding sector contributes over €700m per annum to the economy. According to the *Reaching New Heights - Research Report of Irish Sport Horse Industry Strategy Committee,* (Horse Sport Ireland, Teagasc, Royal Dublin Society, Teagasc, 2015) there are an estimated 12,500 people employed directly or indirectly in the sector. The Sport Horse industry is highly dependent on manual labour, both skilled and unskilled.

Teagasc offers Levels 5 and 6 major award programmes in equitation and stud management. Teagasc is also working closely with other stakeholders to lead the implementation of the *Reaching New Heights Report* recommendations on future training structures in the industry.

Forestry

The forestry sector contributes €2.3bn annually to the economy (Forest Service, 2016) and employs about 12,000 people (Ni Dhubhain et al, 2012). Teagasc will celebrate 30 years of involvement in forestry sector education and training in 2018. It is the only provider of QQI Level 5 and Level 6 major awards in forestry.

Teagasc has worked with DAFM and forestry industry stakeholders to develop a Forest Machine Operators Training Programme utilising a state-of-the-art harvesting simulator at its forestry training hub in Teagasc Ballyhaise College. This training programme has been designed to develop competence in timber harvesting operations within the forest industry. It is envisaged that forestry will also play a greater role in future Irish land use policy in mitigating carbon greenhouse emissions through carbon sequestration.

Pigs and poultry

The pig sector is the third most important farm sector in terms of output value after beef and dairy with an output value of almost €0.5bn. The industry is highly concentrated with fewer than 300 intensive units nationally. Teagasc currently provides a Level 5 Pig Husbandry Programme targeted at operatives in the pig sector.

Teagasc will also introduce a Level 6 Advanced Programme in Pig Herd Management in response to industry needs. Teagasc offers equivalent programmes for the poultry sector subject to sufficient demand. Accredited short duration poultry courses are also offered. While the numbers of potential learners in both the pig and poultry sectors is likely to remain modest, Teagasc view both sectors as important partners in light of their overall contribution to the agri-food economy.

Organic farming

Teagasc has an active programme of accredited and non-accredited short duration courses for organic producers. Teagasc delivered short duration 'Introduction to Organic Farming' courses to over 550 participants in recent years. Teagasc anticipates that demand for organic courses will continue and possibly increase if future EU Common Agricultural Policy reforms further incentivise organic production.

5.4 Food industry training

Teagasc is a leading provider of training to the food processing sector and provides both accredited and non-accredited short duration courses in food safety and quality and innovation. Teagasc food industry training led by the Teagasc Food Research Centres at Ashtown and Moorepark will continue to provide training and up-skilling to the food sector.

5.5 Teagasc ConnectEd Programme

Teagasc has identified rural professionals and others as important future customers and partners of Teagasc. The Teagasc ConnectEd Programme provides access to Teagasc research, education and knowledge resources to professionals and businesses operating in the agri-food sector.

5.6 Postgraduate learners

Teagasc has a key role in postgraduate agricultural education in Ireland. On an annual basis, in excess of 250 postgraduates carry out their postgraduate research studies at Teagasc centres. The substantial majority are engaged in PhD programmes. Teagasc views its involvement in postgraduate training as of strategic importance in adding value and building human capital for the wider agri-food sector.

5.7 Other stakeholders

Teagasc, as the lead scientific and knowledge transfer body, can play a pivotal role in supporting other stakeholders develop education programme content that reflect technological advances and developments across the land sector.

Teagasc also has an important role in advising farm and other families, schools and guidance counsellors regarding education pathways and career planning. This will become more important given the necessity to attract people into farming and land careers in the future. Teagasc can also play an important role in supporting and informing other important stakeholders including farm organisations, state agencies, agricultural science teachers, Agri-aware and others.

Overseas Initiatives

Sustainable Food Systems Ireland (SFSI) is a consortium of the largest food and agriculture agencies of the Irish Government and the Department of Agriculture, Food & the Marine. It acts as a point of contact for overseas governments, agencies and other organisations, and can negotiate participation in international food, agriculture and rural development projects. There may be greater opportunities for Teagasc to engage in education projects with overseas partners in the future.

The future requires continuing improvement to meet the new needs and realities of both agri-food production and of teaching and learning for the coming decades.

6.0 Teagasc Education Vision conclusions

6

6.0 Teagasc Education Vision conclusions

Teagasc must position itself to meet the future education and training needs of the land sector and align itself with changing teaching and learning approaches across the broader education landscape. This Teagasc Education Vision will provide a roadmap for future Teagasc education goals and direction.

6.1 Key themes emerging

The recommendations of the Teagasc Education Vision were informed by the processes and activities of the Vision project as outlined in Appendices 1 and 2. While the terms agriculture and farming are frequently referred to, the overall recommendations refer to all land sectors (e.g. horticulture, equine, forestry, pigs and poultry). Indeed, the Vision consultation process found that common issues permeated across the various sectors. Specific Vision recommendations are noted for individual sectors where warranted.

The Vision process concluded that Teagasc education is fundamentally strong and contains many very positive aspects. The future requires continuing improvements to meet the new needs and realities of both agri-food production and of teaching and learning for the coming decades.

The following themes arising from the Teagasc Education Vision process provide a framework for future goals and actions for Teagasc education.

Career path opportunities in the land sector.
Stakeholders were of the opinion that there was insufficient attention given to career planning by learners, farm families and other stakeholders and indeed Teagasc. Teagasc has a clear role in promoting education and careers in a coherent and holistic manner. Equally, stakeholders themselves have the responsibility for 'selling' their industry to potential career entrants if they intend to rely on an employee workforce for the future.

Gender pro-activeness in Teagasc education and in career promotion.
The Vision process noted the low level of female school leaver participation in vocational agricultural programmes. At adult education level, the Vision process recognised the need for farm business appreciation courses for spouses/partners who may not be involved in day to day operations but who have a role in the administration and development of the farm. The need for more networking opportunities for females involved in farming was also highlighted.

Cultivating entrepreneurial and transversal skills.
The Vision process emphasised the importance of developing entrepreneurial and problem solving education capabilities of future entrants. The World Economic Forum defines entrepreneurship as 'the pursuit of opportunities beyond the resources you currently control' *(Educating the Next Wave of Entrepreneur,* World Economic Forum, 2009). This definition is relevant to the context of Teagasc learners, the majority of whom will acquire land resources through farm inheritance or farm partnerships. The Vision process envisaged that Teagasc motivate learners to evaluate their resources and potential opportunities through an entrepreneurial lens.

There will be a need for greater emphasis on developing learners' capabilities regarding: learning to learn, problem solving, independent and critical thinking skills, self-motivation and resilience. The importance of developing a 'sense of place' among learners and of fostering rural leadership and the importance of civic participation was also highlighted.

Future capability requirements for the land sector.
Core occupational roles and their associated capability requirements need to be clearly identified and linked to appropriate educational pathways. For larger farms, occupational roles are likely to become more differentiated. For smaller farms the various farm occupational roles are frequently compressed into owner operator roles. The Teagasc Education Vision consultation process and broader EU, national and industry thinking emphasise the need to align knowledge, skills and competency to future occupational roles and levels of responsibility. The Vision outcome suggests that knowledge, skills and competency in the following areas will be essential for future entrants:

Environmentally sustainable production. A higher level of knowledge, skill and competency will be required by future land sector entrants regarding sustainable farming approaches and bio-economy principles. This is in the context of climate change mitigation policies and greater environmental regulation.
Technical knowledge and skills. The technical skills portfolio must be up to date and readily adaptable to new needs. Frequently highlighted skills include grass management and grass budgeting, livestock breeding, soil management, farm machinery and mechanisation, and animal and crop husbandry. It is generally accepted that not all technical knowledge and skills may be fully mastered in the formal education system and that lifelong learning will be particularly important.
Business management and financial management. Feedback from the dairy and horticultural sectors places additional emphasis on broader farm business management activities and people management skills. There was a view that more advanced farm business and financial training might be more relevant at a later point in life, when young entrants have built up some experience of farming in their own right.

Safety, risk management and governance. The Vision process highlighted the critical need for future Teagasc graduates to understand governance and asset management, hazard and risk identification and mitigation of damage potential and risk management principles both in terms of compliance requirements and business/financial risk. Farm health and safety will continue to be a core requirement for young entrant education and for lifelong learning.
Market driven requirements. Food supply chain integrity, food safety and traceability, food quality, sustainable food production, animal and plant health, antimicrobial resistance, welfare and biosecurity will be of increasing importance for 'next generation farmers'. These will be of critical market importance to Ireland as a food exporting nation.
Smart technologies and precision farming technologies. While expressed in differing contexts, a common theme emerged regarding the impact digital and smart technologies will have on future farming activities. Familiarity with new 'precision farming technologies' and 'automation and robotics' and other smart technologies and online resources and decision support systems; will be of much greater importance for future entrants.

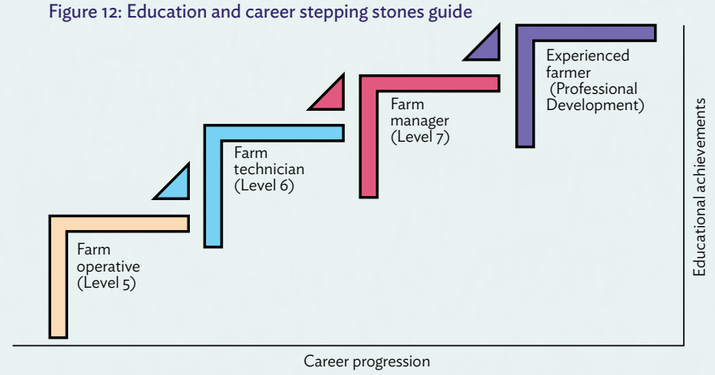
The findings of the Teagasc Education Vision exercise align well with the future land sector capabilities identified in the recent European *Commission Future of Farming and Food* communication, notably in areas such as sustainability and environmental care, smart agriculture and risk management.

Education pathways and future qualification requirements.
The Teagasc Education Vision deliberations on future education and qualification needs centred around three core farm occupational roles (or equivalent occupational role types in other areas of the land sector):

Farm manager. The role of a farm manager encompasses a significant business management dimension be it as an owner manager or as an employed manager.
Farm technician. The role of a farm technician encompasses a significant farm production and farm administration role, be it as a crop production, livestock production or herd manager or supervisor or assistant farm
Farm operative. As farm and herd size expands the role of farm operative or farm assistant will be crucial to everyday farm operation. These roles may be permanent or casual. The importance of training opportunities and career progression at operative level will become more evident.

Based on extensive consultation with stakeholders, consideration of national policy objectives and appraisal of trends in agricultural education internationally, the Teagasc Education Vision proposed the following framework. It links occupation capability needs to desirable education qualification levels. It is acknowledged that for smaller scale farms roles are likely to be less differentiated, with owners fulfilling all functions in some cases.

Figure 12: Education and career stepping stones guide



Box 15: Recommended Teagasc education pathways to meet occupation competence requirements[1]

Farm manager

- Plan and co-ordinate key farm activities.
- Analyse and respond to more complex farming situations and problems.
- Manage and lead farm businesses.
- Conduct strategic options analysis.
- Evaluate work and business performance.
- Manage people, teams and systems.
- Recruit staff and co-ordinate staff induction and training.

Recommended Teagasc education pathway:

- Level 7 degree in Farm Management obtained through a higher apprenticeship programme.

Farm technician

- Lead and carry out farm and/or farm unit routine activities.
- Carry out farm or farm unit administration and recording duties.
- Take routine farm or farm unit decisions.
- Plan for and manage problems.
- Supervise farm/farm unit resources.

Recommended Teagasc education pathway:

- Level 6 Advanced Certificate in Agriculture - two year pathway incorporating the Level 5 Certificate in Agriculture and the Level 6 Advanced Certificate in Agriculture.

Farm operative

- Carry out defined farm work duties competently.
- Exercise initiative in executing routine farm activities.
- Assist in the overall operation of the farm.
- Act effectively as a member of a team

Recommended Teagasc education pathway:

- Level 5 Certificate in Agriculture and/or customised sector-specific skills training programmes.

[1]The Teagasc Education Vision process recommended the above minimum qualifications requirements whilst recognising that the mastery of key skills for a given occupation will only emerge with maturity and 'on the job' training.

The career and qualification pathways indicated for farm occupations has broad application across other land sectors in terms of operative, technician, supervisor and manager/owner roles. Teagasc-linked higher education programmes provide a progression option for Teagasc further education learners. While graduates of higher education programmes typically pursue careers in the wider land sector, a substantial cohort also have an involvement in farming. It was proposed that Teagasc maintain its partnership with the higher education sector for the future.

Professional development for farmers and the wider land sector.

The Vision process identified the need to provide a continuous professional development (CPD) programme to active farmers and to graduates of Teagasc courses. There was a consensus that certain business, people management and cutting-edge technology skillsets may be more effectively deepened and developed after a period of farming experience.

There was also an emphasis on the need to support and mentor graduates who are entering farming as a career. The need for agricultural college learners to have an appreciation of Teagasc advisory and knowledge transfer services was also highlighted. The opportunity to provide informal 'how to' training through online platforms was highlighted and it was recommended Teagasc develop further capability in this regard.

Lifelong learning and CPD programmes may be warranted in other areas of the land sector. It was recognised that Teagasc already provides support and CPD opportunities to farmers notably to the dairy sector under the broad categories of 'start-up' (courses for new entrants), 'grow' (for expanding herds) and 'step-up' (farmers wish to develop new skillsets such as people management). In recognising this, the Vision process concluded that a more integrated and holistic approach to farmer and land sector CPD was required.

Workplace (Practical Learning Period) learning outcomes.

The contribution of Practical Learning hosts in providing critical workplace experience to Teagasc learners was an underpinning theme across the consultation process. Key issues included the need to specify clear learning outcomes for host based practical learning periods; the role of hosts as educators, ensuring that host units are fit for purpose; and ensuring appropriate induction and training for hosts.

Teaching and learning approaches in Teagasc education.

The importance of effective teaching and learning approaches was a major theme throughout the overall consultation process. Key discussions focussed around:

- Developing problem based learning approaches appropriate to a Teagasc context.
- Catering for learner diversity.
- Applying digital technologies to enhance education delivery and learning.
- Addressing the challenges in recognising prior learning while maintaining robust recognition procedures.

Teagasc education staff training and professional development.

The critical importance of pedagogical training and professional development for Teagasc education staff was endorsed throughout the Vision consultation process. Teagasc education staff have a key role in developing skill and competency sets for the next generation of entrants to the land sector. It was recognised that like higher education institutions, formal teaching qualifications are not a recruitment requirement for Teagasc staff.

Staff mobility in Teagasc education is higher than in other education sectors as Teagasc education staff can move freely to take up positions in other areas of Teagasc. This was seen as a significant challenge to the continuous professional development of Teagasc education staff. The Vision process nevertheless concluded staff training and professional development should be an overriding priority for the future.

Land sector award and standards.

The Vision process noted the important role Teagasc already plays as a scientific and knowledge transfer body in supporting and informing the development of land sector award standards. It was articulated that this role will become more important in the future given the challenges and opportunities facing the land sector. The Qualifications and Quality Assurance (Education and Training) Act 2012 lists Teagasc as one of the education bodies that may request delegation of authority from QQI to make awards.

6.2 Goals and recommendations

Goal 1: **Actively promote viable careers and attractive career progression paths in the land sector.**

1. Highlight the minimum desirable qualification requirements for future farm owners.
2. Develop career 'stepping stone' guides that identify occupational roles and the appropriate education levels and qualifications for such roles.
3. Develop, with industry stakeholders, a more coherent strategy for the promotion of viable careers and career progression opportunities in farming and related sectors.
4. Ensure that Teagasc learners are fully acquainted with collaborative farming models and family partnership arrangements.
5. Engage proactively with learners, farm families, schools and career guidance counsellors regarding career and education planning.
6. Provide learners with greater exposure to successful role models.

Goal 2: **Ensure that agricultural education and farming careers are promoted in a gender positive way.**

1. Develop a more gender proactive approach to promoting Teagasc education aimed at schools, career guidance teachers and farm families.
2. Ensure that farming is not stereotyped as a male profession in Teagasc promotion and dissemination activities.
3. Actively highlight female role models that are economically involved in the land sector.
4. Continue to actively encourage female attendance and participation at Teagasc events.
5. Ensure that life long learning and CPD opportunities are provided for spouses/partners
6. Work with other industry stakeholders in providing networking events for spouses/partners.
7. Encourage farm families to equally consider female succession as farm owners.

Goal 3: **Cultivate entrepreneurial and transversal skills that will encourage Teagasc graduates to pursue ideas and opportunities beyond their current resources.**

1. Ensure that entrepreneurial learning is embedded in Teagasc curricula.
2. Develop the capacity and capability of Teagasc educators to adopt entrepreneurial and problem based learning approaches.
3. Provide learning experiences that foster personal iniative and a problem solving attitude.
4. Expose learners to successful peer role models.
5. Increase the focus on transversal skills and competencies that support personal competence as a lifelong investment in a changing and volatile agri-food sector.

Goal 4: **Develop learners' knowledge, skills and competence to meet the changing requirements of the 21st century land sector occupations.**

Sustainable farming

1. Embed sustainable farming principles and technologies in future land sector curricula.
2. Continue to develop the 'Open Source' sustainable farm project at Teagasc Kildalton as a resource to inform curriculum development and facilitate staff training in sustainable farming.
3. Prepare a bio-diversity plan for each agricultural college.

Technical and business knowledge

1. Re-evaluate the core business management competencies appropriate to each education level and identify the most effective teaching and learning approaches that should be employed.
2. Establish Teagasc resource leadership teams involving Teagasc subject matter experts (research and knowledge transfer) and educationalists to ensure that Teagasc education resource materials reflect best current practice, technologies and delivery methods.
3. Establish a cross-college farm enterprise discussion group network involving education staff led by Teagasc knowledge transfer specialists, and supported by an annual technical in-service programme for education staff at Teagasc research centres to ensure that educators have access to the most current business and technology practices.
4. Conduct college farm enterprise benchmark reviews at each college involving knowledge transfer and research staff and education peers to ensure that college farm plans and performance are fully aligned to Teagasc research and knowledge transfer goals for the benefit of learners.
5. Ensure learner exposure to progressive farmers through farm visits.
6. Build on existing links and develop new links with industry and agencies to expose learners to key industry programmes (e.g. Bord Bia, Irish Cattle Breeding Federation, Animal Health Ireland, Sport Horse Ireland, financial institutions, processors and others).

Governance, safety and market driven requirements

1. Actively liaise with key stakeholders and agencies regarding future education needs for health and safety; food safety assurance and traceability; disease and biosecurity and anti-microbial resistance; animal welfare and herd health planning.
2. Continue to develop learners' governance ethics regarding food chain requirements, market specifications, hazard risk assessment and management and farm compliance.
3. Ensure that learners are familiar with industry driven quality assurance schemes regarding food safety, quality, animal welfare, bio-security, antimicrobial resistance and sustainable production compliance.

Smart technologies and precision farming

1. Establish a smart technologies and precision farming working group involving Teagasc education staff, knowledge transfer staff and research staff (and where appropriate external stakeholders) to ensure that quality resources and information on emerging technologies are fed into the Teagasc education system.
2. Expose learners to emerging 'smart and precision' technologies and systems that will increasingly impact on farming and land sector activities.

Goal 5: **Provide Teagasc education pathways and qualification destinations for farm managers, farm technicians and farm operatives with progression routes to enhance career opportunities.**

Farm manager

1. A Level 7 qualification should be the minimum qualification for future farm managers.
2. To facilitate this, a national apprenticeship scheme for the occupational role of farm manager leading to a Level 7 degree award should be developed.
3. The Level 6 Advanced Certificate in Agriculture should be seen as the minimum appropriate qualification for future managers/owners of smaller scale farms.

Farm technician

1. The Level 6 Advanced Certificate in Agriculture should be the minimum qualification for the role of farm technician.
2. Consideration should be given to developing a farm apprenticeship route leading to a Level 6 qualification equivalent to the Advanced Certificate in Agriculture award.

Farm operative

1. A rapidly expanding dairy sector will have an increased need for permanent, temporary and casual operative labour. If not addressed, these labour deficits will pose a risk to dairy expansion.
2. The Level 5 Certificate in Agriculture can provide a route for operatives to pursue Level 6 advanced programmes, facilitating career progression opportunities.
3 Customised operative programmes involving a combination of accredited and non-accredited training may be necessary in some sectors.
4. In addition to delivering operative training, stakeholders proposed that Teagasc take a lead role in developing standards for industry recognised operative training programmes that may be delivered by, or with, other providers.

Other land sectors

1. Explore the potential for entry level and advanced apprenticeships across the land sector.
2. Develop specialised poultry programme streams leading to QQI Level 5 Certificate in Agriculture and Level 6 Advanced Certificate in Agriculture awards.
3. Establish a specialised Level 6 advanced programme in pig husbandry.
4. Develop specialised training opportunities for specific horticultural sectors, including commercial mushroom production, greenkeeping and sports turf management.
5. Expand part-time and blended education options for horticultural education and training.
6. Develop customised operative training programmes for the forestry sector in consultation with DAFM and industry stakeholders.
7. Consult with, and respond to, future education needs for the organic sector.

Teagasc higher education linkages

1. Maintain existing education partnership arrangements with and progression routes to the higher education sector.
2. Support higher education partners in ensuring that programmes remain current and relevant to future land sector occupation capability requirements.

Goal 6: **Establish professional development routes for farmers and the wider land sector including an alumni support programme for Teagasc graduates who are taking up farming.**

1. Develop a Continuous Professional Development (CPD) route for experienced farmers.
2. Link existing Teagasc activities (Discussion Groups, events, conferences) under the umbrella of Teagasc lifelong learning and CPD.
3. Develop a Teagasc alumni support programme for Teagasc education graduates who are taking up farming.
4. Increase Teagasc learner awareness of Teagasc advisory and research services through exposure to Teagasc advisory and research staff.
5. Develop a suite of short practical 'how-to' online video clips both as a resource for learners and a refresher opportunity for established farmers and others across the land sectors.
6. Appoint a social media specialist to lead and co-ordinate the development of such resources.
7. Provide lifelong learning and CPD opportunities for other areas of the land sector.

Goal 7: Strengthen workplace (Practical Learning Period) learning outcomes.

1. Establish clear learning outcomes and assessment approaches for practical learning periods on host farms/units that recognise learners as trainees rather than 'job ready' employees.
2. Review the selection criteria for the Teagasc Practical Learning Host Panel to ensure that learning experiences on host farms/units are appropriate to learners needs.
3. Introduce a practical learning agreement template between Teagasc and hosts that sets out the respective responsibilities of Teagasc, hosts and learners.
4. Introduce a formal induction training programme for hosts and provide a continuous professional development and support programme for existing hosts.
5. Monitor host farmer performance on an on-going basis.
6. Ensure that Level 5 Certificate in Agriculture practical learning periods commence in advance of peak farm workloads to allow the host farmer and the learner time to develop a learning environment. Move Level 6 advanced livestock placements from autumn to spring.

Goal 8: Adopt innovative teaching and learning methodologies, delivery approaches and learner supports that will enhance the capabilities of Teagasc learners in a holistic way.

Teaching and learning methodologies

1. Develop Problem Based Learning (PBL) approaches appropriate to Teagasc learner contexts.
2. Review curriculum design, development, delivery and assessment approaches to facilitate more innovative teaching and learning approaches that develop learners' transversal skills.
3. Ensure that practical instruction group size and classroom group size are conducive to effective teaching and learning.
4. Recognise the important role of the 'student voice' in enhancing teaching and learning.

Learner support

1. Continue to develop Teagasc's learner support policy in line with overall best practice.
2. Equip education staff with 'best practice' techniques and intervention skills to support and engage with all learners.
3. Establish closer working connections with other bodies and organisations (NALA, SOLAS/ETBs/AHEAD and others) to strengthen learner support capabilities and support offerings.
4. Provide a student assistance programme for learners experiencing personal difficulties.

Use of digital technologies to aid education delivery and learning

1. Develop a digital technology strategy for Teagasc education to ensure the effective use of such technologies in teaching, learning and assessment.
2. Assign a dedicated e-learning technologist to develop a vision for, and support to, the implementation of Teagasc's e-learning strategy.
3. Up-skill education staff regarding the effective use of online technologies in teaching and learning.
4. Extend blended and distance education programme offerings.

Recognition of prior learning

1. To review Teagasc recognition of prior learning policies to take account of prior formal, non-formal and informal learning in line with EU and national recognition policies.

Goal 9: Prioritise Teagasc education staff training and professional development to ensure that teaching and learning approaches reflect up to date and innovative best practice.

1. Ensure that initial teaching and learning training is undertaken within a designated period of staff recruitment.
2. Identify postgraduate teaching and learning programmes that will support the continuous pedagogical professional development of Teagasc education staff.
3. Develop and maintain an up to date 'toolkit' of teaching and learning best practice for Teagasc educators drawing both on internal and external sources.
4. Incorporate self-evaluation and continuous improvement plans in teaching and learning as priority objectives within Teagasc business plans and staff meetings.
5. Continue with independent Whole College Evaluations of teaching and learning in Teagasc colleges, Teagasc-linked private colleges and Teagasc Regional Education Centres.
6. Continue the Teagasc Walsh Fellowship (MAgrSc Agricultural Innovation Support) programme of post graduate research regarding innovation in teaching and learning and programme evaluation.
7. Provide an annual programme of technical in-service training and staff technical discussion groups for educators; focussing on best practice, research updates and sector strategic objectives.

Goal 10: Support the development and maintenance of land sector awards standards.

1. Seek delegation of authority from QQI for Teagasc to make awards.
2. Support awarding bodies, education institutions and land sector stakeholders; in ensuring that award standards and curricula adequately reflect the future knowledge, skill and competencies requirements for land sector occupations.

Teagasc has a statutory remit to provide and procure education and training and is the predominant agricultural educator of landowners in Ireland.

Appendix 1: Teagasc Education Vision consultation process

Steering Group

An overall steering group comprising national and international representatives from government institutions, the education sector and the agri-food sector was established to guide and monitor the Teagasc Education Vision project. The membership of the steering group was:

- Professor Seamus Smyth, President Emeritus, Maynooth University; Chairperson, Teagasc Education and Training Forum, Chairperson, Teagasc Education Vision Steering Group.
- Professor Gerry Boyle, Director, Teagasc.
- Professor Tom Kelly, Head of Knowledge Transfer Directorate, Teagasc.
- Mr Bill Callanan, Chief Inspector, Department of Agriculture, Food and the Marine.
- Professor Willie Donnelly, President, Waterford Institute of Technology.
- Dr Domnall Fleming, Senior Inspector, Department of Education and Skills.
- Mr Alan Jagoe, Teagasc Authority; Teagasc Education Forum; President European Council of Young Farmers; Former President Macra na Feirme.
- Mr John O'Brien, Teagasc Education Forum; Chair Master Farmers Association; Member of the
- Ms Marian Coy, President Emeritus, Galway Mayo Institute of Technology; Board of Management Chairperson, Mountbellew Agricultural College.
- Dr Edmond Harty, Chief Executive, Dairymaster; Board of Governors Chairperson, Salesian Agricultural College, Pallaskenry.
- Mr Pearse Kelly, Head of Beef & Sheep Knowledge Transfer Dept., Teagasc.
- Dr Brendan Horan, Dairy Systems Research, Teagasc Dairy Research Centre Moorepark.
- Mr Henrik Dethlefsen, Head of the International Project Department, Green Academy, Aarhus, Denmark; Secretary-General of EUROPEA European association of 'green' vocational schools).
- Mr David James, Asst Principal - Head of Education Division and Regional Dean SRUC, Scotland; (co-ordinator *SRUC National Strategy for Land Based Education and Training).*
- Mr Ton Westerveld, Head of Dairy Farm Department, Wellant College, Netherlands.

The project management team comprised; Mr Tony Pettit, Head of Education, Teagasc; Dr Lance O'Brien, Head of Strategy & International Relations, Teagasc; Mr Frank Murphy, Head of Curriculum Development and Standards, Teagasc; Mr James Maher and Ms Carmel Finlay, Teagasc Curriculum Development and Standards unit and Ms Leanne Tobin, Teagasc Education Administration.

Terms of Reference

The overall thrust of the Teagasc Education Vision is to position Teagasc agricultural education and training to meet the future human capital needs for the land sector. The terms of reference were as follows:

- Assess the future knowledge, skill and competency requirements and technology requirements of the land sector and how they may impact on young farmer education needs over the coming decades. In doing so, to take account of the key findings and recommendations of the recent *Food Wise 2025* report and the *Teagasc Technology Foresight 2035* report.
- Identify the most appropriate and relevant education qualification levels and education pathways for future young farmers and other land sector entrants.
- Review education approaches and developments both across the broader education sector and in agricultural education that are relevant to shaping and improving both the quality of Teagasc education and the modes of education delivery.
- Identify specific innovations and trends in education, including opportunities for learner progression, prior learning recognition, early career development thinking, teaching and learning and education staff training that Teagasc could harness for the future.
- Make recommendations detailing the key strategic and operational measures that are actionable and will enable Teagasc education to meet the future education needs of the sector.

Core elements of the Teagasc Education Vision consultation process

- Invitation to key stakeholders to make submissions.
- Invitation for submissions advertised in the national farming press and the issue of a press release to national and local media.
- Publishing of an online submission template on the www.teagasc.ie Education Vision webpage to facilitate submissions.
- Establishment of dedicated internal Teagasc Working Groups.
- Holding of stakeholder workshops.
- Meetings with farm organisations, agencies and groups.
- Study trips to agricultural education institutions in Northern Ireland, Scotland, Denmark and the Netherlands to inform the Teagasc Vision Project. Additional topic specific visits took place to Sligo Institute of Technology (developing new higher level apprenticeships, use of online technologies in education), the National Maritime College of Ireland (training for competency development); Aalborg University in Denmark (Problem Based Learning approaches).
- Review of outcomes of Teagasc self-evaluation processes, including Whole College Evaluation reports; Teagasc impact of agricultural education studies; and Teagasc Foresight studies, notably the recent *Teagasc Technology Foresight 2035 Report.*
- Review of key national and international reports and policies relating to future needs of the land sector and of future approaches to teaching and learning.

The consultation process resulted in 109 electronic submissions being received, with 85 from individuals and 24 from groups or organisations. The submissions ranged from being detailed and wide ranging to being very brief and specific. Submissions were received from organisations and groups included:

- Irish Farmers' Association, Irish Creamery Milk Suppliers' Association, Macra na Feirme, Aurivo Cooperative Society, six Dairy Discussion groups, the Irish Farm Managers' Association, the Health and Safety Authority.
- Brief submissions were also received from the Food Safety Authority, Education and Training Boards (Sligo/Leitrim, Mayo and Kildare/Wicklow), Ohio State University (a Teagasc partner for student placement), ICOS (Irish Co-operative Organisation and Society), IFAC Accountants, Farm Relief Services, Animal Health Ireland and the Irish Shorthorn Cattle Breeding Society.

Teagasc Working Groups and Stakeholder Workshops.

Eleven Teagasc staff Working Groups were established to explore future education needs across different farming sectors and topics. The Working Groups included staff from Teagasc education and Teagasc-linked private colleges, knowledge transfer/advisory and Teagasc research.

Each Teagasc Working Group organised a Stakeholders' Workshop (in the main but not exclusively attended by farmers and growers). A total of 151 individuals attended the Stakeholder Workshops, with 84 of these being external to Teagasc. In excess of 100 farmers, graduates and current learners were also consulted with regarding their continuing professional development and lifelong learning needs. Close on 400 host farmers, who attended Teagasc host farmer meetings, were briefed on some of the key proposals emerging from the Vision process and feedback was obtained. The Teagasc Education and Training Forum for Teagasc education stakeholders was briefed on the emerging proposals.

The 11 Teagasc Working Groups included eight sector working groups and three specialised working groups. The sector groups were: Dairy, Beef, Sheep, Crops, Pigs/Poultry, Horticulture, Equine and Forestry. The specialised working groups included: Teaching & Learning Approaches and Female Participation in Agricultural Education and Lifelong Learning/Continuous Professional Development.

QQI review of Level 5 and 6 agricultural awards

A substantial review of the existing QQI Level 5 and 6 agricultural awards took place from mid-2015 to mid-2016. This was a separate but parallel process to the Teagasc Education Vision consultation. This review was carried out by a Standards Review Group led by Teagasc on behalf of QQI. The review involved extensive consultation in its own right. The awards review resulted in the strengthening of the existing awards in many aspects.

Key changes included the overall updating and re-alignment of modules and learning outcomes and assessment requirements for the Level 5 QQI Certificate in Agriculture and the introduction of some new modules at Level 5. The Level 5 Certificate in Agriculture award was also broadened to allow for a specialised Level 5 poultry programmes to be developed akin to the specialised Level 5 pig husbandry programme.

The Review found that the Level 6 QQI Advanced Certificate in Agriculture required little change. However a mandatory capstone module was introduced to facilitate learners to integrate their learning across the award programme. The Level 6 Advanced Certificate in Agriculture award was broadened to include pig and poultry modules to facilitate the introduction of specialised advanced programme streams for these sectors.

The Review Group was of the opinion that the Level 6 Specific Purpose Certificate in Farm Administration award was not suited to meeting longer term industry needs and did not align with awards in the wider education sector. For the short term, the Review proposed that this award be strengthened in regard to environmental management, livestock breeding and grass management.

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Glossary

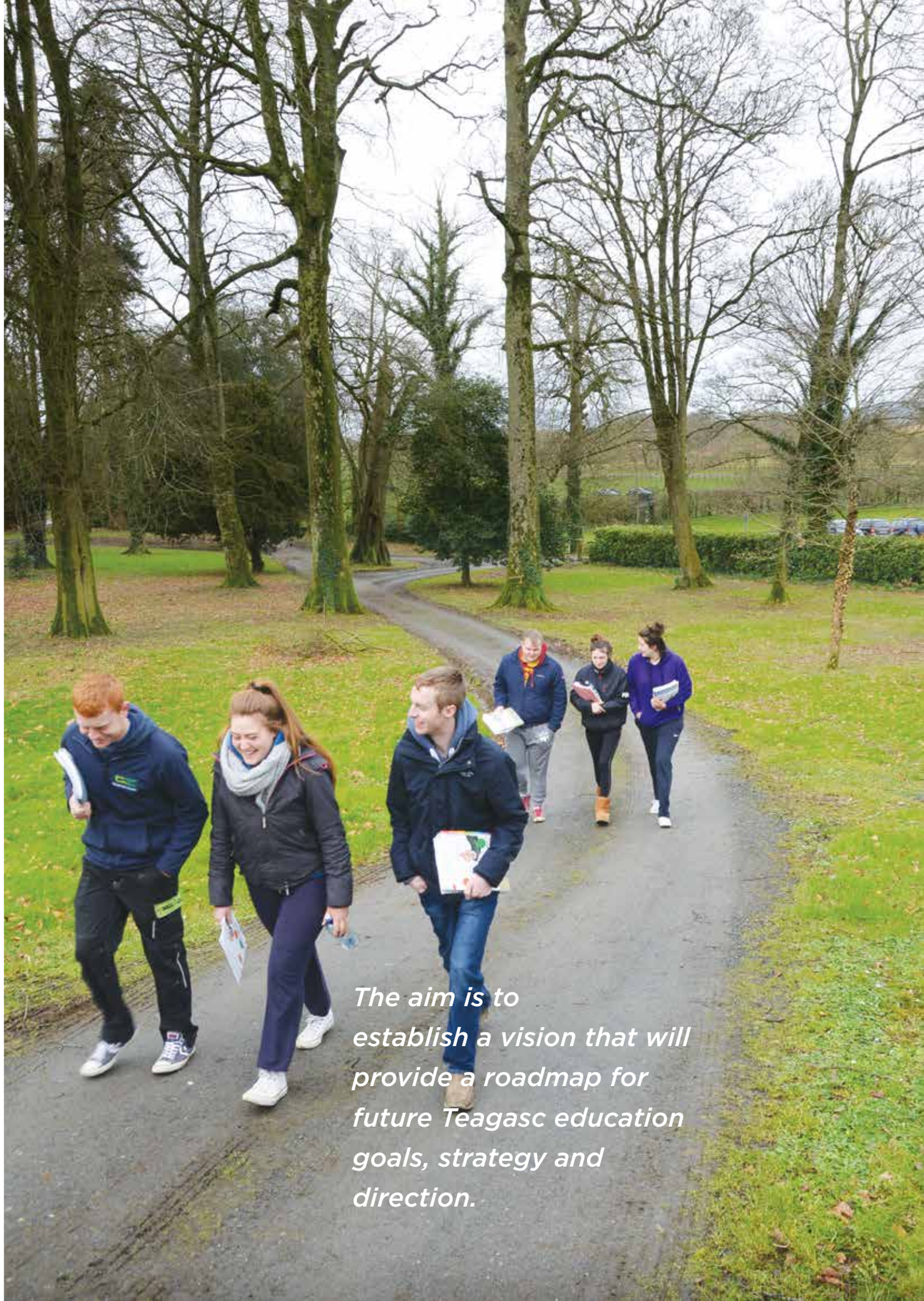
Organisations

Board Bia:	Irish Food Board
CAO:	Central Applications Office
CEDEFOP:	European Centre for the Development of Vocational Training
COFORD:	Council for Forest Research and Development
CSO:	Central Statistics Office
COAH:	Teagasc College of Amenity Horticulture at the National Botanic Gardens
DAFM:	Department of Agriculture, Food and the Marine, Ireland
DES:	Department of Education and Skills
Eurostat:	Statistical Office of the European Union
ETB:	Education and Training Board
ETBI:	National representative association for Ireland's sixteen Education and Training Boards (ETBs)
HEA:	Higher Education Authority
HSI:	Horse Sports Ireland
OECD:	Organisation for Economic Co-operation and Development
QQI:	Quality and Qualifications Ireland
RDS	Royal Dublin Society
SCAR:	Standing Committee on Agricultural Research, European Commission
SFSI:	Sustainable Food Systems Ireland
SOLAS:	Further Education Authority
SRUC:	Scottish Rural Colleges
Teagasc:	Agriculture and Food Development Authority
UCD:	University College Dublin
UNESCO:	United Nations Education, Scientific and Cultural Organisation

Terminology

Bioeconomy:	The production of renewable biological resources and the conversion of these resources, residues, by-products and side streams into value added products, such as food, feed, bio-based products, services and bioenergy. Circular bioeconomy encompasses the generation, regeneration and renewal loop for biological resources.
Brexit:	Potential departure of the United Kingdom from the European Union.
CAP:	Common Agricultural Policy of the European Union.
Further education:	Post second level education outside of higher education. Further education extends up to and includes Level 6 on the National Qualification Framework. Typical areas include vocational qualifications in many disciplines: such as childcare, agriculture, retail, and tourisms; many apprenticeships; but it also covers a range other types of education programmes including short duration courses.
GDP:	Gross Domestic Product.
Green Cert:	Commonly used term to describe Teagasc education programmes that meet the 'young trained farmer' requirements pertaining to schemes and incentives intended for young farmers.
ICT:	Information communication technology.
Land sector/ Agri-food sector:	Land sector refers to commercial activities such as farming, horticulture, forestry and equine enterprises that directly use land resources. The agri-food sector encompasses the land sector and the wider food processing and related service sectors.
PBL:	Problem based learning.
RDP:	Rural Development Programme under the EU Common Agricultural Policy.
Precision agriculture:	Involves specialized equipment, software and IT services that increases the precision and accuracy of farm activities e.g. the use of GPS (Global Positioning Systems) for farm operations.
RPL:	Recognition of prior learning.
Smart farming:	The concept of smart farming encompasses many different new technologies that can be used individually, or together, to increase the efficiency of agricultural operations.
Transversal skills:	Personal skills encompassing, among others, problem solving, critical thinking, communication, teamwork and entrepreneurial skills. May be referred to as 'soft' skills, 'generic' skills or 'transferable' skills.

Notes


The aim is to establish a vision that will provide a roadmap for future Teagasc education goals, strategy and direction.