



# Land and Water Resources Management: Irrigated Agriculture

Course Coordinator: Nicola Lamaddalena

- **Aims**

The aim of the Programme in “Land and Water Resources Management: Irrigated agriculture” is to improve capacities of high-ranking officials and professionals, both agronomists and engineers, in land and water resources management in the Mediterranean region.

The Programme is structured in 2 parts: the first part, the Master Programme, is based on an intensive learning course and on the elaboration of an irrigation project; the second part, the Master of Science Programme (MSc), is dedicated to the acquisition of research methodologies and to the development of a scientific applied research work.

- **Objectives**

The main objective of the Programme in "Land and Water Resources Management: Irrigated agriculture" is to improve scientific knowledge and technological know-how of the candidates in water saving and land conservation issues through the completion of specific research themes and experimental works.

The course is structured in such a way as to promote land and water resources management in the Mediterranean considering agronomic, engineering, environmental and socio-economic aspects on different scales.

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## Part 1 - The Master Programme

The programme is organized in **8 Units (64 ECTS)**

Duration: **9 months, from October 2017 to June 2018**

**2-20 October 2017**

### **UNIT 1 - INTRODUCTORY COURSES (6 ECTS)**

**Content:**

- ✓ Information and Communication Technologies (ICTS). Criteria for bibliographic research on specific topics in the country of origin
- ✓ English language
- ✓ Application of geographic information systems in land and water resources management
- ✓ Pedology and soil survey investigation

**Learning outcomes:**

Trainees should become capable of developing and implementing research protocols and conducting literature reviews.

Enhancement of Language skills for application to field of studies.

Acquiring advanced knowledge-base through the application of GIS in land and water resources management taking into account soil suitability on the basis of soil survey.

**Evaluation procedure:** written examination

**23 October -24 November 2017**

### **UNIT 2 - LAND AND WATER RESOURCES MANAGEMENT (10 ECTS)**

**Content:**

- ✓ Soil physics: water and solute movement
- ✓ Surface Water Hydrology management
- ✓ Groundwater hydraulics and pollution in agricultural settings
- ✓ Soil erosion and desertification: monitoring, modelling and mitigation technologies
- ✓ Water harvesting techniques

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## **Learning outcomes:**

Learning how to manage land and water resources: from processing to interpretation on rainfall data and factors affecting infiltration and runoff, in relation to soil physical characteristics, water movement in the soil and water availability, underground water flow, underground water quality and pollution, factors affecting soil erosion and desertification, monitoring, modelling and mitigation technologies, strategies of cultivated and bare land conservation.

**Evaluation procedure:** written examination

**27 November – 22 December 2017**

## **UNIT 3 – IRRIGATION MANAGEMENT: SOIL-WATER-PLANT-ATMOSPHERE CONTINUUM (8 ECTS)**

### **Content:**

- ✓ Agrometeorology and Seminar on Climate Change
- ✓ Crop response to water and water use efficiency
- ✓ Crop water requirements and practical irrigation scheduling
- ✓ Crop growth modelling: Eco-physiological and Engineering aspects
- ✓ Seminar on Agricultural aspects of irrigation methods

## **Learning outcomes:**

Learning how to manage irrigation in the soil-water-plant continuum starting from studying crop response to water and water use efficiency and its improvement for crop productivity with respect to growth stages and timing of stress occurrence, irrigation practice and management with related effects. Crop growth modelling through “Budget Aquacrop” in relation to climate factors and their effects on plant growth and farm production and climate change.

**Evaluation procedure:** written examination

**2- 19 January 2018**

## **UNIT 4 – IRRIGATION MANAGEMENT AT FARM LEVEL (6 ECTS)**

### **Content:**

- ✓ Design, operation, maintenance and performance evaluation of trickle irrigation systems

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- ✓ Design, operation, maintenance and performance evaluation of sprinkler irrigation systems
- ✓ Design, operation, maintenance and performance evaluation of surface irrigation systems

## **Learning outcomes:**

Learning how to manage on-farm irrigation through design, operation, maintenance and performance evaluation, and methods to improve surface irrigation systems, by sprinkler and micro-irrigation, taking into account agricultural aspects.

**Evaluation procedure:** written examination and group work

**22 January – 9 February 2018**

## **UNIT 5 – IRRIGATION MANAGEMENT AT DISTRIBUTION SYSTEMS LEVEL (6 ECTS)**

### **Content:**

- ✓ Design, operation, maintenance and performance evaluation of large scale open channel distribution systems
- ✓ Design, operation, maintenance and performance evaluation of large scale pressurized irrigation systems
- ✓ Seminar on Determining soil hydraulic properties by field-measured infiltration rates
- ✓ Water management optimization
- ✓ Seminar on Water resources management: the FAO approach

## **Learning outcomes:**

Learning how to manage irrigation of large-scale distribution systems through design, operation, maintenance and performance evaluation of open channels and pressurized irrigation systems; optimization of water management through planning and the application of dynamic management.

**Evaluation procedure:** written examination and group work

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**12 February – 9 March 2018**

## **UNIT 6 – USE OF NON-CONVENTIONAL WATER RESOURCES: TECHNICAL AND ENVIRONMENTAL ISSUES (8 ECTS)**

### **Content:**

- ✓ Salinity control in relation to irrigation
- ✓ Drainage and drainage systems design and management
- ✓ Use of low quality waters: environmental and technical aspects
- ✓ Seminar on Wastewater reuse in irrigation farming
- ✓ Seminar on Non-conventional water use
- ✓ Urban wastewater treatment for agricultural reuse.

### **Learning outcomes:**

Learning how to control salinity as related to water, climate and crop tolerance, leaching and reclamation techniques, management of unconventional waters for irrigation, study of water quality and pollution monitoring systems. Treatment of wastewater, wastewater reuse in irrigation farming. Management and design of drainage systems.

**Evaluation procedure:** written examination and group work

**13 March - 13 April 2018**

## **UNIT 7- IRRIGATION MANAGEMENT: INSTITUTIONAL, ECONOMIC AND ENVIRONMENTAL ASPECTS (10 ECTS)**

### **Content:**

- ✓ Principles of farm economics
- ✓ Optimal water allocation in irrigation sector
- ✓ Cost/Benefit Analysis
- ✓ Cost Recovery
- ✓ Participatory irrigation management (PIM) and transfer (IMT) in a monitoring & evaluation perspective
- ✓ International economics and the role of agriculture in economic development
- ✓ Seminar on Geopolitics of water in the Mediterranean and Middle East

### **Learning outcomes:**

Learning how to perform economic analysis and determine the economic benefits at the irrigated farm level, to perform optimal irrigation water

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allocation through environmental planning at farm scale, to perform cost/benefit analysis, Participatory irrigation management and transfer in a monitoring & evaluation perspective, assessment water cost recovery. The role of agriculture in the economic development.

**Evaluation procedure:** written examination and group work

**23 April - 8 June 2018**

## **UNIT 8 - CASE STUDY - IRRIGATION PROJECT DESIGN (10 ECTS)**

### **Content:**

Collection and analysis of climatic, soil and crop data. Determination of crop water requirements and gross irrigation requirements. Choice of the optimal cropping pattern based on different simulation scenarios (limited water availability, use of saline water, etc.) and economic criteria. Determination of specific continuous discharge. Hydraulic design of a large scale distribution network. Cost/Benefit analysis. Environmental Impact Assessment Applications. Synthesis, conclusions and reporting.

### **Learning outcomes:**

The design of an irrigation project based on a case study of southern Italy will allow for applying the knowledge acquired in the previous seven sections and working in a team work. Such a work will enable to analyse and process data on climate, soil, crops, and quality-oriented crop water requirements, to choose the optimal cropping system based on different simulation scenarios (water availability, quality, economic criteria, etc.). Hydraulic design of large scale distribution networks, environmental impact, cost/benefit analysis. Synthesis, conclusions.

**Evaluation procedure:** written examination and group work

**11-15 June 2018**

### **FINAL EXAMS**

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## Course organization

### **EXAMINATIONS**

Participants take an examination at the end of each subunit. Examinations are in the form of oral or written exams (i.e. sets of questions, exercises, multiple-choice). Questions can also cover seminar topics, field lectures and technical visits. Evaluation is made by lecturers or by the scientific tutor of the course. Participants may retake failed exams only once and up to 8 ECTS.

At the end of the course, participants have to pass a final comprehensive oral exam before an international Examination Board.

### **WORKING LANGUAGE: English**

### **ACADEMIC STAFF**

Master courses are given by MAIB scientific staff and international prestigious visiting professors (from universities, higher institutions, research centres, international organizations); field lectures are also given by experts from reclamation consortia.

### **TOURIST TRIP**

A tourist trip is organized for first-year classes. The aim of the trip is to make students discover some interesting places in Italy and get familiar with its historical and cultural heritage. Furthermore, the trip is a great opportunity to socialize in a context other than the Campus.

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## DIPLOMING COURSE

### From a business idea to its project design: the enterprise culture in the innovation process management (5 ECTS)

#### **Content:**

- ✓ Project cycle management: methods and tools for an innovative idea design
- ✓ Lean Business Model Canvas: tools to analyse and evaluate the economic sustainability of the entrepreneurial idea
- ✓ Web and communication tools: how to improve and strengthen web usage to develop and communicate the entrepreneurial idea

#### **Learning outcomes:**

Knowledge and basic skills to create, develop and communicate an innovative entrepreneurial idea. Development of an innovative entrepreneurial idea proposal.

**Evaluation procedure:** oral presentation of the project proposal

## Part 2 - The Master of Science Programme

### **Research work: thesis and defence (60 ECTS)**

Research activities on Land and Water Resources Management cover different scales of application (from leaf - plant to watershed and region) and allow a multilevel approach through the interaction of various aspects (agronomic, engineering and economic) at different levels of investigation: on the one hand, agricultural management practices are scaled up, from leaf to irrigation district level, which leads to the irrigation water demand of an entire district. This demand is translated into water released from the source and down-scaled through water management practices, from the source of water to farms and single plants.

Such activities are carried out under the supervision of L&W staff and/or national-international experts belonging to the L&W networking.

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Actually, research activities of the Land and Water Division are carried out through the Master of Science Programme, PhD works and research projects.

## Research activities: topics generally available for Master of Science theses

- ✓ Water use efficiency and water productivity
- ✓ Deficit irrigation and supplemental irrigation
- ✓ Crop water requirements and irrigation scheduling
- ✓ Soil-plant-atmosphere relationships and crop growth modelling
- ✓ Saline irrigation practice and management
- ✓ Treated sewage water and its use in agriculture
- ✓ Climate variability and changes and their impacts on agriculture
- ✓ Land evaluation and Agro-ecological characterization
- ✓ Performance assessment of CIS: operational analysis and rehabilitation
- ✓ Management and design of CIS and optimization of on-farm/CIS interaction
- ✓ Water energy consumption: irrigation water supply and pumping station regulation
- ✓ Water resources management: reservoir operation and groundwater exploitation

## Indicative Master of Science theses realized within the area

I.

- ✓ **Title:** “Perturbation indicators for pressurized irrigation systems”
- ✓ **Author:** Derardja Bilal, hydraulic engineering, Algeria (2016)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** N. Lamaddalena, R. Khadra & M. A. Moreno

II.

- ✓ **Title:** “Modelling the spatial distribution of evapotranspiration of main crops in the Apulia region using dual crop coefficient approach”
- ✓ **Author:** Assif El Mahdi, rural engineering, Morocco (2015)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** L. S. Pereira & D. D’Agostino

III.

- ✓ **Title:** “Application of ground based remote sensing techniques to evaluate physiological and biometric variables of potato (*Solanum tuberosum* L.) grown under different water treatments”
- ✓ **Author:** Imen Ben Charfi, Agricultural Engineer, Tunisia (2014)

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- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** R. Albrizio & M. Todorovic

IV.

- ✓ **Title:** “Low cost and sustainable green bean soilless production in greenhouse using closed cycle sub irrigation”
- ✓ **Author:** Bouchaaba, Zakaria, Agricultural Engineer, Morocco (2013)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** F. Montesano & R. Choukr Allah

V.

- ✓ **Title:** “Assessing the impact of climate change on water productivity in the Mediterranean agriculture”
- ✓ **Author:** Saadi Sameh, Agricultural Engineer, Tunisia (2012)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** L. S. Pereira & M. Todorovic

## Course organization

### EXAMINATIONS

Students present the progress of their research work before a Supervising Team twice during the academic year:

- **1<sup>st</sup> Seminar:** bibliographic search; project proposal (objectives, materials and methods) and related written draft;
- **2<sup>nd</sup> Seminar:** presentation and scientific value of the research work (modelling, laboratory or field activity) and related written draft.

At the end of the course, they discuss their thesis and pass a final comprehensive oral exam before an international Examination Board.

**WORKING LANGUAGE: English**

### ACADEMIC STAFF

Students' research theses are supervised by MAIB researchers and external professors in collaboration with MAIB staff.

**Further detailed information is available on: [www.iamb.ciheam.org](http://www.iamb.ciheam.org)**