



The DAFNE approach to understanding and management of the Water-Energy-Food Nexus

DAFNE e-Summer School
August 2020

The DAFNE project

DAFNE is a four-year project funded by the European Union under the Horizon 2020 Research and Innovation Action Programme. The project investigates how water, energy, food and the environment are managed in complex and transboundary rivers by developing a novel framework to explore options for present and future sustainable and integrated management of the basins together with stakeholders.

The novel DAFNE nexus approach highlights the interdependence of water, energy and food security and the natural resources that underpin that security – water, soil and land. Based on a better understanding of the interdependence of water, energy and climate policy, this new approach identifies mutually beneficial responses and provides an informed and transparent framework for determining trade-offs and synergies that meet demand for resources without compromising sustainability.

DAFNE's central objective is to develop a Decision-Analytic Framework (DAF) that can support the quantitative assessment of the social, economic and environmental impacts of expanding energy and food production in complex physical and political contexts, where natural, economic and social processes are strongly interconnected and the institutional setting involves multiple stakeholders and decision-makers.

The DAFNE research consortium

The DAFNE research consortium project includes 14 project partners

- ETH Zurich (ETHZ, project lead), Switzerland
- Politecnico di Milano (POLIMI), Italy
- International Centre for Research on the Environment and the Economy (ICRE8), Greece
- University of Leuven (KU LEUVEN), Belgium
- University of Aberdeen (UABDN), United Kingdom
- Osnabrueck University (UO), Germany
- International Water Management Institute (IWMI), Sri Lanka
- African Collaborative Center for Earth System Science (ACCESS), Kenya
- University of Zambia (UNZA), Zambia
- Eduardo Mondlane University (EMU), Mozambique
- Vista Geowissenschaftliche Fernerkundung GmbH (VISTA-GEO), Germany
- ATEC-3D Ltd (ATEC-3D), United Kingdom
- European Institute for Participatory Media (EIPCM), Germany
- Water and Land Resources Centre (WLRC), Ethiopia

The DAFNE e-Summer School

The DAFNE e-summer school will provide know-how transfer about methodological aspects required for the investigation of the Water-Energy-Food (WEF) Nexus and the identification of sustainable WEF management strategies in the context of complex and transboundary water resources systems. While the value and the applicability of the methodological approach presented is fairly general, its application is illustrated by means of two exemplary case studies, the Zambezi River Basin (ZRB) and the Omo-Turkana Basin (OTB).

The DAFNE approach is based on the principles of the Participatory and Integrated Planning and Management of Water Resources, which emphasises the role of stakeholders throughout the process of formulating and selecting the most interesting and sustainable development pathways. The approach relies on the cause-effect analysis between basin developments and the water, energy and food sectors by means of a Decision-Analytic-Framework (DAF) model. Such a DAF model allows the users to understand the effects of an array of trade-offs at large spatial and temporal as well as transboundary scales, thus enabling the selection of the most sustainable pathways from social, economic and environmental viewpoints. These pathways are analysed in greater detail by means of an advanced and integrated WEF modelling framework. The latter quantifies the impacts in a spatially distributed fashion and at finer temporal scales, ultimately allowing the identification of critical situations across the basin and feeding back to stakeholders the revised development pathways. The ultimate aim is that a properly informed consensus can be reached around the most suitable set of basin interventions.

While the DAF and the WEF models are at the core of the quantitative components of the DAFNE approach, a broad set of other advanced and novel methods represent an essential complement. They contribute the necessary knowledge about the main drivers and scenarios behind the development pathways, and enable negotiation among stakeholders in search of suitable WEF management measures and policies. These methods refer to socio-economic development and institutional models, as well as to ecosystem assessment and service quantification. They all aim to facilitate continuous negotiation among stakeholders as supported by novel information technology tools and the use of modern monitoring techniques.

Format

The DAFNE e-summer school will take place remotely as an online course. The summer school programme is divided into pre-recorded units that are made available to participants via a dedicated access point. By downloading and viewing the recorded lectures, the participants will learn about the DAFNE approach to understanding and managing the Water-Energy-Food Nexus, and will have the opportunity to post questions that will be answered interactively in a dedicated question and answer session to be held in August 2020, one month after opening the access to the recorded sessions. Access to the online lectures and the Q&A session is restricted to registered participants. The number of participants is limited and based on a “first come, first served”. Participants attending the Q&A session will receive a certificate of completion.

More detailed information will be provided upon registration:

Dates

- 9.7.20 Registration opens (until 3.08.20, first come, first served)
- 3.8.20 Access to video lectures opens
- 24.8.20-26.8.20 Q&A sessions

Registration

In order register, please follow this link: www.dafne-project.eu/summerschool



Programme and content

Block	Unit	Unit Titles	Short Content Description
1		<i>The DAFNE approach</i>	
	1	Introduction and DAFNE philosophy	Introduction to the philosophy and foundation of the DAFNE framework for understanding the WEF Nexus and providing evidence of management solutions impacts to support the decision-making process leading to sustainable WEF Nexus management policies.
	2	The Participatory and Integrated Planning (PIP) concept	Introduction to the principles and the methodological aspects of the Participatory Approach in Water Resources Planning and Management and to the role of stakeholders in the DAFNE approach.
	3	DAFNE's framework architecture	Illustration of the DAFNE methodological framework for WEF Nexus analysis and management.
	4	Pathways and indicators in the PIP framework	Introduction to the definition, meaning and use of pathways, indicators, and scenarios in a Participatory and Integrated Planning procedural context.
	5	The OTB case study	Illustration of the main WEF Nexus issues in the OTB case study, including sets of indicators that have emerged from the participatory interaction with the stakeholders.
	6	The ZRB case study	Illustration of the main WEF Nexus issues in the ZRB case study, including sets of indicators that have emerged from the participatory interaction with the stakeholders.
2		<i>Drivers</i>	
	7	Natural drivers: Climate change (CC) local scenarios model	Introduction and description of the long-term dynamics of natural drivers: climatology and meteorology, and hydrology, with particular focus on the consideration of uncertainties and natural variability of climate by means of generating stochastically downscaled climate scenarios.
	8	Downscaled CC scenarios for OTB	Example of application of the stochastic downscaling methodology to the OTB case study with illustration of future climate scenarios and particular focus on spatial variability and uncertainty at local scales.
	9	Downscaled CC scenarios for ZRB	Example of application of the stochastic downscaling methodology to the ZRB case study with illustration of future climate scenarios and particular focus on spatial variability and uncertainty at local scales.
	10	Socio-economic drivers	Introduction to the methodological aspects relevant to the assessment of future socio-economic drivers. These include electricity/energy demand and the potential for coverage by hydropower production, agricultural, industrial, domestic and environmental water demand for present and future development scenarios, which account for country/region specific socio-economic development pathways in the context of Shared Socioeconomic Pathways (SSP) scenarios.

Block	Unit	Unit Titles	Short Content Description
	11	Demand for food and irrigated agriculture	This lecture focuses on GIS-based approaches to convert routinely available geo- and statistical data related to human demography, agriculture, livestock and fisheries into current and future demand for water and food. The approach will be illustrated by an exemplary application to the case studies the growing population of the ZRB and OTB and is accompanied by an exercise.
	12	Ecosystem services in the WEF Nexus	River basin management in the nexus of water, energy and food security faces complex trade-offs between the ecosystem services derived from regulated and free-flowing rivers. Using examples from the OTB and ZRB case studies, this lecture presents methods to identify and quantify the changes in demand and availability of ecosystem services in the context of river basin management and highlights pathways for their economic and monetary valuation.
3		Models	
	13	Socio-Economic Models for the Optimal Allocation of the WEF Nexus in Transboundary Waters	Introduction to welfare maximization models of the interaction of the WFE Nexus with the socio-economy, enabling the quantification and the projection of sectoral water, energy, food and ecosystem services demands, and the allocation of water between them under different governance regimes. The models will be illustrated with an application for the OTB case study.
	14	The DAF strategic model	Introduction to the Decision-Analytic-Framework model based on optimisation methods to analyse many-objective water allocation problems and identify WEF Nexus management solutions with sustainable trade-offs using key sectoral indicators.
	15	The WEF model	Introduction to the WEF Nexus model and its integrated – hydrology and hydrology driven processes, such as erosion and hydrologic transport – and linked components – crop productivity (AquaCrop) and water quality in lakes and reservoirs (Generalized Lake Model, GLM) – to simulate the detailed space-time impact of WEF Nexus management solutions across water user sectors using broad sets of indicators.
	16	TOPKAPI-ETH tutorial	Demonstration of application of the hydrological core of the WEF Nexus model to the DAFNE case studies.
	17	Aquacrop tutorial	This lecture will demonstrate the application of the AquaCrop component of the WEF Nexus model to the DAFNE case studies. AquaCrop is the water productivity model of the Food and Agriculture Organisation (FAO) of the United Nations. The model simulates the biomass development and yield of a particular crop that can be expected in a specific environment (climate and soil type) for a particular irrigation and field management. This short lecture will emphasise the calculation scheme of AquaCrop and the required input data and is accompanied by an exercise.



	18	Generalised Lake Model (GLM) tutorial	This lecture will demonstrate the application of the GLM component of the WEF Nexus model to the DAFNE case studies. The tutorial will present how to work with this open-source tool, address the importance of calibration and validation and show results of the application of GLM to Lake Kariba.
4		Governance and participatory process	
	19	Ecosystems governance and environmental policies	Given the complexity of ecosystems, it is impossible to foresee all consequences of human interventions on them across temporal, spatial and administrative scales. In the first part of this lecture, we present a systems-thinking approach to ecosystem governance that integrates sectors and scales. In the second part, we present an overview of existing environmental management policies in the OTB and ZRB and analyse them regarding their gaps and opportunities for improvement in light of the most pressing environmental issues.
	20	Principles of international water law	The lecture will provide an overview of the key principles of international water law. It will look at the origin, normative nature, and practical implications of the principles. It will finish by examining how policy frameworks – such as the Water-Energy-Food Nexus and the Sustainable Development Goals – could be used to strengthen the implementation of legal frameworks.
	21	Legal framework implementation in transboundary river basins	The lecture will provide an illustration of the legal frameworks applicable to two shared river basins: the Omo-Turkana and the Zambezi. It will detail the existing legal frameworks, any limitations/gaps and potentials for improving governance in the future.
	22	Simulating stakeholder negotiations: Developing solutions in the planning and management of the WEF Nexus	The lecture will introduce a new approach for stakeholder participation involving negotiation in the context of water resources planning and management. The DAFNE project has developed and used its 'Negotiation Simulation Laboratory' (NSL) as a form of continuous and interactive participation of stakeholders in the four-year project. The objective of the NSL is to simulate negotiations in a safe environment and support social learning. The lab provides stakeholders with the opportunity to share their concerns and priorities with other stakeholders, substantiate their arguments in preparation for real negotiations and collectively develop solutions that make trade-offs transparent.

	23	NSL supporting tools	Introduction to novel tools – Multi Perspective Visualisation Tool (MPVT) and Geoportal – to support the participatory process by means of IT solutions enabling the interactive analysis of WEF Nexus management solutions impacts modelled by the DAF and WEF Nexus models.
	24	Demonstration of MPVT	Demonstration of MPVT use and benefits in the OTB and ZRB case studies.
	25	Demonstration of Geoportal	Demonstration of Geoportal use and benefits in the OTB and ZRB case studies.
5		<i>Monitoring strategies and real-world case studies</i>	
	26	Remote Sensing (RS) monitoring techniques	Introduction to remote sensing products to support data acquisition and processing in the context of the WEF Nexus monitoring strategies.
	27	Demo/tutorial on RS monitoring	Demonstration of WEF Nexus related processing of remote sensing data in the OTB and ZRB case studies.
	28	Unmanned Aerial Vehicle (UAV) monitoring techniques	Introduction to the use of Unmanned Aerial Vehicles (UAVs) to generate local remote sensing products supporting data acquisition and processing in the context of the WEF Nexus monitoring strategies.
	29	Demo/tutorial on UAV monitoring	Demonstration of WEF Nexus related UAVs acquisition and data processing in the OTB and ZRB case studies.
6		<i>Real-world application examples</i>	
	30	The DAFNE approach applied to OTB	Synthesis of the DAFNE framework and approach through the lens of application to the OTB case study.
	31	The DAFNE approach applied to ZRB	Synthesis of the DAFNE framework and approach through the lens of application to the ZRB case study.