IDEAS
INNOVATION DEVELOPMENT IN AGRIFOOD SYSTEMS
INTERNATIONAL MASTER OF SCIENCE

General information		
Academic subject	Non-food and industrial energy cropping systems	
Degree course	Innovation development in agrifood systems	
Academic Year	2	
ECTS credits		3
Language	English	
Academic calendar (starting and ending date)	From October 18th,2021 to January 28th,2022	
Attendance	optional	

Professor/ Lecturer	
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Virtual headquarters	TEAMS platform
Tutoring (time and day)	Every day by appointment via e-mail. The tutoring activities can also take place on e-learning platforms

Syllabus	
Learning Objectives	*The course provides an updated and in-depth picture of non-food crops for the production of energy, biofuels, biolubricants, vegetable oils, starch with high added value for industrial applications (bioenergy, biomaterials, biobased products). The main production chains from the agricultural production of the raw material to the finished product will be addressed from a technical-scientific point of view. The different species will be taken into consideration for the various supply chains and the agronomic aspects of the production of the raw material, the level of yield, the qualitative requirements of the main products and co-products and the criteria to be considered to evaluate sustainability and production efficiency. The concept of biorefinery and cascading use of the different biomass components will be illustrated in order to improve production efficiency and reduce waste by contributing to the sustainable use of resources for sustainable development, in line with the 2030 Global Agenda for sustainable development of the United Nations and related Sustainable Development Goals (SDGs). For some sectors, the potential for market penetration and the guidelines of the regulatory framework will be provided. This will allow students to define the most suitable species for each specific production chain and environmental context, to critically evaluate the relationships between technical interventions and the environment, to know their specific quantitative and qualitative characteristics in relation to the intended use and to critically identify their potential and limits. The purpose of the course is to increase scientific knowledge and technical skills on a wide range of non-food crops and their products.*
Course prerequisites	*Knowledge of botany, agronomy, plant pathology*

Contents	- *Introduction to the course: objectives, topics and references, organizational aspects* - *Non food crops: the range of crops, the renewable materials for industrial applications, the lead markets, the agricultural-based supply chain, key environmental, economic and social benefits.* - *Products made from non-food crops categorized by function: biofuel and bioenergy, fibers and biocomposites, building and construction, biopolymers and bioplastics. Main products and overview of the crops used.* - *The bioeconomy, the biorefinery concept and the cascading use of the biomass. - Bio-based products.* - *Biofuels and Bioenergy: the status and objectives of bioenergy at European and Italian level. Biomass from agriculture and forestry. The main crops, the range of technologies and application options. The complexity of the production chain. First-generation and second-generation biofuels: the crops, the feedstock quality, the range of technologies.* - *Fibre and cellulose, building and construction materials. Fiber and biocomposites: the state of the art of fiber plants, production of natural fibers at world, European and national level. The classification of natural fibres. The main crops. Fiber quality and applications.* - *Oils and Lubricants: Oilseed crops. Non-food industrial applications of plant-derived oils. The major and minor oilseed crops, the oil characteristics, the coproducts characteristics, the non food applications. Minor oilseed crops with specific fatty acid composition. Description of the main oilseed species and related agronomic techniques, harvest and handling, legislation and end-product requirement information, sustainability assessment.* - *Bioplastics and biopolymers: Biopolymers from renewable resources. The state of the art, the different sources and types of biomass, their main properties, processing aspects, applications of biopolymers in packaging.* - *For each crop will be described the following topics: Facts of interest, production requirements, varieties, agronomy, pest and disease control, harvest and handling, legislation and end-product requirement information, sustainability assessment.* - *Case Study*

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Books and bibliography	*Power Point presentations provided by the teacher and other in-depth material such as:* AAVV (2017). Crops to Industry: Fibre crops that can be produced in EU27. Pp. 122. AAVV (2017). Crops to Industry: Oilseed crops that can be produced in EU27. Pp. 114 AAVV (2017). Crops to Industry: Specialty crops that can be produced in EU27. Pp. 163 Stephan Piotrowski, Michael , Dirk Carrez (2018) European Bioeconomy in Figures 2008 – 2015. Nova-Institute for Ecology and Innovation, pp. 1-17. Iris Lewandowski (2018) Bioeconomy. Shaping the transition to a sustainable, Biobased Economy. Springer, pp. 355. EPRS, European Parliamentary Research Service (2016) Closing the loop New circular economy package, pp16 Otto Schmid, Susanne Padel and Les Levidow (2012) The Bio-Economy Concept and Knowledge Base in a Public Goods and Farmer Perspective. Bio-based and Applied Economics 1(1): 47-63. Angelini L.G. Fibre Bio-based Internal Report 2015, pp 1-18. Angelini L.G., De Mastro G., Sacco D. Le colture dedicate da energia: potenzialità e limiti. pp 1-16.
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
75	16	14	45
ECTS			
3	2	1	
Teaching strategy			
	The lectures will be given with the aid of Power Point presentations, video clips, reading out of legislative texts, educational tour in bioenergy farm and biorefinery Lecture notes and educational supplies will be provided by means of a mailing list or online platforms (i.e.: Edmodo, Google Drive…)		
Expected learning outcomes			
Knowledge and understanding on:	*Advanced knowledge of non-food crops for the production of energy, biomaterials and bio-based products on the agronomic management of crop systems dedicated to the production of biomass for the production of biomaterials and bioenergy*		

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Applying knowledge and understanding on:	Knowledge and ability to outline the main production chains from a technical-scientific point of view, from agricultural production of the raw material to the finished product.
Soft skills	• *Making informed judgments and choices* - Define the most suitable species for each specific production chain and environmental context, define their specific quantitative and qualitative characteristics in relation to the intended use and critically identify their potential and limits. • *Communicating knowledge and understanding* - Ability to explain and motivate the choices made in the field of cultivation systems for the production of biomass • *Capacities to continue learning* - Ability to learn the criteria for choosing the most suitable species for each specific production chain and environmental context, the relationships between technical interventions and the environment, the specific quantitative and qualitative characteristics in relation to the intended use and to critically identify the potential and limits on the basis of the knowledge acquired during the course. The expected learning outcomes in terms of knowledge and abilities are reported in Annex A of the Academic Regulations (expressed through the European descriptors pertinent to the degree program).

Assessment and feedback	
Methods of assessment	*The exam consists of an oral dissertation on the topics developed during the theoretical and theoretical-practical lectures in the classroom and in the laboratory.*

Evaluation criteria	• *Knowledge and understanding* - The knowledge and understanding of the concepts related to non-food crops and crop systems for the production of biomaterials and bioenergy illustrated during the course will constitute the elements for the basic evaluation of the student. • *Applying knowledge and understanding* - A further element of evaluation will consist of the ability to understand the aspects relating to the choices of non-food crops most suitable for the development of production chains aimed at biomaterials and bioenergy. • *Autonomy of judgment* - The ability to choose the most suitable non-food crops for the development of production chains aimed at biomaterials and bioenergy, while respecting the environment and the health of operators will constitute another essential element of evaluation. • *Communicating knowledge and understanding* - A further element of evaluation will be the student's ability to explain and motivate the choices made in the agronomic management of crop systems dedicated to the production of biomass for the production of biomaterials and bioenergy. • *Communication skills* - At the end of the course the student will be able to demonstrate: a solid knowledge of non-food crops for the production of energy and biomaterials; outline the main production chains from a technical-scientific point of view, from the agricultural production of the raw material to the finished product; define the most suitable species for each specific production chain and environmental context, define their specific quantitative and qualitative characteristics in relation to the intended use and critically identify their potential and limits. • *Capacities to continue learning* Ability of deepening and updating knowledge about the non-food crops for the development of production chains aimed at biomaterials and bioenergy

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Criteria for assessment and attribution of the final mark	*The final exam consists of an oral dissertation concerning the topics developed during the theoretical and practice lessons. The evaluation of the students' accomplishment is expressed by a vote of thirty. The final exam is passed with a vote of at least 18/30. A first class degree can be attributed in the case of top vote (30/30). The oral examinations are public.* *The evaluation of the student's attainment is in agreement with pre-established criteria, as detailed in Annex A of the Academic Regulations for the Agricultural Technologies and Science Degree Course.*
Additional information	