Sustainable Management of the Nexus in Transboundary Systems

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Sustainable Development: Organizing principle for meeting human development goals, while sustaining the ability of natural systems to provide the natural resources and ecosystem services, upon which the economy and society depend.

Sustainable development meets the needs of the present, without compromising the ability of future generations to do the same.

Environmental Sustainability
Economic Sustainability
Social Sustainability
2015: **Transforming Our World – 2030 Agenda for Sustainable Development**
1. No Poverty
2. Zero Hunger
3. Good Health and Well-being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation, and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life on Land
A Global Network of:
Universities & Research and Innovation Centers
Businesses
Civil Society Organizations
Policy Making
Political Institutions

To support **SCIENCE DRIVEN implementation of SDGs**

- SDSN was launched in 2012 by UN Secretary General Ban-Ki Moon
- To mobilize global scientific and technological expertise and promote practical problem solving for sustainable development
The UN SDSN- Greece scientific approach:

Holistic and Interdisciplinary
Aim: Allocation of scarce resources across people, over time & space in a way that social welfare is maximized.

**FRAMEWORK CHARACTERIZATION**
- Natural Resources,
- Socio-Economic
- Institutional
- Stakeholders

**MODELS ON INTERACTION**
- Nature
- Society
- Economy
- Including CC & SE scenarios

**EMPIRICAL APPLICATION of MODELS**
- Total Economic Value of Resources

**OPTIMAL ALLOCATION OF TEV**
- How? SOLUTIONS
  - Socio-Economic Instruments
  - Technological Innovations
  - Social Innovations
  - Infrastructural Investments
  - Nature-Based Solutions

**STRATEGIC MANAGEMENT PLANS & POLICY RECOMMENDATIONS**
DAFNE

DECISION ANALYTIC FRAMEWORK TO EXPLORE THE WATER-ENERGY-FOOD Nexus IN COMPLEX TRANSBORDINARY WATER RESOURCES OF FAST DEVELOPING COUNTRIES.

The PROJECT and the NEXUS

By DAFNE Coordinator and Partners

Funded under the H2020 Framework Programme of the EU, GA No. 690268

www.dafne-project.eu
@dafne_project
What is DAFNE?

• **DAFNE** is a Research and Innovation project funded by the European Union within the framework of the Horizon 2020 Programme

• **DAFNE** is the acronym of the project title “Decision-Analytic Framework to explore the water-energy-food NExus in complex and transboundary water resources systems of fast growing developing countries”

• **DAFNE** focuses on *integrated water resources planning and management* in the context of *competing use* of water by the Energy, Agriculture (Food) and Environment sectors  
  → **WEF nexus**

• **DAFNE** aims to demonstrate that a quantitative analytic framework that allows exploration of trade-offs among planning and management options can maximise the benefits for each of the competing uses

• DAFNE has identified the Zambezi and Omo-Turkana basins case study for demonstrating for the *analysis and quantification of the WEF nexus*
What is the DAFNE project about

GOAL: *explore alternative development pathways* for advancing water management strategies under current and future scenarios

Basin-specific policy making, i.e. exploring which decisions (e.g. a new dam, new irrigation area, new environment protection, …) have which impacts if and when implemented

**NOT a MONOLITHIC DSS:** DAFNE will build and use tools and models to understand how to better support negotiations among stakeholders but these models will not and cannot be integrated into a usable DSS “software”
Project objectives

- **Keywords:** Decision-Analytic Framework, WEF nexus, complex and transboundary water resources systems, competing water uses, fast growing developing countries

- DAFNE will *analyse and quantify the WEF nexus* with respect to the *trade-offs between competing objectives*, such as hydropower production vs. irrigation and land exploitation vs. conservation, formulated by *stakeholders* in the form of *alternative planning options*.

- The overall objective is to *establish a decision-analytic framework (DAF) for Participatory and Integrated Planning (PIP)*.

- It aims to provide support to the identification of sustainable *development pathways*, which ensure water use that *balances* infrastructure development and expanding agriculture with local social, economic, and environmental dimensions.
Two transboundary pilot case studies

ZAMBEZI

- ~2,700 km, ~1.39 million km²
- longest east flowing river in Africa
- 8 riparian states (Angola, Namibia, Botswana, Zambia, Zimbabwe, Mozambique, Malawi, Tanzania).

Four large hydropower dams since the 1970s (Kariba, Cahora Bassa, Itezhi-Tezhi and Kafue Gorges)

**WEF Issues**: resource availability vs. population density, expansion of irrigated agriculture, additional hydropower schemes, ecosystem conservation and expanding tourism.
Two transboundary pilot case studies

OMO-TURKANA

- ~760 km (Omo), ~130,000 km²
- Source in northern Highlands with annual precipitation > 1500 mm
- 2 riparian states (Ethiopia and Kenya)
- outflow into Lake Turkana (endorheic)
- 80-90 % of annual inflow into Lake Turkana comes from Omo

Current & potential issues:
- Gibe I-II-III operational, Koysha planned + large-scale irrigation schemes for commercial sugar cane production
- competing water withdrawal
- effects on Lake Turkana water level variability
- environmental and cultural conservation
DAFNE Expected Outcomes

Innovative aspects

1. Advances in environmental monitoring: remote sensing will be combined with UAV (Unmanned Aerial Vehicle)-based data collection to supplement the currently limited ground monitoring capacity at a low cost

2. Comprehensive across- and multi-scale integrated WEF model

3. Water management and planning based on robust Decision Analytic Framework

4. Methods and tools to facilitate and promote stakeholder engagement and participation in decision making

5. Improved methods for practical interactions between science and policy leading to a strong applicability of the above innovations

6. Transfer of knowledge on methods, monitoring and modelling (Geo-portal)
The Decision-Analytic Framework

The DAF is intended to be a quantitative assessment tool to facilitate social understanding of the impact and to support comparative analysis of alternative pathways.

It will be developed through extensive, quantitative analysis of the anticipated effects of alternative planning options on the broad range of heterogeneous and often competing interests in transboundary river basins, also addressing feedback mechanisms between the WEF components.

It will be informed by, improved upon and validated through:

a) active engagement of stakeholders throughout the process, and

b) involvement of international and local academic expertise (water engineering, agricultural sciences, natural sciences, environmental economics, water governance and law)
The PIP procedure

**MODEL** – WPs

- Models of current processes are set up and validated
- Models of socio-economic processes are set up and validated
- The model components are combined into an integrated model

**ACTION** and **SCENARIOS** – WP2

- Current baseline and future scenarios of the main drivers (boundaries) of the system are built
- Planning and management actions, including infrastructural, normative, and operational interventions are identified (the action will be combined into pathways: temporal sequence of set of actions)

**MONITORING** – WP2

- Historical data acquisition
- Large-scale remote sensing and local scale unmanned aerial vehicle surveys
- Ground truth by field work
- Socio-economic surveys

**INDICATORS** – WP2

- Evaluation indicators representing the different stakeholder groups are identified sector by sector in collaboration with the stakeholders and the decision-makers.
- Additional high-level indicators can be formulated in WP3 to capture governance, economic, and legal aspects of general interest.

**DAF** (decision analytic framework) – WP5

Robust pathways (sequences of actions) are selected via simulation-based optimization of the integrated model built in WP3 for different alternative combinations/timing of planning actions suggested by WP3 and WP4 under current and future climatic and socio-technological scenarios (WP3). Pathways are assessed based on the multiple indicators identified in WP2.

The DAF provides:
- Set of interesting alternative pathways for each scenarios considered.
- A set of robust alternatives across all the scenarios.

**VNL** (virtual negotiation lab) – WP6

In the virtual negotiation lab, the stakeholders/DMs comparatively assess the pathway provided by WP5 and negotiate to extract several interesting largely-agreed-upon alternatives.
WP2 components and links

Drivers of WEF Nexus
(co-variation of climate and socio-economic drivers)

interaction with stakeholders
Map of interconnected relationships

Integrated framework of models for social, economic and institutional developments
Integration of models

Negotiation Simulation Lab (WP6)

- integration with stakeholders

- macro-economic model (T4.1)
- governance model (T4.2)
- social model (T4.4)
- ecosystem services model (T4.3 + T3.1.4)
- WEF integrated model (T3.2)

- evaluation indicators value

- optimal pathways

- DAF model
  - screening of actions (T5.1)
  - selection of design indicators (T5.1)
  - candidate pathways
  - WEF design indicators
  - strategic model + optimization (T5.2)

- formulations of evaluation indicators:
  - Energy (T2.1.2)
  - Food (T2.1.3)
  - Water/environment (T2.1.5)
  - Governance (T2.1.6)
  - Economy (2.1.8)

- observed streamflow in "entry" sections (or estimated via hydrologic model) - T2.1.1
- observed irrigation demand (or estimated via AQUACROP) - T2.1.3
The Negotiation Simulation Lab: Investigating Water, Energy & Food Issues with Stakeholders

The lab is a forum for stakeholders and project partners to share *multiple perspectives* and *identify potential pathways* to sustainable resource management in river basins.

Together in *face-to-face* and “*online*” *meetings* stakeholders and partners look at: what works, what does not work & why, and what can be done differently.
Additional project components and benefits for the riparian countries (1/2)

a) **Education of future professionals in the Omo-Turkana basin** on state of the art, science and engineering through **partnership with basin project partners** (→ training of MSc/PhD students and graduates, and professionals) → *capacity building*

b) **Continuous involvement** in developing the pathways through the NSL and thus the possibility to influence them and study the trade-offs among ‘what if’ scenarios based on your interests → *continuing capacity building and new policy formulation culture*

c) **Full access to results**, i.e. reports, model outputs (usable through interactive tools, e.g. the Geoportal, reusable: model results)

d) **Full access to models** used in DAFNE, including capacity building (training on the use of models, online courses, …)
Additional project components and benefits for the riparian countries (2/2)

e) **Full access** to downscaled stochastic *climate scenarios* for use in future studies (potential integration in national databases)

f) **Full access to data** generated within the project (field work, RS, UAV surveys, …)

g) **Dissemination** of project results to increase awareness of WEF Nexus and implication of development pathways in the Omo-Turkana basin → *exposure to a new policy making approach*

h) **Support** in enforcing the planning, consultation and management role of your institutions → *concrete pathways* (i.e. planning options) to be discussed among the stakeholders and decision makers
Thank you for your attention
EIT Climate-KIC is a European knowledge and innovation community working to accelerate the transition to a zero-carbon economy through whole systems transformation.

EIT Climate-KIC is part of the European Institute of Innovation and Technology (EIT) and the EIT community. The EIT is a body of the European Union. We are one of six KICs acting together as global innovation leaders, delivering world class solutions to societal challenges.
Building a movement of climate action

Convening networks of expertise
Leveraging Grants Smartly & Effectively
Developing People & Capacity
Catalysing Innovation

300+ leading partners
>€550m investment attracted to start-ups
>2,000 full-time jobs created
17,000 participants in our education activities

1000+ innovative start-ups
€2.5bn climate funding leveraged
367 new products and services
Transforming innovation into climate action
**Aim:** To effectively bridge the gap between innovators and end-users in resilience to floods, droughts and extreme weather.
FROM PROTOTYPE TO MARKET READY INNOVATION
ADAPTING TO: FLOODS, DROUGHTS & EXTREME WEATHER

Figure 1.1: BRIGAID’s conceptual approach with three types support for innovations
10 OCTOBER 2018 REPORT
Intergovernmental Panel on Climate Change (IPCC):

Urgency of limiting global warming to 1.5 degrees Celsius.

Beyond which ...the risks of drought, floods, extreme heat and poverty for hundreds of millions of people, significantly worsen!

The world is on course for a disastrous 3C of warming

We have **12 years left** until the point of no return. Most of us will still be alive then!

Urgent and unprecedented changes are needed to reach the target.

The target is affordable and feasible. The final tick box is political will!