MASTER & MASTER OF SCIENCE PROGRAMMES IN
“INNOVATIVE APPROACHES FOR IPM
OF MEDITERRANEAN FRUIT CROPS”
ACADEMIC YEAR 2020-2021

DESCRIPTION

The Master of Science Programme provides a two-year curriculum whose main objective is to prepare a new generation of motivated students towards professional and academic careers that will promote integrated pest and disease management strategies for a sustainable intensification of arboriculture in Mediterranean agroecosystems.

The master frames the management of pests and diseases in arboriculture within an agroecological and food system perspective. Students will learn about ecology and epidemiology features of pests and pathogens, and innovative and smart tools for diagnosis, monitoring and management. IPM strategies will be presented and deeply analysed for major pests for Mediterranean fruit crops. In addition, students will learn about risks connected to emergent transboundary pests and diseases, and about quarantine measures for preventing and controlling diffusion.

At the end of the course students will know:
✓ how to analyse and plan agroecosystems for a sustainable management of pests and diseases;
✓ the range of products for pests and diseases control and regulations;
✓ the tools for a rapid and timely diagnosis and monitoring of crops pathogens and pests;
✓ how to solve farm problems by using diverse methods including farm biodiversity management, cultivars/graft combination choices, use of pesticides and biological control;
✓ how to plan and implement IPM programs for the main fruit crops, in different contexts;
✓ how to organize and manage important preventive measures for pest and disease control, i.e. plant quarantine, certification programs for plant propagating material.

The Programme is carried out in collaboration with national and international Institutions and Universities.

International scientists and practitioners, with a consolidated knowledge on the covered topics, will give lectures.

Students will also undertake several practical activities and assignments, aimed at developing their skills and competencies in the Master sector.

ORGANIZATION

First Year: 60 ECTS
Diploma: Master of MAIB / Master Universitario di I Livello (First level master)
Duration: 8 months (Dec 2020-Feb 2021 distance learning; Mar-Jul 2021 at CIHEAM Bari)

Second Year: 60 ECTS
Diploma: Master of Science
Duration: 12 months (mobility in the country of origin)

CANDIDATES’ PROFILE

Courses are addressed to new graduate students and young professionals with a university background related to agronomic, horticultural and plant protection issues.

Requirements:
• Three years (180 ECTS) or four years (240 ECTS) of university studies;
• Four years out of five of university studies (240 ECTS), upon agreement between the sending University and CIHEAM Bari;
• Five years of university studies (300 ECTS);
• Professionals having a degree (3-4 years) and at least 2 years of experience in a field related to the Master Programme;
• Good Knowledge of spoken and written English;
• Personal access to computer facilities.

ADMISSION

Selection of students is based on:
1. Screening of documents sent online by candidates to support their application;
2. Skype interview.

Submission of applications through the online procedure
Deadline: 30 September, 2020

COSTS

Registration fee: 200.00€/year.
Tuition fee: 500.00€/month (travel, accommodation and insurance expenses not included)

BENEFICIARIES

Master and MSc Programmes are open to candidates of any nationality

SCHOLARSHIPS

CIHEAM Bari grants full or partial scholarships to candidates according to a ranking list. Priority is given to students coming from CIHEAM Member countries and other Mediterranean, Balkan and Middle Eastern Countries

LANGUAGE OF INSTRUCTION: English

For further information and application procedure:
www.iamb.ciheam.org
The Master course will develop according to a series of teaching units and a final project:

**Unit I - Sustainability in agriculture and food systems:** it frames the concepts of sustainability applied to agriculture and food sectors and provides elements for understanding the main challenges to design solutions and actions towards sustainable agri-food systems. The multi-dimensions nature of sustainability challenges will be analysed, bringing students to reflect on processes for sustainability transitions in agri-food systems.

**Unit II – Climate “smart” agroecology:** Agroecology is the discipline that study ecological processes at the base of the functioning of agroecosystems. The course aims to provide a widely applicable knowledge base to increase the resilience and production of agroecosystems in a changing climate scenario. Students will learn how to analyse the complexities and challenges of agroecosystems, and ways for sustainable planning of actions to mitigate and adapt to climate change and other global drivers of change.

**Unit III - Smart tools for the management of natural resources in agriculture:** it provides students with basic knowledge on the use of smart tools important for driving decisions towards more sustainable ways of natural resource management in agriculture. Focuses will be on Remote Sensing, Geographic Information Systems, Global Position Systems as tools for the acquisition, management, processing, analysis and display of spatial data and information. Multi-model mechanism approaches and examples of multi-criteria Decision Supporting Systems will be also presented.

**Unit IV - Fruit crops disorders diagnosis and identification:** the unit provides students with a background on the range of Mediterranean fruit crop pests and diseases, and associated biotic and abiotic disorders, presenting options for identification and diagnosis using conventional and advanced laboratory/field techniques.

**Unit V - Pest & disease control strategies:** students acquire knowledge on basic principles of modern plant breeding and biotech resistance, as a proactive approach in the IPM strategy. They will also learn about the use of beneficial arthropods, the safe and sustainable use of agrochemicals and bio-rationales pesticides and the relative regulations for food quality and safety in IPM. A major focus will be on EU- Mediterranean legislations and regulations for phytosanitary measures.

**Unit VI - IPM of Mediterranean fruit tree crops:** the unit provides in deep knowledge on the main phytosanitary problems affecting Mediterranean fruit tree crops in pre-harvesting through pest/pathogen identification and detection and presents approaches and tools for a sustainable IPM strategy in compliance with EU regulations.

**Unit VII - Transboundary pests & diseases:** the unit presents emergent transboundary plant pests and diseases which are a constraint to food availability, food safety, and security, and ways for their management. Students will also learn about plant quarantine principles and systems, focusing in particular on the monitoring and control of some quarantine pests/diseases threatening the fruit tree crops in Mediterranean areas.

**Project:** through a work team, students will be engaged on a real project that, through literature review, field visits and contacts with stakeholders, will help them develop theoretical and practical skills on fruit tree crops IPM related issues.

**SECOND-YEAR PROGRAMME - MASTER OF SCIENCE**

Students who have successfully completed the first year, and have met all the prerequisites set by the Institute, will be selected for the Master of Science level, and will carry out a scientific research on an original topic related to a plant or food health challenges for fruit crops.

Topics of MSc theses on pests of fruit and vegetable crops are to be chosen among the following research lines:

- Sampling methodology and technical protocols
- Pests monitoring, identification, detection, characterization and management
- Pest epidemiology
- Remote sensing, GIS and information technology applications to plant health
- Pest/disease forecasting models
- Detection and control of mycotoxins and contaminants in agricultural products
- Assessment of damages and losses
The Master of Science Programme provides a two-year curriculum whose main objective is to prepare a new generation of motivated students towards professional and academic careers for the promotion of a sustainable use of land and water in agriculture, in view of important challenges that include water/land scarcity, population growth, climate change and correlated environmental and socio-economic burdens. A major focus will be on the application of modern technologies and tools that integrate agronomic, engineering, environmental and socio-economic aspects of land and water management in agriculture.

Candidates will follow theoretical and practical sessions that aim at framing the water and land resources management within a sustainable development perspective of agriculture and food sectors. The programme presents basic principles and advanced topics of the latest scientific and technological achievements, discussing challenges for the best exploitation of resources and options for a sustainable management at farm and large-scale level. Irrigation technologies and systems are analysed according to technical, social, economic, and environmental issues, taking into considerations the application of innovative “green” management solutions.

At the end of the programme, students will acquire the following skills and competencies:
- treat water management issues in the context of sustainability of agriculture and food systems, taking into consideration the challenges of climate change, resource scarcity, societal changes, food insecurity;  
- manage water resource in a variety of agroecosystems for land conservation and increase the water use efficiency in the irrigation sector;  
- use a range of alternative water resources, including saline and treated wastewater, for irrigation purposes;  
- plan and evaluate irrigation projects, at farm and large-scale level to optimize water/land/nutrient use, considering societal/institutional aspects and economic criteria;  
- use latest technologies and tools for a sustainable management of water resources at different scales and in different agroecosystems.

The Programme is carried out in collaboration with national and international institutions and Universities. International scientists and practitioners, with a consolidated knowledge on the covered topics, will give lectures.

Students will also undertake several practical activities and assignments, aimed at developing their skills and competencies in the Master sector.

MASTER & MASTER OF SCIENCE PROGRAMMES IN “SUSTAINABLE WATER AND LAND MANAGEMENT IN AGRICULTURE

ACADEMIC YEAR 2020 – 2021

ORGANIZATION
First Year: 60 ECTS
Diploma: Master of MAIB / Master Universitario di I Livello (First level Master)
Duration: 8 months (Dec 2020-Feb 2021 distance learning; Mar-Jul 2021 at CIHEAM Bari)
Second Year: 60 ECTS
Diploma: Master of Science
Duration: 12 months (mobility in the country of origin)

CANDIDATES’ PROFILE
Courses are addressed to new graduate students and young professionals with a university background related to agronomic, irrigation, agricultural engineering and socio-economic issues

Requirements:
• Three years (180 ECTS) or Four years (240 ECTS) of university studies;
• Four years out of five of university studies (240 ECTS), upon agreement between the sending University and CIHEAM Bari;
• Five years of university studies (300 ECTS);
• Professionals having a degree (3-4years) and at least 2 years of experience in a field related to the Master Programme;
• Good Knowledge of spoken and written English;
• Personal access to computer facilities.

ADMISSION
Selection of students is based on:
1. Screening of documents sent online by candidates to support their application
2. Skype interview
Submission of applications through the online procedure
Deadline: 30 September 2020

COSTS
Registration fee: 200.00€/year.
Tuition fee: 500.00€/month (travel, accommodation and insurance expenses not included)

BENEFICIARIES
Master and MSc Programmes are open to candidates of any nationality

SCHOLARSHIPS
CIHEAM BARI grants full or partial scholarships to candidates according to a ranking list. Priority is given to students coming from CIHEAM Member countries and other Mediterranean, Balkan and Middle Eastern Countries.

LANGUAGE OF INSTRUCTION: English
For further information and application procedure: www.iamb.ciheam.org
The Master course will develop according to a series of teaching units and a final irrigation project design:

Unit I - Sustainability in agriculture and food systems: it frames the concepts of sustainability applied to agriculture and food sectors and provides for elements r understanding the main challenges to design solutions and actions towards sustainable agri-food systems. The multi-dimensions nature of sustainability challenges will be analysed, getting students to reflect on processes for sustainability transitions in agri-food systems.

Unit II - Climate "smart" agroecology: Agroecology is the discipline that studies the ecological processes at the base of the functioning of agroecosystems. The course aims to provide a widely applicable knowledge base to increase the resilience and production of agroecosystems in a changing climate scenario. Students will learn how to analyse the complexities and challenges of agroecosystems, and ways for sustainable planning of actions to mitigate and adapt to climate change and other global drivers of change.

Unit III - Smart tools for the management of natural resources in agriculture: it provides students with basic knowledge on the use of smart tools important for driving decisions towards more sustainable ways of natural resource management in agriculture. Focuses will be on Remote Sensing, Geographic Information Systems, Global Position Systems as tools for the acquisition, management, processing, analysis and display of spatial data and information. Multi-model mechanistic approaches and examples of multi-criteria Decision Supporting Systems will be also presented.

Unit IV - Sustainable on-farm irrigation management: it focuses on water and land management problems and solutions at farm level and aims to enhance students’ capacities to apply sustainable irrigation practices and tools in different environments and contexts. Students will enhance their knowledge on Pedology, Soil physics, Agro-meteorology, Soil-Plant-Atmosphere Continuum, Crop water requirements and Practical irrigation scheduling, Resources use optimization, Crop growth modelling, and On-farm irrigation methods and management.

Unit V - Irrigation systems design, planning and management: this unit explores an integrated approach that fosters a resilient design and an efficient management of water in agriculture, at scheme and farms levels. Students will learn about advances in surface irrigation technologies, innovations in micro-irrigation, open channel irrigation design and management, multi-objective planning of large-scale pressurized systems, renewable energy in water systems.

Unit VI - Use of Alternative Water Resources in Agriculture: this unit offers a holistic approach towards AWR (Alternative Water Resources) management and practices in agriculture as a sustainable, innovative and cost-effective way of improving community access to water in water scarce areas, thereby contributing to climate adaptation. Major focuses will be on rainwater harvesting, use of low-quality waters, salinity control and its impact on soils and crops, drainage systems design and management.

Unit VII - Water Economics and Governance: the unit introduces concepts of basic economic principles and tools for efficient irrigation water allocation and planning of irrigation projects considering the main institutional issues of the Mediterranean irrigation sector. Cost Recovery and Water Pricing Policy will be important focuses. Students will understand how to undertake a Cost/Benefit Analysis of irrigation projects and learn about Participatory approaches for Irrigation Management (PIM) and Transfer (IMT).

Irrigation project design: an integrated approach: students will be engaged in a team aimed at developing multi-disciplinary skills for the design of irrigation schemes. The process will include a comprehensive analysis of climatic, soil and crop data; hydraulic design of a large-scale distribution network based on the choice of the optimal cropping pattern determined using different simulation scenarios (limited availability of water, use of salt water, etc.) and economic criteria.

SECOND-YEAR PROGRAMME - MASTER OF SCIENCE

Students who have successfully completed the first year, and have met the prerequisites set by the Institute, will be admitted to participate in the 2nd year programme for the implementation of applied research, under academic supervision. Research will cover the latest scientific, technological, and/or socio-economic challenges related to water and land management issues, at farm or large-scale level, which need investigation and solutions.

Topics available for Master of Science include:

❖ Application of remote sensing technologies and other modern tools to improve land, water and nutrient use in agriculture;
❖ Soil water balance and crop-growth modelling under different climatic and management scenarios;
❖ Resource-use optimization and eco-efficiency in land and water management
❖ Nexus Energy - Hydraulic Performance, based on Management of Large-Scale Pressurized Irrigation Systems;
❖ Modernization techniques of pressurized irrigation system and related technical and socio-economic impacts;
❖ Impact of saline and treated wastewater use on the environment, cropping pattern, irrigation management and irrigation systems performance;
❖ Agro-hydrological modelling and modern techniques to estimate soil hydraulic parameters;
❖ Agroecological characterization, soil degradation and conservation, sustainable soil/land management;
❖ Characterization, modelling and participatory simulations of water use and development strategies at the level of rural households and rural territories;
❖ Economic policies and tools for an effective implementation of Water Demand Management in agriculture.
The Master of Science Programme provides a two-year curriculum whose main objective is to prepare a new generation of motivated students towards professional and academic careers that promote the development of organic agriculture, with a particular emphasis to Mediterranean contexts.

The programme proposes a holistic view for the organic sector development, presenting theoretical and methodological approaches to sustain transition to organic agriculture through agroecological principles, and with a perspective of sustainable food systems development. The course provides deep insights into organic farming and food regulatory frames. Special emphasis is given to the range of on-farm technologies and practices to improve soil health and fertility and manage pest and diseases. Economics and marketing issues are also presented, leading students through an understanding of sustainable food value chains.

At the end of the course students will have the following skills and competencies:

✓ Understand the importance of sustainable production and advocate for ecologically sound solutions, at different levels;
✓ Know the organic legislative and policy frameworks and how to drive farms to a transition towards organic farming and agroecological principles;
✓ Know how to produce safe, high quality and sustainable organic food;
✓ Understand economics and market issues, being able to analyse and design organic food value chains;
✓ Learn how to facilitate multi-actors networking for the organic sector development;
✓ Have expertise to assess agricultural, environmental, and socio-economic opportunities and constraints of organic agriculture in different Mediterranean areas.

International scientists and practitioners, with a consolidated knowledge on the covered topics, will give lectures.

Students will also undertake several practical activities and assignments, aimed at developing their skills and competencies in the Master sector.

ORGANIZATION

First Year: 60 ECTS
Diploma: Master of MAIB / Master Universitario di I Livello (First level master)
Duration: 8 months (Dec 2020-Feb 2021 distance learning; Mar – Jul 2021 at CIHEAM Bari)

Second Year: 60 ECTS
Diploma: Master of Science
Duration: 12 months (mobility in the country of origin)

CANDIDATES’ PROFILE

Courses are addressed to new graduate students and young professionals with a university background related to agronomic, horticultural, agricultural marketing and socio-economic issues.

Requirements:
• Three years (180 ECTS) or four years (240 ECTS) of university studies;
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SCHOLARSHIPS

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LANGUAGE OF INSTRUCTION: English

For further information and application procedure: www.iamb.ciheam.org
FIRST-YEAR PROGRAMME
MASTER/MASTER UNIVERSITARIO DI I LIVELLO
OCTOBER 2019 - JUNE 2020

The Master course will develop according to a series of teaching units and a final project:

Unit I - Sustainability in agriculture and food systems: the unit frames the concepts of sustainability applied to agriculture and food sectors and provides elements for understanding the main challenges to designing solutions and actions towards sustainable agri-food systems. The multi-dimensions nature of sustainability challenges will be analyzed, bringing students to reflect on processes for sustainability transitions in agri-food systems.

Unit II - Climate “smart” agroecology: Agroecology is the discipline that studies ecological processes at the base of the functioning of agroecosystems. The course aims to provide a widely applicable knowledge base to increase the resilience and production of agroecosystems in a changing climate scenario. Students will learn how to analyze the complexities and challenges of agroecosystems, and ways for sustainable planning of actions to mitigate and adapt to climate change and other global drivers of change.

Unit III - Smart tools for the management of natural resources in agriculture: the unit provides students with basic knowledge on the use of smart tools important for driving decisions towards more sustainable ways of natural resource management in agriculture. Focus will be on Remote Sensing, Geographic Information Systems, Global Position Systems as tools for the acquisition, management, processing, analysis and display of spatial data and information. Multi-model mechanistic approaches and examples of multi-criteria Decision Supporting Systems will be also presented.

Unit IV - Organic agriculture principles, standards and regulations: the unit helps students get a better understanding of organic agriculture principles and of standards required for organic farming, including controls and certification, getting the details of the most recent European Union organic regulations, with an overview of the rules in place in Mediterranean countries and other important international contests.

Unit V - Soil management and fertility: soil health is a fundamental aspect in organic farming. Students will understand how to manage the soil resource, from the conversion to the production phase. They will learn about the range of agronomic techniques and practices to be applied at farm level to maintain and improve soil fertility and quality. Focuses on crop organic management will help students gain practical skills.

Unit VI - Crops diseases and pests management: students will learn about existing options for pest and disease management of Mediterranean fruit crops in organic farming. Strategies will include crop choice and rotations schemes, preventive measures, biological control strategies, use of authorized Plant Protection Products (PPP). The main pests and diseases of olives, vines and citrus will be analyzed to give students a practical view of the issue.

Unit VII - Economics, marketing and policies: the unit develops an understanding of the economic and marketing aspects of the organic agri-food system, including policy issues. It provides knowledge and methods to approach the study of farm management, food system and marketing with a multi-stakeholder and supply chain perspective. Rural development policies are analysed, putting into evidence opportunities for the sustainable development of the agri-food sector and market.

Unit VIII - Food value chains: the unit aims at giving students a view on organic market and food from a farm to fork perspective. Specific attention is given on sustainable food value chains analysis and development. Students will learn how production, processing, post-harvesting and packaging influence food quality and safety and add value to food products.

Project on Social Capital: typologies of social capital, in forms of linkages among farmers and or other actors, are key elements for promoting organic agriculture. Students will engage in group activities, stakeholder analysis, territorial visits aimed at analyzing different forms of social capital, and learning ways for their promotion, development and management.

SECOND-YEAR PROGRAMME - MASTER OF SCIENCE

During the second year, students who have successfully completed the first year, and have met all the prerequisites set by the Institute, draft a thesis based on experimental research work.

Topics generally available for Master of Science theses are:

- Management of cropping systems and soil fertility, quality of agricultural products and agricultural by-product recovery
- Biological control and natural biomolecules
- Sustainability of agricultural and natural systems
- Economic and market research
- Socio-economic impacts and impacts of support policies
MASTER in

Innovative Approaches for IPM of Mediterranean Fruit Crops

Academic Year 2020-2021
DESCRIPTION

The Master course aims at preparing a new generation of motivated students towards professional and academic careers that will promote integrated pest and disease management strategies for a sustainable intensification of arboriculture in the Mediterranean agroecosystems. The course deals with the management of pests and diseases in tree growing with a look towards agroecological and food systems. Students will learn about the ecological and epidemiological features of pests and pathogens, and how to apply innovative and smart tools for diagnosis, monitoring and management. IPM strategies will be introduced and analysed in depth for the pests affecting the most important Mediterranean fruit crops. In addition, risks connected to emerging transboundary pests and diseases will be highlighted and quarantine measures to prevent their introduction and possible establishment will be analysed.

At the end of the course, students will know:

✓ how to analyse and plan agroecosystems for a sustainable management of pests and diseases;
✓ the range of products for pests and diseases control and their relevant regulations;
✓ the tools for a rapid and timely diagnosis and monitoring of pathogens and pests affecting fruit crops;
✓ how to solve farm problems by using diverse methods including farm biodiversity management, cultivars/graft combination choices, use of pesticides and biological control;
✓ how to plan and implement IPM programmes for the main fruit crops, in different contexts;
✓ how to organize and manage important preventive measures for pest and disease control, i.e. plant quarantine and certification programmes for plant propagating material.

The program is organized in 8 Units and a Project, awarding a total of 60 credits (see details in the table below).

<table>
<thead>
<tr>
<th>Units</th>
<th>Credits</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Unit I - Sustainability in agriculture and food systems</td>
<td>6</td>
<td>30 Nov – 31 Dec 2020</td>
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<tr>
<td>Unit II – Climate “smart” agroecology</td>
<td>6</td>
<td>1-31 Jan 2021</td>
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<tr>
<td>Unit III - Smart tools for the management of natural resources in agriculture</td>
<td>6</td>
<td>1-28 Feb 2021</td>
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<tr>
<td>Unit IV - Biotic and abiotic plant disorders</td>
<td>8</td>
<td>1-30 Mar 2021</td>
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<tr>
<td>Unit V - Plant pests and pathogens diagnosis</td>
<td>5</td>
<td>31 Mar – 19 Apr 2021</td>
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<tr>
<td>Unit VI - Pest / Pathogen control strategies and Food quality and safety</td>
<td>8</td>
<td>20 Apr – 21 May 2021</td>
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<tr>
<td>Unit VII - IPM of Mediterranean fruit tree crops</td>
<td>8</td>
<td>24 May – 29 Jun 2021</td>
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<tr>
<td>Unit VIII - Transboundary pests &amp; diseases</td>
<td>5</td>
<td>30 Jun – 16 Jul 2021</td>
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<tr>
<td>Project</td>
<td>8</td>
<td>Nov 2020 – Jun 2021</td>
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</table>
UNIT I: Sustainability in agriculture and food systems

Food systems encompass all elements (environment, human resources, inputs, infrastructures, institutions, etc.) and activities relating to the production (agriculture), processing, distribution and consumption of food. They include the supply and consumption features as well as the food environment that has an influence on food access. Over the last decades, food systems have been central in the debate on sustainable development (cf. Sustainable Development Goals - SDGs). Indeed, food systems are under an unprecedented confluence of pressures and lie at the centre of a global nexus of environmental, social and economic problems, as humanity faces the challenge of achieving sustainable food security in the face of ecosystem degradation and biodiversity loss, resource scarcity, human population growth, and climate change. On the one hand, food systems are among the main contributors to sustainability challenges such as land degradation, climate change, biodiversity loss, etc. On the other hand, they are dramatically affected by these challenges faced by humanity. Moreover, the dysfunction of modern food systems is a major cause of several societal issues such as food insecurity and malnutrition, rural poverty and livelihoods vulnerability, social inequality. This has all culminated in different calls for the transformation of food systems and their transition towards sustainability. Transition to sustainable agri-food systems is the objective of many policies, strategies and initiatives. While some initiatives focus on single stages of the food chain (e.g. sustainable agriculture, sustainable diets, etc.), others are more systemic and holistic (e.g. short food supply chains, alternative food networks, etc.). Food-related challenges are particularly pressing in the Mediterranean where there is an urgent need for action.

AIMS

- Explaining the concepts of sustainability and sustainable development and the way of applying them to agriculture and food systems (cf. sustainable agriculture, sustainable diets, sustainable food systems);
- Exploring environmental, social, economic, and health-nutritional challenges affecting the sustainability of agriculture and food in the Mediterranean area and worldwide;
- Introducing examples of sustainability assessment approaches and show how they have been used in agriculture and food systems;
- Presenting policies, strategies and initiatives to foster transition towards sustainability in agriculture and food systems in the Mediterranean, European Union and worldwide.

LEARNING OUTCOMES

By the end of the Unit, students will be able to:

- understand the concepts of sustainability and sustainable development and apply them to agriculture and food systems;
- explain sustainability challenges regarding agriculture and food in the Mediterranean area and worldwide;
- know how sustainability assessment approaches are used in agriculture and food systems with practical examples;
- understand strategies, pathways, and actions for transition towards sustainability in agriculture and food systems.
UNIT II: Climate “smart” agroecology

Agroecology is a relatively new discipline that studies the ecological complexity and functioning of the agroecosystem. It is therefore a key discipline to drive the transition of agriculture to sustainable paths, facing challenges posed by the climate change. It focuses on biological processes and on how they interact and influence the functioning of agroecosystems and of farming systems, to propose sustainable agricultural practices. Concepts of biodiversity, natural capital and the provision of ecosystem services will be analysed, and the agroecosystem will relate to the use of natural resources, health of soil, plant, environment and ecosystems in relation to abiotic and biotic threats under a changing climate.

AIMS

The course aims to provide a widely applicable knowledge base to increase agroecosystems’ resilience and production in a changing climate scenario.

- Explaining agroecosystem functioning;
- Examining the agroecosystems’ complexities and challenges;
- Reviewing agroecological practices which enable a more sustainable production;
- Understanding how climate change affects agroecosystems functioning;
- Identifying sustainable management solutions to mitigate and adapt to climate change and other global drivers of change;
- Understanding the value of agroecological approach for improving rural livelihood and promote social equity.

All along the course, practical sessions will be promoted to provide and improve skills, knowledge and abilities of students to use specific tools and technologies that enable proper analysis of agroecosystems and biodiversity at different scale and support rational management of natural resources at multiscale levels.

LEARNING OUTCOMES

At the end of the Unit students will:

- become knowledgeable on principles of agroecology and related practices;
- acquire practical skills on integrated multi scale agroecosystem analysis.
- achieve basic knowledge on nature-based solutions for biodiversity and ecosystem service provision.
- understand how climate change affects agroecosystems and sustainable management practices for adaptation and mitigation across energy-food-ecosystem nexus.
UNIT III: Smart tools for the management of natural resources in agriculture

Nowadays, the sustainable planning and management of agriculture and farming systems rely a lot on a range of SMART tools that permit the rapid collection and analysis of large geo-spatial data. In particular, Remote sensing, Geographic Information Systems and Global Positioning Systems are commonly used for the acquisition, management, processing, analysis and display of spatial data and information. For the management of huge amount of collected/generated data (big data), forecasting and decision support models are available.

Their application is within a variety of fields that include farming systems analysis, water and irrigation management, forecasting/monitoring of pests and diseases, specific agroecological and food systems.

The use of these technologies requires the access to software (open licenses) and devices, often combined and integrated.

AIMS

The main objective of the Unit is to present how SMART tools may help support decisions in agriculture towards a sustainable management of natural resources, using modern approaches and tools available in geomatic, geoscientific and computer science environments.

In particular, the Unit will provide basic knowledge for the use and applications of the following technologies:

- Remote sensing
- Geographic Information Systems
- Cartography and Geographic Positioning Systems
- Decision Support System
- Forecasting modelling
- Big data management

LEARNING OUTCOMES

At the end of the Unit, students will acquire:

- basic concepts, principles, methods, and practical applications of the Geographic Information System (GIS), Cartography and Geographic Positioning System (GPS).
- fundamental concepts of remote sensing for the management and sustainability of the territory, the agricultural system, and the water resources.
- notions on the Decision Support System (DSS) and GIS-based Multiple Criteria Decision Aiding (MCDA) notions.
- principles of mechanistic modelling and general concepts and procedures for proper model validation and judgment of utility under integrated and organic management.
- the main techniques and practical applications of the big data and the blockchain.
UNIT IV: Biotic and abiotic plant disorders

Biotic and abiotic factors in plants may seriously compromise food security and safety and induce severe economic and environmental consequences for specific crops and territories, including social destabilizations. Pests are responsible for direct yield losses ranging between 20 and 40% of the global agricultural productivity. Indeed, their indirect negative effects to consumers, public health, societies, environments, and farmers are much higher.

The identification of the nature of disorder symptoms in plants is a key step in plant protection. The causal agents are numerous and complex and include both biotic and abiotic factors. With regards to the biotic factors the range of pathogens and pests is wide and include viruses, phytoplasmas, bacteria, fungi, insects, nematodes, often with specificities in symptoms. The infestation and infection are facilitated by ecological conditions and or human behaviour.

AIMS

- Presenting a range of typical plant symptoms caused by different groups of biotic and abiotic factors;
- Providing the basic elements to recognize the main groups of pathogens according to morphological and physiological characteristics, with brief hints to their taxonomy;
- Describing the main epidemiology mechanisms of plant pathogens, parasites and pests and the relationship between host-pathogen-environment;
- Providing basic information for the identification in field and in the lab of the causal agent of biotic or abiotic disorders.

LEARNING OUTCOMES

At the end of this course students manage to:

- identify disease aetiologies and distinguish disorders induced by biotic and/or abiotic factors;
- understand the cycle of the symptomatological manifestation induced by the pathogen/pest/abiotic disorder and understand how to intervene for its control;
- identify the best strategy for detecting and controlling relevant weeds and nematodes;
- implement in practise the acquired knowledge during field visits, laboratory activities, and analysis of specific case studies.
UNIT V: Plant pests and pathogens diagnosis

Today the diagnosis of plant pathogens and pests is mainly based on laboratory methods that resort to advanced technologies, which on the one hand offer simple, rapid, sensitive and efficient diagnostic approaches, and on the other hand overcome those constraints associated with conventional methods and data analysis. The course will introduce the basic principles that encompass every diagnostic technique, whether biological, serological, or molecular. Students will also interface with all aspects relating to precautions and safety measures to be taken into consideration in the laboratory when carrying out the experiments. The course will enable students to list and distinguish between the different utilities of conventional and advanced diagnostic techniques and of those used for the identification and characterization of pathogens. Eventually, the attention will be focused on the world of bioinformatics and on how this domain is continuously gaining space in the research area to reveal and understand the infectious mechanisms of pathogens in plants through the use of a range of automated technologies combined with powerful bioinformatics tools for data mining.

AIMS

- Presenting the general principles on traditional and advanced diagnostic methods used in the plant pathology domain;
- Addressing the advantages and disadvantages of each diagnostic technique;
- Introducing new horizons in biotechnology and bio-informatic in phytopathology;
- Emphasizing the lab safety measures for a secure manipulation of experiments.

LEARNING OUTCOMES

At the end of this course students became able to:

- recognise the genetic features encompassing the genomes of dissimilar pathogens;
- understand the diagnostic challenges when dealing with different types of pathogens;
- apply different biological, serological, and molecular laboratory diagnostic techniques of plant pests and pathogens;
- characterize and classify pathogens based on genome sequences analysis and bioinformatic-assisted tools.
UNIT VI: Pest/Pathogen control strategies and Food quality and safety

A wide variety of pathogens (e.g. viruses, bacteria, and fungi) and pests (e.g. insects and nematodes) seriously affect fruit crops, both in the field and after harvest. It has been estimated that, especially in developing countries, they can cause serious yield losses (30-50%), because of spoilage and contamination by toxic metabolites. Hence, it is of paramount importance to set up effective prevention and control strategies all through the production chain (farm to shelf) to reduce food losses that might have serious economic consequences in producing countries. Several conventional control means are available on the market; however, over-reliance and improper use might have negatively impacted on beneficial organisms, as well as left multi-residues on produce and in the environment. It is therefore fundamental to increase knowledge in the sustainable use of conventional means and the integration with safe alternatives as biocontrol agents, generally recognised as safe (GRAS) compounds, resistance inducers, etc. This strategy could count on the use of plant genetic resources (e.g. selecting resistant varieties), as well as on forecasting models for timely application of the control means, avoiding unneeded use and increasing the chance of success. Furthermore, attention should be paid to the postharvest life of commodities, whose spoilage might greatly influence their final safety, quality, and marketability. Indeed, both in the field and after harvest commodities might be contaminated by toxic secondary metabolites of fungi known as mycotoxins with detrimental effects on consumers’ health. It is of important to monitor, prevent and control not only the microorganism but also its metabolite, as required by national and international legislations. Indeed, the fulfilment of produce quality standards is nowadays of paramount importance in a global market where commodities are sold and shipped over short and long distances.

AIMS

- Explaining the current most updated knowledge and regulations for a sustainable control of plant pests and pathogens by conventional chemical and physical means;
- Examining the alternatives to conventional control of pests by using biocontrol agents and forecasting model for a more timely, proper, and successful control;
- Reviewing the knowledge on the use of plant genetic resistance in the disease control strategies by conventional and innovative approaches, as well as specific inducers;
- Giving an overview of the postharvest diseases causing quality losses and their conventional and alternative control means;
- Highlighting the safety issues related to mycotoxin contamination, consequences on produce marketability and control strategies;
- Guiding towards the obtainment of a produce not only of high-quality but also safe for consumers, thus highly marketable.
LEARNING OUTCOMES

Students will learn:

- basic principles of modern plant breeding, biotech resistance, sustainable use of chemical control means, biocontrol, forecasting modelling, management of postharvest disease, risks of mycotoxin contamination, relevant regulations for food quality and safety;
- to discuss the strategies for preserving food quality and safety by a sustainable management all along the production chain to obtain an added-value production;
- to implement the acquired knowledge into every-day practice with the aid of site/field visits and laboratory activities, as well as the elaboration of a topic project to address a relevant issue to their country of origin;
- to boost their capacities of adaptation to the continuously changing requirements of production, handling, and marketing environments.

UNIT VII: IPM of Mediterranean fruit tree crops

Integrated Pest Management strategies are of key importance for the sustainable management of modern fruit cropping. IPM strategies require a deep knowledge of pests and pathogens, including their morphological, ecological, and epidemiological features. Successful IPM strategies also need strong and developed institutional and political frameworks and farmers to monitor the presence and distribution of key pests and pathogens on Mediterranean fruit tree crops.

The Unit will provide useful tools for the elaboration of an integrated pest management program to control economically important pests/pathogens affecting the main Mediterranean fruit tree crops, in accordance with the EU guidelines and regulations.

AIMS

This Unit will provide:

- an in-depth knowledge of the main phytosanitary problems affecting Mediterranean fruit tree crops in pre-harvesting;
- fundamental knowledge of morphological, ecological, and epidemiological characteristics of the key pests and pathogens and the innovative methods for their identification;
- methods and strategies to establish a sustainable IPM program in compliance with the EU regulations.

LEARNING OUTCOMES

Students will develop:

- the know-how and skills on the sound identification and management of the main pests and pathogens affecting Mediterranean fruit crops in pre-harvesting;
- the ability to use innovative tools (different practices) for implementing sustainable IPM strategies.
UNIT VIII: Transboundary pests & diseases

Globalization (trade intensification associated with the movement of goods and people) increases the risk of introducing harmful organisms in new areas. These organisms may become invasive and more harmful due to the absence of defence and evolutionary adaptation mechanisms in new host plants and to climate change effects. The introduction and spread of these harmful organisms in new areas may seriously compromise food security and safety and induce severe economic and environmental consequences for specific crops and territories, including social destabilizations. This plant health crisis may be raised by weak quarantine measures. The strengthening of quarantine and other preventive control measures (e.g. the use of healthy certified plant propagating materials), the early and rapid monitoring and detection of pathogens and pests in the field, and the increase and sharing of knowledge can greatly contribute to limit the occurrence of health crises.

AIMS

- Presenting the principles and strategies governing the international quarantine system;
- Knowing the main international phytosanitary measures (ISPM) that are applied in plant quarantine;
- Describing the criteria to define a quarantine pest and to decide the extent of phytosanitary measures to be taken;
- Examining the current quarantine legislation in place in the European Union;
- Analysing the certification system of propagation material as the main measure of prevention of harmful organisms;
- Evaluating the importance of the action of Surveillance and Monitoring of territories to contain the spread of quarantine pests;
- Examining the application of quick and easy-to-use diagnostic techniques, as well as innovative systems that utilize information technology to support the activity of Surveillance and Eradication of quarantine pests;
- Studying some potential invasive harmful organisms for the Euro-Mediterranean area and planning possible countermeasures.

LEARNING OUTCOMES

Students will learn:

- to understand the basic principles and international agreements that must regulate trade between countries in order to avoid the spread of harmful organisms;
- to discuss the strategies for preventing the introduction and spread of invasive pests in new areas;
- to transfer scientific innovations in the diagnostic and technological fields to make the disease control more efficient through adequate quarantine and surveillance of the area;
- to understand the importance of an efficient interconnection between scientific, legislative, and phytosanitary service activities for an effective control of pests and pathogens in the territory;
✓ to implement the acquired knowledge into every-day practice with the aid of site/field visits and laboratory activities, as well as the elaboration of a project to address a relevant issue in their country of origin.

PROJECT ON AN EMERGING PHYTOSANITARY PROBLEM

During the year, students will be asked to carry out, partly in their origin country and partly at CIHEAM Bari, a project activity on a phytosanitary problem that is a priority and/or an emerging issue in their country.

In particular, once the problem is identified, students must prepare a dossier containing data on the characteristics of the treated harmful organism, its spread, the damage it may cause, the possibility of its introduction and establishment in their own country, the control methods applicable for its containment, the techniques available for its diagnosis, any measures implemented by the country to deal with it (legislative, technical, financial), any quarantine measures taken, management measures implemented in other countries.

For data collection, students could use scientific publications, articles in specialised papers, information on the Internet, interviews with technicians and officials of plant protection services, agronomists or university professors, and any other source they consider to be useful for the purpose.

At the end of the academic year, students will present their project in PowerPoint before their colleagues and lecturers.

Throughout the project, students will be supervised by CIHEAM Bari experts.
MASTER in

Mediterranean Organic Agriculture

Academic Year 2020-2021
Master in Mediterranean Organic Agriculture- AY 2020-21

**Description**

The Master provides a one-academic year curriculum whose main objective is to prepare a new generation of motivated students towards professional and academic careers that promote the development of organic agriculture, with emphasis on Mediterranean contexts.

The programme proposes a holistic view for the organic sector development, presenting theoretical and methodological approaches to sustain transition to organic agriculture through agroecological principles, and with a perspective of sustainable food systems development. The course provides deep insights into organic farming and food regulatory frames. Special emphasis is given to the range of on-farm technologies and practices to improve soil health and fertility and to manage pests and diseases. Economics and marketing issues are also presented, leading students through an understanding of sustainable food value chains.

At the end of the course students will have the following skills and competencies:

- Understanding the importance of sustainable production and advocate for ecologically comprehensive solutions, at different levels;
- Knowing the organic legislative and policy frameworks and how to lead farms towards organic farming and agroecological principles;
- Knowing how to produce safe, high quality and sustainable organic food;
- Understanding economics and market issues, being able to analyse and design organic food value chains;
- Learning how to facilitate multi-actors networking for the organic sector development;
- Having expertise to assess agricultural, environmental, and socio-economic opportunities and constraints of organic agriculture in different Mediterranean areas.

The Programme is organized in 8 Units and a Project, awarding a total of 60 credits (see table below). From Unit I to Unit III, activities will be implemented in distance learning.

<table>
<thead>
<tr>
<th>Units</th>
<th>Credits</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Unit I - Sustainability in agriculture and food systems</td>
<td>6</td>
<td>30 Nov – 31 Dec 2020</td>
</tr>
<tr>
<td>Unit II – Climate “smart” agroecology</td>
<td>6</td>
<td>1-31 Jan 2021</td>
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<tr>
<td>Unit III - Smart tools for the management of natural resources in agriculture</td>
<td>6</td>
<td>1-28 Feb 2021</td>
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<tr>
<td>Unit IV - Organic agriculture principles, standards and regulations</td>
<td>6</td>
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<tr>
<td>Unit V - Soil management and fertility</td>
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</tr>
<tr>
<td>Unit VI - Crop disease and pest management</td>
<td>6</td>
<td>26 Apr – 14 May 2021</td>
</tr>
<tr>
<td>Unit VII - Economics, marketing and policies</td>
<td>7</td>
<td>24 May – 18 Jun 2021</td>
</tr>
</tbody>
</table>
UNIT I: Sustainability in agriculture and food systems

Food systems encompass all elements (environment, human resources, inputs, infrastructures, institutions, etc.) and activities relating to the production (agriculture), processing, distribution and consumption of food. They include the supply and consumption features as well as the food environment that has an influence on food access. Over the last decades, food systems have been central in the debate on sustainable development (cf. Sustainable Development Goals - SDGs). Indeed, food systems are under an unprecedented confluence of pressures and lie at the centre of a global nexus of environmental, social and economic problems, as humanity faces the challenge of achieving sustainable food security in the face of ecosystem degradation and biodiversity loss, resource scarcity, human population growth, and climate change. On the one hand, food systems are among the main contributors to sustainability challenges such as land degradation, climate change, biodiversity loss, etc. On the other hand, they are dramatically affected by these challenges faced by humanity. Moreover, the dysfunction of modern food systems is a major cause of several societal issues such as food insecurity and malnutrition, rural poverty and livelihoods vulnerability, social inequality. This has all culminated in different calls for the transformation of food systems and their transition towards sustainability. Transition to sustainable agri-food systems is the objective of many policies, strategies and initiatives. While some initiatives focus on single stages of the food chain (e.g. sustainable agriculture, sustainable diets, etc.), others are more systemic and holistic (e.g. short food supply chains, alternative food networks, etc.). Food-related challenges are particularly pressing in the Mediterranean where there is an urgent need for action.

AIMS

- Explaining the concepts of sustainability and sustainable development and the way of applying them to agriculture and food systems (cf. sustainable agriculture, sustainable diets, sustainable food systems);
- Exploring environmental, social, economic, and health-nutritional challenges affecting the sustainability of agriculture and food in the Mediterranean area and worldwide;
- Introducing examples of sustainability assessment approaches and show how they have been used in agriculture and food systems;
- Presenting policies, strategies and initiatives to foster transition towards sustainability in agriculture and food systems in the Mediterranean, European Union and worldwide.

LEARNING OUTCOMES

By the end of the unit, students will be able to:

- understand the concepts of sustainability and sustainable development and apply them to agriculture and food systems;
- explain sustainability challenges regarding agriculture and food in the Mediterranean area and worldwide;
- know how sustainability assessment approaches are used in agriculture and food systems with practical examples;
understand strategies, pathways, and actions for transition towards sustainability in agriculture and food systems.

UNIT II: Climate “smart” agroecology

Agroecology is a relative new discipline that studies the ecological complexity and functioning of the agroecosystem. It is therefore a key discipline to drive the transition of agriculture to sustainable paths, facing challenges posed by the climate change. It focuses on biological processes and on how they interact and influence the functioning of agroecosystems and of farming systems, to propose sustainable agricultural practices. Concepts of biodiversity, natural capital and the provision of ecosystem services will be analysed, and the agroecosystem will relate to the use of natural resources, health of soil, plant, environment and ecosystems in relation to abiotic and biotic threats under a changing climate.

AIMS

The course aims to provide a widely applicable knowledge base to increase agroecosystems’ resilience and production in a changing climate scenario.

- Explaining agroecosystem functioning;
- Examining the agroecosystems’ complexities and challenges;
- Reviewing agroecological practices which enable a more sustainable production;
- Understanding how climate change affects agroecosystems functioning;
- Identifying sustainable management solutions to mitigate and adapt to climate change and other global drivers of change;
- Understanding the value of agroecological approach for improving rural livelihood and promote social equity.

All along the course, practical sessions will be promoted to provide and improve skills, knowledge and abilities of students to use specific tools and technologies that enable proper analysis of agroecosystems and biodiversity at different scale and support rational management of natural resources at multiscale levels.

LEARNING OUTCOMES

At the end of the unit students will:

- become knowledgeable on principles of agroecology and related practices;
- acquire practical skills on integrated multi scale agroecosystem analysis;
- achieve basic knowledge on nature-based solutions for biodiversity and ecosystem service provision;
- understand how climate change affects agroecosystems and sustainable management practices for adaptation and mitigation across energy-food-ecosystem nexus.
UNIT III: Smart tools for the management of natural resources in agriculture

Nowadays, the sustainable planning and management of agriculture and farming systems rely a lot on a range of SMART tools that permit the rapid collection and analysis of large geo-spatial data. Remote sensing, Geographic Information Systems and Global Positioning Systems are commonly used for the acquisition, management, processing, analysis and display of spatial data and information. For the management of huge amount of collected/generated data (big data), forecasting and decision support models are available.

Their application is within a variety of fields that include farming systems analysis, water and irrigation management, forecasting/monitoring of pests and diseases, specific agroecological and food systems.

The use of these technologies requires the access to software (open licenses) and devices, often combined and integrated.

AIMS

The main objective of the Unit is to present how SMART tools may help support decisions in agriculture towards a sustainable management of natural resources, using modern approaches and tools available in geomatic, geoscientific and computer science environments.

In particular, the unit will provide basic knowledge for the use and applications of the following technologies:

- Remote sensing
- Geographic Information Systems
- Cartography and Geographic Positioning Systems
- Decision Support System
- Forecasting modelling
- Big data management

LEARNING OUTCOMES

At the end of the Unit, students will acquire:

- basic concepts, principles, methods, and practical applications of the Geographic Information System (GIS), Cartography and Geographic Positioning System (GPS).
- fundamental concepts of remote sensing for the management and sustainability of the territory, the agricultural system, and the water resources.
- notions on the Decision Support System (DSS) and GIS-based Multiple Criteria Decision Aiding (MCDA) notions.
- principles of mechanistic modelling and general concepts and procedures for proper model validation and judgment of utility under integrated and organic management.
- the main techniques and practical applications of the big data and the blockchain.
UNIT IV: Organic agriculture principles, standards and regulations

Organic agriculture is a production system based on specific principles of sustainability that rely on the use of environmentally friendly practices and inputs. It is a sector that is governed by precise rules and regulations, which concern farm conversion, production processes (for plants and animals, including aquaculture), food and feed processing and marketing. Control systems are also set up to ensure producers comply with the rules and to certify the produce as organic. The rules also govern the import/export of products to different markets.

AIMS

The aim of this Unit is to make students knowledgeable about the following contents:

- Introduction to organic farming, definitions, concepts, principles and framework of organic agriculture;
- Farm context analyses before converting to organic;
- Essential agroecological practices as tools to farm organically and how to connect these practices to farm conditions;
- Organic farming regulations in the EU and state-of-the-art in Mediterranean countries;
- Import/export of organic products in the EU (TRACES);
- Export procedures from third countries;
- Control and surveillance: the Italian and European Union experience;
- Regulatory framework of a certification body to certify organic products;
- Regulatory framework of inspection and control in organic agriculture.

LEARNING OUTCOMES

At the end of the Unit students will be capable to:

- become familiar with organic agriculture as regulated production system to achieve sustainability;
- understand the rules related to control and certification of organic productions and production processes;
- analyse farm conditions, by using tools and agroecological practices, to convert to organic;
- plan and conduct on-farm inspection audits according to the ISO standards and the organic regulations.
UNIT V: Soil management and fertility

The knowledge of the sustainable management of the non-renewable soil resource is of utmost importance in organic farming. This Unit will deal with the fundamental principles of soil management and soil fertility using environmentally sustainable practices aimed to maintain or improve soil health and to guarantee production quantity and quality.

The Unit will illustrate the main chemical, physical and biological principles that regulate the functioning of soil as a living system (soil web), whose understanding is fundamental to manage soil fertility in various environmental and climatic regions. Organic farming practices aimed to soil fertility management will be described in detail but, at the same time, they will be treated in the framework of a global and strategic approach. An overall and systemic concern will be given to the concept of organic farming as self-sustaining biological system rather than based on external inputs.

AIMS

- Describing the main soil components (biological, physical and chemical) and processes;
- Illustrating and describing both soil nutrients with related cycles and basic plant nutrition/uptake principles;
- Describing the main agronomic practices (rotation, associated crops, cover crops, tillage management);
- Providing an overview of fertilizers and fertilizing practices allowed in organic farming;
- Reutilization of plant residues and farm by-products.

LEARNING OUTCOMES

Students will learn:

- the soil nutrients dynamics;
- the characteristics and behaviour of various fertilizers and by-products;
- how to apply annual or poly-annual fertilizing plans on organic farms;
- how to select and apply various cover crop species;
- how to read soil tests.
UNIT VI: Crop disease and pest management

Disease and pest management in organic farming is challenging, mainly considering the strict limitations to chemical control and the delicate balance between external inputs and ecosystem services that the management should be based on.

The Unit will deal with: a) the main principles of organic agriculture connected to disease and pest control in organic farming; b) pesticides admitted in organic agriculture and future perspectives for sustainable chemical control; c) biological control, side-effects of control tools and approaches on ecosystem services, and strategies to preserve natural enemies populations; d) management of vector-borne plant pathogens in organic agriculture.

Particular emphasis will be put on the Mediterranean crops of economic/ecological/historical importance.

AIMS

The Unit will describe:

- principles for disease and pest control in organic agriculture;
- pesticides admitted in organic agriculture, mechanisms of action and novel products for pest control;
- biological control strategies and rearing of beneficial insects;
- “Key pests” lifecycle the Mediterranean crops and their control strategies;
- the novel techniques of disease transmission.

LEARNING OUTCOMES

Students will learn how:

- to approach pest and disease control in organic farming;
- to select and apply products for pest and disease control;
- to increase the presence of beneficial insects at farm level;
- to prepare control strategies in accordance with the EU regulation on organic farming.
UNIT VII: Economics, marketing and policies

In general, the Unit is meant to teach how the organic agri-food chain approaches the challenge of constantly improving its competitiveness and profitability by producing high-quality food and products, respecting the environment, and aiming to attain greater sustainability in the territorial context. The Unit develops an understanding of the economic and marketing aspects of the organic agri-food system, including policy issues. It provides knowledge and methods to approach the study of farm management, food system and marketing with a multi-stakeholder and supply chain perspective. Rural development policies are analysed, putting into evidence impacts and opportunities for the sustainable development of the agri-food sector and market.

AIMS

The Unit will deepen:

- the principles of farm economics, with an organic prospective, particularly farm management, accounting and budgeting, economic analysis and sustainability;
- main policies for the planning and development of organic agri-food systems;
- different forms of coordination and integration in the organic supply chain, in particular concerning distribution and retailing;
- tools to manage a supply chain;
- marketing strategies in organic markets;
- business plan and consumer behaviour analysis.

LEARNING OUTCOMES

Students will learn:

- about the decision-making process for the improvement of the competitiveness and profitability of the producers in the organic supply chain;
- how to prepare business and marketing plans;
- principles of the organic sustainable supply chain management;
- to foster the cooperation and partnership among actors of the organic supply chain;
- how to analyse and plan the policies needed for the development of the organic agri-food chain.
UNIT VIII: Food value chains

"A value chain approach deals with the process of transformation of a physical product from input and production through processing and consumption". The value chain is a key concept in the development of more sustainable, resilient and diverse organic food systems. Nowadays organic food value chains function in an increasingly complex and dynamic environment characterized by new consumer demands, new technologies and solutions, changing structures and cooperation modes. The organic food value chain comprises all stakeholders who participate in the coordinated production and value-adding activities that are needed to make food products. Strategic alliances between different stakeholders provide high-quality, differentiated food products and distribute rewards equitably across the chain.

AIMS

The Unit, presenting real cases from organic and non-organic food value chains, will:

- provide knowledge about the value chain concept and functioning, by analysing its components and phases, actors and services;
- present innovative, careful and sustainable technologies and solutions that are in line with organic standards, regulations and principles;
- introduce a range of approaches in developing new organic food value chains.

LEARNING OUTCOMES

Students will learn to:

- apply value chain development concepts and perform its analysis;
- develop ability to manage, facilitate and innovate within the organic food value chains;
- understand how production, processing, post-harvesting and packaging add value to organic food;
- enable multi-stakeholder processes and empowering actors on more inclusive, equitable and sustainable value chains.
PROJECT ON SOCIAL CAPITAL

Nowadays, social capital is considered as one of the key assets for sustainable livelihoods, territorial development and for the organic sector development as well. Different forms of relationships, organizations, collective actions can provide a wide range of services to involved stakeholders, such as enhancing access to and management of natural resources, accessing input and output markets, lowering certification costs, improving access to information and knowledge, support solutions to problems of environmental and economic sustainability of the agri-food sector, etc.

Forms of social capital are different, and they can be represented by formal organizations such as cooperatives and associations, but also by the relationships and connections among different actors. Naturally, the creation of social capital requires its stakeholders to have a profound shared vision and actively participate in its achievement. Still, it remains the challenge for institutions and organizations, whether governmental or non-governmental, to promote and manage processes for social capital development and management. Among others, the preparation of professionals, with specific soft skills and competencies, is a key step in this process.

AIMS

- Introducing students to concepts of social capital, defined as personal and institutional relationships in a community and its role in mediating challenges of contemporary and organic agriculture;
- Presenting different forms of social capital and different ways for its promotion, development and management, especially for local and organic sector development;
- Presenting a set of soft skills important for facilitating social capital development, such as participation, observation, dialogue, reflection and visioning;
- Proposing the action-learning methodology to develop soft skills and support the creation of relationships among different sector actors.

LEARNING OUTCOMES

As a result of the Project, students are intended to achieve the following learning outcomes:

- becoming knowledgeable about main concepts, forms and dimensions of the social capital in the agri-food sector and understanding the importance of tailor-made approaches to stakeholders;
- performing community-level analysis and proposing problem-solving and development strategies (pathways);
- improving the understanding of the interplay of social capital with other elements of the agri-food system, such as institutional arrangements, governance of markets, consumer awareness, etc;
- developing and improving the knowledge and experience related to the set of soft skills needed for active involvement and management of the social capital.
MASTER in Sustainable Water and Land Management in Agriculture

Academic Year 2020-2021
Description

The Master aims at preparing a new generation of motivated students towards professional and academic careers for the promotion of a sustainable use of land and water in agriculture, in view of important challenges that include water/land scarcity, population growth, climate change and correlated environmental and socio-economic burdens. A major focus is on the application of modern technologies and tools that integrate agronomic, engineering, environmental and socio-economic aspects of land and water management in agriculture.

Students follow theoretical and practical sessions that aim at framing the water and land resources management within a sustainable development perspective of agriculture and food sectors. The programme presents basic principles and advanced topics of the latest scientific and technological achievements and discusses challenges for the best exploitation of resources and options for a sustainable management at farm and large-scale level. Irrigation technologies and systems are analysed according to technical, social, economic, and environmental issues, taking into considerations the application of innovative “green” management solutions.

At the end of the programme, students will be able to deal with water management issues in the context of sustainability of agriculture and food systems, taking into consideration the challenges of climate change, resource scarcity, societal changes, food insecurity. Specifically, they will acquire the following skills and competencies:

✓ management of water resources in agriculture with a view to land conservation and water use efficiency increase in Mediterranean agroecosystems,
✓ management of a range of alternative water resources including saline and treated wastewater, and water harvesting systems for irrigation purposes,
✓ planning and evaluation of irrigation projects, at farm and large-scale level to optimize water/land/nutrient use, considering societal/institutional aspects and economic criteria,
✓ knowledge of the latest technologies and tools for a sustainable management of water resources at different scales and in different agroecosystems.

The program is organized in 8 Units, awarding 60 credits in total (see details in the table below). From Unit I to Unit III the activities are implemented in distance learning modality.

<table>
<thead>
<tr>
<th>Units</th>
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<th>Tentative calendar</th>
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<tr>
<td>Unit I - Sustainability in agriculture and food systems</td>
<td>6</td>
<td>Nov 30th – Dec 31st 2020</td>
</tr>
<tr>
<td>Unit II – Climate “smart” agroecology</td>
<td>6</td>
<td>Jan 1st – 31st 2021</td>
</tr>
<tr>
<td>Unit III - Smart tools for the management of natural resources in agriculture</td>
<td>6</td>
<td>Feb 1st – 28th 2021</td>
</tr>
<tr>
<td>Unit IV - Sustainable on-farm irrigation management</td>
<td>8</td>
<td>Mar 1st – 26th 2021</td>
</tr>
</tbody>
</table>
UNIT I - Sustainability in agriculture and food systems

Food systems encompass all elements (environment, people, inputs, infrastructures, institutions, etc.) and activities relating to the production (cf. agriculture), processing, distribution, and consumption of food. They include the supply and consumption features as well as the food environment that has an influence on food access. Over the last decades, food systems have been central in the debate on sustainable development (cf. Sustainable Development Goals - SDGs). Indeed, food systems are under an unprecedented confluence of pressures and lie at the centre of a global nexus of environmental, social and economic problems, as humanity faces the challenge of achieving sustainable food security in the face of ecosystem degradation and biodiversity loss, resource scarcity, human population growth, and climate change. On the one hand, food systems are among the main contributors to sustainability challenges such as land degradation, climate change, biodiversity loss, etc. On the other hand, they are dramatically affected by these challenges facing humanity. Moreover, the dysfunction of modern food systems is a major cause of several societal issues such as food insecurity and malnutrition, rural poverty and livelihoods vulnerability, social inequality. This has all culminated in different calls for the transformation of food systems and their transition towards sustainability. Transition to sustainable agri-food systems is the objective of many policies, strategies, and initiatives. While some initiatives focus on single stages of the food chain (e.g. sustainable agriculture, sustainable diets), others are more systemic and holistic (e.g. short food supply chains, alternative food networks). Food-related challenges are particularly pressing in the Mediterranean where there is an urgent need for action.

AIMS

- Explaining the concepts of sustainability and sustainable development and the way of applying them to agriculture and food systems (cf. sustainable agriculture, sustainable diets, sustainable food systems),
- Exploring environmental, social, economic, and health-nutritional challenges affecting the sustainability of agriculture and food in the Mediterranean area and worldwide,
- Introducing examples of sustainability assessment approaches and showing how they have been used in agriculture and food systems,
- Presenting policies, strategies, and initiatives to foster transition towards sustainability in agriculture and food systems in the Mediterranean, European Union and worldwide.

LEARNING OUTCOMES

By the end of the Unit, students will be able to:

- Understand the concepts of sustainability and sustainable development and apply them to agriculture and food systems,
✓ Explain sustainability challenges regarding agriculture and food in the Mediterranean area and worldwide,
✓ Know how sustainability assessment approaches are used in agriculture and food systems with practical examples,
✓ Understand strategies, pathways, and actions for transition towards sustainability in agriculture and food systems.

UNIT II Climate smart agroecology

Agroecology is a relatively new discipline that studies the ecological complexity and functioning of the agroecosystem. It is therefore a key discipline to drive the transition of agriculture towards sustainable paths, facing the challenges posed by climate change. It focuses on biological processes and on how they interact and influence the functioning of agroecosystems and farming systems, to propose sustainable agricultural practices. Concepts of biodiversity, natural capital and the provision of ecosystem services will be analysed and the agroecosystem will relate to the use of natural resources, health of soil, plant, environment and ecosystems in relation to abiotic and biotic threats under a changing climate.

AIMS

The course aims to provide a widely applicable knowledge base to increase agroecosystems’ resilience and production in a changing climate scenario.

- Explaining agroecosystems functioning,
- Examining the agroecosystems’ complexities and challenges,
- Reviewing agroecological practices which enable a more sustainable production,
- Understanding how climate change affects agroecosystems functioning,
- Identifying sustainable management solutions to mitigate and adapt to climate change and other global drivers of change,
- Understanding the value of agroecological approach for improving rural livelihood and promote social equity.

All along the course, practical sessions are promoted to provide and improve skills, knowledge and abilities of students, to use specific tools and technologies that enable proper analysis of agroecosystems and biodiversity at different scale and support rational management of natural resources at multiscale levels.

LEARNING OUTCOMES

At the end of the Unit students will:

✓ become knowledgeable on principles of agroecology and related practices,
✓ acquire practical skills on integrated multi scale agroecosystem analysis,
✓ achieve basic knowledge on nature-based solutions for biodiversity and ecosystem service provision,
✓ understand how climate change affects agroecosystems and sustainable management practices for adaptation and mitigation across energy-food-ecosystem nexus.
UNIT III: Smart tools for the management of natural resources in agriculture

Nowadays, the sustainable planning and management of agriculture and farming systems rely a lot on a range of SMART tools that make possible the fast collection and analysis of large geo-spatial data. In particular, Remote sensing, Geographic Information Systems and Global Position Systems, are commonly used for the acquisition, management, processing, analysis and display of spatial data and information. For the management of huge amounts of collected/generated data (big data), forecasting and decision support models are available.

They apply to a variety of fields that include farming systems analysis, water and irrigation management, forecasting/monitoring of crops pests and diseases, specific agro-ecological and food systems.

The use of these technologies requires the access to software (open licenses) and devices, often combined and integrated.

AIMS

The main objective of the Unit is to present how SMART tools may help support decisions in agriculture towards a sustainable management of natural resources, using modern approaches and tools available in geomatic, geoscientific and computer science environments.

In particular, the Unit provides basic knowledge for the use and applications of the following technologies:

- Remote sensing
- Geographic Information System
- Cartography and Geographic Positioning System
- Decision Support System
- Forecasting modelling
- Big data management

LEARNING OUTCOMES

At the end of the Unit, students will acquire:

- Basic concepts, principles, methods, and practical applications of the Geographic Information System (GIS), Cartography and Geographic Positioning System (GPS).
- Fundamental concepts of remote sensing for the management and sustainability of the territory, the agricultural system, and the water resources.
- Notions on the Decision Support System (DSS) and GIS-based Multiple Criteria Decision Aiding (MCDA) notions.
- Principles of mechanistic modelling and general concepts and procedures for proper model validation and judgment of utility under integrated and organic management.
- The main techniques and practical applications of the big data and the blockchain.
Unit IV - SUSTAINABLE ON-FARM IRRIGATION MANAGEMENT

Sustainable on-farm irrigation management integrates the different dimensions of the most relevant bio-physical and hydrological principles, laws governing soil-plant-atmosphere continuum processes, and crop growth under different management practices.

Through theoretical and practical sessions, this Unit provides the basic and advanced knowledge to determine soil physical and hydro-pedological characteristics, elaborate weather data for irrigation scheduling, model crop growth for a sustainable on-farm irrigation management.

AIMS

Providing theoretical knowledge and explaining basic and advanced concepts and relations on the topics of interest to practical application of sustainable on-farm irrigation management practices. Hence, the Unit focuses on:

- interpreting soil pedological characterization and classification and agro-meteorological data,
- understanding soil physical properties and processes,
- investigating the complex interactions of the Soil-Plant-Atmosphere Continuum system,
- estimating crop water requirements and crop response to water,
- designing irrigation scheduling,
- Resource use efficiency,
- Crop growth modelling,
- On-farm irrigation methods.

LEARNING OUTCOMES

Students enhance their theoretical understanding of the above topics and acquire practical skills and capacity to use:

- instruments to set up a pedological survey and to classify soils, to interpret and use information to estimate the soil quality in relation to the various land-uses,
- field and laboratory equipment/procedures for acquisition/analysis of soil samples, agro-meteorological data and for assessment of crop physiological status/parameters, an irrigation-scheduling tool based on the pattern of the plant-atmosphere as a support to the selection of optimal schedules,
- a crop growth model to simulate growth, development, and yield as a function of the soil-plant-atmosphere dynamics,
- a practical tool (irrigation app) for on-farm irrigation management.
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Unit V - Irrigation systems design, planning and management

The scientific understanding combined with new technology leads to better development, maintenance, and management of durable and efficient delivery systems that convey irrigation water from its source to the land and provide reliable services to users. This Unit explores an integrated approach that fosters a resilient design and an efficient management of water in agriculture, at scheme and farm level, in a performance-oriented perspective. Students learn about advances in surface irrigation technologies, innovations in micro-irrigation, open channel irrigation design and management, multi-objective planning, design and management of large-scale pressurized systems and use of renewable energy in water systems. They also acquire knowledge on how a system would react to fluctuations of its input (supply and/or demand), and thus an understanding, through a problem-solving approach, of the location of bottlenecks, of the importance of failures and, consequently, of actions to be built-in. This curriculum is built on the key supporting sciences of hydrology, hydraulics, soil and plant science, and economics.

AIMS

✈ providing the general overview and systems level knowledge on the technical and engineering aspects of irrigation water equipment and infrastructure,
✈ familiarizing students with the latest insights, concepts, and theories of irrigation technologies for sustainable development,
✈ planning, designing, operating, maintaining, controlling, and managing water resources and irrigation-related infrastructure, emphasizing the modernization of irrigation.

LEARNING OUTCOMES

On conclusion of the Unit, the student:

✔ acquires and masters knowledge on different types of irrigation systems, techniques and technologies, and is able to use the most appropriate, under different conditions,
✔ fully understands the delivery processes, structural components, function and performance of irrigation systems and the interaction of scales,
✔ obtains sufficient technical background for system level planning, operation, maintenance, control, and management.

UNIT VI - Use of Alternative Water Resources in Agriculture

Pressures from population growth and climate change have widened the gap between the availability and the demand for water in agriculture, reaching unsustainable levels in some regions, especially in the Mediterranean region. Thus, it is imperative to re-orientate the best water management practices in agriculture towards Alternative Water Resources (AWR) use, such as drainage water, treated wastewater, rainwater harvesting, and desalinated water.

This Unit offers a holistic approach towards AWR management and practices in agriculture as a sustainable, innovative, and cost-effective way of improving community access to water in water-
scarcely areas. This contributes to climate change adaptation and to preserve soil and crop quality, ensuring crop productivity to keep up with current population growth. Major focus is on:

- the reuse of low-quality waters, the treatments, methods, and processes,
- salinity control and its impact on soils and crops,
- drainage systems design and management,
- rainfed agriculture techniques.

**AIMS**

Explaining the main techniques, strategies and technologies related to the use of AWR in agriculture.

- examining the role of AWR as a potential contributor to water and food security,
- reviewing agricultural practices adoption with alternative sources of water in supporting farming sustainability,
- proposing irrigation and agriculture management practices and monitoring techniques to control deep percolation fluxes and limit soil and groundwater contamination.

**LEARNING OUTCOMES**

Students will:

- acquire a better understanding of the role of AWR use in water scarcity alleviation and irrigation management,
- develop knowledge on the water treatment techniques for a safe and proper management and use of AWR in agriculture,
- discuss irrigated agriculture and techniques suitable for the use of AWR and assess its impact on soil and crop production,
- highlight the regulation related to the use of AWR in agriculture and its management,
- implement sustainable water management in agriculture projects using AWR.

Unit VII: WATER ECONOMICS AND GOVERNANCE

Basic concepts of economics applied in irrigated agriculture and water management at farm, district and basin level are explored for an efficient water allocation and irrigation projects’ planning. By taking into account the major institutional dimensions of the Mediterranean irrigation sector, the following main topics are addressed:

- technical and allocative efficiency in multi-input and multi-output farm production process,
- agro-economic mathematical programming models,
- analysis of the main farm accounting balance sheet and income statement components,
- Cost Benefit Analysis to evaluate the economic and financial feasibility of investment projects,
- main institutional models of water governance with a particular focus on participatory approaches and water pricing policies in Mediterranean countries.

**AIMS**

Explaining:
how to plan the optimal allocation and use of water resources at farm and irrigation district scale,
how to assess the economic feasibility of irrigation project,
the environmental and economic impacts of economic tools and policies adoption in irrigation water management,
the guiding principles and challenges of participatory approaches in irrigation management (PIM) and transfer (IMT) with a focus on the Mediterranean countries.

**LEARNING OUTCOMES**

Students will:
- understand the role of economic parameters and criteria in the water management decision making process at farm and basin scale,
- acquire knowledge on quantitative methods used to support agricultural policies decision making,
- develop skills to comparatively assess the effectiveness of water policies and water governance models in irrigation sector,
- learn how to implement simple Cost/Benefit Analysis in irrigation projects.

**Unit VIII: Project on Irrigation Design**

An irrigation project at district level is designed, capitalizing on the knowledge acquired in the different Units. It integrates the environmental, agronomic, engineering, and socio-economic dimensions.

This process includes a comprehensive analysis of climatic, soil and crop data, the identification of the optimal cropping pattern, and the hydraulic design of a large-scale pressurized distribution network under different scenarios of water availability and quality. This Unit integrates the use of GIS tools, simulation, and optimization models.

**AIMS**

The Unit aims at developing a comprehensive logical approach to the design and management of irrigation systems. It also aims at developing the analytical skills and abilities of trainees to observe, research and interpret complex problems and solutions.

**LEARNING OUTCOMES**

Students will be able to:
- use and interpret climate, soil, crop data,
- determine the crop response to water and soil hydrological behaviour,
- optimise water allocation for irrigation at farm and district level,
- design and model the operation performance of large-scale irrigation systems in a service-oriented perspective,
- evaluate the economic feasibility and environmental impacts of irrigation projects.