Introduction
The development of sustainable production systems is a key component of agricultural development. 'Foodwise 2025' states that: 'development must be undertaken within a framework of sustainability with environmental protection and economic competitiveness being complementary'.

The agri-food industry, led by Bord Bia, continues to strive for market advantage by demonstrating the sustainability of Irish food through initiatives such as Origin Green. International food buyers are increasingly demanding verification and ongoing improvements of the sustainability credentials of food exports.

Teagasc aims to mainstream sustainability across all its programmes by developing and disseminating the technologies needed to make Ireland a world leader in science-based sustainable agricultural and food production. Environmental research will play a key role in supporting policy formation, in developing and promoting sustainable production and in developing the metrics and evidence base to verify the sustainability of Irish produce.

Teagasc will integrate ‘sustainability’ into all advisory and education programmes and will focus on improving farmers’ capacity to implement sustainable technologies and practices. Teagasc will support farmers in achieving cross-compliance standards and in participating in the green low-carbon agri-environment scheme (GLAS) and other targeted environmental schemes.

Nutrient efficiency
Improving nutrient efficiency is essential if Irish farmers are to meet growth and environmental objectives. Improved soil fertility management through the adoption of practices that increase the proportion of nutrients recovered in farm output and reduce losses to water and air is the key objective. Achieving widespread utilisation of nutrient management plans, which are based on soil analysis results and appropriate recommendations is a priority.

Actions
Research will continue to focus on quantifying crop requirements for macro and micro nutrients, on evaluating fertiliser formulations which can deliver positive environmental outcomes, on evaluating diversity in nutrient requirements based on soil typology and on maximising nutrient recycling and recovery from organic fertilisers and soil reserves. Research will focus on further development of NMP Online and integration with the soil information system and PastureBase Ireland, to tailor fertiliser recommendations by pasture productivity and soil type. Teagasc Knowledge Transfer (KT) will roll out NMP Online to prepare nutrient management plans for approximately 60,000 farmers from 2016 to 2019. The focus will be on improving the quality of planning and improving the use of plans by farmers through the use of maps and graphics.

Targets 2025:
- use NMP Online with 60% of farmers (with soil analysis);
- reduce soils at Index 4 to less than 10%;
- reduce proportion of soil at phosphorus (P) Index 1 on high stocking rate farms (>130Kg nitrogen (N)/ha) by 15% by 2025; and,
- increase proportion of land on high stocking rate farms with pH >6.2 from 33% to 50%.

Water quality
Achieving good or excellent status in 100% of ground and surface water is the ultimate water quality objective. The timeline to achieve this has been reviewed in light of the ‘time lag’ between changes in practice and water quality outcomes.

Actions
Research: knowledge gaps remain in relation to the pathways, residence times and transformations of nutrients along the transfer continuum to a water body. Primarily through the agricultural catchments programme, research will focus on modelling of environmental and economic impacts of farm practices in relation to water quality, on investigation of the scope for meeting Nitrates and Water Framework Directive objectives in the context of Foodwise 2025, on the development and testing of mitigation measures and on the development of a toolkit for environmental advice and planning.

Advisory services will focus on better nutrient planning by farmers using NMP Online. Throughout all advisory programmes there will be an increased focus on eliminating point source pollution and ensuring that cross compliance standards are met.

Targets 2025:
- halt the decline in the proportion of high status water bodies;
- increase the proportion of rivers achieving good or high
status from 53% (Environmental Protection Agency (EPA), 2015) to 60% in 2025;  
- completion of a national high-resolution hydrological source area map to provide a basis for targeted actions by 2025; and,  
- develop a water quality module on a specially based land use/land management tool to improve water quality.

Gaseous emissions
Achieving reductions in gaseous emissions represents the most significant challenge for Irish agriculture. Ireland has a target to reduce its CO\textsubscript{2} emissions by 30% by 2030 compared to 2005 levels. Proposed growth of the agricultural sector will make this a very challenging target. Achieving reductions in ammonia emissions is also required.

Actions
Research will focus on greenhouse gas (GHG) mitigation through improving the understanding of interactions between lime, P and N, on optimisation of land management including drainage and management for sequestration and on evaluating emerging technologies for reducing emissions during slurry storage and enteric fermentation in the rumen. Teagasc research will continue to play a key role in informing policy and regulation. Advisory services will focus on increasing awareness of agricultural GHGs and achieving improvements in the carbon footprint of Irish food. The Carbon Navigator will be a key tool in this process.

Targets 2025:
- increase the proportion of urea based N to 40% of total N (65% as protected urea);  
- GHG emissions per unit of dairy and beef output reduced by 2.5% per annum to 2025;  
- increase slurry spread using low emissions technology to 25% and improve timing of spread; and,  
- to support an increase in forestry planting to 8,000ha/year.

Biodiversity
The European Union is strengthening its policy framework to halt the loss of biodiversity by 2025. Biodiversity targets will feature prominently among future Common Agricultural Policy (CAP) and environmental reforms. The National Biodiversity Action Plan 2017-2021 targets biodiversity conservation in the wider countryside as well as in protected areas.

Actions
Teagasc research will focus on the identification of high nature value (HNV) farming systems and on developing sustainable management strategies to improve outcomes. Along with Bord Bia, Teagasc will develop a methodology for the inclusion of biodiversity in farm scale sustainability assessment to support product marketing. Teagasc research will develop and assess best practice for the implementation of outcome-based approaches, which can inform locally led and national agri-environmental schemes. The advisory service will support the maintenance of farmland habitats through advice on best management practice, promotion and support of agri-environmental schemes and agri-environment education. This will be facilitated by the integration of biodiversity into all Teagasc KT programmes.

Targets 2025:
- contribute to the restoration of Annex 1 habitats and species to favourable conservation status by 2025 (including the freshwater pearl mussel);  
- improve management of farmland habitats through contribution to targeted national and locally led schemes and KT actions; and,  
- development of methodology for the inclusion of biodiversity in the assessment of farm scale sustainability.

Soil
Soil is the key resource of farming. The role of farmers in soil protection involves maintaining and improving the capability of soils to perform a multitude of functions including crop production, carbon storage, water purification and storage, and ecological habitat stability. Increased information on our soils is required in order to continue the development of agriculture.

Actions
The completion of the land management, assessment, research, knowledge (LANDMARK) and soil quality research (SQUARE) projects in developing a national soil quality database and contributing to an EU-wide soil quality database is a priority. These projects will supplement existing soils information in terms of ability to perform a series of soil functions and will support functional land management at farm level and policy development. Advisory services will focus on supporting farming systems and practices which avoid degradation and where possible achieve improvements in soil quality.

Targets 2025:
- utilise the national soil map of Ireland to create a functional land use map relevant for policy;  
- develop a national soil quality database and map; and,  
- develop farmer friendly tools to assess soil quality at farm level.

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The road map for environment is available on www.teagasc.ie.