Syllabus

Course Description

Course Title	Sustainable soil management
Course Code	47302
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Master in Smart Sustainable Agriculture Systems in Mountain Areas
Other Degree Courses (Loaned)	
Lecturers	Prof. Tanja Mimmo, Tanja.Mimmo@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/26968 Prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	6
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	Module 1: Soil Protection (3 ETCS) The course aims to provide knowledge for understanding and managing soil conservation issues. It emphasizes the critical role of soil in ecosystems and examines various threats to soil health and quality. These threats include erosion, pollution, sealing, compaction, loss of organic matter and soil biodiversity, chemical

	contamination, and the impacts of global change. Also, key topics will include soil health indicators and health conservation techniques and the relevant legislation. The course will also include practical field excursions to complement theoretical knowledge, providing hands-on experience in soil protection practices.¿ Module 2: Molecular Agroecology & Biochemistry (3 ETCS) The course provides a comprehensive understanding of molecular approaches to agroecology and biochemistry. It focuses on the biochemical and molecular interactions within agroecosystems, including plant-soil interactions, nutrient cycling, and the role of soil biodiversity processes in sustainable agriculture. Key topics include enzymatic activities in soils linked with biogeochemical cycles, soil biomass, and the application of next-generation sequencing based on environmental DNA for soil biodiversity monitoring in agroecosystems. Relevant laboratory techniques will also be covered. The course will include practical exercises related to laboratory activities and data analysis derived from environmental DNA and biochemical data, providing students with a comprehensive knowledge of molecular and biochemical to be applied in agro-ecosystems.
Course Topics	Mdule I: Soil Protection 1. Introduction and Functions of Soil The importance of soil protection for ecosystems, climate regulation, and human well-being. 2. Drivers of Soil Degradation Climate change impacts: warming, rainfall extremes and SOC loss War and conflict as drivers of degradation. 3. Soil Carbon and Nutrient Dynamics Soil carbon: functions, trends in Europe, peatlands, and inorganic carbon. Nutrient dynamics: nitrogen, phosphorus, potassium, secondary nutrients. Causes of Nutrient Imbalances and Strategies for Sustainable Management 4. Physical and Chemical Degradation Processes Soil acidification, erosion, and compaction. Salinisation and sodification. Pollution and soil contamination.

	5. Monitoring and Soil Indicators Soil quality indicators Climate Change, SOC, and Soil Resilience. Tools for assessing soil protection. 6. Plant–Soil Interactions and Biological Dimension Rhizosphere processes, nutrient availability, and plant growth promotion Module II: Molecular Agroecology & Biochemistry 1. Soil Enzymes as Indicators Soil enzymes as markers of soil functionality, ecosystem quality, and resilience under stress. 3. Agroecological network of biodiversity 4. Environmental DNA (eDNA) Approaches Applications of eDNA in agriculture and agroecosystems. Soil sampling and data analysis. From eDNA to soil functions 5. Integrated Approaches Combining eDNA and enzymatic activities for holistic soil assessment. Case studies from agricultural and natural soils. 6. Agroecological Applications Monitoring biodiversity shifts under sustainable management practices
Keywords	Soil formation Soil degradation Soil indicators Soil carbon Soil Health Agroecological network of biodiversity Soil biochemistry Environmental DNA (eDNA) Approaches in agriculture
Recommended Prerequisites	
Propaedeutic Courses	No
Teaching Format	Lectures, Laboratory Activities and Fieldwork
Mandatory Attendance	No
Specific Educational Objectives and Learning	Knowledge and understanding --> - Actively participate in research projects in the field of mountain

Outcomes	agriculture - Collaborate with other professionals in the fields of architecture, engineering, and natural sciences - Work in interdisciplinary, national, and international teams Ability to apply knowledge and understanding --> Graduates of the Master's degree program (Master SAM) are equipped with a solid scientific and technical foundation that enables them to address and solve complex problems. Thanks to their scientific and technical training in agriculture, economics, and management, graduates are able to develop analyses and plans for the development and management of agricultural businesses in mountainous regions, taking into account their specificity and multifunctionality (ecosystem services). In these specialized fields, graduates are able to coordinate interdisciplinary groups in the agricultural sector. The ability to apply acquired specialized knowledge is achieved through critical reflection on the course materials and classroom learning activities, complemented by case study analysis and practical exercises conducted by instructors. Furthermore, practical exercises in the laboratory, computer, and field are included, as well as field trips, literature research, the development of individual and/or group projects, and the preparation of the final thesis. The assessment of success (oral and written exams, seminar reports) and the exercises are designed in such a way that graduates must demonstrate mastery of the work tools, the methods learned, and a critical and independent way of working. Autonomy of judgement --> - choose the best production techniques while taking environmental protection into account; - analyze data and information to independently assess the quality and effectiveness of results obtained when designing strategies to manage difficulties. - make independent decisions on professional issues. These may specifically concern the feasibility of agricultural projects. - evaluate quality assurance systems for agricultural products, including those in the tourism sector, and the methods for defining internal and external quality criteria. - plan activities and strategies based on predefined objectives,

	taking into account timeframes and methods. Communication Skills --> Graduates will be able to work professionally in one or more foreign languages. Mandatory courses and elective courses are taught in English. Additionally, some elective courses may be offered in Italian or German. In accordance with unibz's trilingualism policy, the unibz Language Centre offers the opportunity to take extracurricular courses (levels A1-C1) in Italian and German. Graduates will be able to communicate fluently with other professional groups they work with and will be able to participate in European projects with foreign partners thanks to the international focus of the Master's program. Written and oral communication skills are promoted through seminars, excursions, exercises, and teaching activities, which include the preparation of reports and written documents and their oral presentation in English and, where appropriate, in Italian and German in elective subjects. The aforementioned communication skills are also acquired and assessed/verified through the writing of the final thesis and its defense in English. The master's degree program also promotes the acquisition of additional language skills in German and Italian. This should enable graduates to successfully enter the international job market (e.g., Austria-Switzerland-Italy-Germany). Learning Capacity --> Graduates will be able to manage complex projects thanks to the specialized knowledge acquired during their studies. They will be able to continuously expand and update the specialized knowledge acquired during their studies. They will learn to use the most modern methods to competently perform analyses, project planning, and management measures in their professional lives. Graduates will be able to use various information systems to further their cultural and professional development. They will also be able to choose the methods and training paths best suited to their cultural and professional development. Graduates will be able to manage complex projects thanks to the specialized knowledge acquired during their studies. They will be able to continuously expand and update the specialized knowledge acquired during

	their studies. They will learn to use the most modern methods to competently perform analyses, project planning, and management measures in their professional lives. Graduates will be able to use various information systems to further their cultural and professional development. They will also be able to choose the methods and training paths best suited to their cultural and professional development. Learning skills are encouraged throughout the degree program. Special emphasis is placed on individual study, especially in completing group work on proposed topics. This skill is enhanced during compulsory lectures, which include group work, and subsequently in the preparation of the final thesis. Learning progress is assessed regularly throughout the courses and during the preparation of the final thesis. Specifically, this practice-oriented program involves working in small groups (3-5 students) on a shared project (e.g., a plan for the development of agricultural businesses in mountain areas), from the initial stages (development of objectives and measures, collection of available data) to cooperation with various stakeholders (e.g., public administration, mountain agriculture advisory center, farmers' association), which also includes communication activities for agriculture and society. The projects are carried out under the supervision of two or more professors, with exchanges between students and the private companies and/or public authorities involved. Learning skills are assessed through continuous assessment during the learning units and in the preparation of the final thesis.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Oral Examination (50%) Evaluates understanding of the main course topics, the ability to connect theoretical concepts, and critical reasoning on soil protection issues. Practical Project Presentation (50%) Assesses the capacity to apply knowledge to real-world soil conservation and management problems, propose practical solutions, and communicate them effectively.
Evaluation Criteria	- Knowledge of Key Concepts (40%)

	- Application and Critical Thinking (30%) - Integration of Topics (15%) - Communication Skills (10%) - Engagement and Argumentation (5%)
Required Readings	Course materials will consist of lecture slides and supplementary resources prepared and provided by the professor
Supplementary Readings	Blanco, Humberto, e Rattan Lal. 2023. Soil Conservation and Management. 2ª edizione. Cham: Springer. https://doi.org/10.1007/978-3-031-30341-8
Further Information	
Sustainable Development Goals (SDGs)	Zero hunger, Good health and well-being, Quality education, Life on land, Sustainable cities and communities, Responsible consumption and production, Climate action, Clean water and sanitation

Course Module

Course Constituent Title	Soil Protection
Course Code	47302A
Scientific-Disciplinary Sector	AGR/13
Language	English
Lecturers	Prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124 Prof. Tanja Mimmo, Tanja.Mimmo@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/26968
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	18
Lab Hours	12

Individual Study Hours	45
Planned Office Hours	9
Contents Summary	Module 1: Soil Protection (3 ETCS) The course aims to provide knowledge for understanding and managing soil conservation issues. It emphasizes the critical role of soil in ecosystems and examines various threats to soil health and quality. These threats include erosion, pollution, sealing, compaction, loss of organic matter and soil biodiversity, chemical contamination, and the impacts of global change. Also, key topics will include soil health indicators and health conservation techniques and the relevant legislation. The course will also include practical field excursions to complement theoretical knowledge, providing hands-on experience in soil protection practices.
Course Topics	
Teaching Format	The course will be delivered through a combination of frontal lectures, field excursions, and laboratory activities. Lectures will provide the theoretical background on soil conservation, soil degradation processes, and protection strategies. Field excursions will enable students to observe soil threats, such as erosion and compaction, directly, and to conduct real sampling and data collection. Laboratory sessions will provide hands-on experience in analysing soil samples and applying soil health indicators, thereby linking theoretical knowledge with practical skills.
Required Readings	Course materials will consist of lecture slides and supplementary resources prepared and provided by the professor.
Supplementary Readings	Blanco, Humberto, e Rattan Lal. 2023. Soil Conservation and Management. 2ª edizione. Cham: Springer. https://doi.org/10.1007/978-3-031-30341-8

Course Module

Course Constituent Title	Molecular Agroecology & Biochemistry
Course Code	47302B
Scientific-Disciplinary Sector	AGR/13
Language	English

Lecturers	Prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	18
Lab Hours	12
Individual Study Hours	45
Planned Office Hours	9
Contents Summary	Module 2: Molecular Agroecology & Biochemistry (3 ETCS) The course provides a comprehensive understanding of molecular approaches to agroecology and biochemistry. It focuses on the biochemical and molecular interactions within agroecosystems, including plant-soil interactions, nutrient cycling, and the role of soil biodiversity processes in sustainable agriculture. Key topics include enzymatic activities in soils linked with biogeochemical cycles, soil biomass, and the application of next-generation sequencing based on environmental DNA for soil biodiversity monitoring in agroecosystems. Relevant laboratory techniques will also be covered. The course will include practical exercises related to laboratory activities and data analysis derived from environmental DNA and biochemical data, providing students with a comprehensive knowledge of molecular and biochemical to be applied in agro-ecosystems.
Course Topics	
Teaching Format	Lectures, Laboratory Activities and Fieldwork
Required Readings	Course materials will consist of lecture slides and supplementary resources prepared and provided by the professor
Supplementary Readings	