

MSc in Agriculture, Climate change & Transitions (MSc.ACT)

M1 Programme – material to be delivered by the Plant & AgriBiosciences Research Centre (PABC), College of Science, National University of Ireland, Galway

In addition to their summer school at BOKU (5 ECTS), all students take the following 55 ECTS of taught modules within their MSc.ACT M1 as follows:

Semester I

1. Climate Change, Agriculture & Global Food Security (5 ECTS)
2. Soil Science (5 ECTS)
3. Agriculture & AgriFood Systems (including farm visits) (5 ECTS)
4. Understanding AgriBusiness & AgriFood Market Trends (5 ECTS)
5. AgriFood Sustainability & Agri-Resilience Challenges (5 ECTS)

Semester II

1. Agri-Biological Responses to Climate Change (5 ECTS)
2. Crop and Animal Agri-Biotechnologies (5 ECTS)
3. Natural Resources & Livelihoods (5 ECTS)
4. Gender, Agriculture and Climate Change (5 ECTS)

Running across Semesters I and II

1. Perspectives in Agriculture & Food Security (5 ECTS)
2. Career, Communication & Impact Pathway Skills (5 ECTS)

Detailed description of the course

Semster I Modules

Sem I, Module 1. Climate Change, Agriculture & Global Food Security (5 ECTS)

Training Objectives. This module provides an introductory overview of the key topics of agriculture and climate change. The module will provide students with an introduction to a range of climate change, agriculture and food security topics in the context of current challenges regarding sustainable global development.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Demonstrate knowledge of the current climate change challenges regarding sustainable global development.

LO2) Display a clear understanding of the implications of these challenges on sustainable production and global food security.

LO3) Identify and discuss the issues and evidence surrounding these challenges and related approaches to mitigation.

LO4) Evaluate options for climate change mitigation and adaptation strategies in the context of sustainable production and food security.

Sem I, Module 2. Soil Science (5 ECTS)

Training Objectives. An introduction to soil sciences in natural and agricultural environments. The module will also include assessment of plant interactions with their physical environment. The course examines how the distribution and growth of plants responds to climate, soil, nutrients and salinity. The course will prepare students for understanding soil-plant-environment interactions in ecological, physiological and agronomic contexts.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Critically assess the importance of links between plant and crop communities and their prevailing environment, including climate, soil type, and the availability of water and nutrients.

LO2) Relate the characters of plant communities to variation in nutrient status, soil and salinity.

LO3) Describe, measure and calculate key characteristics of soils from different habitats.

LO4) Make and interpret soil profiles and texture triangles.

LO5) Relate different soils to their possible agricultural uses, and consider the possible environmental impacts of these.

Sem I, Module 3. Agriculture & AgriFood Systems (5 ECTS)

Training Objectives. The module provides postgraduate students working on an agri or agrifood related topics to contextualise their research within the broader context of agriculture and the agrifood sector. Students will be enabled to understand the origins of agriculture and agrifood sectors, especially in Ireland, their current status, challenges and opportunities of national and international relevance. The module will be taught in conjunction with experts from partner organisations of the PABC, and will include lectures/seminars from leading international experts. Students will augment their learning experience with a visit to a local farming enterprise and interaction with the agricultural community. Students will conclude the module by making a presentation of a topic of relevance to Irish agriculture; and by writing a report that describes how their own areas of research interest relate to the wider context of the field.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Summarise the main factors which have affected the development of agricultural systems.

LO2) Explain the linkages between agri-related research across different research areas.

LO3) Identify priority and opportunity areas in which research can assist the development of agriculture and agrifood systems.

LO4) Write a report placing their own research topic in the broader context of Irish and international agriculture and agrifood systems.

LO5) Demonstrate an improved ability to make oral and written communications of their research topic in context of agriculture and agrifood systems.

Sem I, Module 4. Understanding AgriBusiness & AgriFood Market Trends (5 ECTS)

Training Objectives. The module will provide research students with an improved understanding of agribusiness structures and dynamics. The student will gain insights into agri-economics, agri-business, and agri-market trends. Particular focus will be placed on understanding value chains and the role of research and innovations in driving change, economic and commercial benefits for value-chain stakeholders. Students be provided with insights into food systems and geospatial, material and environmental footprint dimensions

of agrifood systems. The module will also provide insights into social, demographic, behavioural and gender dimensions of agriculture and agrifood systems, particular in relation to agrifood systems generating both social and economic impacts in Ireland and internationally. The module will involve a field study visit to the Teagasc Rural and Economy Centre in Athenry. During the course, students will maintain a Blackboard journal in which they record their experiences and are encouraged to reflect on how the topics relate to the future impacts of their own research; an overview of this process will be included in the first taught session. The final assessment of the course is via a 'business elevator pitch' to a judging jury in which the student presents how an idea developed during a research program (related to their own project, where applicable) could be used to develop a new product, service or market opportunity.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Summarise the dynamics of national and international agrifood markets and trends.

LO2) Understand the basic components for developing an agri-business plan.

LO3) Identify new export markets for agricultural and food products or services.

LO4) Develop and present a business plan for exploitation of an international market.

LO5) Appreciate the contribution of different disciplines and research approaches for developing and implementing a business plan for an agrifood product or service.

Sem I, Module 5. AgriFood Sustainability & Agri-Resilience Challenges (5 ECTS)

Training Objectives. The module will provide researchers with an understanding of the major sustainability and resilience challenges facing agriculture and agrifood systems in Ireland and internationally (including in developing and rapidly growing economies). The module will provide students with a cutting-edge understanding of major planetary boundaries relating to agriculture, and their inter-relationships with agriculture, diets, public health, food systems, markets and value chains. In the context of the development of future agricultural and agrifood systems in Ireland, students will gain an understanding of different scenarios and trajectories for agriculture and agrifood systems. Students will be required to identify emerging areas for disciplinary and inter-disciplinary research that can improve prospects for addressing sustainability and resilience challenges facing agriculture and agrifood systems in Ireland and internationally. The module will include field course visits to

agricultural sustainability initiatives, including value chain and business models that have a substantial agrifood sustainability component. This course is examined by participation in a 'conference format' class workshop in which each student will present a case-study of an environmental mitigation strategy.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Describe the major sustainability and resilience challenges facing the agriculture and agrifood sector globally.

LO2) Describe the major sustainability and resilience challenges facing the agriculture and agrifood sector in Ireland.

LO3) Identify research priorities and opportunities for improving sustainability and resilience of agriculture and agrifood systems.

LO4) Have an improved understanding how different research skills and interdisciplinary approaches can develop and deliver agrisustainability innovations.

LO5) Suggest strategies for improving the sustainability and resilience potential of agricultural and agri-food activities related to their own research area/topic.

LO6) Communicate in an Elevator Pitch format how their research topic can be relevant to agriculture and agrifood sustainability.

Semester II Modules

Sem II , Module 1. Agri-Biological Responses to Climate Change (5 ECTS)

Training Objectives. Global climate change impacts can already be observed in many physical and biological systems. Climate change will affect agriculture and forestry systems through higher temps, elevated CO₂ concentration, precipitation changes, increased weeds, pests, and disease pressure, and increased vulnerability of carbon pools. This module will examine biological responses of plants/crops and agri-systems to climate changes.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Appreciate how climate change can impact on environmental adaptation of biological organisms of relevance to agriculture and agri-food systems.

LO2) Discuss the difference between avoidance, acclimation and adaptation.

LO3) Describe how susceptibility to, or tolerance of stress can explain plant survival and habitat preferences.

LO4) Summarise photosynthetic pathways and how they are affected by different environmental conditions, including climate change.

LO5) Describe different plant stresses and the implications for global crop productivity.

Seml II, Module 2. Crop and Animal Agri-Biotechnologies (5 ECTS)

Training Objectives. This module provides an advanced understanding of plant and agri-biotechnologies. Such biotechnologies encompass a wide range of technologies and they can be applied for a range of different purposes, such as the genetic improvement of plant varieties and animal populations to increase their yields or efficiency; genetic characterization and conservation of genetic resources; plant or animal disease diagnosis; vaccine development; and improvement of feeds. Some of the technologies may be applied to all the food and agriculture sectors, such as the use of molecular DNA markers or genetic modification, while others are more sector-specific, such as tissue culture (in crops and forest trees), embryo transfer (livestock) or triploidization and sex-reversal (fish). When appropriately integrated with other technologies for the production of food, agricultural products and services, biotechnology can be of significant assistance in meeting the needs of an expanding and increasingly urbanized population.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) To provide an advanced understanding of the range and applications of plant and agricultural biotechnologies for meeting human needs.

LO2) To be able to describe plant and livestock improvement strategies using biotechnological approaches.

LO3) To consider how biotechnological approaches can be used to meet agricultural and sustainability challenges.

Seml II, Module 3. Natural Resources & Livelihoods (5 ECTS)

Training Objectives. This module deals with how climate change is affecting soils, microbes, water and marine systems, including impacts on sustainable livelihoods and livelihood security. In many instances, climate change impacts are requiring an urgent need for response measures that minimize current vulnerabilities. By understanding how climate change impacts on natural resources and capital, response and resilience systems for adaptation and mitigation of negative effects of climate change can be fostered.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Describe which social or economic groups within the community are particularly vulnerable to climate change.

LO2) Evaluate which resources are most important to the livelihoods of different social groups.

LO3) Identify how current climate hazards affect livelihoods and related resources of different groups.

LO4) Assess which livelihoods resources are most vulnerable to climate change.

LO5) Investigate adaptation and mitigation strategies to maintain viable livelihoods when faced with climate change challenges.

Sem II, Module 4. Gender, Agriculture and Climate Change (5 ECTS)

Training Objectives. This module will address climate change from a social perspective, including considering how its causes and effects relate to concepts of equity. This will include examining issues such as gender equality, human rights and livelihoods in relation to agriculture and climate change issues.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Understand climate change and gender linked ramifications in four pillars of food security: food availability, food accessibility, food utilization and food systems stability.

LO2) Outline gender linked differences in other key issues in the context of climate change (water, health, migration patterns due to environmental degradation).

LO3) Underline the importance of involving women as agents of change in climate change responses and incorporate gender perspectives in research agendas, information, and climate change responses.

LO4) Appreciate the gender-relevance of frameworks for policy analysis, databases, methods and ex ante impact assessment for planning responses to climate change in agriculture.

LO5) Generate ideas for gender sensitive responses to the effects of climate change – in technology developments and financing mechanisms (gender analysis of budget lines and financial instruments for climate change, gender-sensitive investments in programmes for adaptation, mitigation, technology transfer and capacity building).

LO6) Outline how governments can incorporate gender perspectives into their interventions on climate change

Running across Semesters I and II

Cross-year, Module 1. Perspectives in Agriculture & Food Security (5 ECTS)

Training Objectives. This module will provide a range of different and multi-disciplinary perspectives & case studies on Agriculture and Climate Change involving seminars and discussion with experts from government, research centres, universities, NGOs, private sector and other stakeholders. The module will develop students breadth of knowledge and perspectives, and develop critical thinking skills that are of relevance for research to inform decision-making and actions regarding climate change, agriculture and food security.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Consider how different disciplines and sectors have differing perspectives regarding agriculture and climate change.

LO2) Appreciate how presentations and case studies on relevant topics can be differently framed by different sectors and disciplines.

LO3) Critically review case studies and perspectives in the context of global transition challenges.

LO4) Present and discuss opinions in an open forum as a group and individually.

LO5) Learn how to present questions to different agricultural stakeholders and to engage in dialogue with other disciplines/sectors.

Cross-year, Module 2. Career, Communication & Impact Pathway Skills (5 ECTS)

Training Objectives. Science communication can aim to generate support for scientific research or study, to inform decision making, political and policy thinking. This module will develop an understanding of the interactions between science and society, ensuring an understanding of the social significance of science in society. This module will introduce topics in science communication, internet and social media skills, social marketing and critical thinking regarding science and communication activities.

Learning Outcomes. *On successful completion of this module the learner will be able to:*

LO1) Critically evaluate which sources of information regarding agriculture and climate change are most reliable and trustworthy.

LO2) Discuss a technical scientific topic for various audiences through news print, broadcast and social media.

LO3) Identify key approaches and constraints for environmental and risk communication.

LO4) Assess the efficacy of different science communication approaches.

LO5) Consider different approaches for the analysis and implementation of effective science communication.