

TEAGASC TECHNOLOGY  
FORESIGHT  
TECHNOLOGY TRANSFORMING  
IRISH AGRI-FOOD AND BIOECONOMY

2035

FORESIGHT REPORT

# Teagasc Technology Foresight 2035

EURAGRI Annual  
Conference, Tartu, Estonia  
25-27 September 2016

Professor Gerry Boyle,  
Director Teagasc, Ireland

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## Global megatrends and drivers of change



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## Needed transformation



*“To address the unprecedented challenges that lie ahead, the food system needs to change more radically in the coming decades than ever before, including during the Industrial and Green Revolutions”*

(UK Food and Farming Foresight, 2011, p.176)



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## Project overview

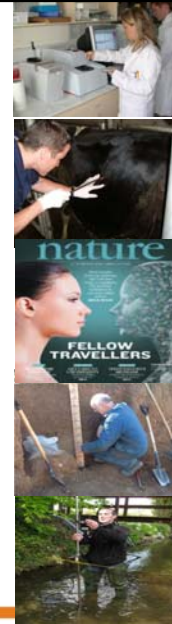
The identification of the key technologies that have the potential over the next 20 years or so to underpin competitiveness, sustainability and growth in the Irish agri-food and bioeconomy sector



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## Five transformative technologies

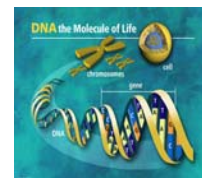
- Plant and animal genomics and related technologies
- Human, animal and soil microbiota
- Digital technologies
- New technologies for food processing
- Transformations in the food value chain system



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## Plant and animal genomics and related technologies

- Reducing cost of genotyping and sequencing hugely facilitated **genomic selection** where genetic information supplements phenotypic information
- Genomic selection in dairy cattle is one successful application – introduced in Ireland in 2009
- Multi-breed beef genomic selection to be launched in Ireland in autumn 2016
- Sheep genomic selection in 2017?
- Genomic selection in ryegrass breeding in c. 2 years



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## Next phase?

- Gene editing techniques such as CRISPR/CAS allows us to precisely tweak existing DNA in a way that resembles natural mutation
- Speed-up breeding
- Novel traits such as disease resistance, Nitrogen use efficiency, polledness in cattle

### Production of hornless dairy cattle from genome-edited cell lines

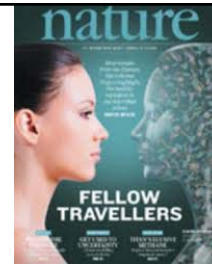
[Carlson](#) et al., Nature Biotechnology, May 2016



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## Better understanding of the human, animal and soil microbiota

- Microbiota = the totality or community of microbes in particular organism, place or environment
- Next generation DNA sequencing allows us to study the whole microbial community, whereas traditional culturing only allowed a fraction to be grown and studied



Illumina -  
NextSeq



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## Current state- of- the- art

- Rapidly expanding evidence that the human microbiota influences physical and mental health and development
- Human gut microbiota is influenced by food intake
  - opportunities for the food industry
- Potential to apply these insights to animal, soil and plant microbiota



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## Digital technologies

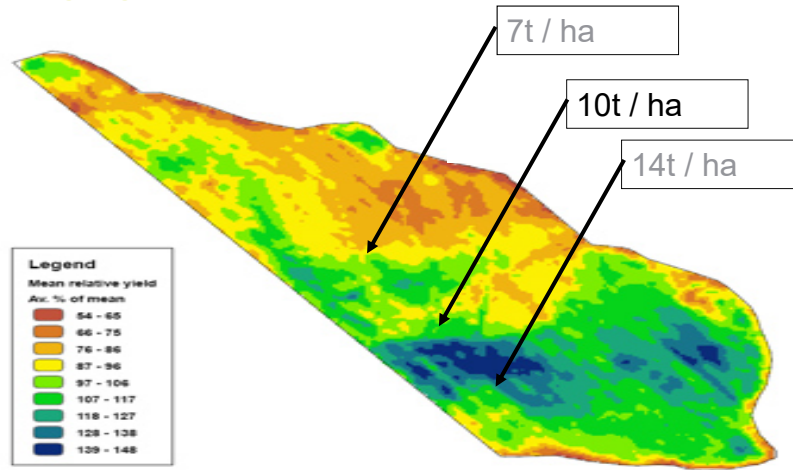
Suite of technologies that involve the application of ICT, sensing, robotics, data analytics and other digital technologies to agriculture



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## Yield maps (e.g., pasture) measured using remote imaging or machine-mounted sensors



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## Measuring pasture yields

Measuring pasture growth from space

Percentage difference from average accumulated biomass for the period April-May 24th



PastureBaseIreland



Could drones be a future platform for grass measurement?



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## Technology for animal monitoring

Biosensors in veterinary diagnostics

## New emerging technologies for food processing

... extraction technology, non-thermal technology, biotransformation, bio-refining, synthetic biology and 3-D printing ...

Conventional and Advanced Food Processing Technologies  
Edited by Susanto Bhattacharya

Flavouring, Canning, Baking, Blanching, Dehydration, Ultraviolet, Ultrasonics, Instantiation, Gelation, Emulsification, High Pressure Processing, Non-thermal, Biotransformation, Bio-refining, Synthetic biology, 3-D printing

## Re-focus of food processing sector

- From provider of food and beverage to providers of nutrition and health
- Minimally processed foods
- Foods for nutrition and health (reduced salt, sugar and fat)
- Life stage (infant, expectant mother, elderly) and extreme (sports, cognitive function) nutrition
- Sensiometrics will exploit the relationship between sensory, chemical and consumer science



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## transformations in the biomaterials value chain system



Inputs sub-system

Farm production sub-system

Processing sub-system

Distribution and trading sub-system

Retail and consumer sub-system



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Your



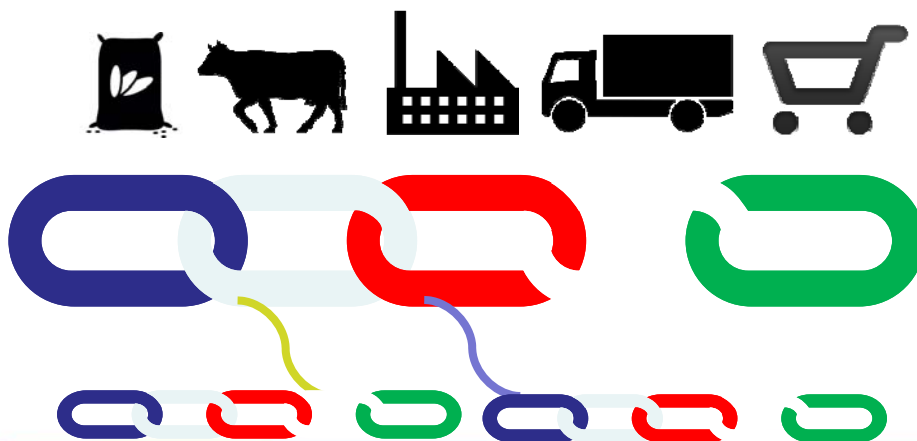
## Transformations in the food value chain system

- Changes in scale, changes in specialisation or changes in the relationships between components of the value chain will occur
- The inevitability of new disruptive business models within the food industry



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## potential new value chains will emerge



- Genetic differentiation of raw materials to produce higher value products

- Extraction of high-value trace chemicals from raw materials, e.g. milk
- Biorefining of biomass, including waste

Authority

## Teagasc Foresight

<http://www.teagasc.ie/about/our-organisation/foresight/>



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