



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 graduate students, researchers, high-ranking officials and professionals, 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 the scientific knowledge and technological know-how of 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 (66 ECTS)**

Duration: **9 months, from October 2019 to June 2020**

1-19 October 2018

UNIT 1 - INTRODUCTORY COURSES (7 ECTS)

Content:

Introduction to the general principles of thematic areas of great interest for agriculture that can be shared between the 3 Master courses: biodiversity, climate change and high technology for agriculture.

Learning outcomes:

Providing students with in-depth information on relevant issues and topics that have a great impact on agriculture. GIS and remote sensing will be discussed more in depth in Unit 2 on Water and Land Resources Management. Climate change will be deepened in Unit 3 on Irrigation Management: Soil-Water-Plant-Atmosphere Continuum.

Evaluation procedure: written examination

14 October -29 November 2019

UNIT 2 - LAND AND WATER RESOURCES MANAGEMENT (14 ECTS)

Content:

- ✓ Pedology and soil survey investigation
- ✓ Application of geographic information systems in land and water resources management & remote sensing
- ✓ Soil physics: water and solute movements
- ✓ 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 by taking into account: Soil quality, interpretation of 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, water quality and pollution, factors affecting soil erosion and desertification through monitoring, modelling and mitigation technologies, water harvesting techniques.

Knowledge-based techniques on GIS and remote sensing are also provided.

Evaluation procedure: written examination

2 December 2018 - 3 January 2020

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

7-24 January 2020

UNIT 4-IRRIGATION MANAGEMENT AT FARM LEVEL (6 ECTS)

Content:

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

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

21 January – 8 February 2020

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 distribution 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

17 February – 13 March 2020

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

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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

16 March - 17 April 2020

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
- ✓ Participatory irrigation management (PIM) and transfer (IMT) in a monitoring & evaluation perspective
- ✓ Cost Recovery
- ✓ 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 allocation through environmental planning at farm scale, to perform cost/benefit analysis, participatory irrigation management and transfer in a monitoring & evaluation

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perspective, assessment water cost recovery. The role of agriculture in the economic development.

Evaluation procedure: written examination and group work.

27April – 12 June 2020

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

15-16 June 2020

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.

Part 2 - The Master of Science Programme

Duration: **12 months, from November 2019 to October 2020**

MASTER OF SCIENCE ORGANIZATION

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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Topics generally available for Master of Science theses

- Eco-Efficiency analysis of irrigation
- Impact of treated wastewater use on the cropping pattern, irrigation management and hydraulic performance of irrigation network
- Generation of the discharge hydrograph in large scale irrigation system
- Modernization of an on-demand pressurized irrigation systems: Assessment of the flexibility impact on the cost effectiveness
- Formulation of a physically-based pedotransfer function to determine soil hydraulic parameters for an agro-hydrological model
- Energy and Hydraulic Performance-Based Management of Large-Scale Pressurized Irrigation Systems
- Actual soil erosion loss and sediment yield estimation in the Candelaro watershed of Apulia region in Italy using the G2 model
- Characterization, modelling and participatory simulations of water use and development strategies at the level of rural households and rural territories
- The impact of conversion from surface irrigation to drip irrigation on groundwater exploitation
- Combination of new sensor technologies, satellite navigation and positioning technology to manage irrigation, fertilisation and applying automated optical sensing to detect diseases undetectable by traditional means

MASTER OF SCIENCE - EVALUATION

EXAMINATIONS

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

- **1stSeminar:** bibliographic search; project proposal (objectives, materials and methods) and related written draft;
- **2ndSeminar:** presentation and scientific value of the research work (modelling, laboratory or field activity) and related written draft.

Supervised research work: the research work carried out by the student is assessed by the supervisor(s).

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Final exam and thesis evaluation: at the end of the course, students 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 CIHEAM Bari researchers and external professors in collaboration with CIHEAM Bari staff.

Indicative Master of Science theses realized within the area

I.

- ✓ **Title:** "Treated wastewater use on citrus in morocco: assessing the economic feasibility of irrigation and nutrient management strategies"
- ✓ **Author:** Oubelkacem Abdellah, Agricultural Engineer, Morocco (2018)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** A. Scardigno, G. Dragonetti, & R. Khadra , CIHEAM -Bari, Italy

II.

- ✓ **Title:** "Assessing field spatial variability of soil hydraulic properties by combining a multiple dripper system, 2D soil water flow numerical modeling and Time Domain Reflectometry (TDR)"
- ✓ **Author:** Moghrani Siham, hydraulic engineering, Algeria (2017)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** A. Coppola & G. Dragonetti

III.

- ✓ **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

IV.

- ✓ **Title:** "Modelling the spatial distribution of evapotranspiration of main crops in the Apulia region using dual crop coefficient approach"

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- ✓ **Author:** Assif El Mahdi, rural engineering, Morocco (2015)
- ✓ **Place of realization:** MAI-Bari, Italy
- ✓ **Thesis supervisors:** L. S. Pereira & D. D'Agostino

V.

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

Further detailed information is available on: www.iamb.ciheam.org