



AWESOME

WATER-ECOSYSTEM-FOOD

SUMMER SCHOOL on the Water, Energy, Food, and Ecosystems Nexus

28th – 31st of August 2023

Online

Registration link: <https://polimi-it.zoom.us/meeting/register/tJckf-CgrjlrGtCo-0KOrEMqj8Alf5OjoxUb#/registration>

Organizing Committee: Marta Castellini, Camilla Gusperti, Ilenia Gaia Romani - FEEM



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Program

Day 1 – Monday 28th of August 2023

Module 1 (9-10:30 CET): General introduction on the WEF Nexus: definition of the Nexus, resources, drivers, and problems contextualisation. The WEF Nexus in the light of the complexity of the Agenda 2030 and Sustainable Development. Context of the AWESOME project, structure, goals, progresses (roadmap).

Speaker: Andrea **Castelletti** (POLIMI)

Module 2 (11-12:30 CET): In this module, the focus will be on demonstrating technically of the potential innovative technological solutions for increasing agricultural productions, while reducing water consumption. Moreover, different cultivation systems, aquaculture-agriculture integration to enhance the efficiency of consumed water with their implementation and their role in mass production will be introduced. A closer look at the demo site and an overview of results from case-study.

Speakers: Demet **Cekin** (RWTH), Mostafa **Hassanen** (ZG)

Module 3 (14-15:30 CET): Future scenarios: demographic and climate change projections

Introduction to the construction of future scenarios according to global demographic and climatic projections. After providing an overview of state-of-the-art scenarios relying on Shared Socioeconomic Pathways and Representative Concentration Pathways, they will illustrate the different models supporting the scenario generation as well as discuss scenario-related uncertainties.

Speakers: Matteo **Giuliani** (POLIMI), Georgios **Papayiannis** (AUEB), Athanasios **Yannacopoulos** (AUEB)

Day 2 – Tuesday 29th of August 2023

Keynote speech 1 (9-10:30 CET) – **On-farm Water Energy Food Carbon-footprint Nexus Index for Quantitative Assessment of Integrated Resources Management for Wheat farming in Egypt.**
Mohie Omar (ICARDA)

To improve the farming efficiency, Egypt has been struggling to narrow the water, energy, and yield gaps owing to exacerbated water shortage. For quantitative diagnosis of farming performance, the paper presented an on-farm water, energy, food, and carbon-footprint (WEFC) nexus index made

up of four equally pillars. The arithmetic average preserved the multi-centric approach and equal importance of the four pillars. The index was applied to test and rank 2,042 wheat-based farmer fields in Egypt representing diverse inputs, agronomic and irrigation practices, soil types, and agroecological conditions. The water metric was the ratio of saved water, difference between maximum water consumption recorded in the country and actual water consumption, to the maximum water consumption. Likewise, the energy metric was obtained. The food metric was the ratio of actual yield to maximum yield in the country. The carbon-footprint metric was the ratio of difference between maximum CO₂ emission in the country and actual emission to the maximum emission. The index values showed a wide range from 18.69% to 87.33% with a high standard deviation emphasizing the diversity of farming practices, soil types, and agroecological conditions. The highest ten values were recorded in fields with sandy soils, relatively large area, drip irrigation, recommended seeding and fertilization rates, well drainage, weeds removal, and tillage. The drip irrigation system in 51 out of 52 fields had above average value. The lowest ten values were in fields with clay soils and flood irrigation, where 18.7% of 1,780 fields exceeded the above average value. Raised beds with furrow irrigation in 83.15% of 184 fields exceeded the above average value. Fertilization rates of nitrogen and phosphorus in 61% and 53% of fields respectively exceeded the recommended rates with no significant reflection on the food metric. The low index values in fields with flood irrigation were attributed to high water losses causing high water consumption, energy consumption, and CO₂ emission. The index was a good indicative of input resources consumption and output production as it varied inversely with water and energy consumption and CO₂ emission and proportionally with yield.

Module 4.a (11-12:30 CET): Stakeholder engagement.

Intro to participatory approaches for SH engagement in natural resources management, from a WEFE perspective. Defining the WEFE approach and the relevant SHs; Methods from SH identification and analysis, to co-creation, Live case study from the AWESOME project - Overview of the models developed within the MAWGs: a) WEFE mental maps, their findings and the resulting policy suggestions. b) participatory storylines on the future of the case study area.

Speakers: Lydia **Stergiopoulou** (AUEB)

Module 4.b (14-15:30 CET): Future scenarios: food and energy components

Food: Overview of the current agricultural production in the Nile Basin and exposition of potential alternative strategies to enhance crop productivity while minimizing blue water consumption. Different allocation scenarios including climate change and diet shifts are discussed in relation to the availability of water and suitable land for crop production.

Energy: Exploration of different pathways of future energy scenarios for the spatial domain useful for the AWESOME project (i.e. including Egypt, Ethiopia, and Sudan), in terms of energy demand

and infrastructure evolution and their economic and environmental impacts. The future sectoral energy demand scenarios are developed based on the Socio-economic Pathways (SSPs) and the outcomes the demographic projections, using a multi-sectoral optimal resource allocation economic model.

Speakers: Davide Danilo **Chiarelli** (POLIMI), Martina **Sardo** (POLIMI), Matteo Vincenzo **Rocco** and Yassin Rady (POLIMI)

Day 3 – Wednesday 30th of August 2023

Keynote speech 2 (9-10:30 CET) – to be defined

Module 5.a (11-12:30 CET): Overview on the use of macroeconomic models in the field of the WEFE nexus, presenting a list of selected scientific publications by theme, main results and contribution. Focus on the most studied topics, how they are combined, and through which macroeconomic model these are studied.

Speakers: Camilla **Gusperti** (FEEM)

Module 5.b (14-15:30 CET): Integrated assessment modelling of climate, economy and agricultural nexus for the Mediterranean Region.

Introduction to the RICE-MED model, i.e. a framework where the global externality of climate change is incorporated, allowing the study of its impacts on the socio-economic environment; policy implementation; focus on the impacts of climate change on the Mediterranean countries and the agricultural sector; the role of uncertainty; overview of the results.

Speakers: Marta **Castellini** (FEEM)

Day 4 – Thursday 31st of August 2023

Module 6.a (9-10:30 CET): Introduction to the decision-analytic platform, i.e. strategic river basin model coupled with optimisation methods, to analyse many-objective water planning and management problems and to explore synergies and trade-off among the components of the WEF Nexus.

Speaker: Matteo **Giuliani** (POLIMI)

Module 6.b (11-12:30 CET): Global Computable general equilibrium (CGE) model with alternative water sources for WEF nexus analysis

Global Computable general equilibrium (CGE) model with alternative water sources for WEF nexus analysis and ecological benefit-cost trade-offs of natural resources used in different cultivation methods.

Computable general equilibrium models are a powerful economic modelling tool that uses actual economic data. CGE models are structured to estimate the impacts of external shocks on an economy while considering interrelations between the various economic sectors and international trade. Within the WEF nexus, CGE contributes to the overall economic component by directing the impact through interlinks of the economy. The module will introduce the results of YVC&UH teams to analyze the macroeconomic effects of Climate Change, focusing on the WEF nexus in the Mediterranean countries while explicitly incorporating alternative water sources in CGE. The role of novel technologies of controlled-environment agriculture (e.g., hydroponics) that save water and land at the cost of higher energy intensity compared to traditional practices will be discussed.

In this module, the RWTH team instantiates the ecological footprints of natural resources (water, land, nutrients, energy use etc.) with the total cost of environment for several agricultural cropping systems from the demo site. Furthermore, the model for the environmental impacts of desalination on ecosystem services will be discussed, in which soilless cultivation systems provide crop growth using desalination in areas having vast regions of non-arable lands, such as deserts and dry coastal belts.

Speaker: Ruslana Palatnik (YVC and UH), Demet Cekin (RWTH)