5-6 November 2024

Nexus Implementation: Potential and Opportunities

A lead-up initiative

DRESDEN NEXUS CONFERENCE

UNU FLORES

NexusNet

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

DRESDEN NEXUS CONFERENCE

Nexus Implementation: Potential and Opportunities
Organisers: UNU-FLORES, SUSTAINFOOD, NEXUSNET, PRIMA, and GIZ.
AGENDA

Dates and time: Tuesday 5 November, 2024 at 13.00-18.00 CET
Wednesday 6 November at 9.00-18.00 CET

Link for registration:
https://unu-edu.zoom.us/webinar/register/WN_KEBAgSj6RNapgaNO9K2AuA

This workshop advances technical and policy-oriented research skills related to Nexus topics. Participants will gain valuable insights and practical guidelines for effectively integrating Nexus approaches into their case studies, strengthening their research's impact and rigour.

Main Topics and Objectives

a. **Selection of Case Studies**: the workshop will explore methodologies for the selection and design of case studies pertinent to Nexus research on different environmental resources, including water, energy, food, climate, ecosystems, soil, material, and space
b. **Data Integration:** Address the complexities of accessing and integrating data from diverse sources to enhance the robustness of research outcomes
c. **Stakeholder Involvement:** Discuss criteria for the selection and commitment of stakeholders to ensure meaningful and impactful research collaborations
d. **Application of Practical Tools:** Evaluate the use of practical tools and knowledge derived from real-world applications to strengthen case study research

5 November, 2024
Time: 13:00 to 18:00 CET

13:00 – 14:00 CET
Opening Remarks and Welcome by the (co-) organisers.
Speakers: **Prof Edeltraud (Edel) Günther**, Director UNU-FLORES, Dresden, Germany
Dr Giulio Pattanaro, European Research Executive Agency, Brussels, Belgium
Dr Octavi Quintana Trias, Director of PRIMA Foundation, Barcelona, Spain
Prof Chrysi Laspidou, NEXUSNET, University of Thessaly, Volos, Greece
Prof Michael Jacobson, SUSTAINFOOD, Penn State University, Pennsylvania, United States
Mr Dieter Rothenberger, Cluster Coordinator Water, German Agency for International Cooperation (GIZ), Bonn, Germany
Moderator: **Dr Floor Brouwer,** UNU-FLORES, Dresden, Germany
Topics: Introduction to the workshop objectives and overview of the agenda.

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14:00 - 14:45 CET

What makes a Nexus case study, and what is a Nexus application?

Speaker: **Dr Dimitris Kofinas**, University of Thessaly, Greece

Moderator: **Prof Michael Jacobson**, Penn State University, Pennsylvania, United States

Topics: Presentation of a taxonomy for case studies through a bottom-up approach to analyse the implications of human-induced stresses that act as trends and has worked on producing recommendations for the increase of nexus projects' impact. It also explores the circular economy paradigm as a Nexus-compliant practice.

14:45 - 15.30 CET

What are the specific features of a Nexus project beyond technological innovations?

Speaker: **Prof Ali Rhouma,** PRIMA Foundation, Spain

Moderator: **Prof Serena Coetzee,** UNU-FLORES, Dresden, Germany

Topics: Presentation of two cases in the Mediterranean region to show the efforts made by PRIMA Foundation in implementing the Nexus Approach.

15.30 – 16.15 CET

The Role of Analytics and Community Engagement in Supporting Sustainable and Equitable Water-Energy-Food Systems Transformation.

Speaker: **Dr Bassel Daher,** Texas A&M University, United States

Moderator: **Assist. Prof Giannis Adamos**, Aristotle University of Thessaloniki, Greece

Topics: This talk will explore the critical role of analytics and community engagement in driving sustainable and equitable transformations within water-energy-food (WEF) systems. This will be illustrated through multiple global case studies to reflect on best practices, lessons learned, and open questions.

16.15 – 17.00 CET

Collaborative student assignments: Urban planning and ecology in Nexus-aware public spaces.

Speakers: **Dr Mirela Sertić Perić**, University of Zagreb, Croatia
Dr Tamara Zaninović, University of Zagreb, Croatia
Dr Ana Sopina, University of Zagreb, Croatia

Moderator: **Dr Natalia Ruiz Morato,** UNU-FLORES, Dresden, Germany

Topics: Presentation of the results of innovative interdisciplinary methodology in research, design, and education in developing projects from the Urban Ecology and STUDIO III - Landscape Architecture courses at the University of Zagreb, Croatia. The Round table will contribute to the Nexus discussion of urban planning and natural resources.

17.00 – 17.45 CET

Empowering Sustainability Research through the Sustainability Nexus Analytics, Informatics, and Data (AID) Programme

Speakers: **Dr Mir Matin**, UNU-INWEH, Richmond Hill, Canada
Dr Azin Zarei, UNU-FLORES, Dresden, Germany
Mr Taha Loghmani (MSc), UNU-FLORES, Dresden, Germany
Ms Ghada Amin (MSc), UNU-FLORES, Dresden, Germany

Moderator: **Dr Bassel Daher**, Texas A&M University, College Station, Texas, United States

Topics: The Sustainability Nexus Analytics, Informatics, and Data (AID) Programme was initiated by the United Nations University (UNU) to tackle critical challenges in sustainable development. In this presentation, we will demonstrate through two PhD research cases how the AID Programme facilitates spatial data analysis, environmental monitoring, and sustainability assessment.

17.45 – 17.50 CET

Closing of the day

Moderator: **Dr Floor Brouwer,** UNU-FLORES, Dresden, Germany

6 November, 2024
Time: 8:55 to 17:00 CET

8:55 - 9:00 CET

Welcome & Recap of Day 1

Moderator: **Dr Floor Brouwer,** UNU-FLORES, Dresden, Germany

9.00 – 9.45 CET

Stakeholder co-creation approach to governance of the water-energy-food-ecosystem nexus: transdisciplinary methods and insights from application in 5 river basins

Speakers: **Mrs Caro Mooren, MSc,** KWR Water Research Institute, Nieuwegein, the Netherlands
Mrs Sabina Khan, MSc, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany

Moderator: **Dr Floor Brouwer**, UNU-FLORES, Dresden, Germany

Topics: The presentation is firmly rooted in stakeholder co-creation and aims to transform siloed sectoral policies into a coordinated and coherent nexus governance system. It will present the four phases of the approach: problem identification, stakeholder dialogue, realising new nexus governance instruments, and implementation. Also, it will showcase studies in four river basins: Lielupe (Latvia-Lithuania), Mesta-Nestos (Bulgaria-Greece), Jiu (Romania), Adige (Italy), and Inkomati-Usunthu (South Africa).

9.45 – 10.30 CET

Strengthening Gender in the WEFE Nexus—Insights from the CGIAR Initiative on NEXUS Gains

Speakers: **Dr Riina Jalonen**, Alliance of Bioversity international and CIAT
Dr Muzna Alvi, International Food Policy Research Institute, Delhi

Moderator: **Dr Mirela Sertić Perić**, University of Zagreb, Faculty of Science, Department of Biology, Zagreb, Croatia

Topics: Presentation of a NEXUS Gains learning module and approach to promote gender equality and social inclusion (GESI) in WEFE nexus research and interventions; Case study on developing and applying a new tool on women's empowerment in energy.

10.30 – 11.15 CET

Business and finance models to accelerate the adoption of renewable energy technologies for water and food security: Insights from South Asia

Speakers: **Mr Shisher Shrestha**, International Water Management Institute (IWMI), Nepal
Dr Mutum Lamnganbi, IWMI India

Moderator: **Dr Saroj Kumar Chapagain,** UNU-FLORES, Dresden, Germany

Topics: The CGIAR Initiative on NEXUS Gains used two differing case study approaches to identify inclusive business and finance models suitable for accelerating the adoption of solar irrigation systems in India and in the mid-hills region of Nepal.

11.15 – 12.00 CET

Companies with Conservation: Deep Dive into NEXUS Innovators with a Cause

Speakers: **Mr Robert Kranefeld**, GIZ, Bonn, Germany
Mr Admore Chiumia, Innovator Speaker Green Impact Technology, Malawi
Mrs Acacia Leakey, Innovator Speaker Turkana Basin Institute, Kenya

Moderator: **Dr Mirela Sertić Perić**, University of Zagreb, Zagreb, Croatia

Topics: The Water and Energy For Food (WE4F) Global Challenge, a joint international initiative that targeted established small and medium-sized enterprises changing the status quo in the agricultural sector across Africa and Asia. This presentation will highlight innovators, their innovations and approaches, and how they engaged with multiple stakeholders to scale their nexus solutions within the communities that they serve.

12.00 – 12.45 CET

Screening for environmental hotspots and organising a field campaign, lab analysis, and data interpretation

Speaker: **Prof Alexey Alekseenko,** UNU-FLORES, Dresden, Germany

Moderator: **Dr Floor Brouwer**, UNU-FLORES, Dresden, Germany

Topics: Presentation of a case study assessed the resource deterioration and restoration abilities in mining-affected areas under arid climates. It will show the Resource Nexus approach and suggestions for improving Nexus case studies, including policy recommendations.

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12.45 – 13.30 CET

The Summit of the Future and the Implications for a Nexus Research Agenda

Speaker: **Dr Natalia Ruiz Morato,** UNU-FLORES, Dresden, Germany

Moderator: **Assist. Prof Giannis Adamos**, Aristotle University of Thessaloniki, Greece

Topics: Given the relevance of the United Nations Declarations and the interrelations of the SDGs and the Nexus Approach, this presentation addresses the opportunities, necessities, and missing points in the last UN Summit for the Future for the resource nexus research-practice agenda.

13.30 – 14.15 CET

Advancing Resource Nexus Studies through Replication Studies

Speaker **Dr Floor Brouwer,** UNU-FLORES, Dresden, Germany

Moderator: **Prof Daniel Karthe**, UNU-FLORES, Dresden, Germany

Topic: Credible scientific knowledge is essential for the design of effective policies and programs. Presentation on replication studies and their importance for advancing Resource Nexus studies. Drawing from some literature on replication studies in environmental and resource economics, the presentation will recommend steps to create momentum for replicability in Resource Nexus studies.

14.15 – 15.00 CET

Experiences from the SustainFood USA-Africa-Europe Network of Networks: Lessons for Engaging Early Career Researchers in Transdisciplinary Water Energy, food Nexus

Speaker: **Prof Michael Jacobson,** SUSTAINFOOD Penn State University, Pennsylvania, United States

Moderator: **Dr Floor Brouwer**, UNU-FLORES, Dresden, Germany

Topics: Presentation of lessons from experiences from SustainFood activities focusing on the two Collaborative Learning Schools held in Africa and the US to advance in the WEF nexus systems thinking for decision-making and the completion of the SDG 17, "Partnerships for the Goals."

15.00 – 15.45 CET

Round Table Session: What makes an impactful NEXUS project?

Speaker: **Dr Mirela Sertić Perić,** University of Zagreb, Croatia

Moderator: **Prof Michael Jacobson,** SUSTAINFOOD Penn State University, Pennsylvania, United States

Topic: Presentation of the results of a pilot study conducted by European Junior Water Programme participants that demonstrates how bringing COST Action initiatives together with capacity-building programs can equip them with essential professional and technical skills through collaborative and interdisciplinary work to address the current Nexus challenges.

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15.45 – 16.45 CET

Lessons Learned and Future for the Nexus Implementation

Speakers: **Assist. Prof Giannis Adamos**, Aristotle University of Thessaloniki, Greece
Prof Serena Coetzee, UNU-FLORES, Dresden, Germany
Prof Michael Jacobson, SUSTAINFOOD Penn State University, Pennsylvania, United States
Prof Ali Rhouma, PRIMA Foundation, Spain
Dr Bassel Daher, Texas A&M University, College Station, Texas, United States
Dr Natalia Ruiz Morato, UNU-FLORES, Dresden, Germany
Dr Mirela Sertić Perić, University of Zagreb, Zagreb, Croatia
Dr Saroj Kumar Chapagain, UNU-FLORES, Dresden, Germany
Dr Floor Brouwer, UNU-FLORES, Dresden, Germany

Moderator: **Prof Daniel Karthe**, UNU-FLORES, Dresden, Germany

Topic: Summary of workshop outcomes, participant reflections, and recommendations for follow-up.

16:45 - 16:55 CET

On the Horizon: Dresden Nexus Conference, 8-10 April 2025, Dresden, Germany

16.55 – 17.00 CET

Closure of the workshop

Speaker: **Dr Floor Brouwer,** UNU-FLORES, Dresden, Germany

NexusNet

COST Action | CA20138 | NexusNet

Network on Water-Energy-Food Nexus for a low-carbon economy in Europe and beyond

what makes a Nexus case study and what is a Nexus application?

NEXUSNET

an international network of researchers, universities, policymakers, and the business sector to better understand and manage the interconnections between water, energy, food and other nodes.

funded by the European Cooperation in Science and Technology (COST)

Prof. Chrysi Laspidou

Action Chair

Systems modeling, Nexus interlinkages

Dr. Floor Brouwer

Action Vice-Chair

Resource economics, Resource Nexus

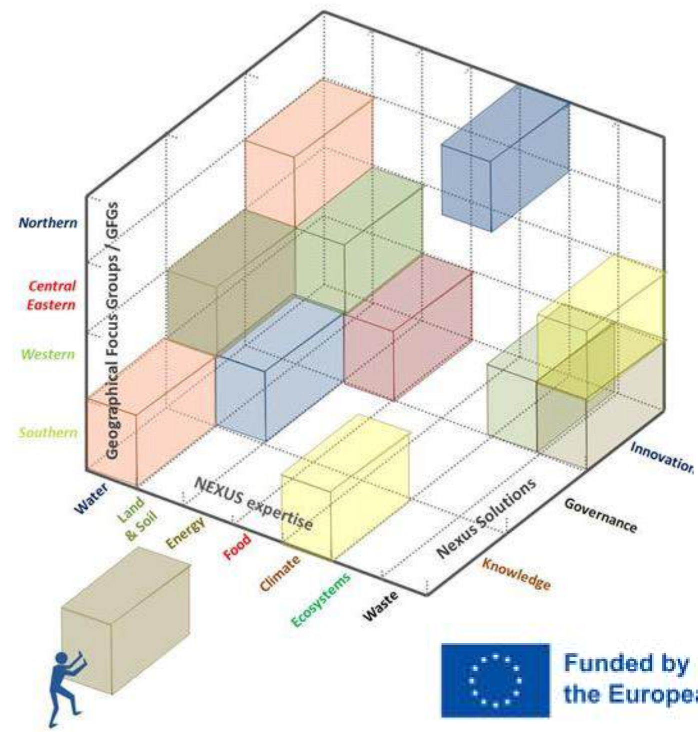
Working Group 2: Nexus Case Studies, Applications and Conceptualization

leading: Stefania Munaretto (KWR)

co-leading: Dimitris Kofinas (University of Thessaly)

about 150 members

organized in parallel threads around the WG objective



cost
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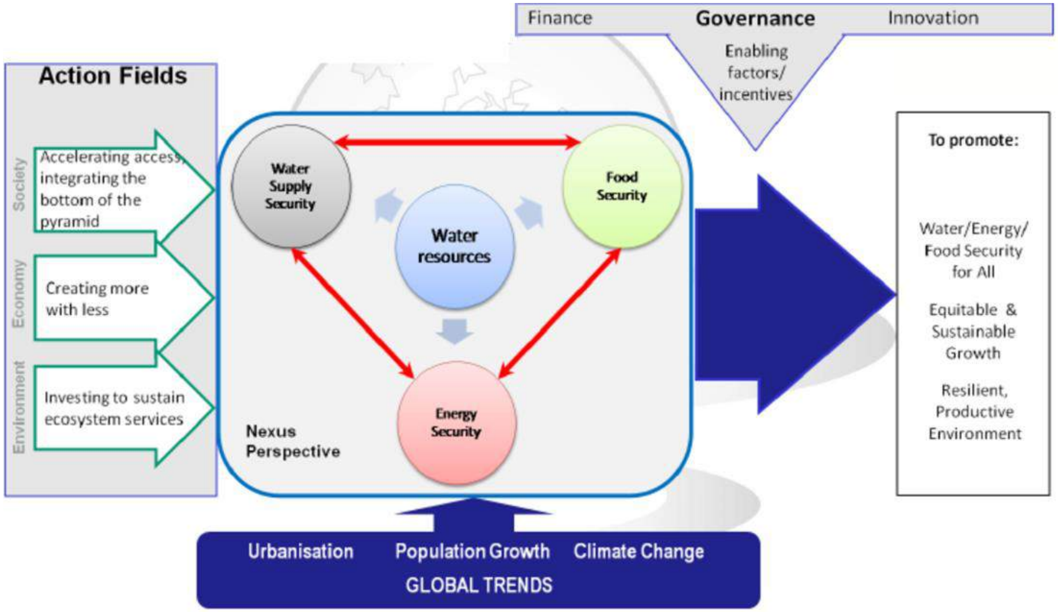
Nexus evolution

water centered resources security nexus

WEF Framework: Bonn2011 Nexus Conference (Hoff, 2011)

- three dimensions defined as resource securities
- bidirectional connections of securities
- responds to unsustainable development models that violate natural resource constraints
- focuses on the interconnections of water, energy, and food sectors
- centered on water resources
- considers global trends, environment, economy, society, investments, and innovation as externalities



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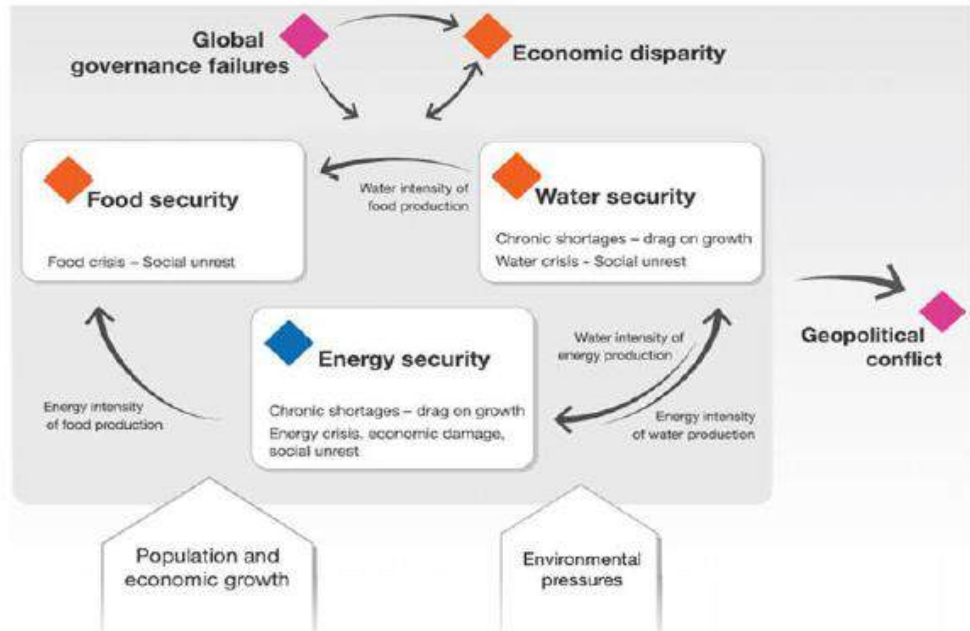
Nexus evolution

resources security nexus with specified directionalities

World Economic Forum, 2011

- an equal framework with respect to the three dimensions
- the three dimensions are defined as resource securities
- bidirectional connections only between W-E
- externalities: global trends, the economy, global governance, geopolitics
- goal: resource security

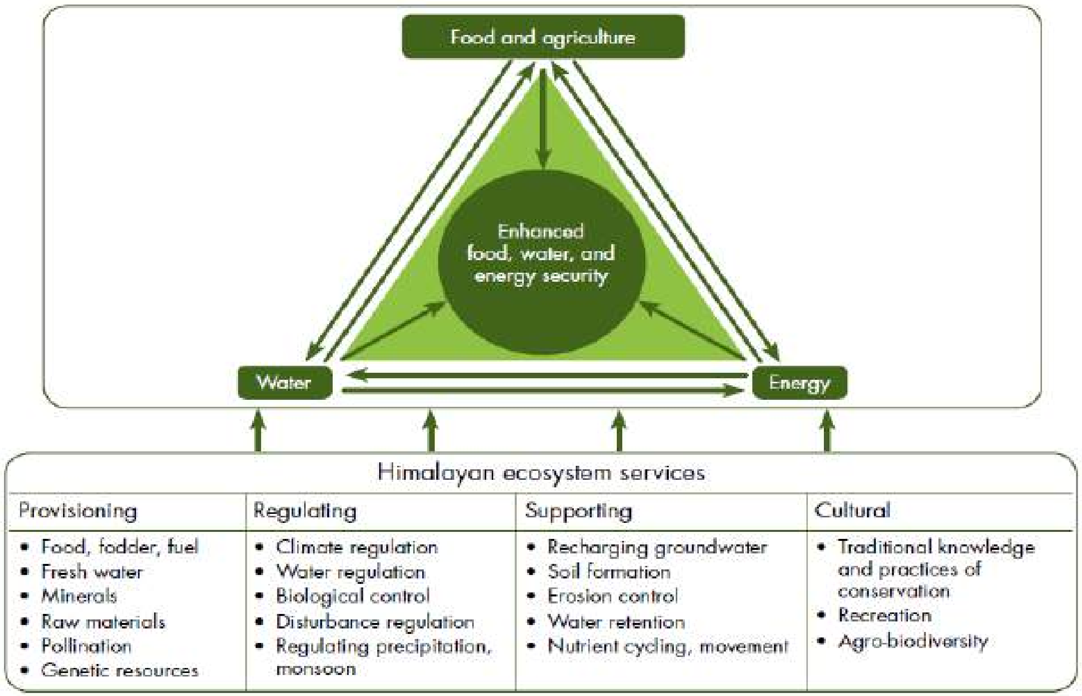


Nexus evolution

resources nexus aiming at resources security

ICIMOD, 2012

- an equal framework with respect to the three dimensions
- the three dimensions are defined as resources
- bidirectional connections between the WEF
- externalities: the ecosystems
- goal: resource security



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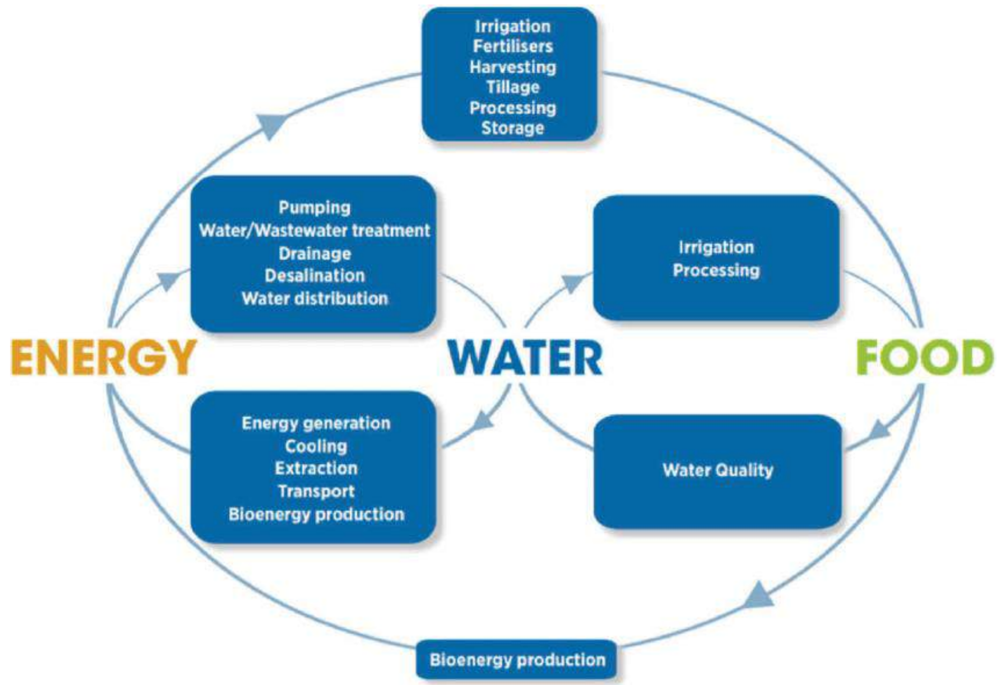
Nexus evolution

sector nexus

Mohtar et al., 2015 και Albrecht et al., 2018

defines nexus interlinkages

which describe positive or negative interactions, flows of mass and energy, or effects related to infrastructure



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Nexus evolution

sector nexus implying different layers of analysis

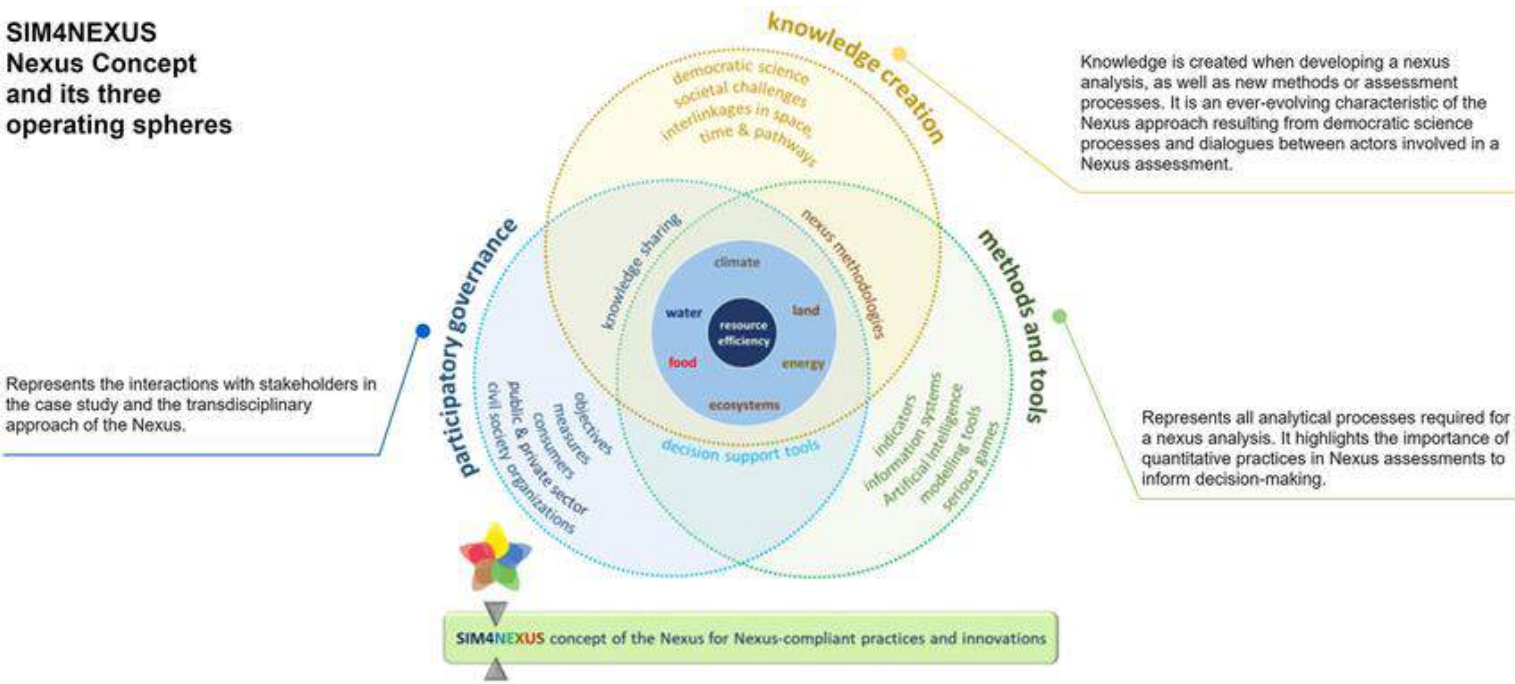
Sim4Nexus, 2017

three threads of Nexus analysis

bio-physical/bio-chemical analysis
socio-economic analysis
policy analysis

three operating spheres for the Nexus

- knowledge creation
- participatory governance
- methods and tools



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Nexus evolution

extended nexus schemes

additional nexus dimensions

WEFE- ecosystems
WEFCL- climate- land
WEFS - soil
WEFH - health
WEFW - waste
WEFB - biodiversity
WEFT - transportation
…
WEF+
SDGs-WEF

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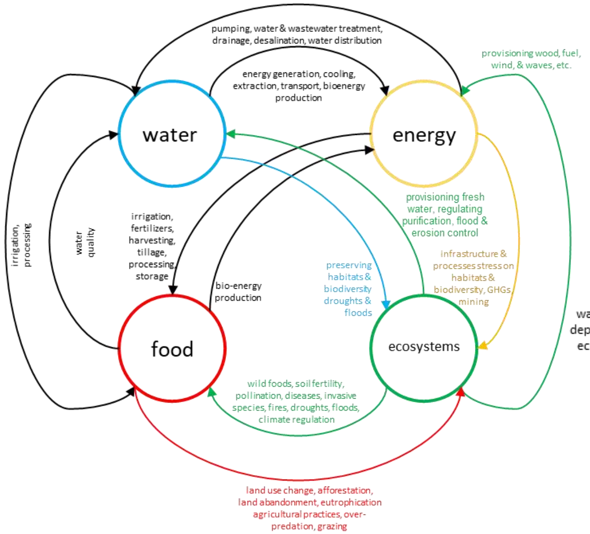
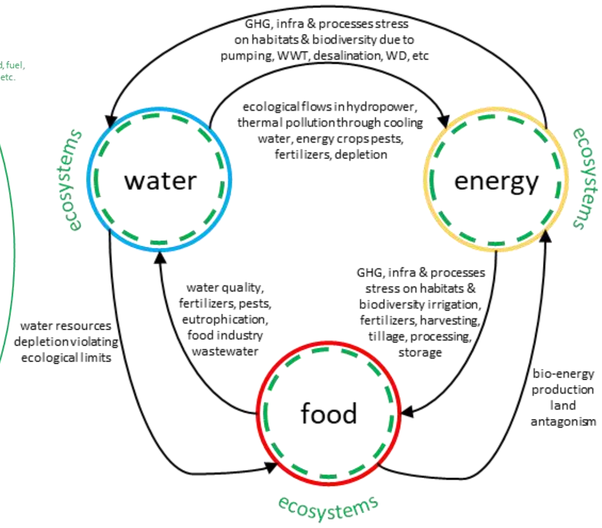
the integration of ecosystems

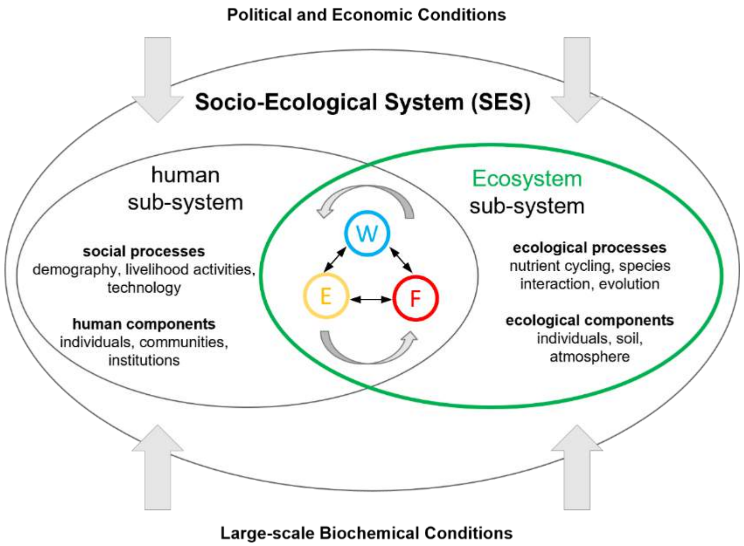
ecosystems as an additional nexus dimension

ecosystems as an underlying layer in the nexus dimensions

the Social-Ecological Systems framework







adapted from Virapongse et al. 2016

a perspective article of 39 authors coming soon from NEXUSNET led by WG2 and Enrico Lucca, Dimitris Kofinas and Tamara Avellan

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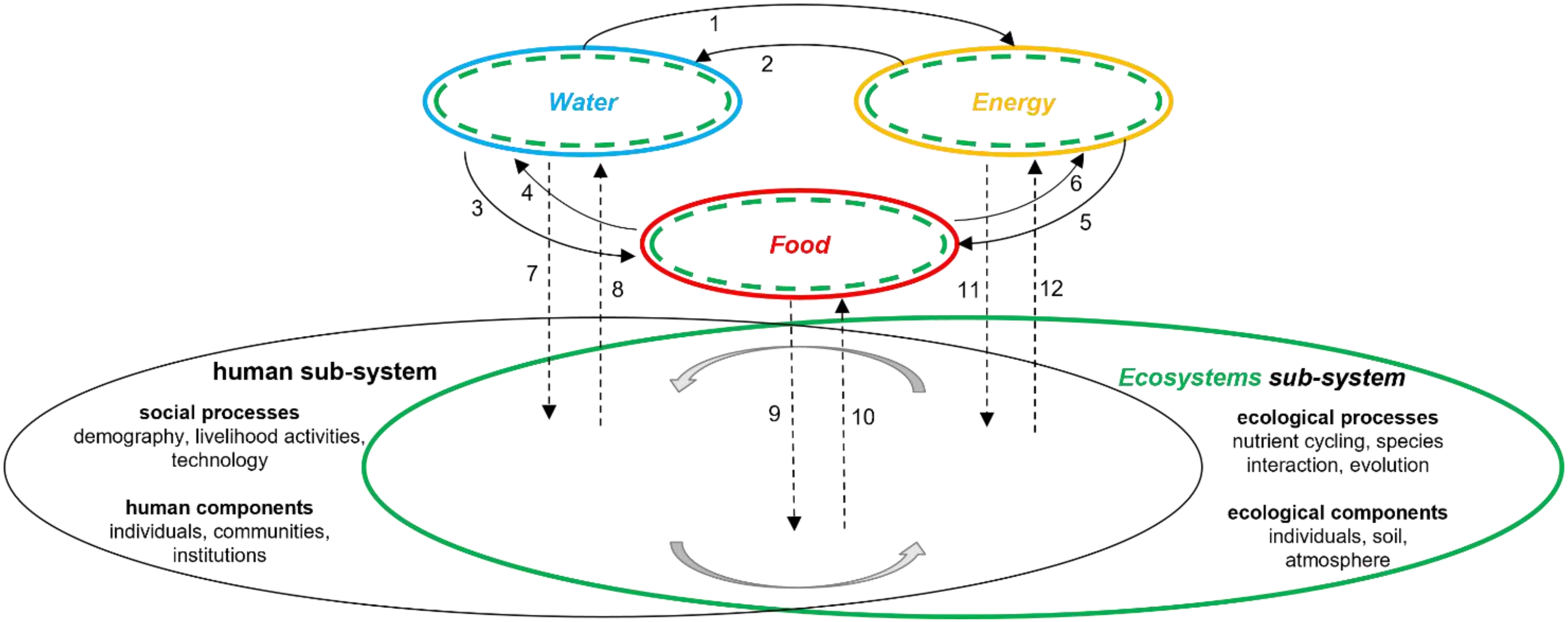
the integration of ecosystems

a new hybrid model for the integration of ecosystems into the nexus



a perspective article of 39 authors coming soon from NEXUSNET led by WG2 and Enrico Lucca, Dimitris Kofinas and Tamara Avellan

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a Case Studies inventory tool

NEXUSNET develops
an interactive platform to
showcase Nexus case studies
from around the world

hosting information on

- attributes of analysis
- methodological tools
- case studies specifications

offering metadata analysis
functionalities

an effort led by WG2,
Alexandra Spyropoulou, and
Konstantinos Ziliaskopoulos

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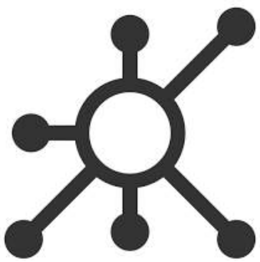
a Case Studies inventory tool

case study scale

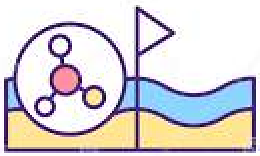
global
continental
international
national
regional
local (municipality/city)

nexus dimensions



water
food
energy
soil
ecosystems, biodiversity
land use
climate
waste
health

and transboundariness



transboundary between countries
transboundary between regions

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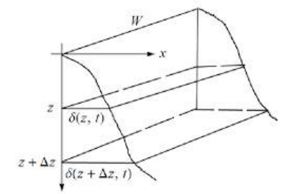
a Case Studies inventory tool

layers of analysis

biophysical modeling and analysis



System Dynamics Modelling, Material flows analysis, engineering modelling, Resource flows, etc.

SWAT, CLEWS model, SEWEM, WEF Nexus tool 2.0, PRIMA, MCDA, MuSIASEM, Integrated assessment models, etc.

behavioral studies and stakeholders' perceptions

Institutional analysis, surveys, interviews, Agent based modelling, Delphi technique, Stakeholder analysis, Focus groups, Living labs

governance and policy analysis

Policy Coherence Assessment, SDG’s assessment, etc

economic analysis

Input-output analysis, Cost-benefit analysis, Trade-off/Synergy analysis, Economic modelling, Value chain analysis, Supply chain analysis, etc.

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nexus of extreme events taskforce

<u>objective</u>

evidence that extreme events are nexus events
nexus domino patterns for each extreme event type
recommendations for regional resilience

shocks that can be
described as natural hazards

- *flood*
- *drought*
- *heatwaves*
- *forest fire*
- *earthquake*
- *tsunami*
- *volcano*
- *landslide*

other shocks:

- *pandemics*
- *conflicts*
- *migration flows*
- *major athletic and cultural events, such as the* Olympic Games

task force of 37 members
an effort led by WG2,
Dimitris Kofinas, and
Melek Kazezyilmaz-Alhan

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nexus of extreme events taskforce

extended literature review upon natural hazards to create **a list of potential case studies**

NUTS3 or NUTS2, aiming at **regional resilience**

mainly focusing on European continent

cost
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nexus of extreme events taskforce

the dimensions

identify all the referred or implied nexus interlinkages between

water
energy
food
soil
climate
ecosystem
health
land uses
transportation
ICT








cost
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nexus of extreme events taskforce
adaptation solutions

The identification of interlinkages exercise will be repeated for three time-scales:

- short-term: less than month
- mid-term: less than a year
- long-term: more than a year

link each interlinkage to recommendations:

- operational
- tactical
- strategical

cost
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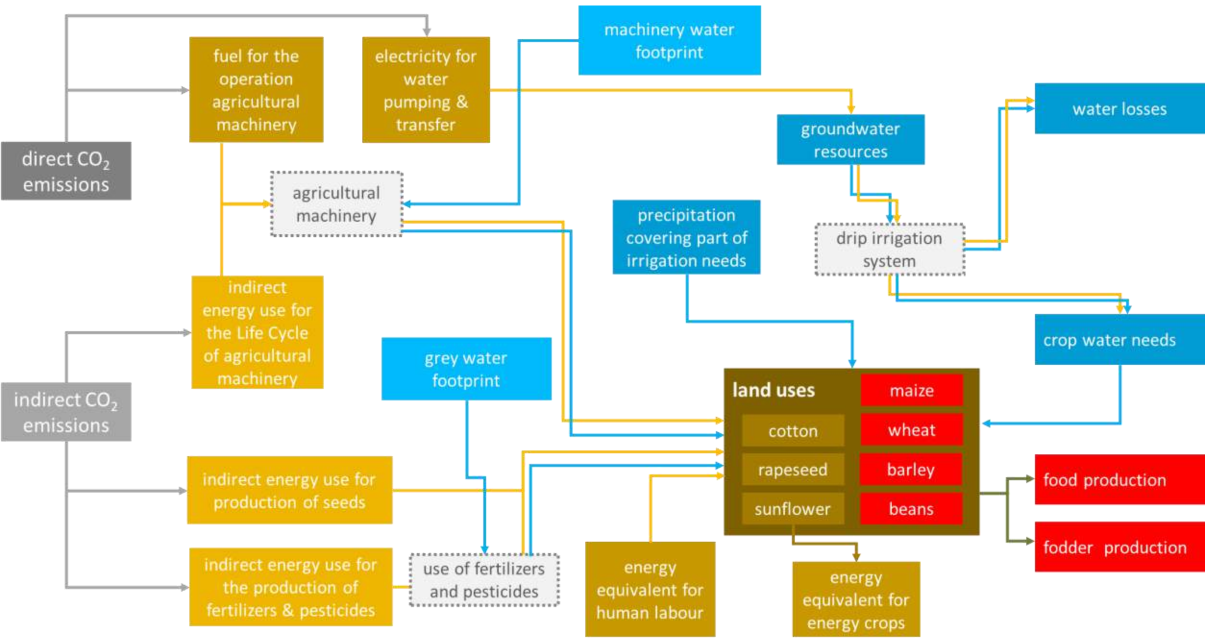
nexus improved land use strategies



Tsimelas and Kofinas, 2022

case studies of Thessaly and Sardinia

Nexus Indicator 1 focusing on food security:

$$NI_1 = \frac{\sqrt{Caloric\ value * Protein\ value}}{\sqrt[3]{total\ Water\ consumption * total\ Energy\ consumption * Land\ cover}}$$

Nexus Indicator 2 focusing on a protein-based food security:

$$NI_2 = \frac{\sqrt[3]{Caloric\ value * Protein\ value^2}}{\sqrt[3]{total\ Water\ consumption * total\ Energy\ consumption * Land\ cover}}$$

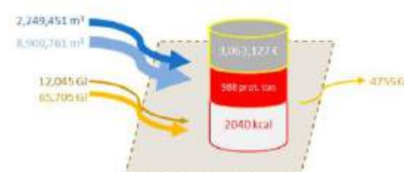
Nexus Indicator 3 focusing on the economy:

$$NI_3 = \frac{Economic\ value}{\sqrt[3]{total\ Water\ consumption * total\ Energy\ consumption * Landcover}}$$

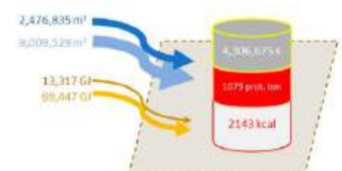
Nexus Indicator 4 focusing on energy security:

$$NI_4 = \frac{Energy\ output\ value}{\sqrt[3]{total\ Water\ consumption * total\ Energy\ consumption * Land\ cover}}$$

Business as usual



Scenario A: food security and moderate energy security



Scenario B: focus on food security

ARSINOE

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Nature Based Solutions as a nexus option

- **multiple benefits** across the WEF sectors

For example, wetlands can improve water quality, support biodiversity, and offer flood protection, while also serving as carbon sinks

- **Sustainability** by enhancing ecosystem functions and reducing environmental degradation
- **Cost-Effectiveness** compared to traditional engineering solutions.
- **Climate Resilience** by mitigating risks such as floods, droughts, and extreme weather events.
- **Biodiversity Conservation** by preserving and restoring natural habitats

NATALIE
Accelerating and mainstreaming transformative NATure-bAsed solutions to enhance resiLIEnce to climate change for diverse bio-geographical European regions

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Circular Economy as a nexus option

- **resource efficiency:** helps to conserve WEF resources
- **waste reduction:** reduces the strain on natural resources
- **sustainability**: products and systems of longer lifecycle and lower environmental impact
- **economic benefits**: lead to cost savings and new economic opportunities
- **climate resilience:** reduces GHG emissions and promotes use of renewable resources, mitigating the impacts of climate change on WEF

www.europarl.europa.eu

an effort led by WG2,
Janez Susnik, and Hai-Ying Liu
19 members

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Dimitris Kofinas, PhD
Department of Civil Engineering,
University of Thessaly

Thank you!

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00306986625291

@thethrillisgone

Dimitris Kofinas

Stefania Munaretto
Dimitris Kofinas
Alexandra Spyropoulou
Enrico Lucca
Mirela Sertić Perić
Hai-Ying Liu
Melek Kazezyılmaz-Alhan
Janez Susnik

Specific features of a WEFE Nexus project beyond technological innovations?

Prof. Ali RHOUMA

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

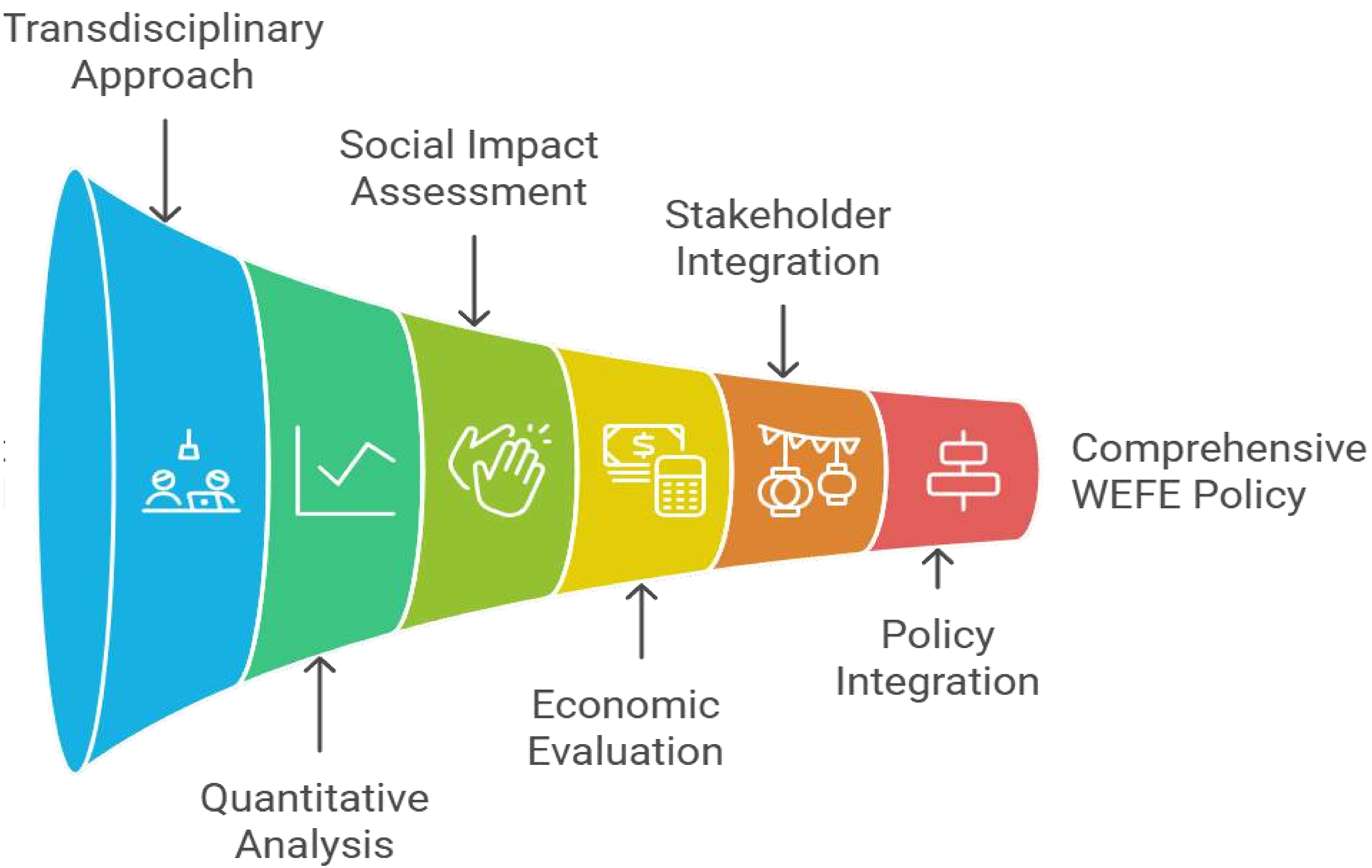
November 5th, 2024

PRIMA is supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation

Content

1. The Human component: Stakeholder Engagement and Inclusivity
2. Policy Coherence and Institutional Integration
3. Innovation in Finance and Economic Models
4. Scalability and Transferability Across Regions
5. Insights from PRIMA Funded Projects
6. Conclusion

WEFE Nexus project components



1. Human Component of the WEFE Nexus

Community Empowerment

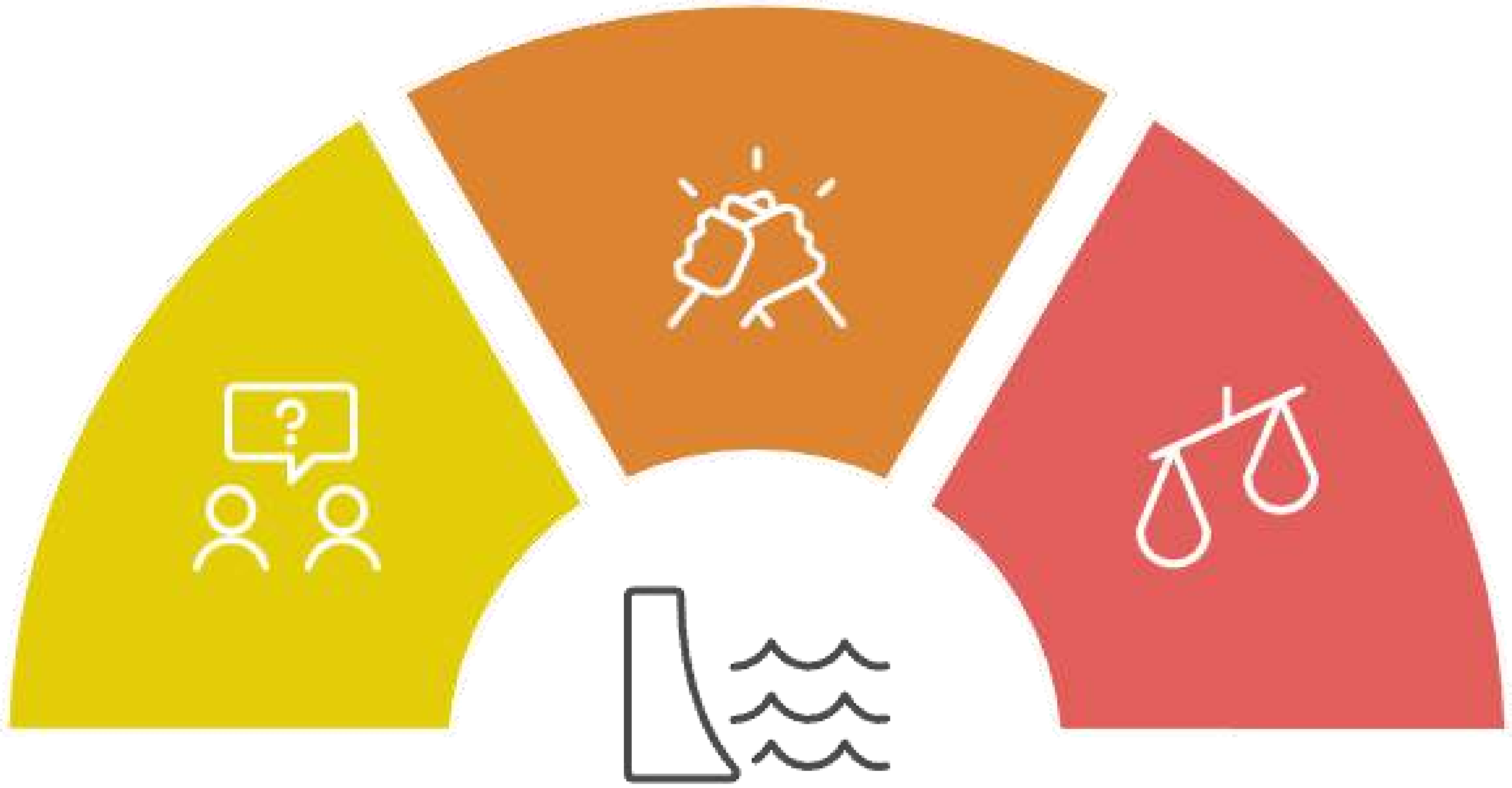
Builds trust and ownership among local communities for sustainable outcomes.

Stakeholder Engagement

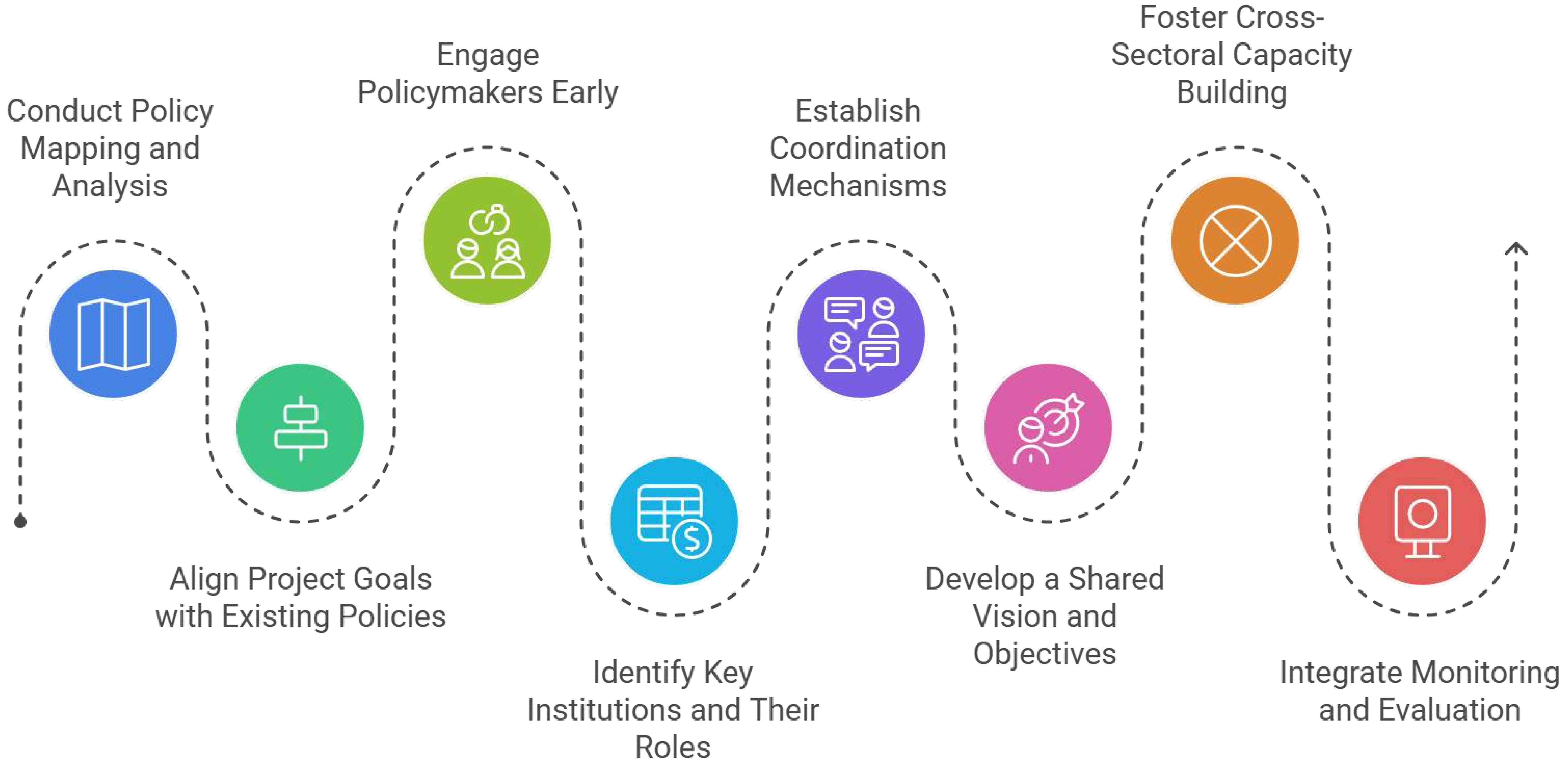
Involves diverse groups to ensure comprehensive project input and support.

Social Equity

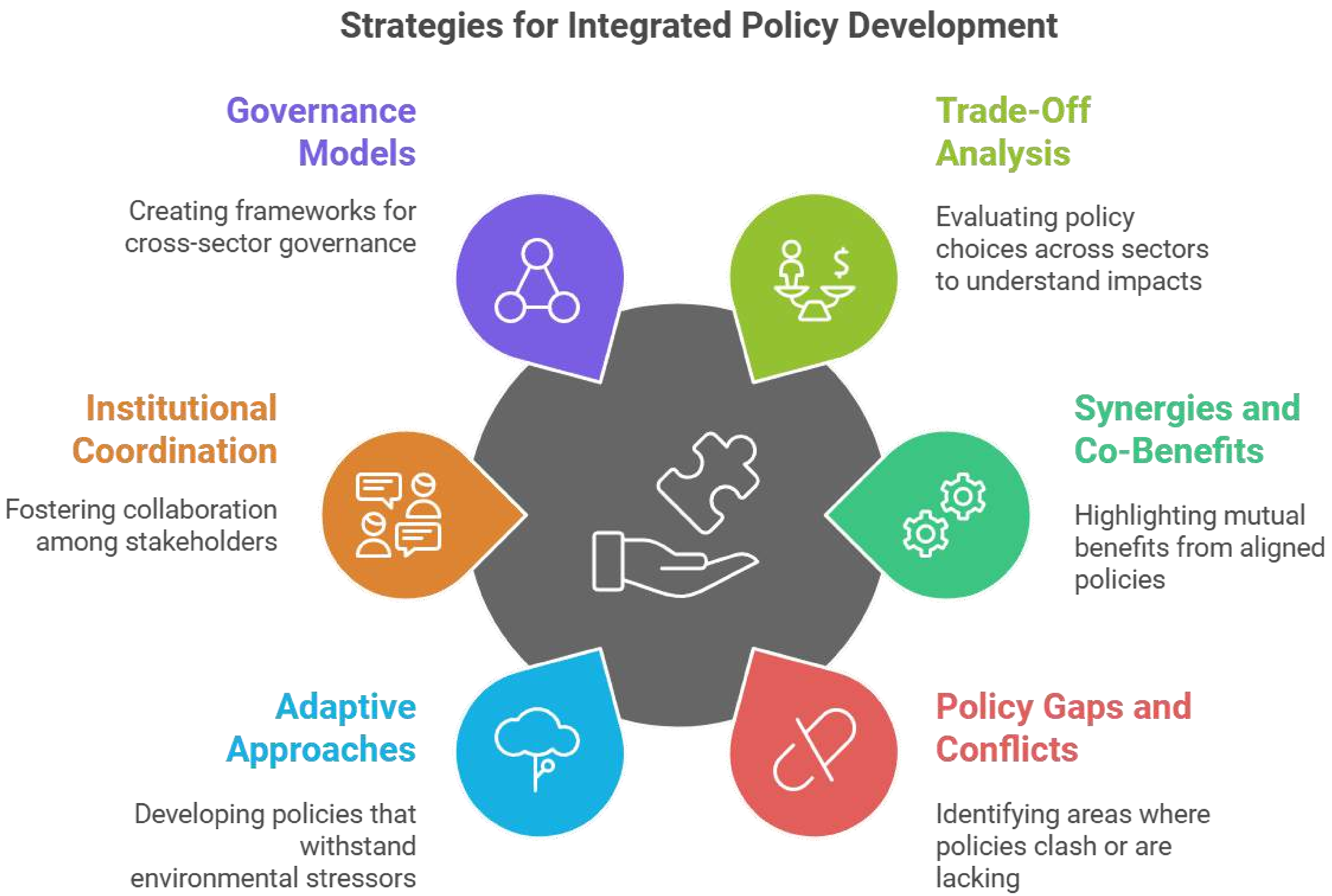
Ensures marginalized voices are included in decision-making processes.



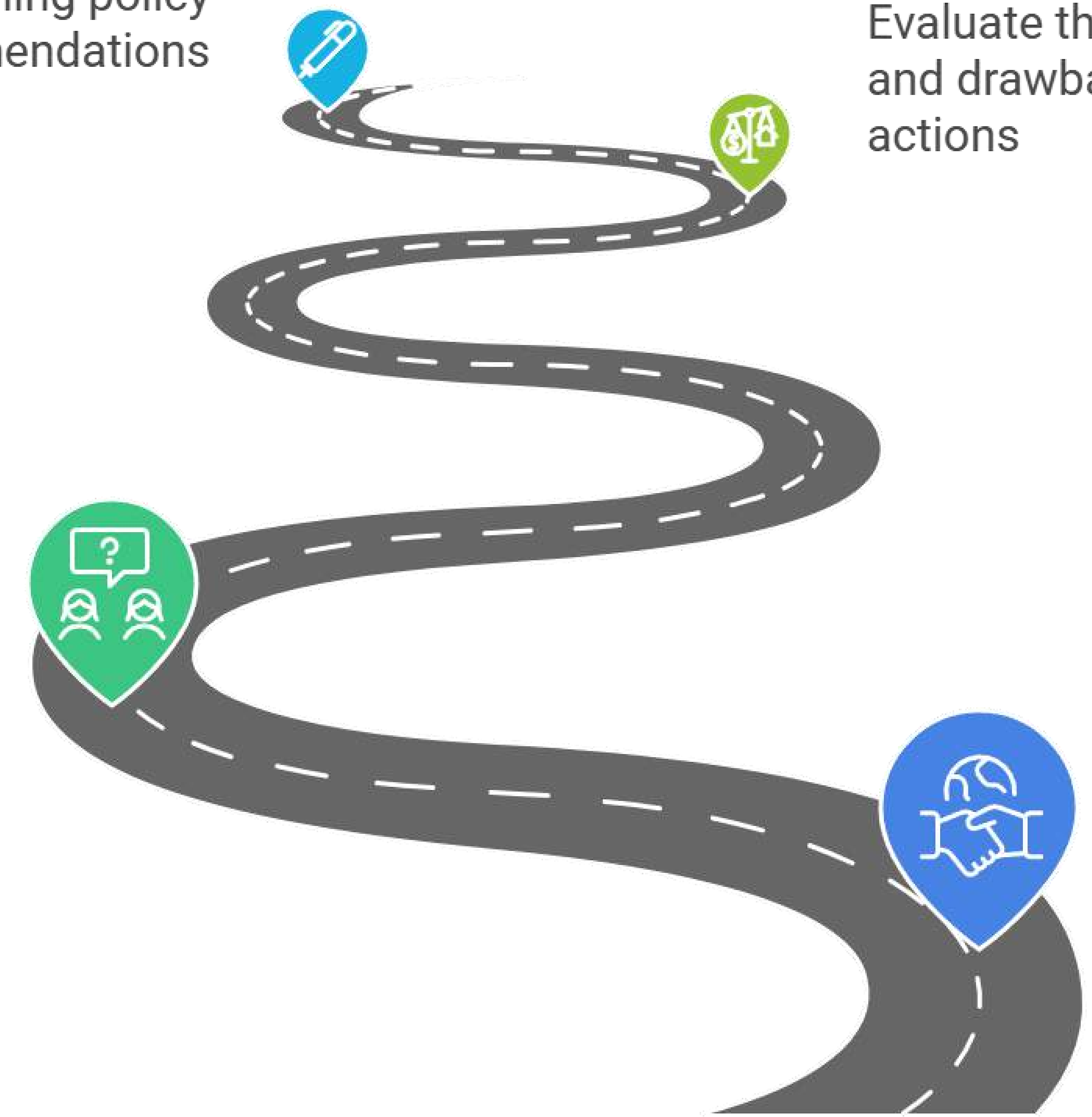
2. Policy Coherence and Institutional Integration



2. Policy Coherence :Cross-Sectoral Policy Assessments



3. WEFE Nexus Projects at Regional Level



Check Regional Agreement

Verify if there is a consensus among regions

Engage Key Stakeholders

Involve relevant parties in the discussion

Assess Trade-offs and Synergies

Evaluate the benefits and drawbacks of actions

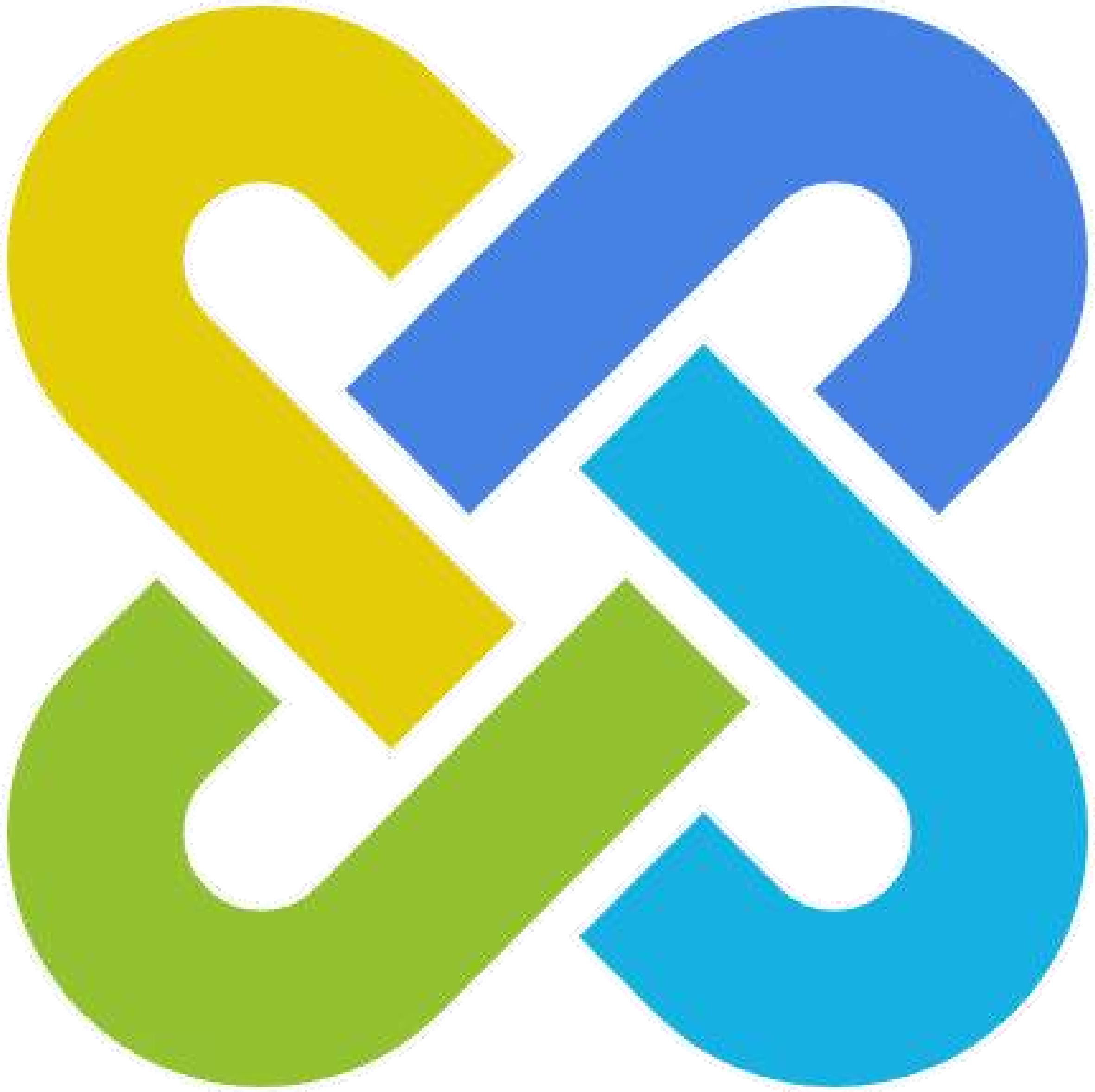
Produce Policy Briefs

Create documents outlining policy recommendations

4. Innovation in Finance and Economic Models

Community-Based Finance

Supports local economic development through microfinance



Blended Finance

Uses public funds to attract private investment

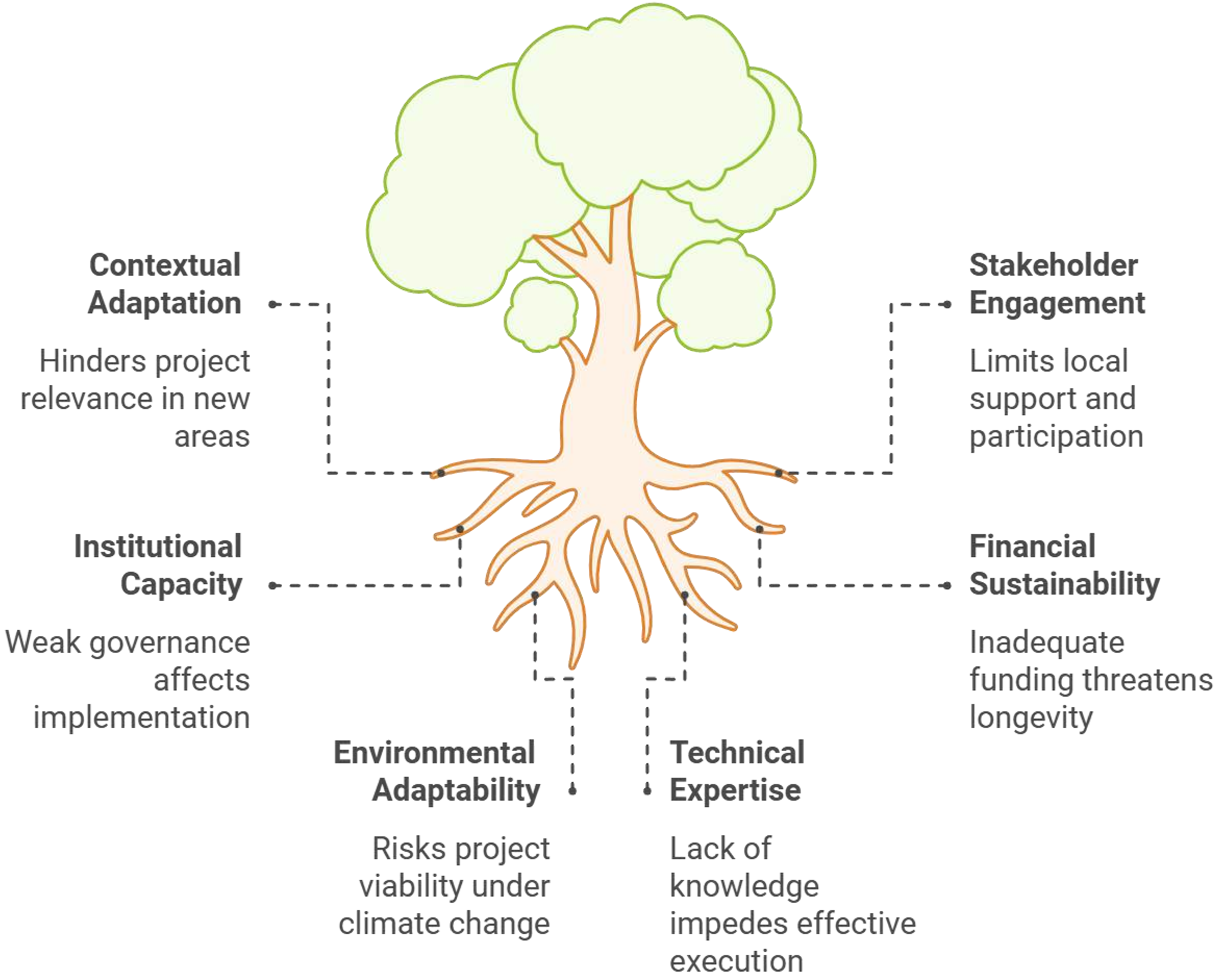
Incentive-Based Subsidies

Provides financial incentives for resource efficiency

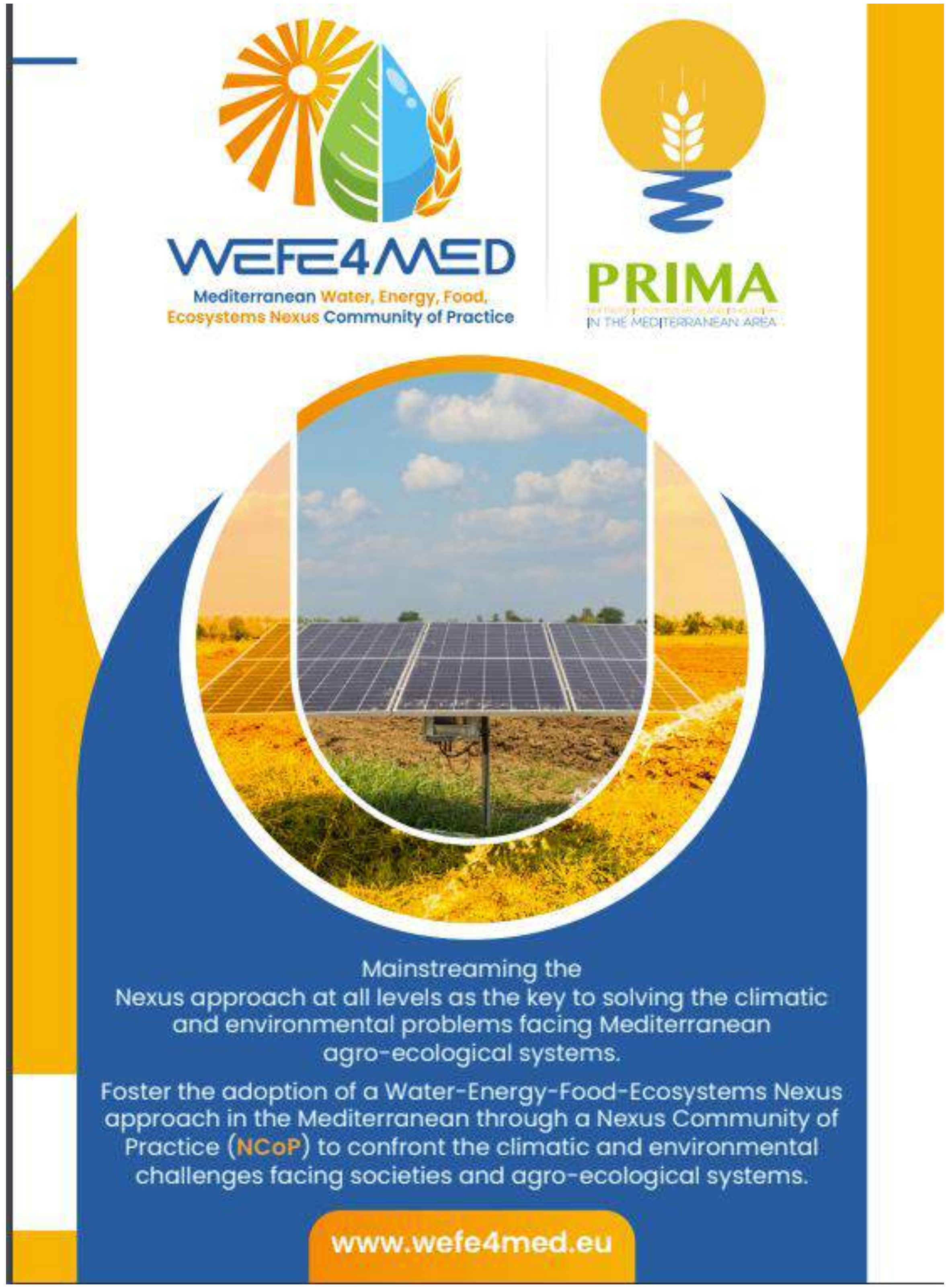
Payments for Ecosystem Services

Rewards sustainable land management practices

5. Replication and scaling up of WEFE Nexus Project



6. WEFE Nexus Community of Practices

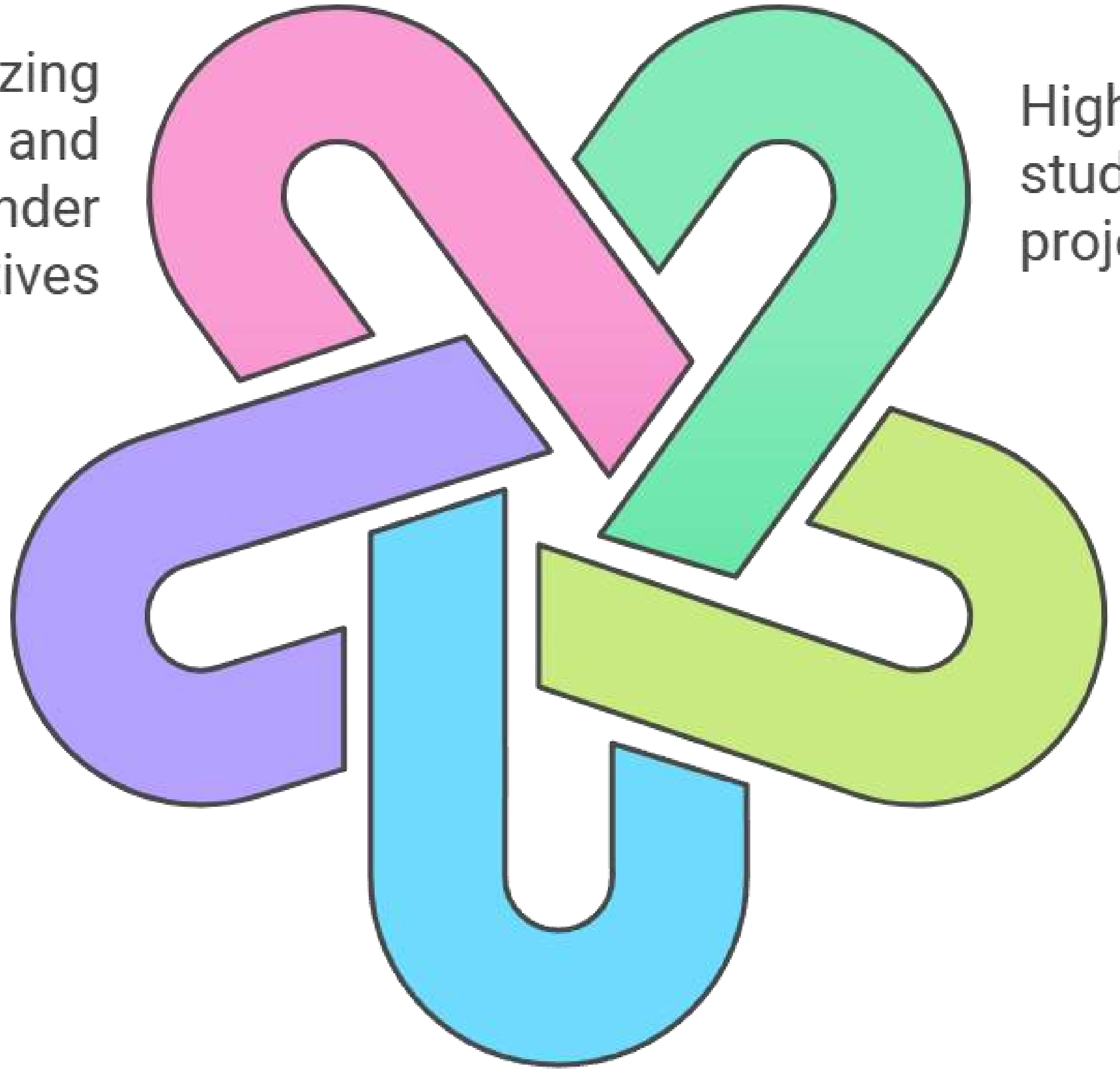


Multi-Stakeholder Engagement

Emphasizing collaboration and gender perspectives

Successful Practices

Highlighting case studies and projects



Policy Examination

Analyzing existing policies and frameworks

Best Practices

Facilitating knowledge exchange on innovative solutions

Governance Models

Discussing effective frameworks for integration

WEFE Nexus PRIMA funded Projects

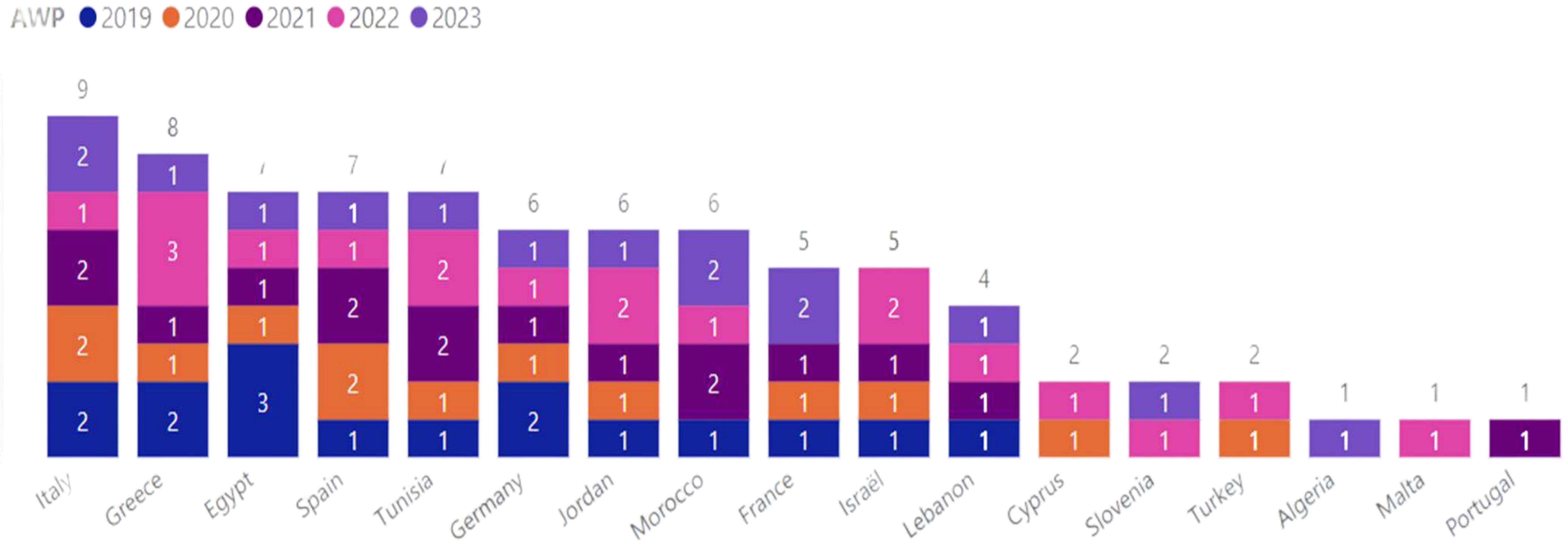
WEFE NEXUS
PROJECTS

12
funded projects

137
total Beneficiaries

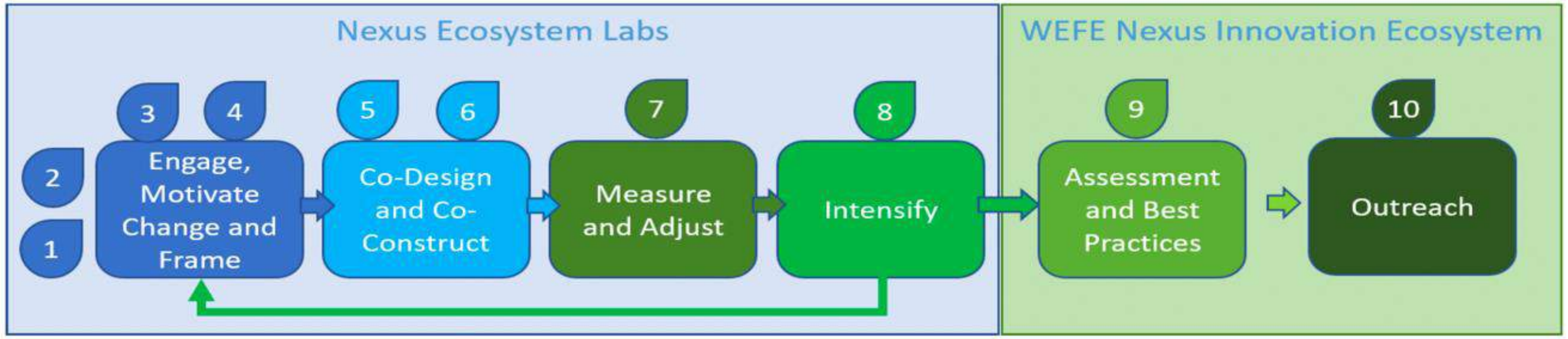
34.18M€
Budget

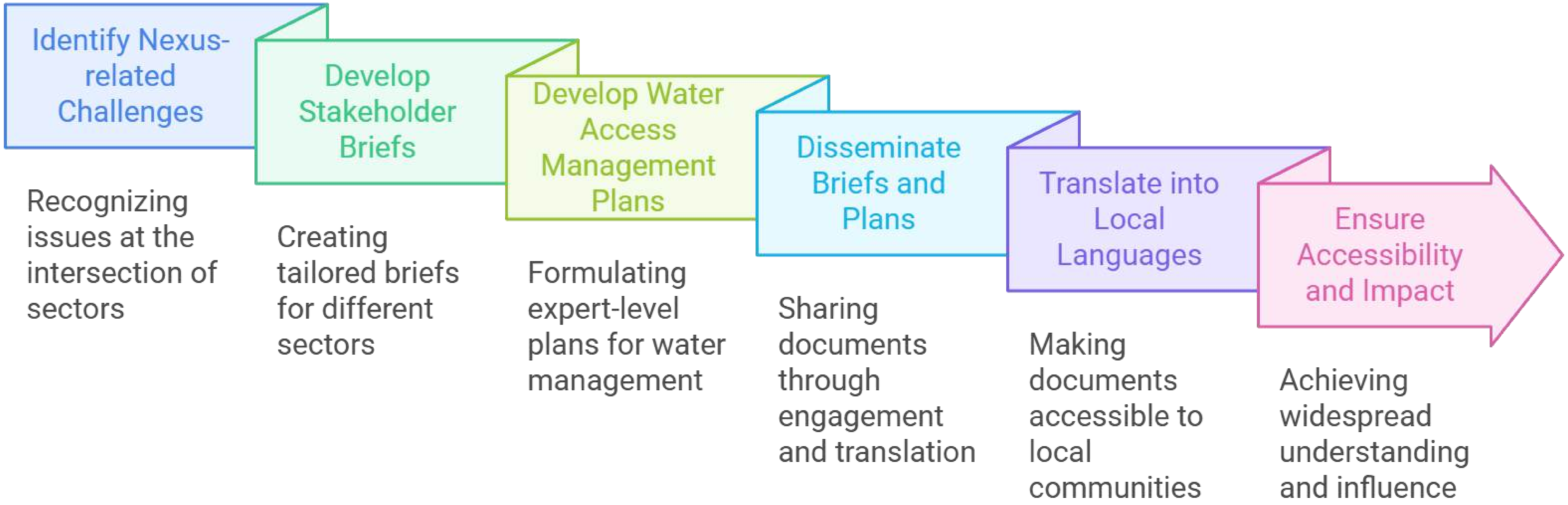
249.46K€
Budget/ Beneficiary



Example NEXUS-NESS Project

NEXUS-NESS seeks to merge earth science, engineering, social sciences and humanities, transferring WEFE Nexus top science, data and tools to solve real field issues.





Conclusion

•**Human-Centered Approach**: Emphasizing the importance of people in the WEFE Nexus, projects prioritize stakeholder engagement and inclusivity to ensure solutions are rooted in local needs and context.
•**Stakeholder Engagement**: Actively involving communities, policymakers, and various sectors helps build trust, gather diverse perspectives, and foster shared responsibility in managing water, energy, food, and ecosystems.
•**Policy Cohesion**: Cross-sectoral policy alignment is essential to bridge gaps, avoid conflicting goals, and promote synergy between environmental, agricultural, and energy policies.
•**Building Local Capacity**: Training and knowledge-sharing initiatives strengthen local capacity, enabling communities to independently implement, scale, and sustain WEFE Nexus solutions.
•**Scalability and Transferability**: By focusing on replicable frameworks, WEFE Nexus projects pave the way for sustainable resource management practices that can be adapted to different regions.

PRIMA

PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Ali Rhouma

Project Officer

ali.rhouma@prima-med.org

Thank you

Prima Program

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Mediterranean Partnership
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PRIMA Programme

Prima-med YouTube

prima_foundation_med

TEXAS A&M UNIVERSITY
Texas A&M
Energy Institute

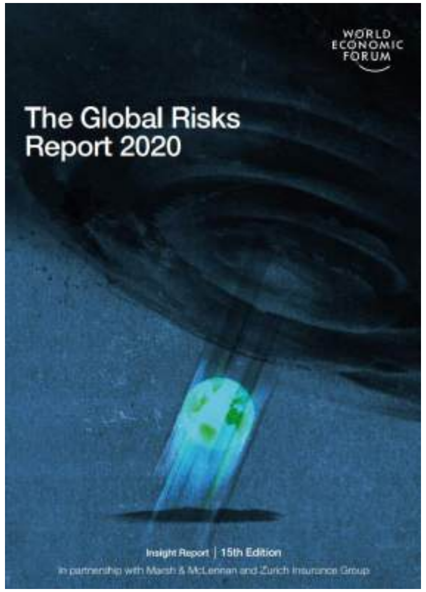
TEES
Texas A&M Engineering
Experiment Station

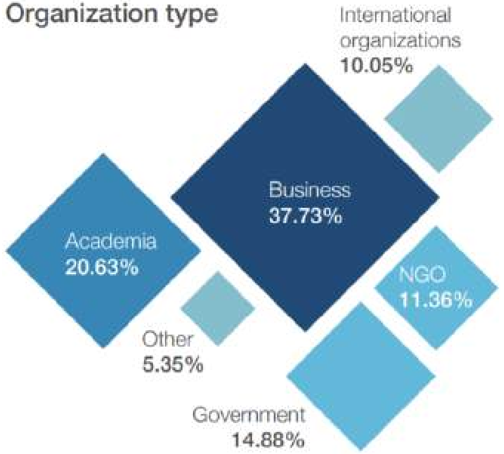
The Role of Analytics and Community Engagement in supporting Sustainable and Equitable Water-Energy-Food Systems Transformation

Bassel Daher, PhD
Assistant Director for Sustainable Development | Texas A&M Energy Institute
Research Fellow | Institute for Science, Technology, and Public Policy
Adjunct Assistant Professor | Department of Biological and Agricultural Engineering
Texas A&M University

November 5, 2024

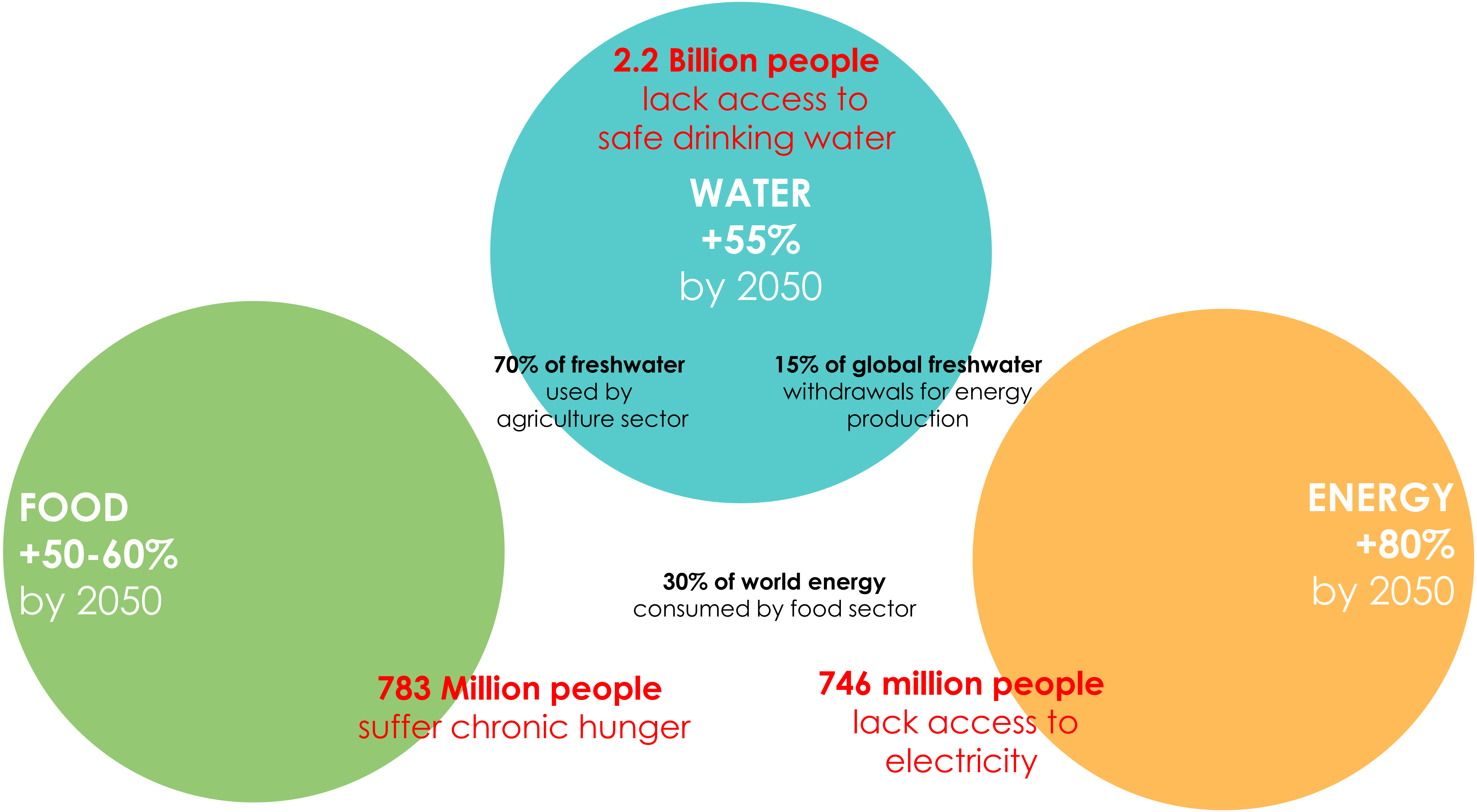
Global Risks Landscape 2020





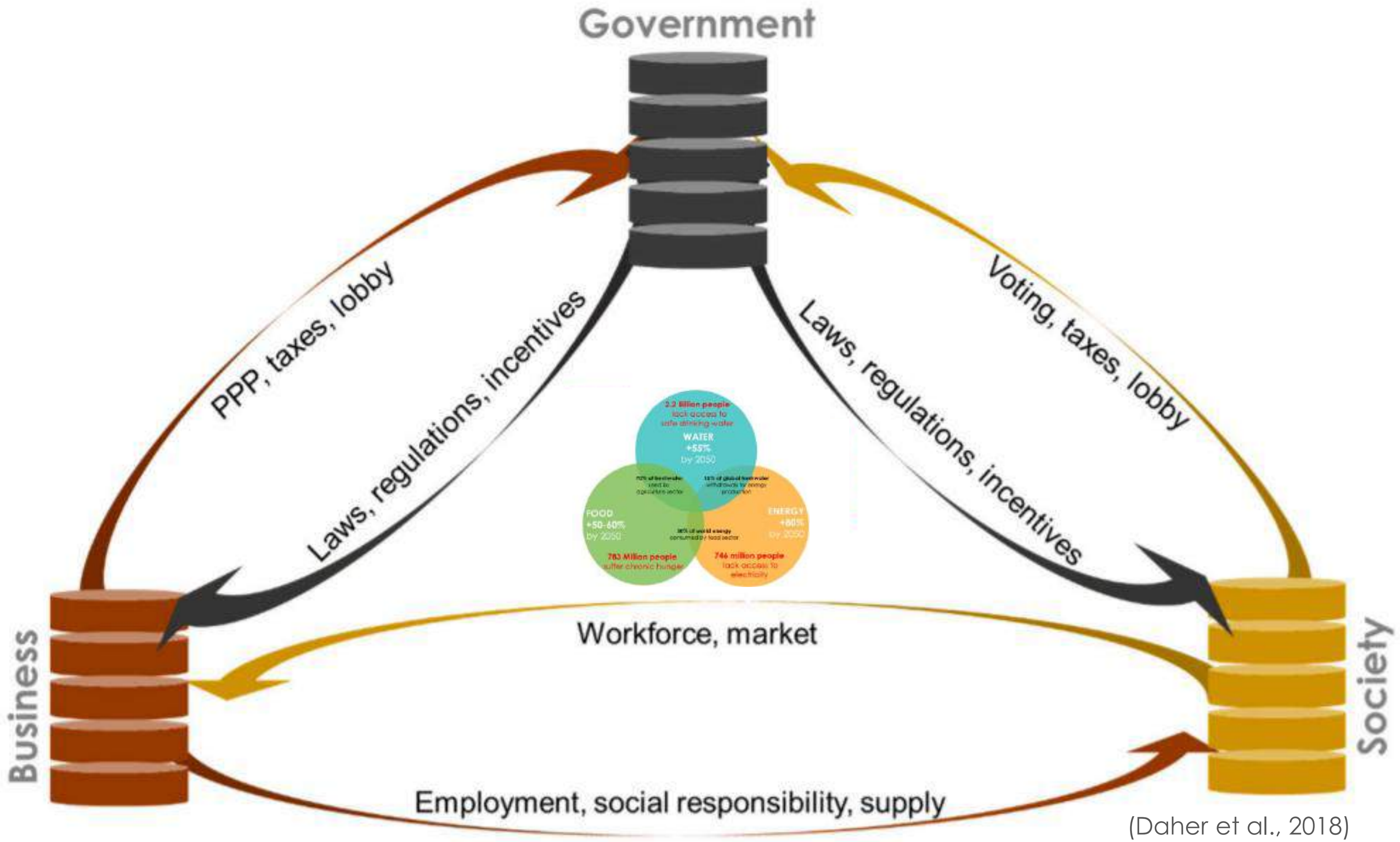
- *Wide range of **complex challenges***
- ***Highly interconnected** challenges*
- ***Hard to predict***
- *Need for **systems thinking***
- *Require **rapid response***
- *Require **high level of cooperation***

- ***Infrastructure for improving future resilience:***
  - *environments to innovate at the interface of different disciplines*
  - *environments to innovate in ways diverse actors cooperate*



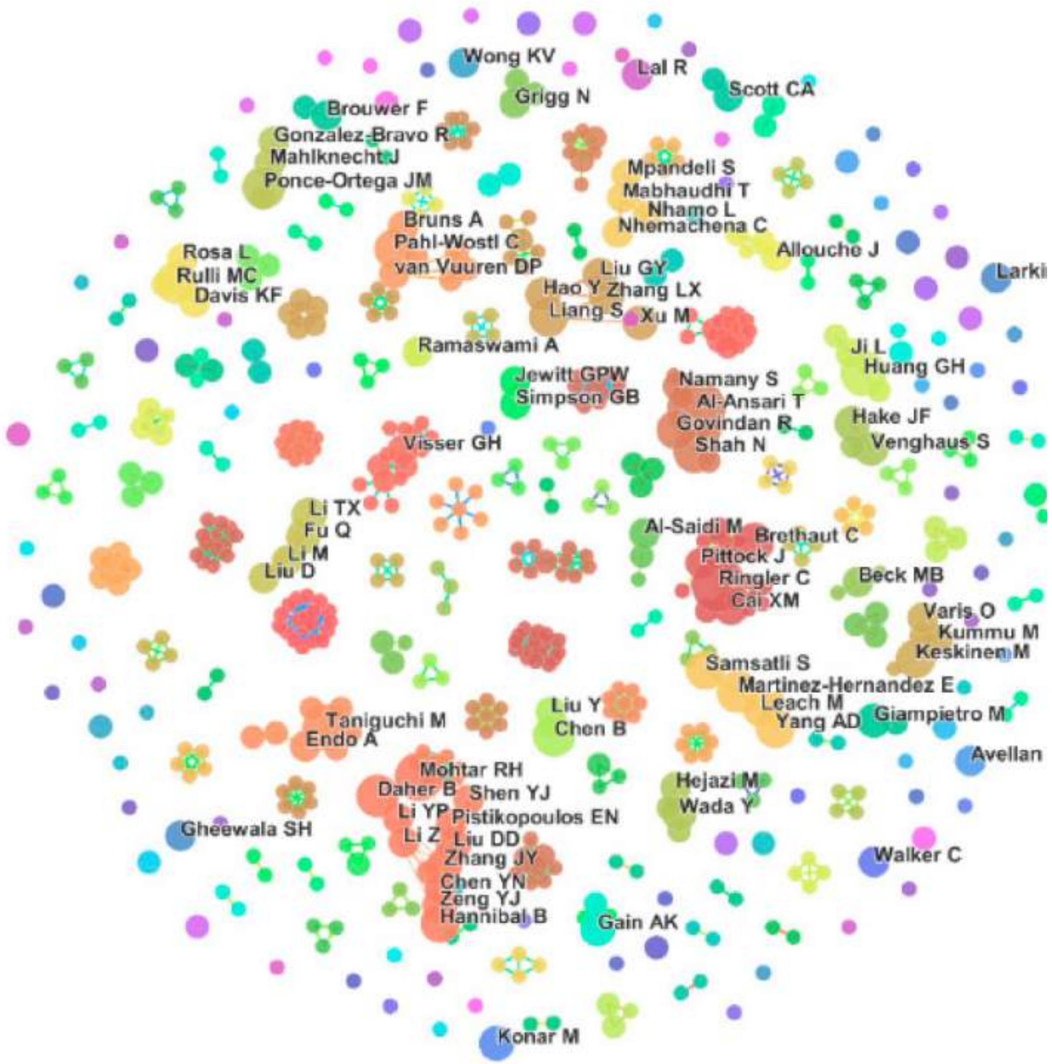
(IRENA 2015; Daher and Mohtar, 2022)

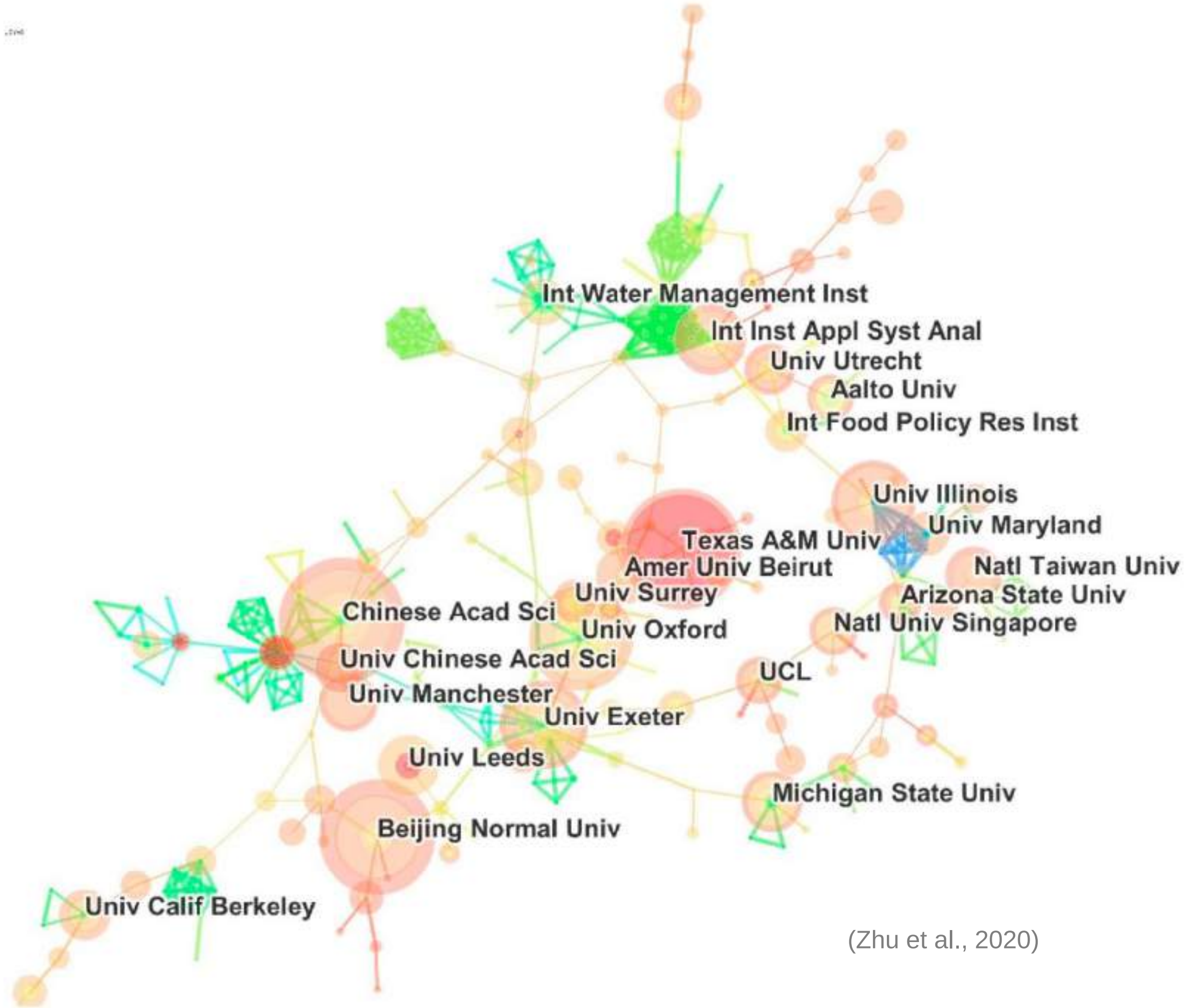
Interconnected Stakeholders



(Daher et al., 2018)

WEF Nexus Research Networks





(Zhu et al., 2020)

Seven Strategic Action Areas

IWMI
International Water Management Institute

Policy Brief

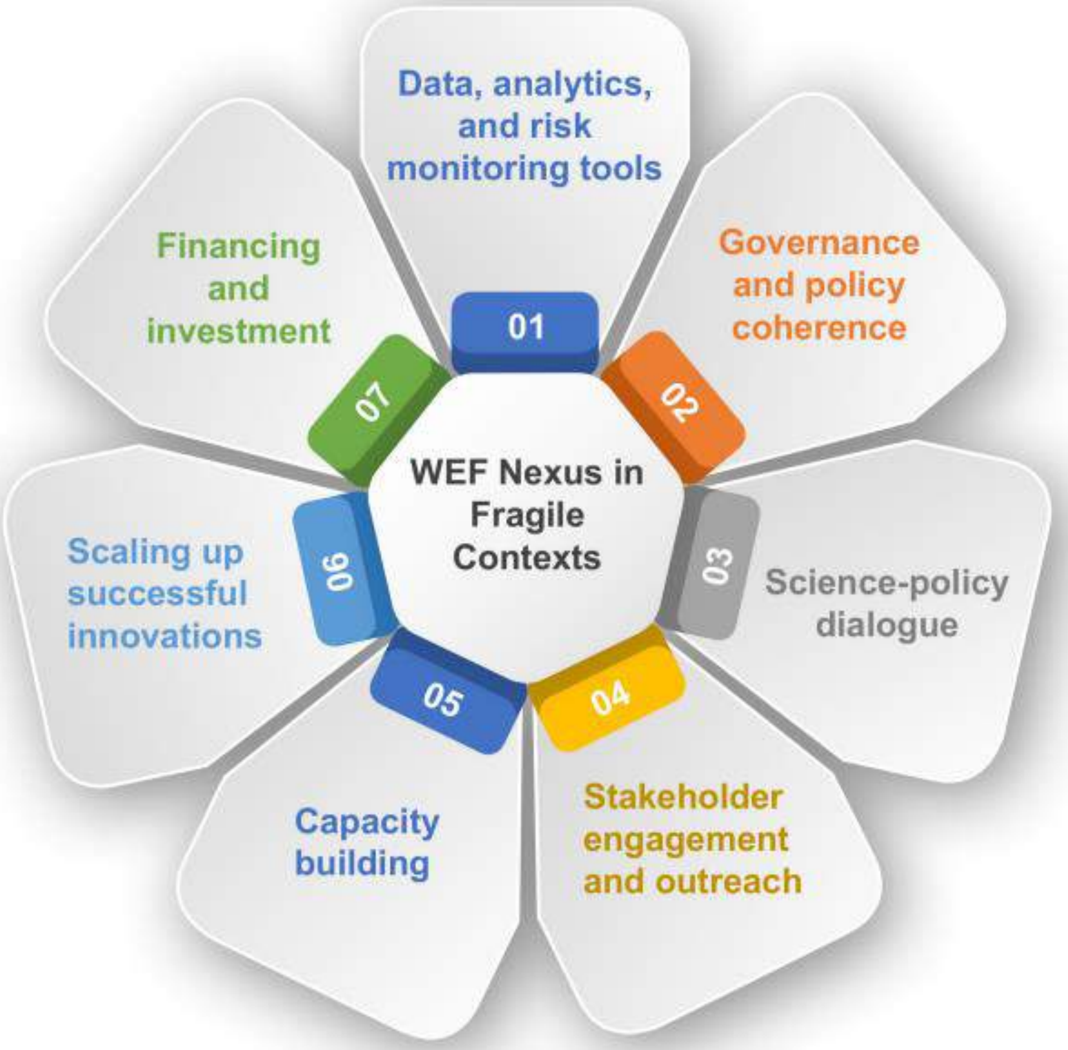
Building resilience in fragile and conflict-affected agrifood systems through a water-energy-food nexus approach

Fragility has become a prevailing reality in an increasing number of countries in various areas, including Central and West Asia and North Africa (CWANA) [1]. The concept of fragility encompasses a range of dimensions, including armed conflict, migration, economic and political instability, erosion of the social fabric, and scarcity, depletion, and contamination of natural resources [2]. The World Economic Forum's recent survey data highlights the significant risks the region is least prepared to face, with water crises ranking among the top risks, followed by profound social instability, state collapse, and interstate conflict [3]. These risks are all interconnected with situations of fragility posing existential threats to the prosperity and well-being of millions of people living in the region.

The CWANA region, which spans a vast area across Central and West Asia and North Africa including all countries covered by the United Nations Economic and Social Commission for

Drying water pond in Jordan, July 2020 (photo: Seema Abaza / IWMI).

CGIAR
INITIATIVE ON
Fragility to Resilience in Central and West Asia and North Africa



(Al-Zu'bi, M.; Daher, B.; Brouziyne, Y.; Laamrani, et al., 2023)

WEF Nexus Tools

Table 4. The main quantitative models used in food–energy–water nexus.

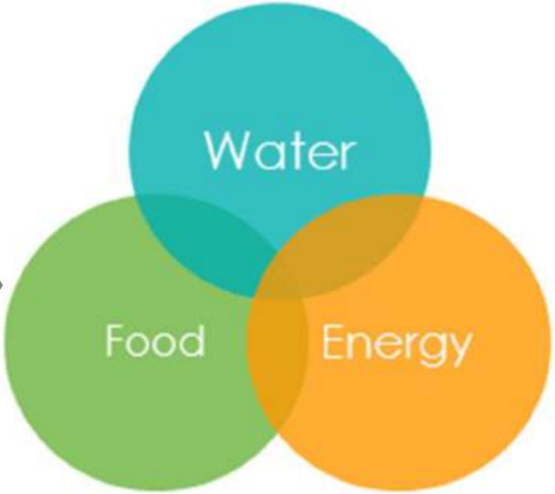
Method	Model	Publication
Econometrics	Based on existing research or expert judgments	Fu et al. [45] Nerini et al. [86]
Target decision-making	Multicriteria comprehensive evaluation; econometric model	Weitz et al. [87] Huang et al. [71]
Input–output analysis	Input–output model; data envelopment analysis (DEA)	Munoz Castillo et al. [62] Sueyoshi et al. [64]
Life cycle assessment	Life cycle assessment (LCA)	Laurent et al. [66]
Econometric model	Global macro-econometric model	Brouwer et al. [88]
Simulation modeling prediction	Threshold 21; system dynamics model; Integrated model for sustainable development goals (iSDG); Bayesian networks; agent-based model	Collste et al. [76] Li et al. [72] Bakhshianlamouki et al. [73] Chai et al. [74] Abdel-Aal et al. [75]
Multi-system model	Computable general equilibrium (CGE); long-range energy alternatives planning (LEAP); water evaluation and planning model (WEAP); climate, land-use, energy and water systems (CLEWS); WEF Nexus Tool	Weitz et al. [80] Payet-Burin et al. [81] Zhang et al. [82] Philippidis et al. [83] Olawuyi [84] Welsch et al. [85] Daher and Mohtar [79]

(Zhu et al., 2020)

Trade-off Tools & Analytics: a catalyst for inclusive dialogue

Alternative pathways & interventions

- Policies
- Technologies
- Social



Tools & Analytics

Trade-off Analysis

Scenario Assessment

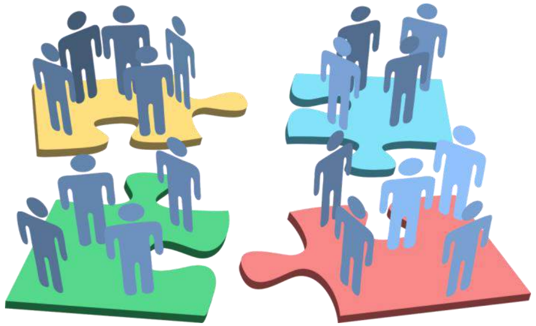
1- Water Requirements (m3)
2- Energy Requirements (kwh)
3- Financial Investment/Cost ($)
4- Carbon Footprint (ton CO_2)
5- Land Requirement (ha)

Sustainability Index

(Social, Economic, Environmental Indicators)

Stakeholder Preferences

Dialogue



WEF Nexus Research Group

TEXAS A&M UNIVERSITY

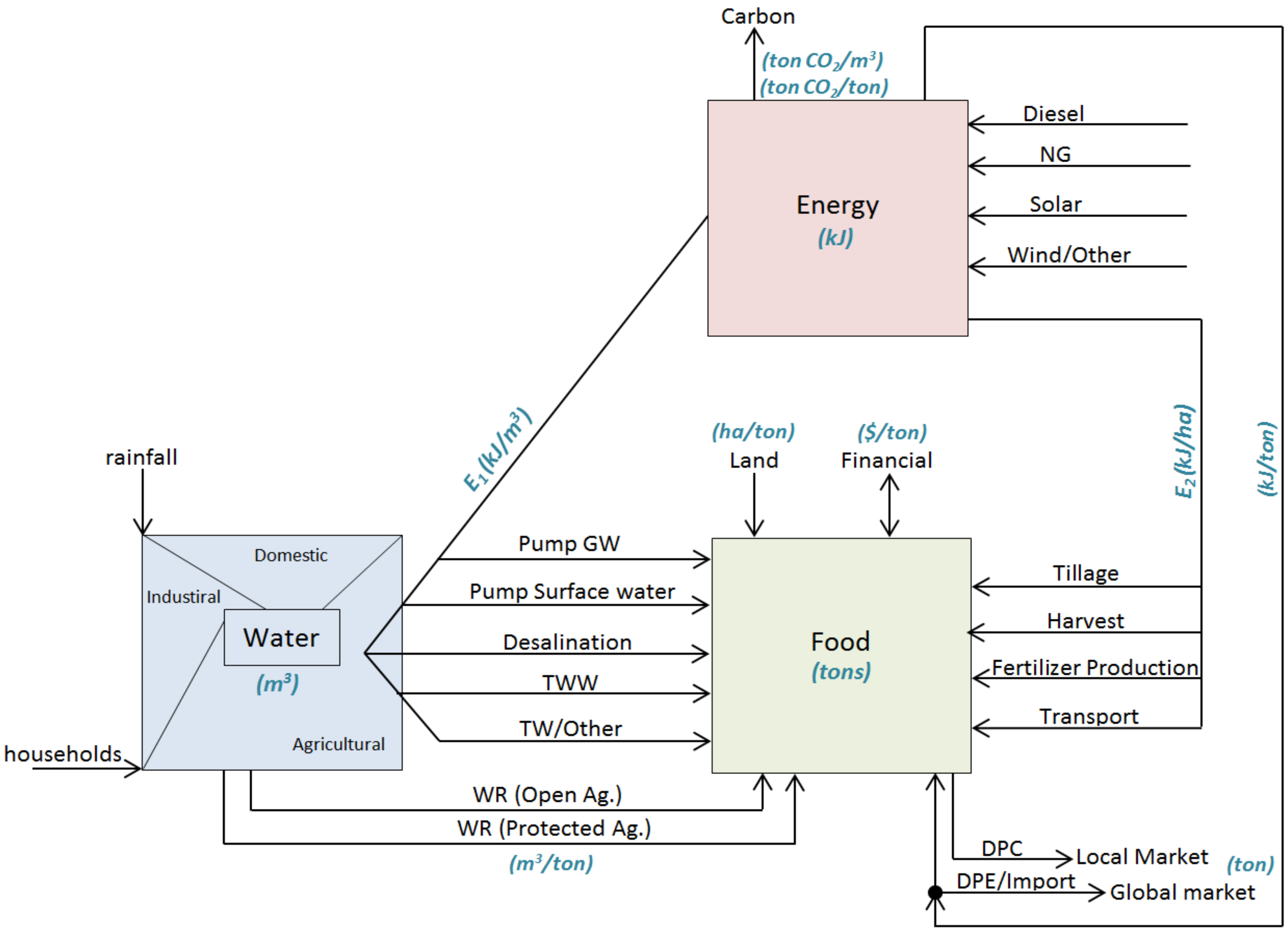
(Daher et al., 2019; Mohtar and Daher, 2016; Daher and Mohtar, 2015)

WEF Nexus Hotspots: Case Studies

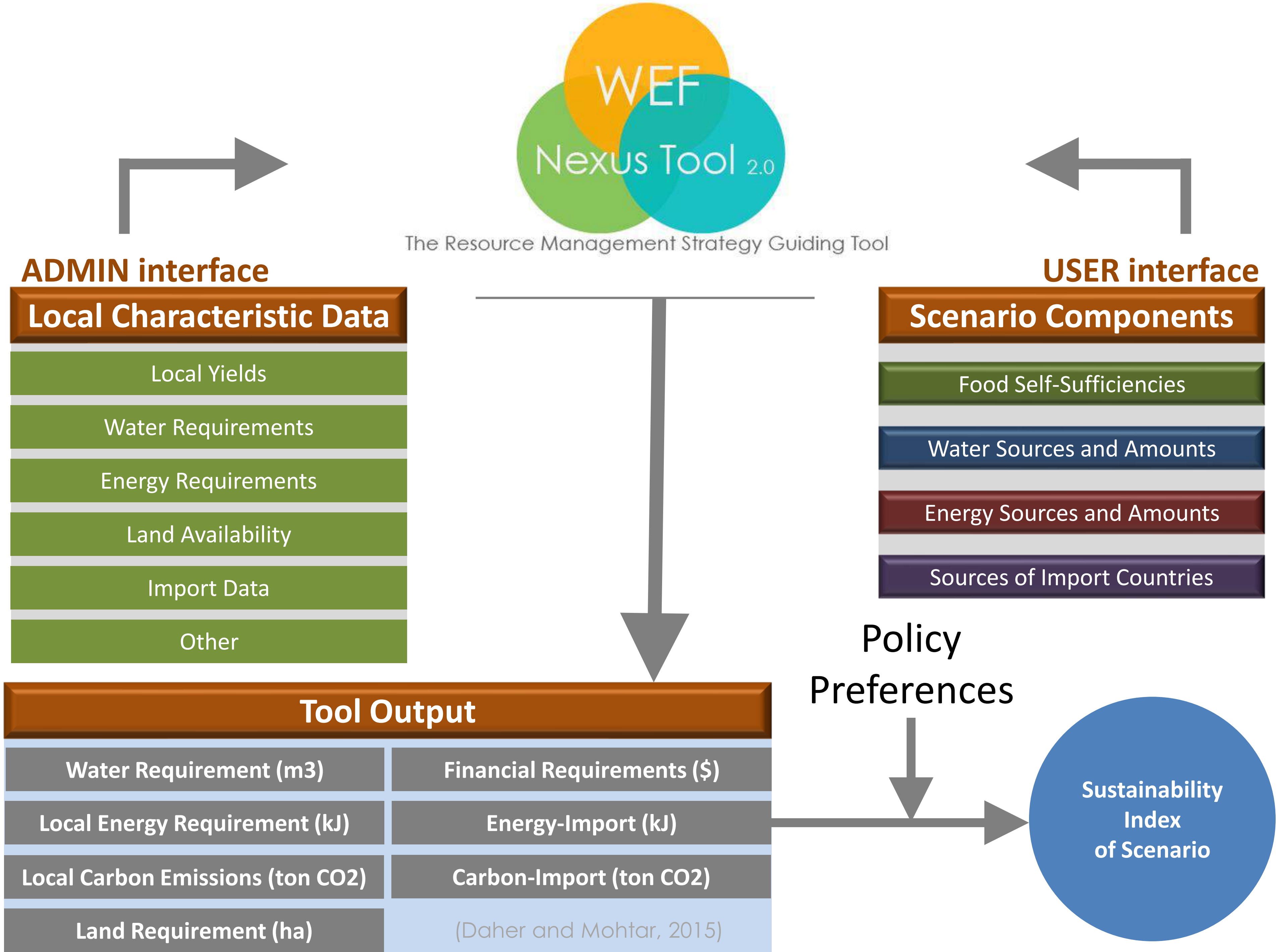
- Ranks 3rd in NG reserves; Ranks 12th in Oil reserves
- Arid Climate
- **Water**: 99% Desalination
- **Agriculture**: limited by low water quantity and quality, unsuitable soil, climatic conditions→ low crop yields
- Food imports exceed **<u>90%</u>**
- Qatar National Vision 2030
- Qatar National Food Security Program (QNFSP)

(Source: Athaia, 2011)

Water–Energy–Food Interconnections



(Daher and Mohtar, 2015)


WEF
Nexus Tool 2.0
The Resource Management Strategy Guiding Tool
ADMIN interface
Local Characteristic Data
Local Yields
Water Requirements
Energy Requirements
Land Availability
Import Data
Other
USER interface
Scenario Components
Food Self-Sufficiencies
Water Sources and Amounts
Energy Sources and Amounts
Sources of Import Countries
Tool Output
Water Requirement (m3)
Financial Requirements ($)
Local Energy Requirement (kJ)
Energy-Import (kJ)
Local Carbon Emissions (ton CO2)
Carbon-Import (ton CO2)
Land Requirement (ha)
(Daher and Mohtar, 2015)
Policy Preferences
Sustainability Index of Scenario

Scenarios using WEF Nexus Tool 2.0

Combined self-sufficiency = 15% (2010)

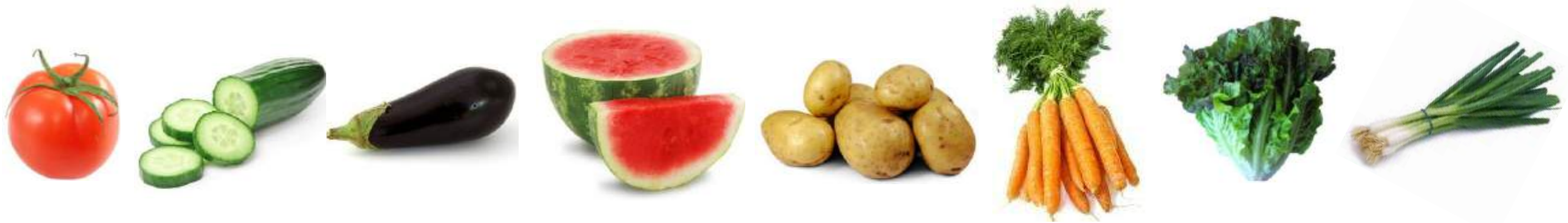
Tomato & **Cucumber** are partially grown using protected ag.

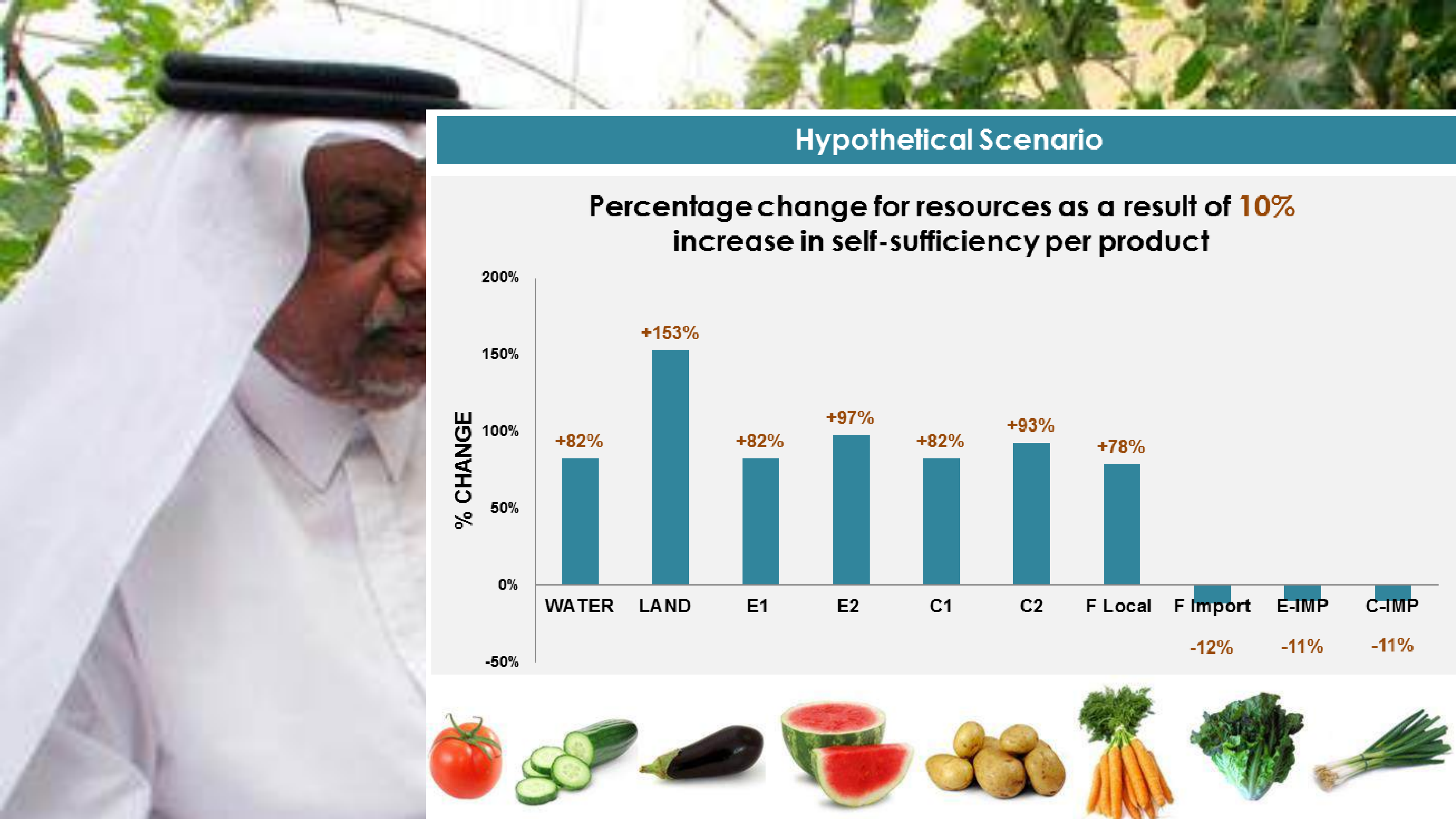
Groundwater is main source for agriculture

Natural Gas is main source of energy

Imports secured from **15 different countries**

WATER (m3)	5,783,797
LAND (ha)	792
E1 (kJ)	24,699,706,932
E2 (kJ)	15,000,733,177
C1 (ton CO2)	3,039,436
C2 (ton CO2)	1,089
F Local (QAR)	48,940,200
F Import (QAR)	3.68E+08
E IMP (kJ)	1.2117E+12
C IMP (kJ)	92,987





Hypothetical Scenario
Percentage change for resources as a result of 10% increase in self-sufficiency per product
% CHANGE
200%
150%
100%
50%
0%
-50%
WATER +82%
LAND +153%
E1 +82%
E2 +97%
C1 +82%
C2 +93%
F Local +78%
F Import -12%
E-IMP -11%
C-IMP -11%

Key messages

- Shift in narrative from full self-sufficiency to trade-offs
- Develop robust trade strategies for primary food needs; identify countries of low risk; diversify import sources
- High water, energy, land, $ costs = higher security
- Improve yields of locally produced food products and invest in research to crops best suited to dryland agriculture

wefnexustool.org

WEF NEXUS Tool 2.0 light

WEF Nexus Tool 2.0

The Resource Management Strategy Guiding Tool

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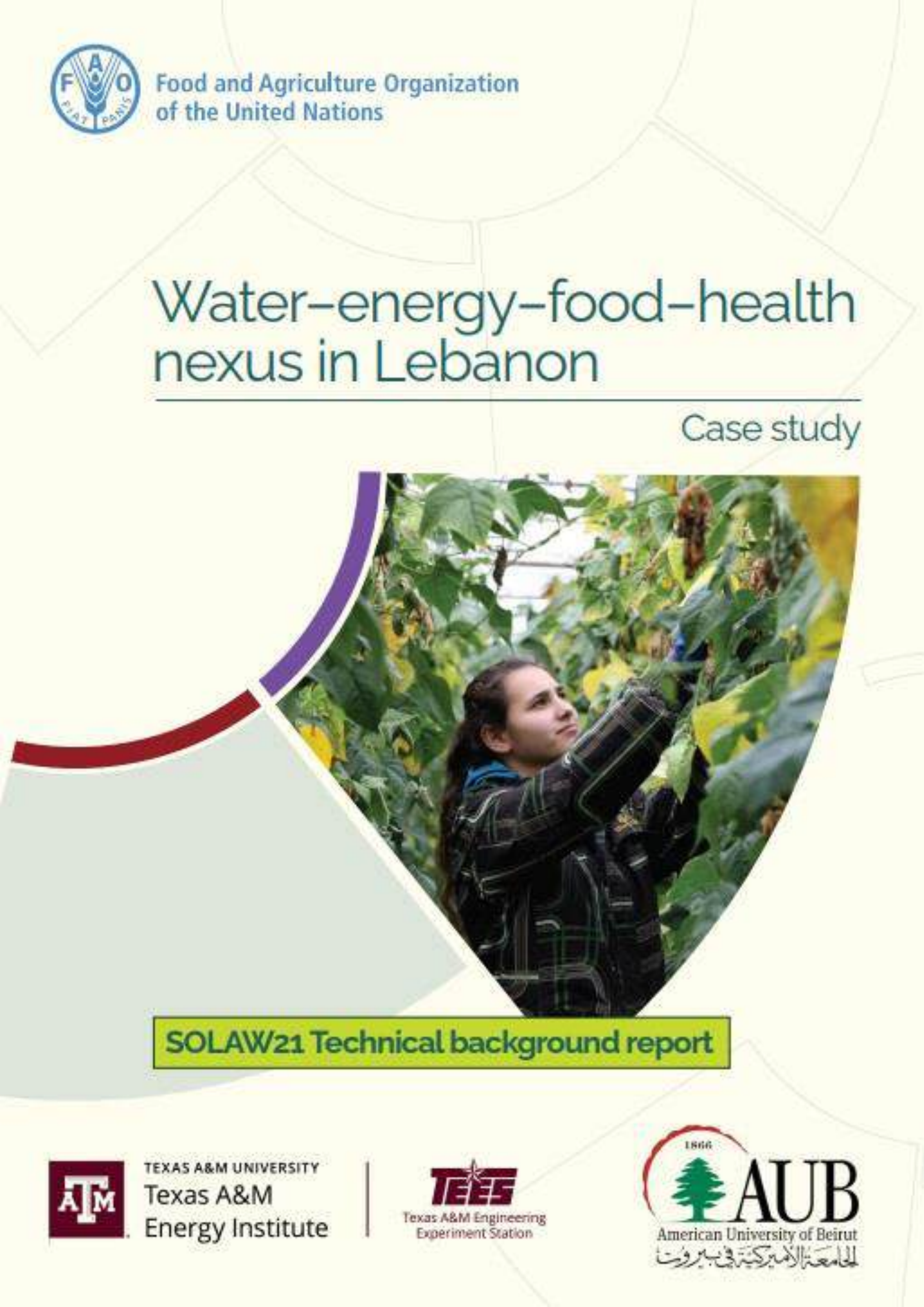

frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 22 December 2022
DOI 10.3389/fsufs.2022.969248

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Food security under compound shocks: Can Lebanon produce its own Mediterranean food basket?

Bassel Daher[1,2,3], Roula Bachour[4], Sandra F. Yanni[4,5], Sasha Koo-Oshima[6] and Rabi H. Mohtar[2,4,7]*

Project Objectives

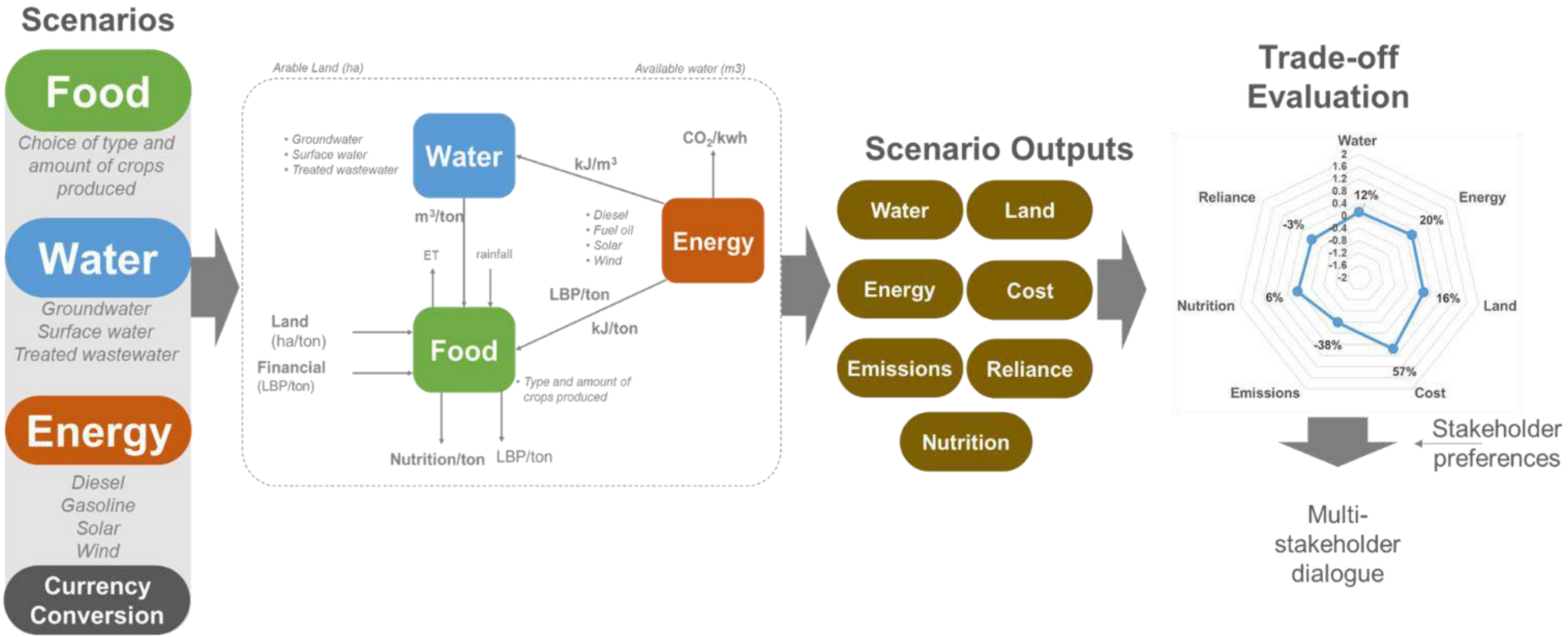
1) **Identify and quantify** the critical interconnections between water, energy, and food systems in Lebanon;

2) **Develop** a nexus framework to assess the trade-offs associated with adopting interventions within the current water, energy, and agriculture portfolios and practices;

3) **Evaluate** farmer perceptions and willingness to implement proposed interventions.

Methodology – Overarching Framework

b. Framework identification & interconnections quantification

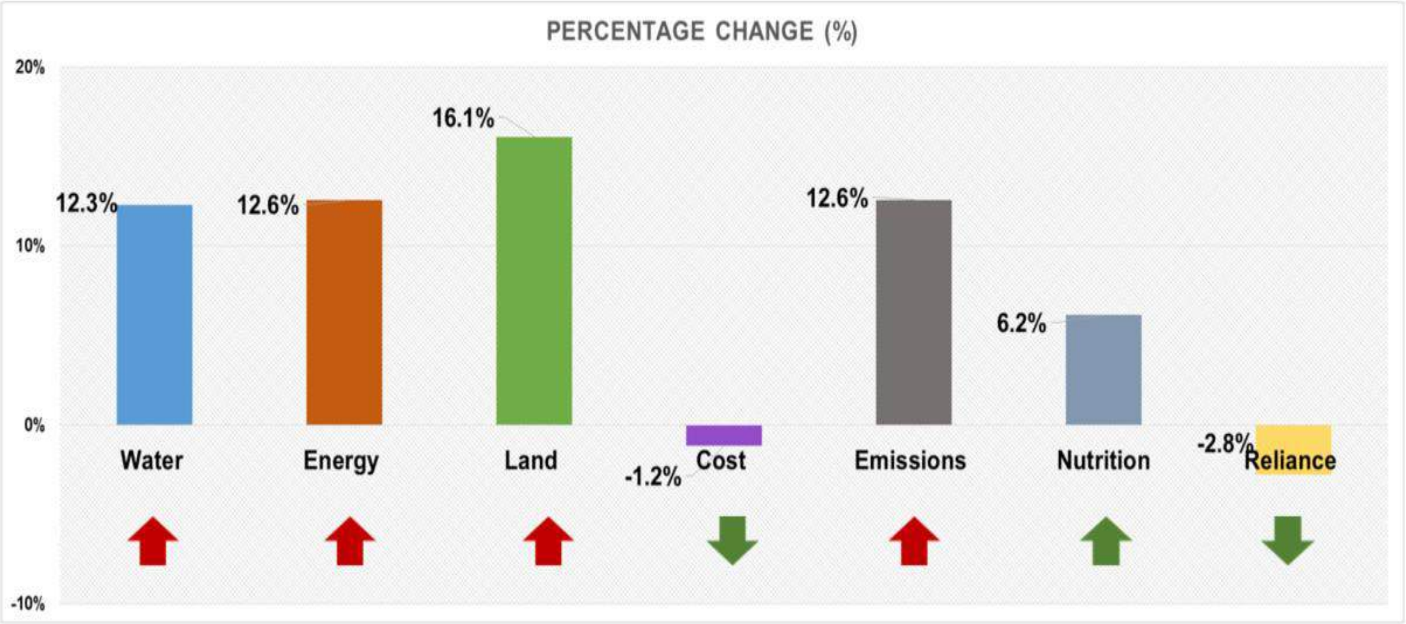


Results

Scenario A: Nutrition-centric

Increase beans (green, broad, dry), lentils, chickpeas and peas (dry, green) to **100% SS**

- **Water:** 80% groundwater, 20% surface water (same as 2017)
- **Energy-Water:** 100% Diesel (same as 2017)
- **Energy-Food:** 70% Diesel, 30% Gasoline (same as 2017)
- **Currency conversion**: 1 USD = 1500 LBP (same as 2017)



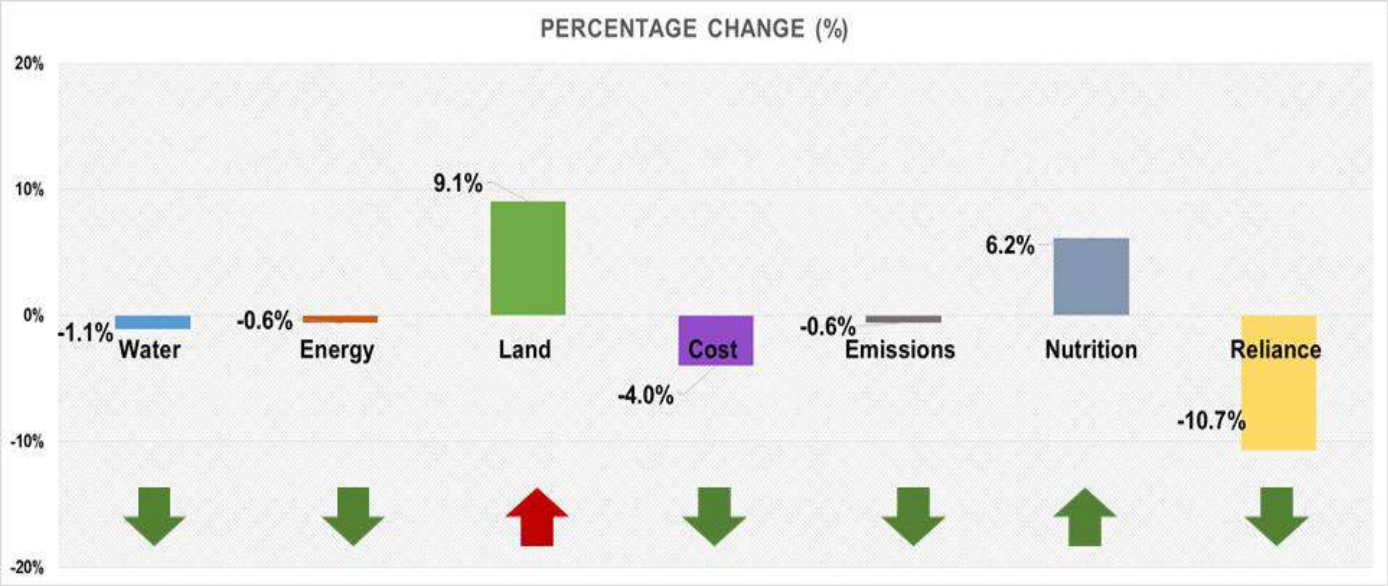
Results

Scenario B1: Shifting from export to more local production

Increase beans (green, broad, dry), lentils, chickpeas and peas (dry, green) to **100% SS**

Decrease production of crops with SS > 100% to SS = 100%; no export, no additional import of these products

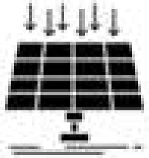
- **Water:** 80% groundwater, 20% surface water
- **Energy-Water:** 100% Diesel
- **Energy-Food:** 70% Diesel, 30% Gasoline
- **Currency conversion:** 1 USD = 1500 LBP



Results - Survey Findings about Willingness to Accept

Rank the decisions you are **most likely** to do on your farm.

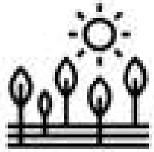
1. **Use alternative energy sources**



in an effort to

1. improve profit
2. save water
3. reduce emissions

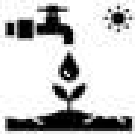
2. **Grow different crops**



in an effort to

1. improve profit
2. save energy
3. save land
4. save water
5. reduce emissions
6. improve nutritional value

3. **Use alternative irrigation sources**



in an effort to

1. improve profit
2. save energy
3. save underground water
4. reduce emissions

Underlying challenge, shocks, and impacts

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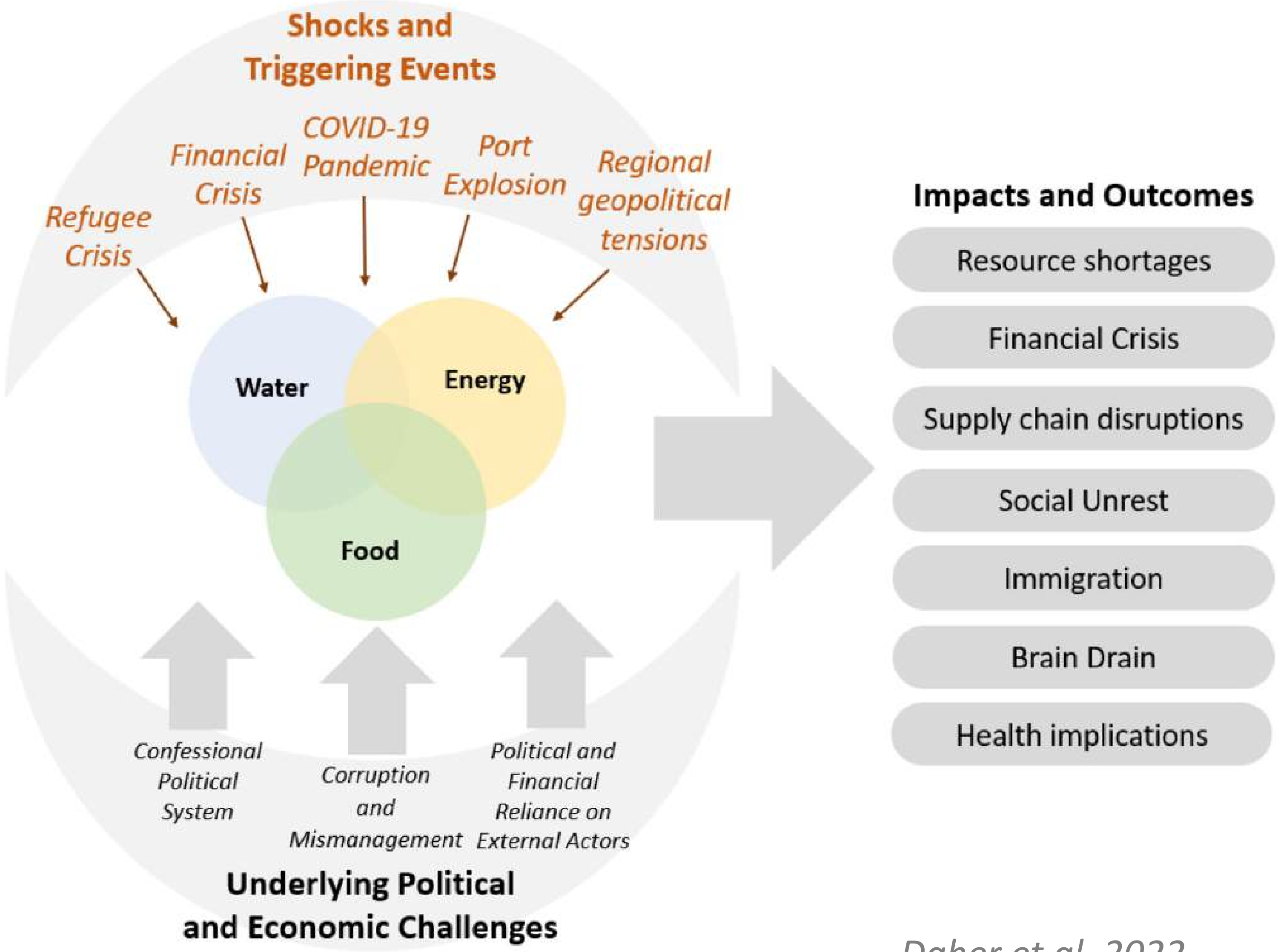
ORIGINAL RESEARCH
published: 20 May 2022
doi: 10.3389/fsufs.2022.748343

Examining Lebanon's Resilience Through a Water-Energy-Food Nexus Lens

Bassel Daher[1,2,3*], Silva Hamie[4], Konstantinos Pappas[1,5] and Julie Roth[4]

[1] Texas A&M Energy Institute, Texas A&M University, College Station, TX, United States, [2] Department of Biological and Agricultural Engineering, Texas A&M University, College Station, TX, United States, [3] Bush School of Government and Public Service, Institute of Science Technology and Public Policy, College Station, TX, United States, [4] Bush School of Government and Public Service, Texas A&M University, College Station, TX, United States, [5] Borders & Migration Program, Bush School of Government and Public Service, Mosbacher Institute for Trade, Economics, and Public Policy, Texas A&M University, College Station, TX, United States



Daher et al. 2022

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Albuquerque
SANTA FE
Colorado Springs
Shreveport
BATON ROUGE
New Orleans
LITTLE ROCK
JACKSON
Lubbock
Midland
Odessa
Big Spring
Roswell
Hobbs
Carlsbad
Alamogordo
Las Cruces
Truth or Consequences
Socorro
Deming
Durango
Farmington
Gallup
Los Alamos
Tucumcari
Clovis
Pecos
Fort Stockton
Van Horn
Alpine
Del Rio
Eagle Pass
San Marcos
New Braunfels
Victoria
Bay City
Port Lavaca
Freeport
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Conroe
Bryan
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Nacogdoches
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Huntsville
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Lafayette
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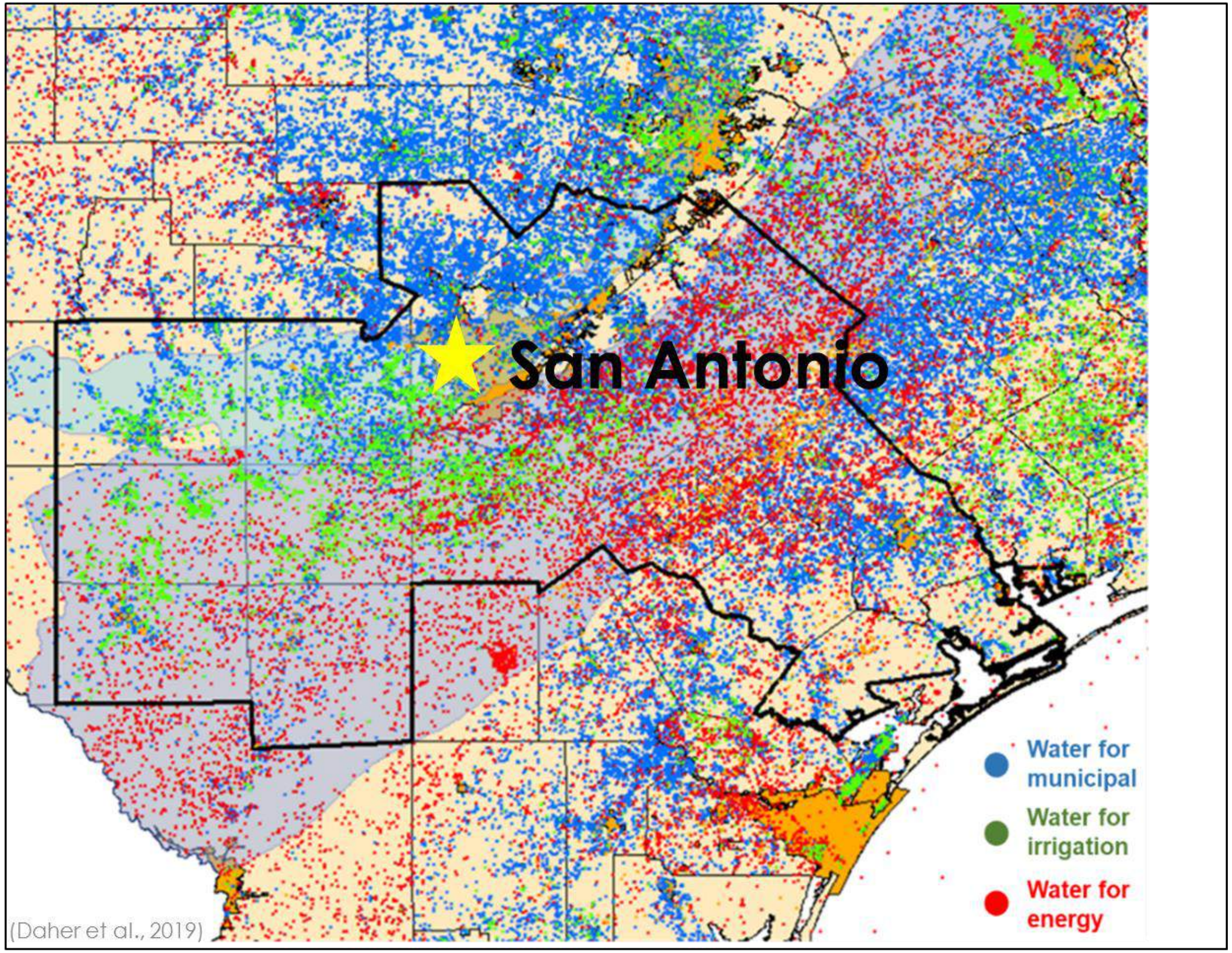
Abilene
Arlington
Cleburne
Denton
Tulsa


Socorro
Alamogordo
Carlsbad
Truth or Consequences
Las Cruces
El Paso
Deming
Chihuahua

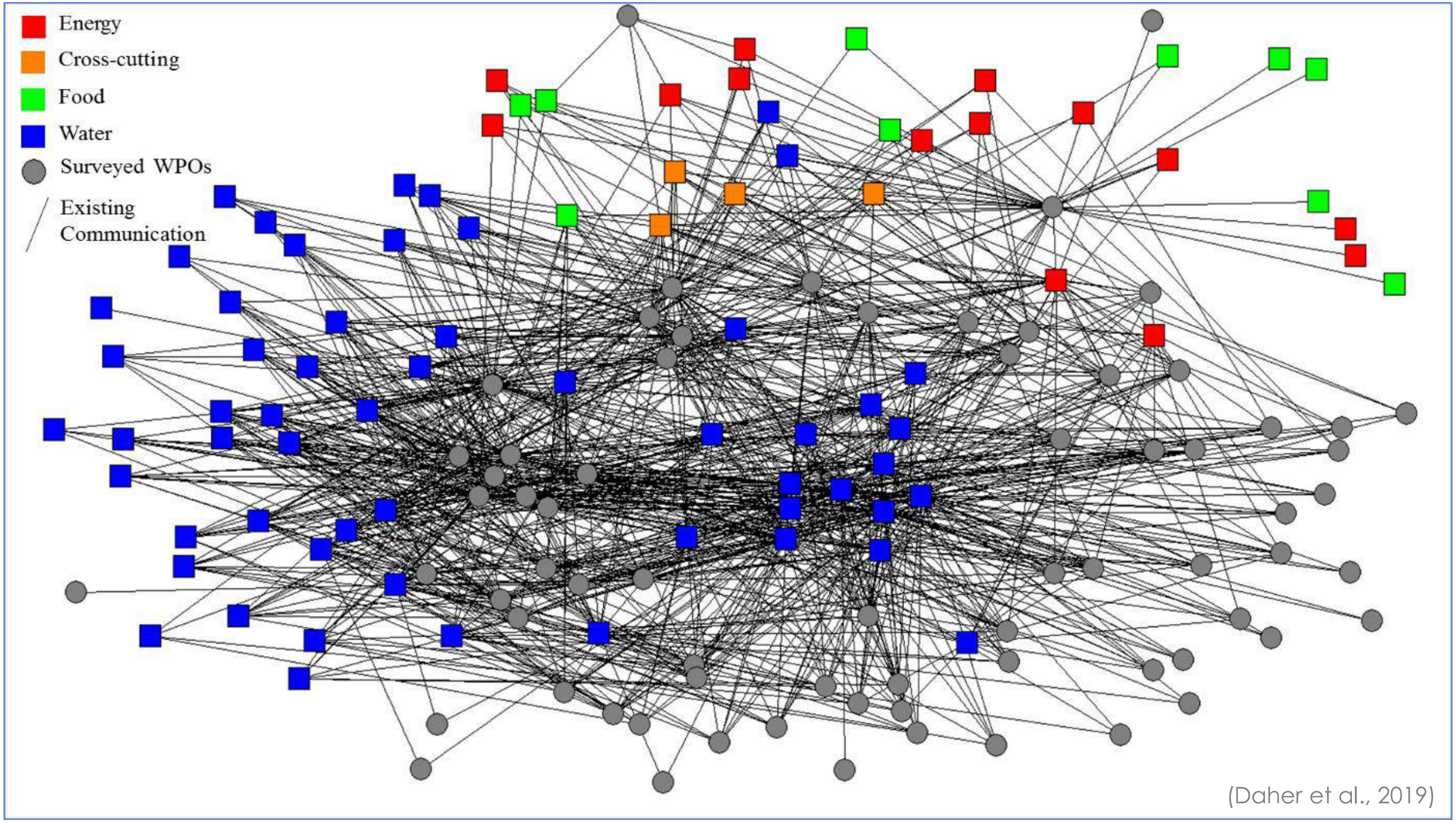
Water-Energy-Food Nexus Hotspot

Region L Projections
2020 - 2050

- Population: **+44%**
- Water demand: **+21%**
  - **49%** water for municipal
  - **24%** water for irrigation
  - **25%** water for energy (manufacturing, steam electric power, mining)

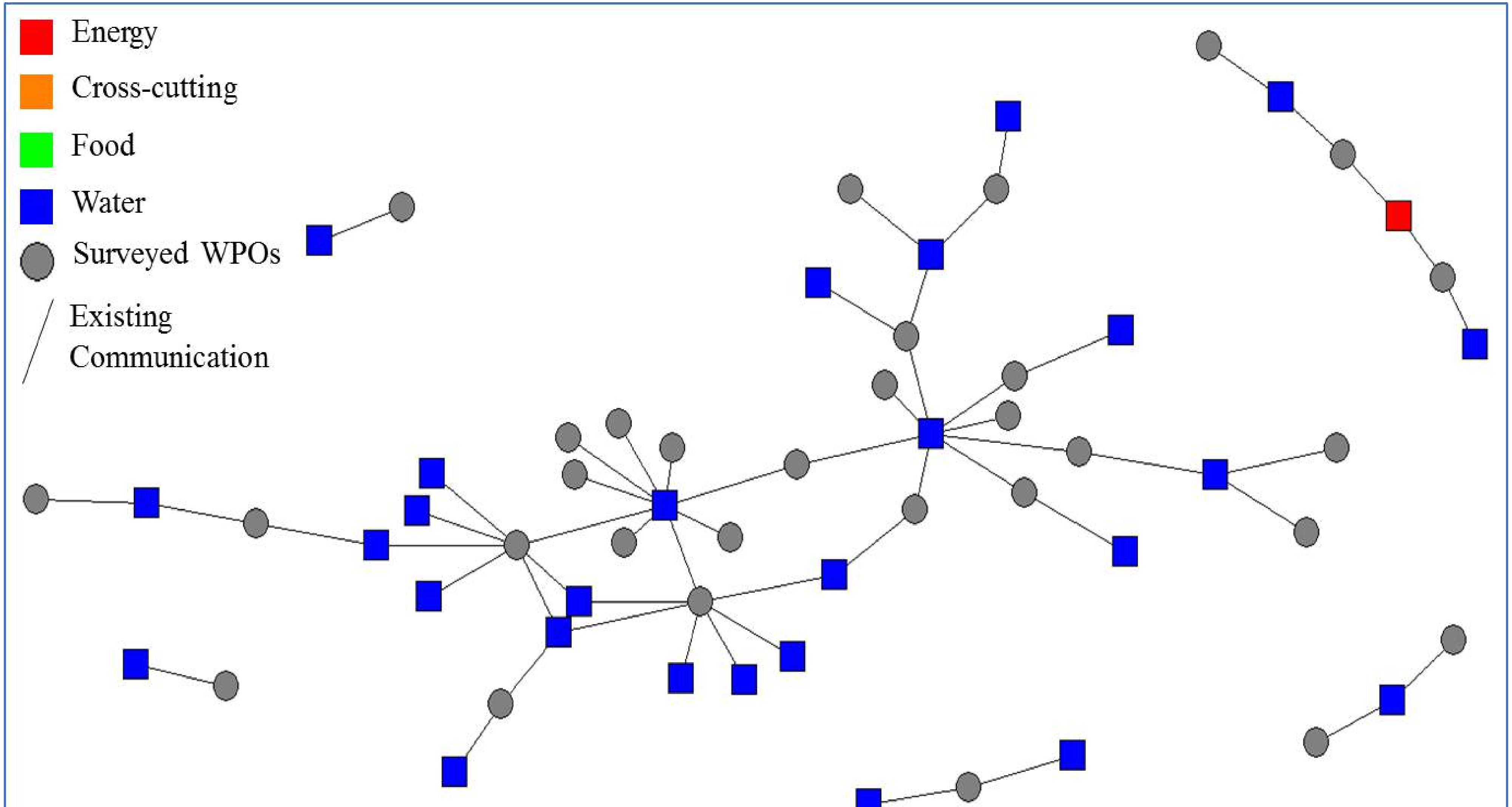


Network Map: **any level** of communication



(Daher et al., 2019)

Network map: **weekly** communication



(Daher et al., 2019)

Stakeholder Engagement Workshop

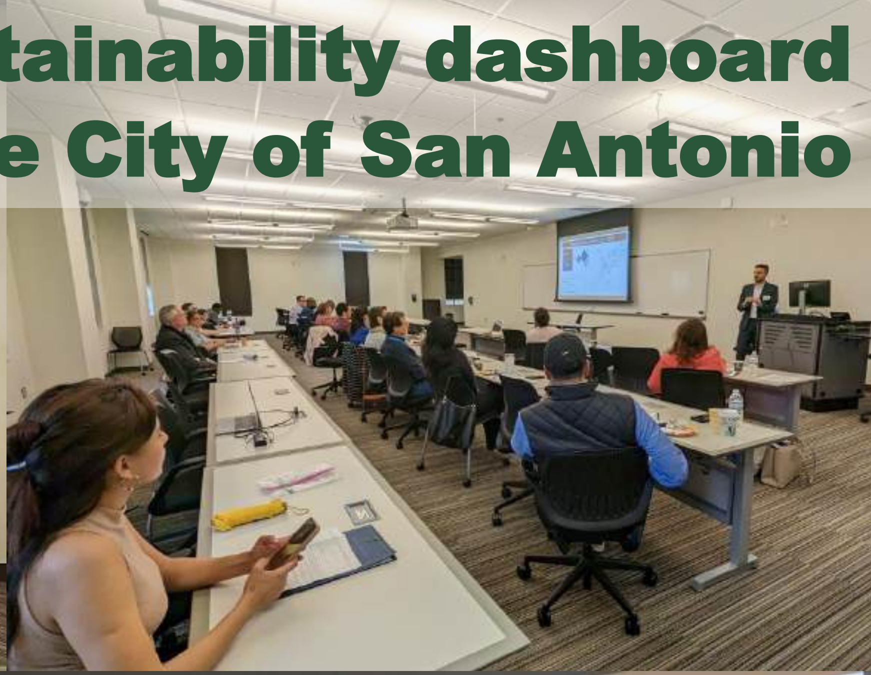
Barriers to Communication

Stakeholder Engagement Meeting in San Antonio, TX

1. **Legal and procedural barriers**: Institutional mandates and lack of coordination mechanisms.
2. **Financial:** who will pay for the time and effort involved in pursuing increased communication?
3. **Uniformity of Language** (units, abbreviations, syntax and context of problems and solutions).
4. **Planning Horizons** differ for water, energy, and food (10 to 50 years) causing ideological differences and creating barriers.
5. **Different values systems** differ across sectors and organizations.
6. **Competition** between local, regional, global organizations and across industries leads to issues of confidentiality, restricted data.
7. **Self-interest versus collective goals** - Silo mentality
8. **Lack of common goals** and collaborative projects

Localized sustainability dashboard for the City of San Antonio

March 2023



October 2023

PROJECT TIMELINE

SEP 2022
Project initiation

MAR 2023
First multi-stakeholder workshop

1 NO POVERTY
2 ZERO HUNGER
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
11 SUSTAINABLE CITIES AND COMMUNITIES

OCT 2023
Second multi-stakeholder workshop

3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
8 DECENT WORK AND ECONOMIC GROWTH
10 REDUCED INEQUALITIES
13 CLIMATE ACTION

JAN 2024
First Sustainability Symposium

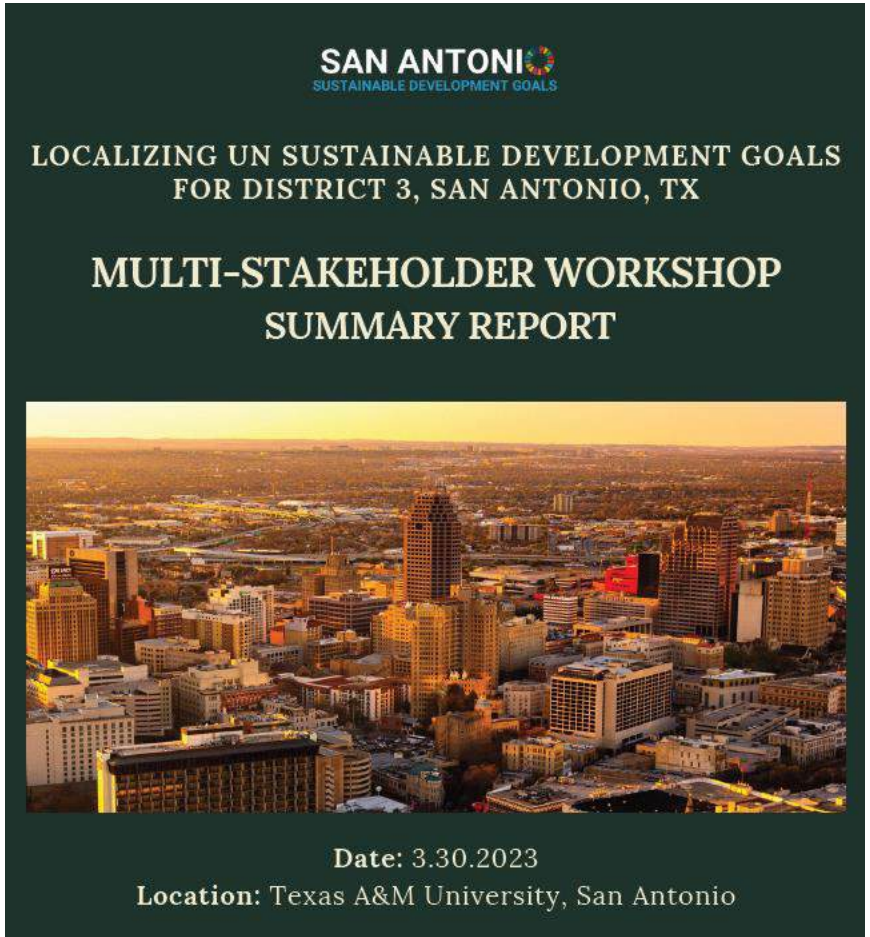
OCT 2024
Share sustainability Dashboard – Feedback

SAN ANTONIO
DEEP IN THE HEART.

PROJECT – OUR WORK SO FAR

10 out of 17 priority goals identified

2 multi-stakeholder workshops



SAN ANTONIO
SUSTAINABLE DEVELOPMENT GOALS

LOCALIZING UN SUSTAINABLE DEVELOPMENT GOALS FOR DISTRICT 3, SAN ANTONIO, TX

MULTI-STAKEHOLDER WORKSHOP
SUMMARY REPORT

Date: 3.30.2023
Location: Texas A&M University, San Antonio

SAN ANTONIO
SUSTAINABLE DEVELOPMENT GOALS

LOCALIZING SUSTAINABLE DEVELOPMENT GOALS FOR DISTRICT 3 AND SAN ANTONIO, TX

MULTI-STAKEHOLDER WORKSHOP
SUMMARY REPORT

Date: 10.20.2023
Location: Texas A&M University, San Antonio

PROJECT – OUR WORK SO FAR

10 out of 17 priority goals identified

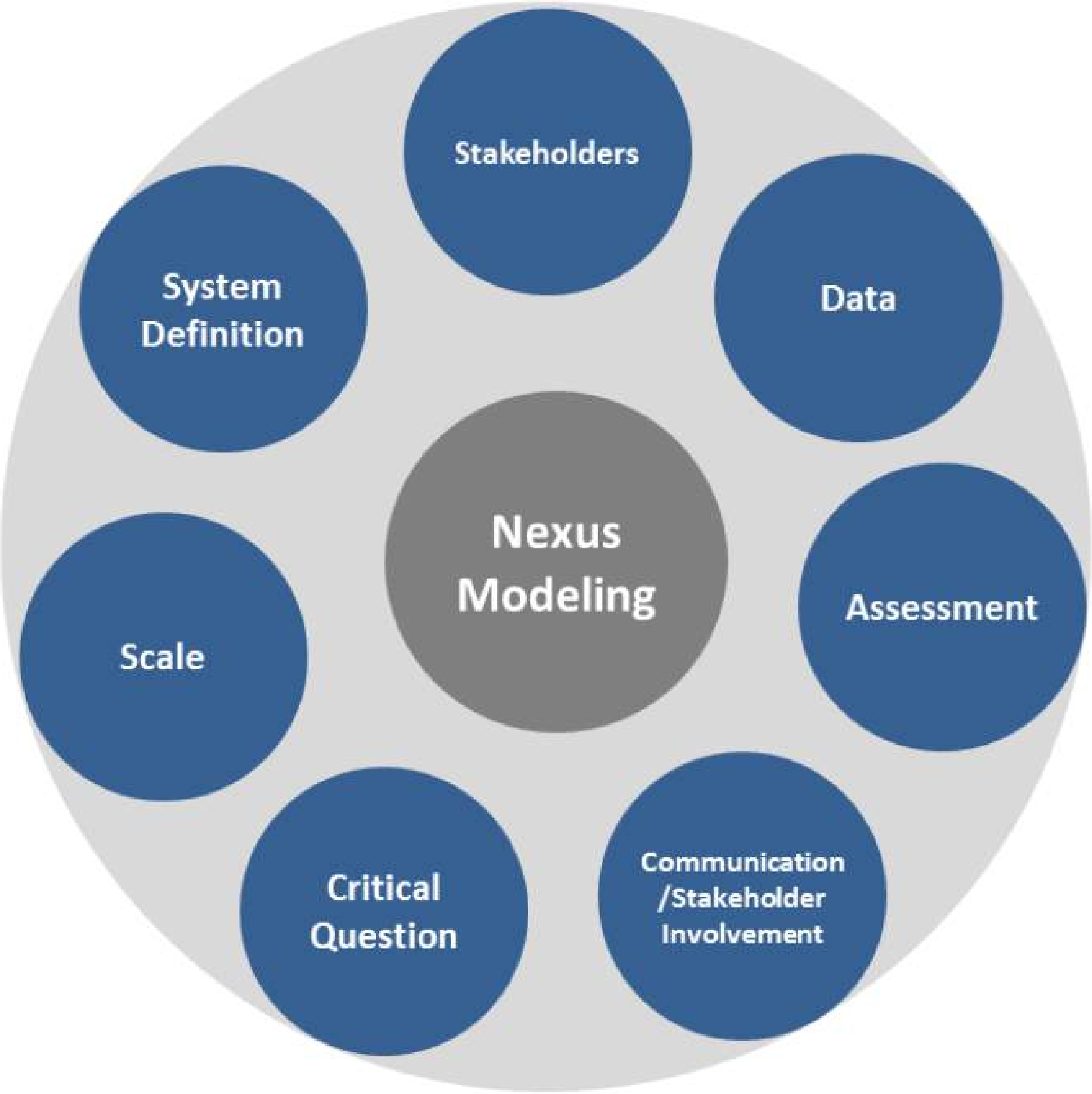
2 multi-stakeholder workshops

	MARCH 30, 2023	OCTOBER 20, 2023	TOTAL
Number of participants	23	15	38
Number of participating organizations	14	10	24
Sustainability tracking indicators identified by researchers	57	63	120
Sustainability tracking indicators identified by stakeholders	33	22	55
Sustainability solutions identified by researchers	29	24	53

SUSTAINABILITY DASHBOARD

How do we “model a nexus hotspot”?

- No cookbook method
- A 7-Q guideline



SCENARIO PLANNING CASE STUDY TEMPLATE

Case Study Title: ....

Briefly answer the following questions. An explanation for each of the questions is provided on page 2.

1- ***What is the critical question?***

2- ***Who are the players/stakeholders?***

3- ***At what scale?***

4- ***How is the system of systems defined? (complementary figure recommended)***

5- ***What do we want to assess?***

6- ***What data is needed?***

7- ***How do we communicate it? Where do we involve the decision-maker in the process?***

For more details on the 7-Q guideline:

- Daher, B., Mohtar R.H, Lee, S.H., Assi, A. 2017. **Modeling the Water-Energy-Food Nexus: A 7-Question Guideline**. Water-Energy-Food Nexus: Principles and Practices 229, 57. download

For detailed example:

- Daher, B., and Mohtar, R.H (2015). **Water-energy-food (WEF) Nexus Tool 2.0: guiding integrative resource planning and decision-making**, Water International, DOI:/02508060.2015.1074148. download

SCENARIO PLANNING CASE STUDY TEMPLATE

The 7-Question Framework

- ***What is the critical question?*** It is important to identify what is driving the study; whether it is water scarcity, food insecurity, economic development or other. The central question, around which the interconnections and system of systems will be framed, is a starting point and a building block.
- ***Who are the players/stakeholders?*** Defining the critical question comes hand in hand with identifying the stakeholders, the beneficiaries of addressing those questions as well as other players connected to the systems being considered. Stakeholders need to be involved and accounted for in the process and be part of any prescribed solution. It is important that we understand the role of policy, private sector, public sector, as well as the role of civil society. These players do interact, and understanding that interaction is critical in evaluating the feasibility and effectiveness of any proposed solutions.
- ***At what scale?*** Is the critical question to be addressed at farm, city, state, national, regional, global or some other level? Identifying the scale has a major impact on how the model is created; who are the stakeholders; and what data is needed. The question also helps identify how scenarios might be assessed.
- ***How is the system of systems defined?*** It is important to define the systems based on the critical question/s identified. The more components the model includes, the more complex it will be to create and manage. Simplify the system as much as possible, without losing the key interactions of interest. Our understanding of how resource systems are interconnected may be the result of a specific methodology or approach that helps capture our understanding of more generic processes and interactions. Having said that, the level of urgency to looking at these interlinkages may vary from one country to another depending on local characteristics.
- ***What do we want to assess?*** How a scenario is assessed is an important step that allows the modeler to identify outputs that need to be quantified; and this is highly dependent on the stakeholders and the availability of data.
- ***What data is needed?*** Depending on the end use of the analysis, data resolution and complexity can be determined. If we are looking at quick assessment to better understand certain trends, a coarser level of data may be sufficient. This is particularly useful in the absence of capacity, resources, and time. If more specific interlinkages are of particular importance, more granular data may be needed.
- ***How do we communicate it? Where do we involve the decision-maker in the process?*** The point at which a decision-maker becomes involved is critical. The model should be presented so that unnecessary complexities are eliminated: such complexities should be addressed within the model, but appear 'transparent' to the stakeholder. The model should not take over the decision-maker's authority or make decisions on their behalf, rather, it should be able to assess possible scenarios and highlight the trade-offs associated with each. These trade-offs would then be presented to the decision-maker who would prioritize them and make choices based on simplified results.

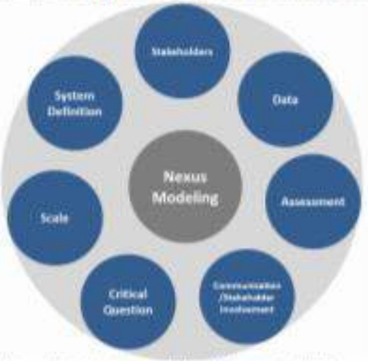
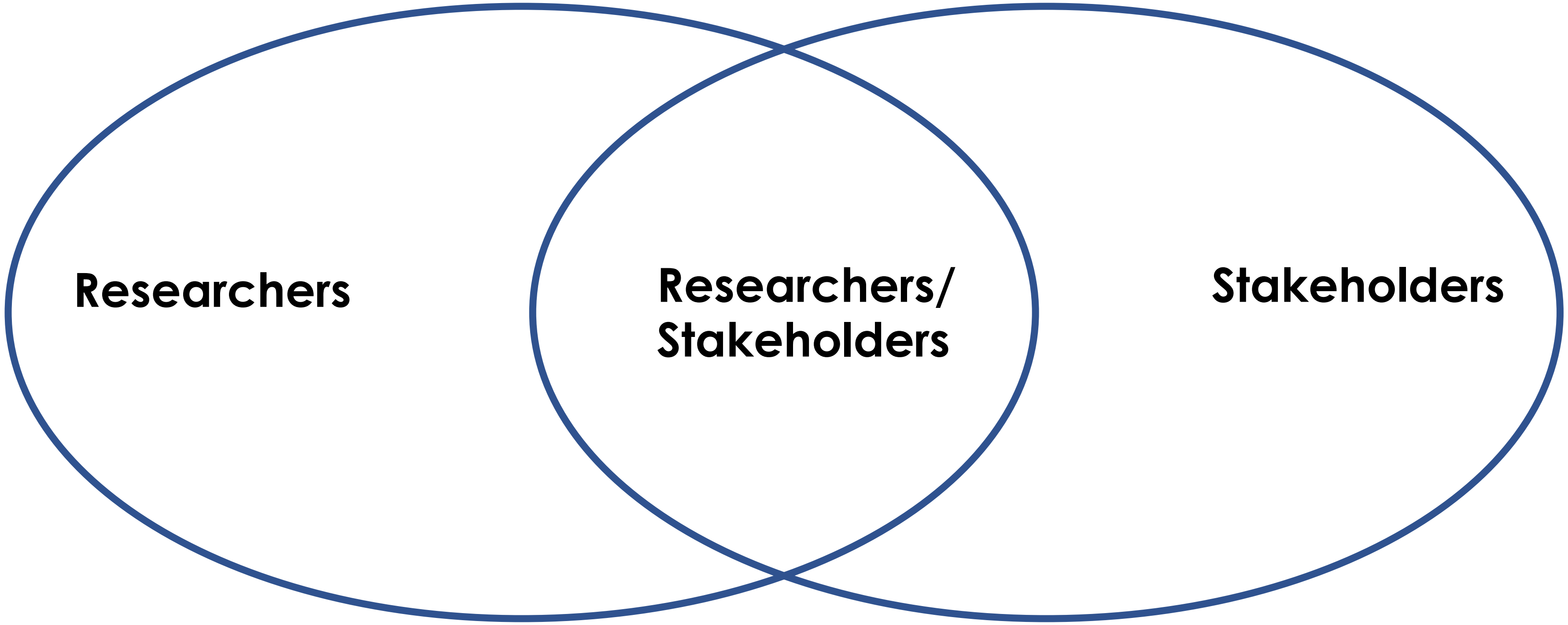


Figure 1: 7-Question guideline (Daher et al., 2017)

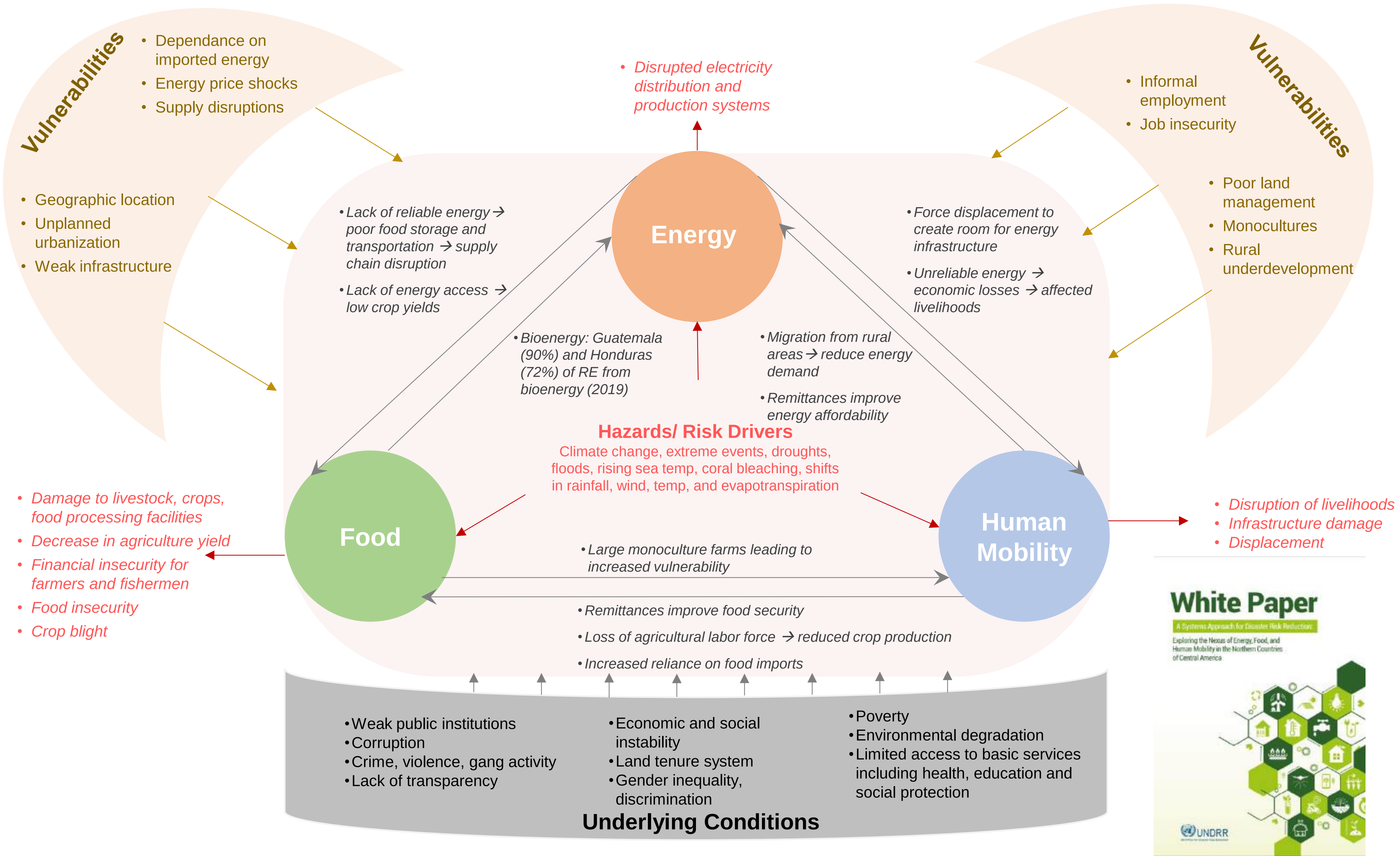
Overall concluding reflections

- Need for systems thinking to address WEF nexus challenges
- Need for developing and improving **assessment tools for trade-offs analysis** in support of stakeholder dialogue
- **There is NO** ‘one-size-fits-all’ tool: different tools
    - ➢answer **different questions** at **different scales**,
    - ➢require **different data resolution**
    - ➢involve **different stakeholders**
- **Holistic** yet **localized** assessments and solutions are necessary
- Critical to co-create tools with stakeholders and engage throughout projects

Three enabling environments



- Daher, B., Hannibal, B., Mohtar, R. H., & Portney, K. (2020). ***Toward understanding the convergence of researcher and stakeholder perspectives related to water-energy-food (WEF) challenges: The case of San Antonio, Texas.*** *Environmental Science & Policy, 104, 20–35. doi: 10.1016/j.envsci.2019.10.020*
- Daher, B. (2019). ***Bridging Physical and Social Sciences to Unlock New Potential for Addressing Interconnected Resource Challenges***. *PhD Dissertation, Texas A&M University.*


Vulnerabilities
Dependance on imported energy
Energy price shocks
Supply disruptions
Geographic location
Unplanned urbanization
Weak infrastructure
Disrupted electricity distribution and production systems
Vulnerabilities
Informal employment
Job insecurity
Poor land management
Monocultures
Rural underdevelopment
Energy
Lack of reliable energy → poor food storage and transportation → supply chain disruption
Lack of energy access → low crop yields
Force displacement to create room for energy infrastructure
Unreliable energy → economic losses → affected livelihoods
Bioenergy: Guatemala (90%) and Honduras (72%) of RE from bioenergy (2019)
Migration from rural areas → reduce energy demand
Remittances improve energy affordability
Hazards/ Risk Drivers
Climate change, extreme events, droughts, floods, rising sea temp, coral bleaching, shifts in rainfall, wind, temp, and evapotranspiration
Food
Human Mobility
Damage to livestock, crops, food processing facilities
Decrease in agriculture yield
Financial insecurity for farmers and fishermen
Food insecurity
Crop blight
Disruption of livelihoods
Infrastructure damage
Displacement
Large monoculture farms leading to increased vulnerability
Remittances improve food security
Loss of agricultural labor force → reduced crop production
Increased reliance on food imports
Weak public institutions
Corruption
Crime, violence, gang activity
Lack of transparency
Economic and social instability
Land tenure system
Gender inequality, discrimination
Poverty
Environmental degradation
Limited access to basic services including health, education and social protection
Underlying Conditions
White Paper
A Systems Approach for Disaster Risk Reduction:
Exploring the Nexus of Energy, Food, and Human Mobility in the Northern Countries of Central America
UNDRR

WEBINAR SERIES

BUILDING NEXUS RESILIENCE

ADDRESSING MIGRATION AND CONFLICTS IN WATER ENERGY FOOD SYSTEMS

Webinar #1

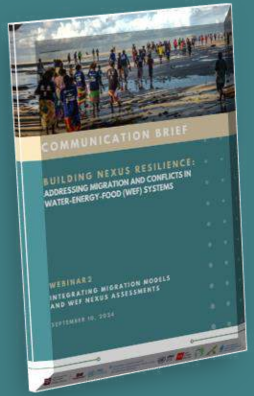
May 30, 2024

Introduction to Migration and Water-Energy-Food (WEF) System Interconnections

Webinar #2

September 10, 2024

Integrating Migration Models and WEF Assessments



Webinar #3

December 3, 2024

Governance Considerations and Evidence-based Policy Making

Texas A&M University Texas A&M Energy Institute | TEES Texas A&M Engineering Experiment Station | UNU FLORES | Columbia Climate School Center for International Earth Science Information Network | UNU EHS | ULB École de Santé Publique | NexusNet | IWRA International Water Resources Association

Thank You

Bassel Daher, PhD

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Bassel Daher

BasselDaher.com

Collaborative student assignments: Urban planning and ecology in Nexus-aware public spaces

Mirela Sertić Perić[1], Tamara Zaninović[2], Ana Sopina[2]

[1] University of Zagreb, Faculty of Science, Department of Biology
[2] University of Zagreb, Faculty of Architecture, Department of Urban Planning, Spatial Planning and Landscape Architecture

Our goal…

…showcase the results of student projects from **two university courses (*Urban Ecology* & *DESIGN STUDIO III - Landscape Architecture*)** developed through a collaborative effort between the Faculty of Science, Department of Biology, and the Faculty of Architecture, Department of Urban Planning, Spatial Planning, and Landscape Architecture at the University of Zagreb, Croatia;

…over three years (**2021-2024**), students engaged in lectures, workshops, and seminars that emphasized the **importance of interdisciplinary synergies** in urban ecology and urban planning;

…these projects highlight **strategies to enhance the quality of life and promote sustainable development** in urban public spaces;

…present a case study demonstrating how to **integrate the Nexus concept into higher education**, fostering students' appreciation for interdisciplinarity and collaborative work while developing sustainable, Nexus-connected solutions.

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Multidisciplinary, interdisciplinary, transdisciplinary

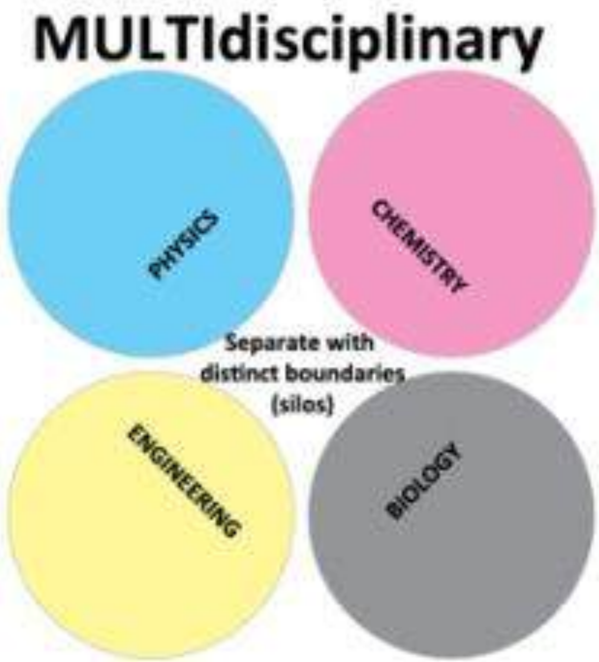
➢ terms used to denote efforts that involve several disciplines*

However, do we all know what these terms mean exactly?

➢ Do these terms mean the same or different things?

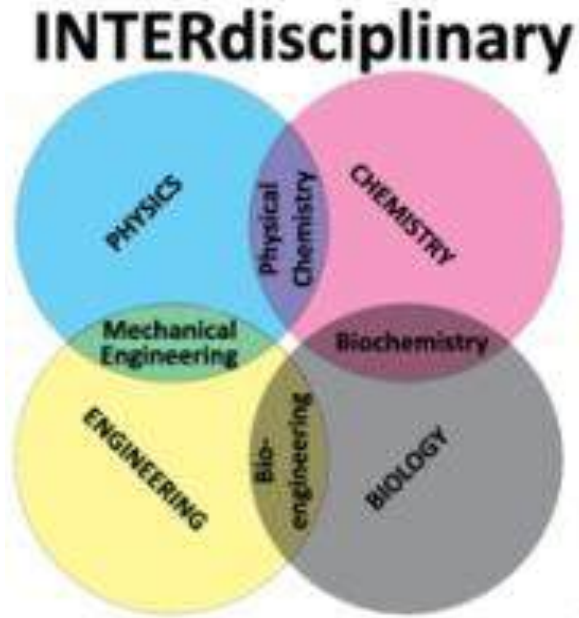
*disciplines → the result of artificial fragmentation of overall knowledge

Figure source: https://bit.ly/4eG8vtX



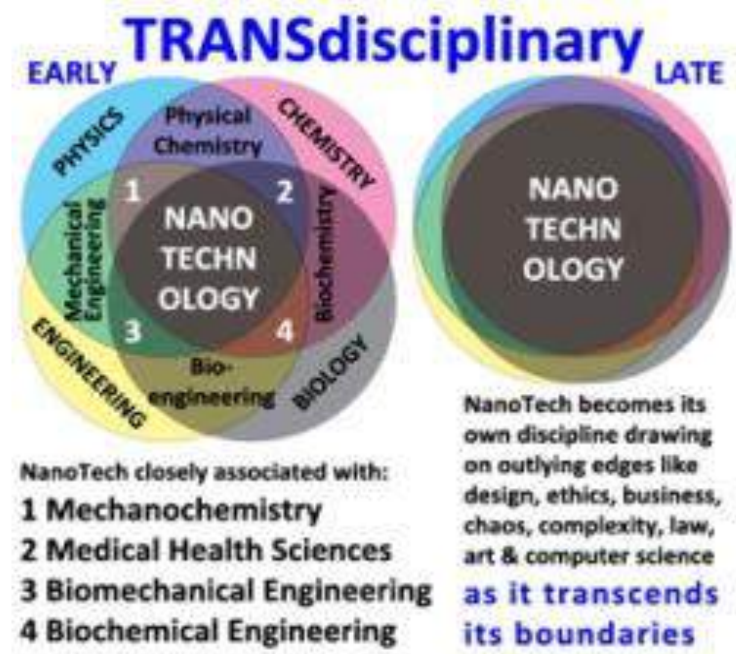
Multidisciplinarity draws on knowledge from different disciplines but stays within the boundaries of those fields (NSERC, 2004).

Natural Sciences and Engineering Research Council of Canada (NSERC). Guidelines for the Preparation and Review of Applications in Interdisciplinary Research. Ottawa: NSERC, 2004.



Interdisciplinarity analyzes, synthesizes and harmonizes links between disciplines into a coordinated and coherent whole (CIHR, 2005).

Canadian Institutes of Health Research (CIHR). Training Program Grant Guide: Strategic Training Initiative in Health Research. Ottawa: CIHR, 2005.



Transdisciplinarity integrates individual disciplines/different stakeholders in a humanities context, and in doing so transcends each of their traditional boundaries (Soskolne, 2000).

Soskolne C. Transdisciplinary approaches for public health. Epidemiology 2000; 11: S122.

Source: https://kinamu.wordpress.com/2016/01/24/interdisciplinary-curriculum/

The educational landscape is **evolving from (multi)disciplinary approaches**, where disciplines coexist side by side, to increasingly integrated **transdisciplinary learning** environments that actively synthesize knowledge and methods from various fields to address complex real-world challenges collaboratively.

While the trend towards transdisciplinary learning is growing, **fully integrated approaches remain rare** in today's educational environment, often due to institutional silos and traditional curriculum structures.

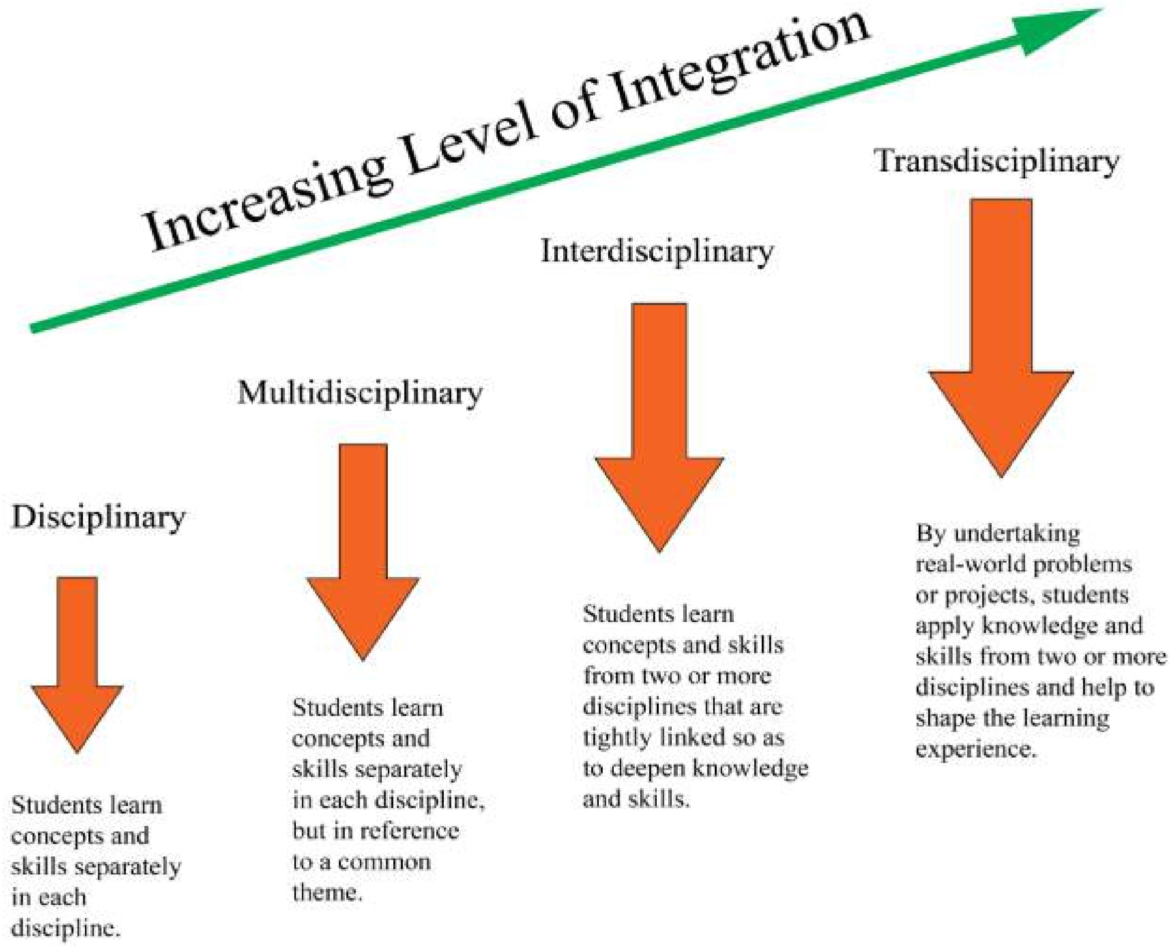


Figure source: https://bit.ly/3MXn6FB

Collaborative student assignments: Urban planning and ecology in Nexus-aware public spaces

Our presentation highlights our progress in...

...integrating teaching across our faculties (from multidisciplinarity to interdisciplinarity)

...embracing Nexus approaches that emphasize the significance of interdisciplinary synergies in urban ecology and urban planning

...promoting the sustainable development of urban public spaces

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START → academic year 2020/21

	Urban Ecology - **an elective for graduate students of Environmental Sciences (University of Zagreb, Faculty of Science, Department of Biology)**
Expected learning outcomes at the level of the course	1) Assess the impact of urbanization on urban ecosystems using appropriate **ecological, urban, landscape and social methods** including analysis and evaluation of spaces and habitats in urban areas. 2) Propose strategies to mitigate the negative effects of urbanization on natural habitats and urban landscape, which are based on basic **ecological** concepts and theories, principles and strategies of **sustainable development** and **biodiversity** protection in interaction with **urban** and **landscape planning** and **design**. 3) Assess the effects of global **environmental** and **social changes** on the dynamics and sustainability of urban ecosystems and the quality of life of the urban population.

Urban Ecology (FoS)

1st year - 2020/21 - multidisciplinary approach: lectures + student seminars

Topic	Lecturer	Institution
Biology, ecology	Dr. Mirela Sertić Perić*, Assoc. Prof. Dr. Vesna Gulin Beljak	University of Zagreb, Faculty of Science (FoS), Department of Biology
Geophysics	Dr. Ivana Herceg Bulić, Assoc. Prof.	University of Zagreb, Faculty of Science, Department of Geophysics
Landcape architecture	Dr. Bojana Bojanić Obad Šćitaroci*, Prof. Dr. Ana Sopina	University of Zagreb, Faculty of Architecture (FoA), Department of Urban Planning, Spatial Planning and Landscape Architecture
Environmental social sciences (Environmental Economics)	Dr. Ivana Logar	Guest lecturer, EAWAG, CH
Energy efficiency	Dr. Tea Žakula, Assoc. Prof. Borut Omerzo, mag. ing. mech. Nikola Bađun, mag. ing. mech.	Guest lecturers, The Faculty of Mechanical Engineering and Naval Architecture (FAMENA), Department of Thermodynamics and Thermal and Process Engineering, Laboratory for Energy Efficiency

*Course leaders

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2nd year onwards - since 2021/22 - shift towards interdisciplinarity: lectures, common assignments locations for student projects, guided field tour, peer presentations of student project proposals, student seminar, participation on student forums and exhibitions

Topic	Lecturer	Institution
Biology, ecology	Dr. Mirela Sertić Perić*, Assoc. Prof. Dr. Vesna Gulin Beljak	University of Zagreb, Faculty of Science (FoS), Department of Biology
Geophysics	Dr. Ivana Herceg Bulić, Assoc. Prof.	University of Zagreb, Faculty of Science, Department of Geophysics
Landcape architecture	Dr. Bojana Bojanić Obad Šćitaroci*, Prof. Dr. Tamara Zaninović, Assist. Prof. Dr. Ana Sopina	University of Zagreb, Faculty of Architecture (FoA), Department of Urban Planning, Spatial Planning and Landscape Architecture
Environmental social sciences (Environmental Economics)	Dr. Ivana Logar	Guest lecturer, EAWAG, CH
Energy efficiency	Dr. Tea Žakula, Assoc. Prof. Borut Omerzo, mag. ing. mech. Nikola Bađun, mag. ing. mech.	Guest lecturers, The Faculty of Mechanical Engineering and Naval Architecture (FAMENA), Department of Thermodynamics and Thermal and Process Engineering, Laboratory for Energy Efficiency

*Course leaders

TASKS CYCLE 2021–2024

STUDENT PROJECTS:
PROPOSALS FOR PUBLIC SPACE DESIGN IN *NEW ZAGREB*

Urban Ecology course (FoS)
Design Studio III – Landscape Architecture course (FoA)

The student projects showcase a wide range of innovative approaches to integrating **urban design principles** with **biodiversity conservation** in public spaces of the *New Zagreb*. These proposals are the outcome of the **three-year cycle of practical exercises and seminars (2021–2024)**, highlighting the importance of interdisciplinary collaboration in urban planning to **enhance residents' quality of life and promote sustainable development**. The partnership between the Faculty of Science (FoS) and the Faculty of Architecture (FoA) exemplifies an innovative, **multidisciplinary approach** to **reflecting on, researching, designing, and educating** about **sustainable urban public spaces**.

TASKS CYCLE 2021–2024

STUDENT PROJECTS:
PROPOSALS FOR PUBLIC SPACE DESIGN IN *NEW ZAGREB*

Urban Ecology course (FoS)
Design Studio III – Landscape Architecture course (FoA)

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2021/2022

TASK: *NEW ZAGREB* EAST / HERITAGE REVITALIZATION

Leaders and collaborators / Multidisciplinary teaching

FoS:
Dr. **Mirela Sertić Perić**, Assist. Prof.

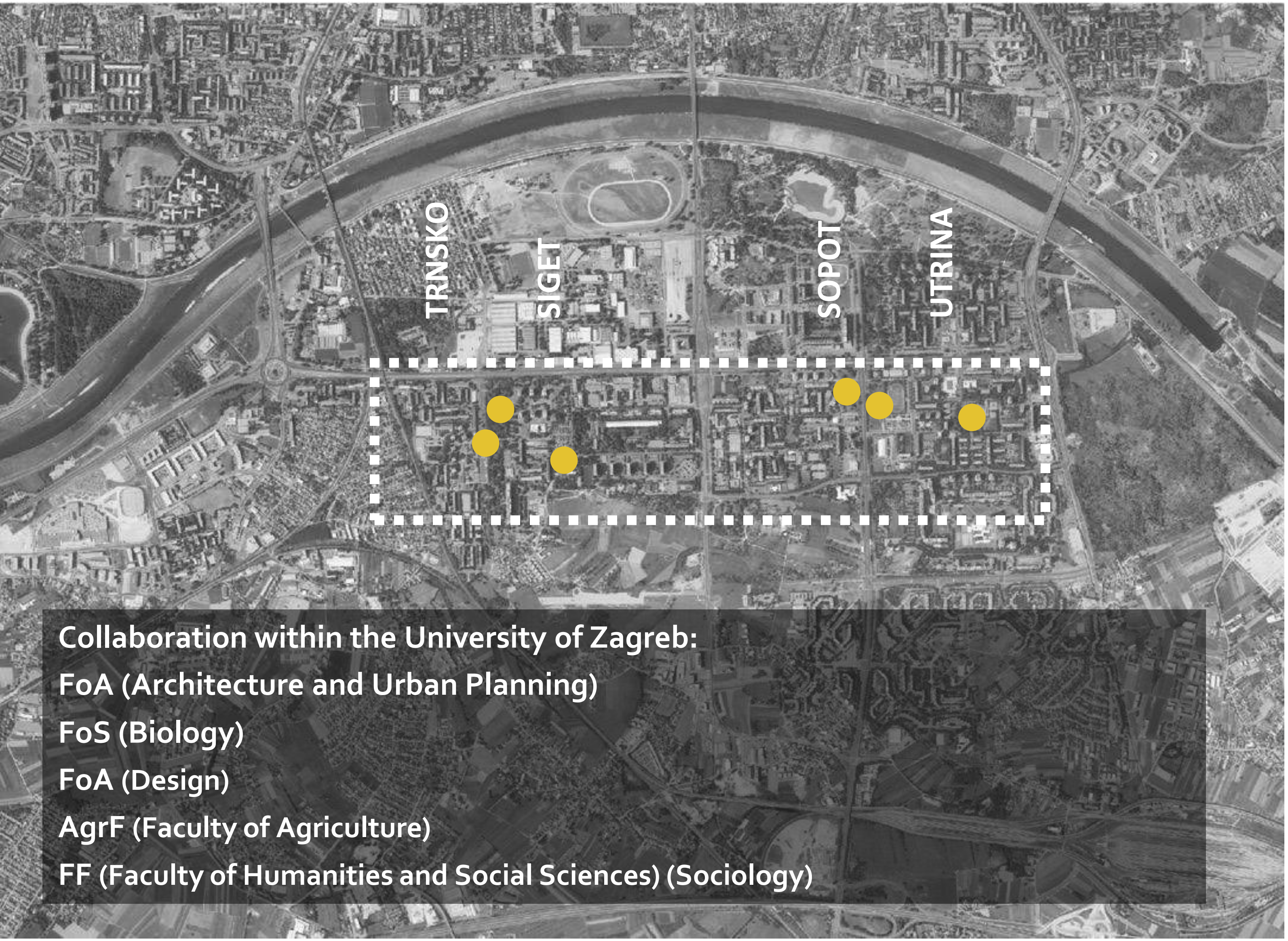
FoA – Architecture and Urban Planning:
Dr. **Bojana Bojanić Obad Šćitaroci**, Prof.
Dr. **Zlatko Karač**, Prof.
Dr. **Tihomir Jukić**, Prof.
Dr. **Ivan Mlinar**, Prof.
Dr. **Sanja Gašparović**, Assoc. Prof.
Dr. **Marko Rukavina**, Assist. Prof.
Dr. **Alen Žunić**, Assist. Prof.
Dr. **Tamara Zaninović**
asist. **Marin Duić**
asist. **Kristina Perkov**
asist. **Ana Sopina**

FoA – Design:
mr. sc. **Sanja Bencetić**, Assoc. Prof.
mr. sc. **Ivana Fabrio**, Assoc. Prof.

FF:
Dr. **Jana Vukić**, Assoc. Prof.

2022/2023

TASK: *NEW ZAGREB* SOUTH / COMMUNITY SPACES



Collaboration within the University of Zagreb:
FoA (Architecture and Urban Planning)
FoS (Biology)
FoA (Design)
AgrF (Faculty of Agriculture)
FF (Faculty of Humanities and Social Sciences) (Sociology)

Leaders and collaborators / Multidisciplinary teaching

FoS:
Dr. **Mirela Sertić Perić**, Assoc. Prof.
asist. **Vesna Gulin Beljak**

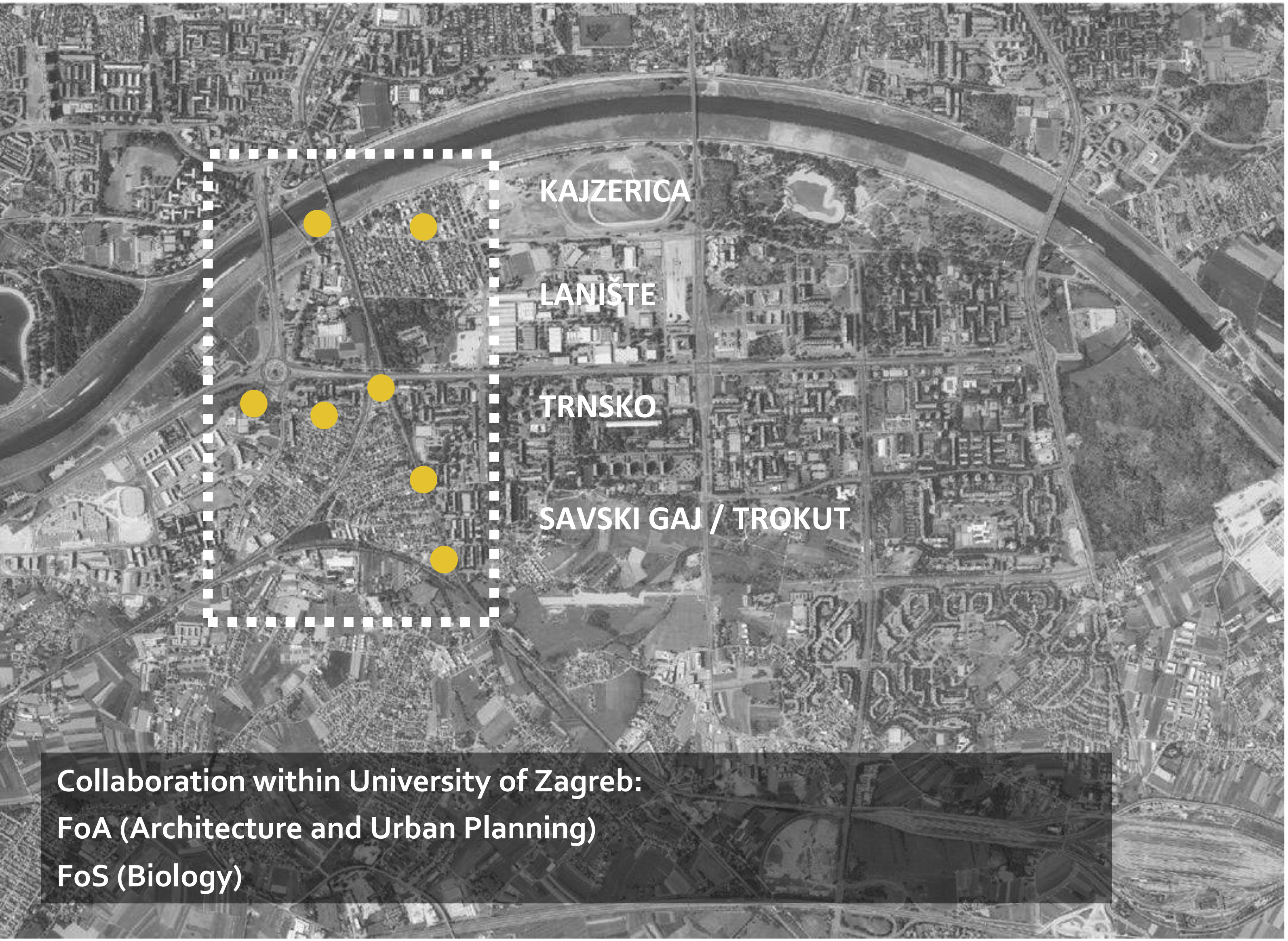
FoA – Architecture and Urban Planning:
Dr. **Bojana Bojanić Obad Šćitaroci**, Prof.
Dr. **Tihomir Jukić**, Prof.
Dr. **Ivan Mlinar**, Prof.
Dr. **Alan Kostrenčić**, Prof.
Dr. **Sanja Gašparović**, Prof.
Dr. **Vedran Ivanković**, Assoc. Prof.
Dr. **Ana Mrđa**, Assoc. Prof.
Dr. **Marko Rukavina**, Assist. Prof.
Dr. **Tamara Zaninović**
asist. **Marin Duić**
asist. **Kristina Perkov**
asist. **Ana Sopina**

AgrF:
Dr. **Ines Hrdalo**, Assoc. Prof.

FoA – Design:
mr. sc. **Sanja Bencetić**, Assoc. Prof.

FF:
Dr. **Jana Vukić**, Assoc. Prof.

2023/2024 **TASK: *NEW ZAGREB* WEST / SLASH CITY**



Collaboration within University of Zagreb:
FoA (Architecture and Urban Planning)
FoS (Biology)

Leaders and collaborators / Multidisciplinary teaching

FoS:
Dr. **Mirela Sertić Perić**, Assoc. Prof.
Dr. **Vesna Gulin Beljak**

FoA:
Dr. **Bojana Bojanić Obad Šćitaroci**, Prof.
Dr. **Tihomir Jukić**, Prof.
Dr. **Ivan Mlinar**, Prof.
Dr. **Alan Kostrenčić**, Prof.
Dr. **Damir Krajnik**, Prof.
Dr. **Vedran Ivanković**, Assoc. Prof.
Dr. **Marko Rukavina**, Assist. Prof.
Dr. **Tamara Zaninović**, Assist. Prof.
Dr. **Marija Premužić Ančić**
Dr. **Ana Sopina**
asist. **Marin Duić**
asist. **Kristina Perkov**

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Biološki odsjek

Synergy of Biology and Urbanism in Teaching

Course structure / content: *Urban Ecology* and *Design Studio 3 - Landscape Architecture*

- **Lectures: multidisciplinary approach delivered by core teachers and guest lecturers**
- **Guided field tours with local communities and experts**
- **Practical exercises: students engage in dynamic discussions with experts and guest critics**
  - Active participation encourages students to apply theoretical knowledge to real-world scenarios, fostering the development of individual or group projects. By integrating insights from various disciplines, students generate transformative proposals for urban spaces;
  - Interactions with experts and guest critics promote interdisciplinary problem-solving. Students develop critical thinking skills by analysing urban and ecological challenges from multiple perspectives, enhancing their project proposals through the exchange of diverse ideas.
- **Seminar and research papers**
  - Students present their work through seminar papers, research projects, and poster/oral presentations. These are evaluated based on clear criteria and followed by joint reviews from peers and teachers, promoting learning through constructive feedback and collaboration.
- **Joint exhibitions of student projects**

Synergy of Biology and Urbanism in Teaching

EXPERT LECTURES – 2023 Tekstilpromet
Multidisciplinary approach delivered by core teachers and guest lecturers

Dr. Ivan Mlinar, Prof.
Lecture: The New Zagreb of Većeslav Holjevac

Dr. Tihomir Jukić, Prof.
Lecture: New New Zagreb

Synergy of Biology and Urbanism in Teaching

GUIDED FIELD TOURS WITH LOCAL COMMUNITIES AND EXPERTS

***New Zagreb* East 2021**

Dr. Zlatko Karač, Prof.
Filed lectures on *New Zagreb* East, September 2021

Travno Neighbourhood
New Zagreb East, September 2021

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PRIRODOSLOVNO-MATEMATIČKI FAKULTET
Biološki odsjek

Synergy of Biology and Urbanism in Teaching

GUIDED FIELD TOURS WITH LOCAL COMMUNITIES AND EXPERTS

New Zagreb South 2022 / *New Zagreb* West 2023

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PRIRODOSLOVNO-MATEMATIČKI FAKULTET
Biološki odsjek

Synergy of Biology and Urbanism in Teaching

MULTIDISCIPLINARY LECTURES / SEMINARS

The comprehensive transfer of theoretical knowledge emphasizes the core principles of landscape architecture and urban ecology, helping students build a deep understanding of these essential concepts

Dr. Alan Kostrenčić, Asst. prof.
Lecture: Planning the public space

Dr. Mirela Sertić Perić, Assoc. prof.
Lecture: Introduction to Urban Ecology

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Biološki odsjek

Synergy of Biology and Urbanism in Teaching

EXHIBITION OF STUDENT PROJECTS FROM THE PREVIOUS YEAR

Digital pop-up exhibitions of student projects are organised at the beginning of each semester to present results from the previous academic year and objectives for the active assignment

Zagreb Architects Association (DAZ)
Exhibition *New Zagreb* East, November 2022

Synergy of Biology and Urbanism in Teaching

PRACTICAL EXERCISES / WORKSHOPS

Students engage in dynamic discussions with teachers, experts, guest critics, and within themselves to develop critical thinking skills by analysing urban and ecological challenges from multiple perspectives

Synergy of Biology and Urbanism in Teaching

PRACTICAL EXERCISES / WORKSHOPS - PRESENTATIONS AND EXHIBITIONS

Students present their work through seminar papers, research projects, poster, and oral presentations, within themselves and with guest critics from different fields of expertise

Faculty of Architecture, University of Zagreb (FoA)
Internal exhibition *New Zagreb* West, December 2023

Faculty of Architecture, University of Zagreb (FoA)
Internal exhibition *New Zagreb* South, January 2023

DEPARTMENT OF URBAN PLANNING, SPATIAL PLANNING AND LANDSCAPE ARCHITECTURE KUPPA

Af

SVEUČILIŠTE U ZAGREBU PRIRODOSLOVNO-MATEMATIČKI FAKULTET Biološki odsjek

Synergy of Biology and Urbanism in Teaching

PRACTICAL EXERCISES / WORKSHOPS – FINAL PRESENTATIONS AND DISCUSSIONS

Final presentations and discussions with guest critics promote learning through constructive feedback and collaboration

Zagreb Architects Association (DAZ)
New Zagreb West, January 2024

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Biološki odsjek

Synergy of Biology and Urbanism in Teaching

PUBLIC EXHIBITIONS

Public exhibitions showcase student projects, fostering engagement with the local community and providing an opportunity for students to present their ideas in a real-world context.

MSU Pop-Up Exhibition in public space – *New Zagreb* South, May 2023
Co-organized by the Faculty of Architecture and Local Committees of New Zagreb

Q'art in your quarter, July 2024
Local Committee of Trnsko

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Synergy of Biology and Urbanism in Teaching

Student projects posters and presentation
***New Zagreb* East-South-West**
Science Fair, April 2024

Co-organized Fair by the Universities of Split, Zagreb, Rijeka, Zadar, and Osijek, in collaboration with the Nikola Tesla Technical Museum and the British Council, under the high patronage of the Ministry of Science and Education.

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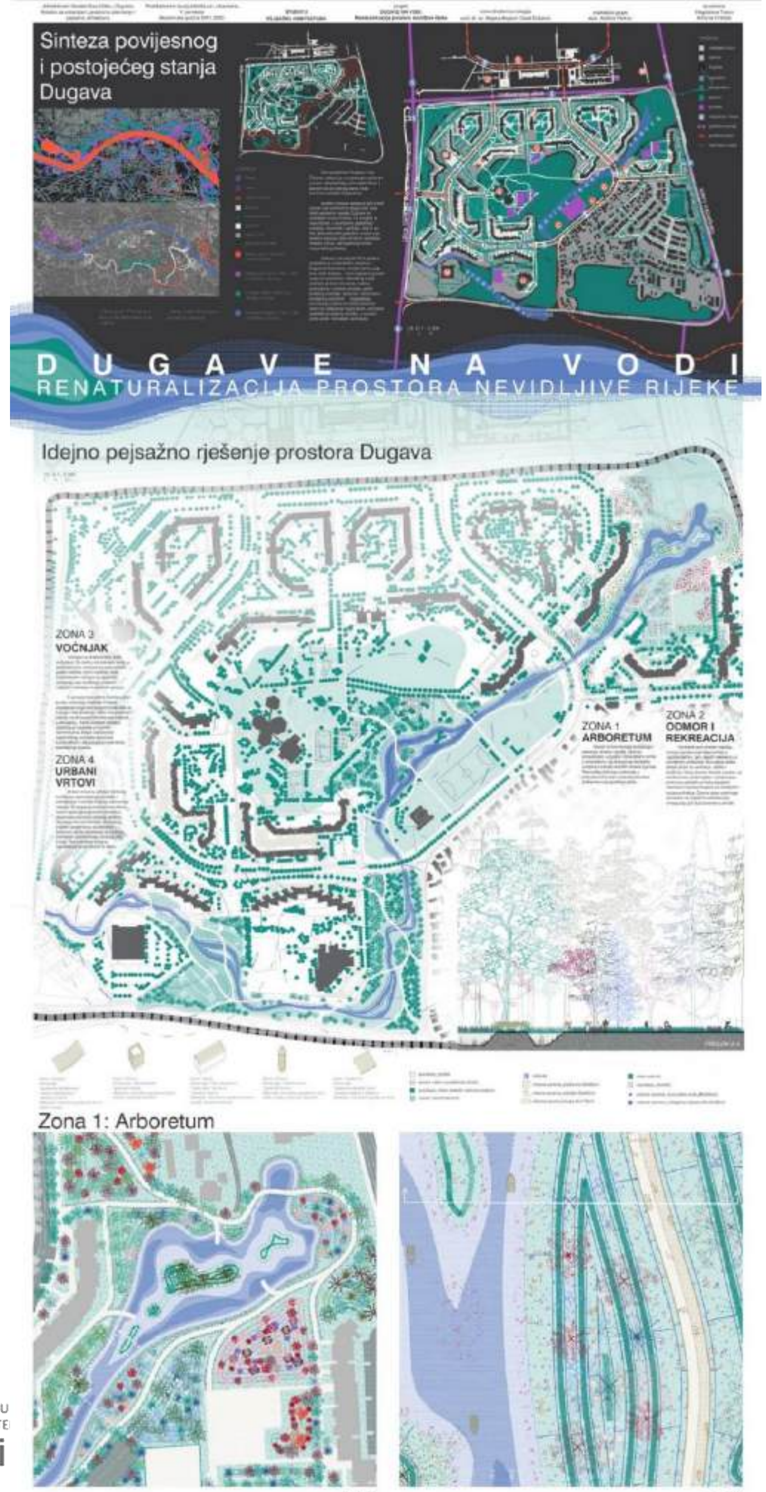
Resulting projects

NEW ZAGREB EAST
2021./2022. FoA

NEIGHBOURHOOD PARK
DUGAVE



(left) students: Magdalena Tusun, Antonia Vrdoljak; mentor: K. Perkov

(right) students: Ana Maria Kušić, Gabriela Lencur, mentor: dr. M. Rukavina

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SVEUČILIŠTE U ZAGREBU PRIRODOSLOVNO-MATE
Biološki

Resulting projects

Tin Lukačević	Social sustainability of Dugave
Ivan Beno	Flora
Nađa Miličić	Biodynamics
Filip Bužleta	S.O.S. Butterflies

NEW ZAGREB EAST 2021./2022. FoS

PROJECT: ECOPARK DUGAVE / Integral proposal presentation, 4 seminars

Students: Ivan Beno, Filip Bužleta, Tin Lukačević, Nađa Miličić

Mentors: dr. M. Sertić Perić et. al. (FoS + FoA)

Urban Ecology course, 2021. / 2022., master programme

Photo_Ana Sopina, 2021.

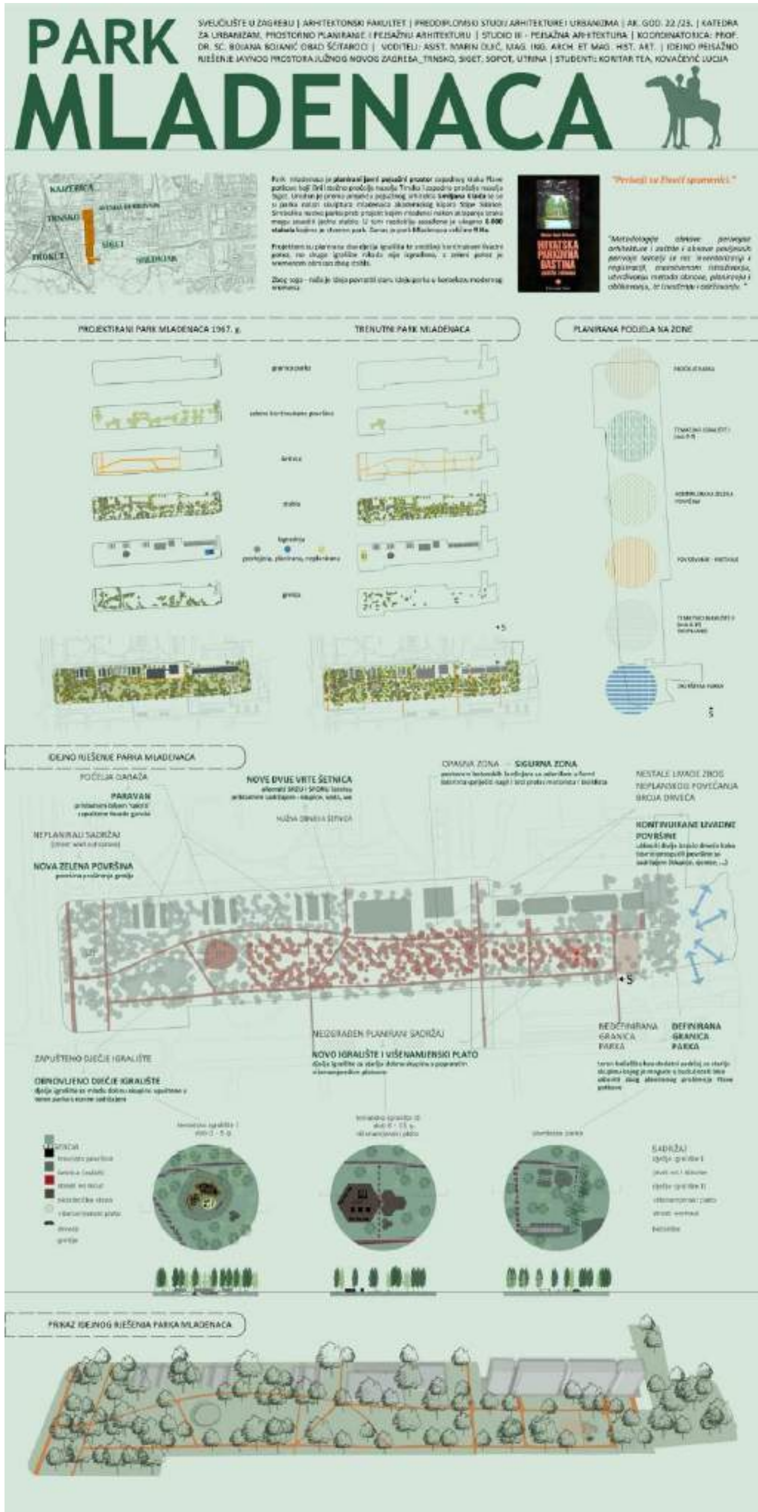
Resulting projects in comparison

NEW ZAGREB SOUTH
2022./2023.

PARK MLADENACA

FoS poster (left)
student: Marija Dadić
mentors: dr. M. Sertić Perić et. al.

FoA poster (right)
students: Tea Koritar, Lucija Kovačević
mentor: M. Duić



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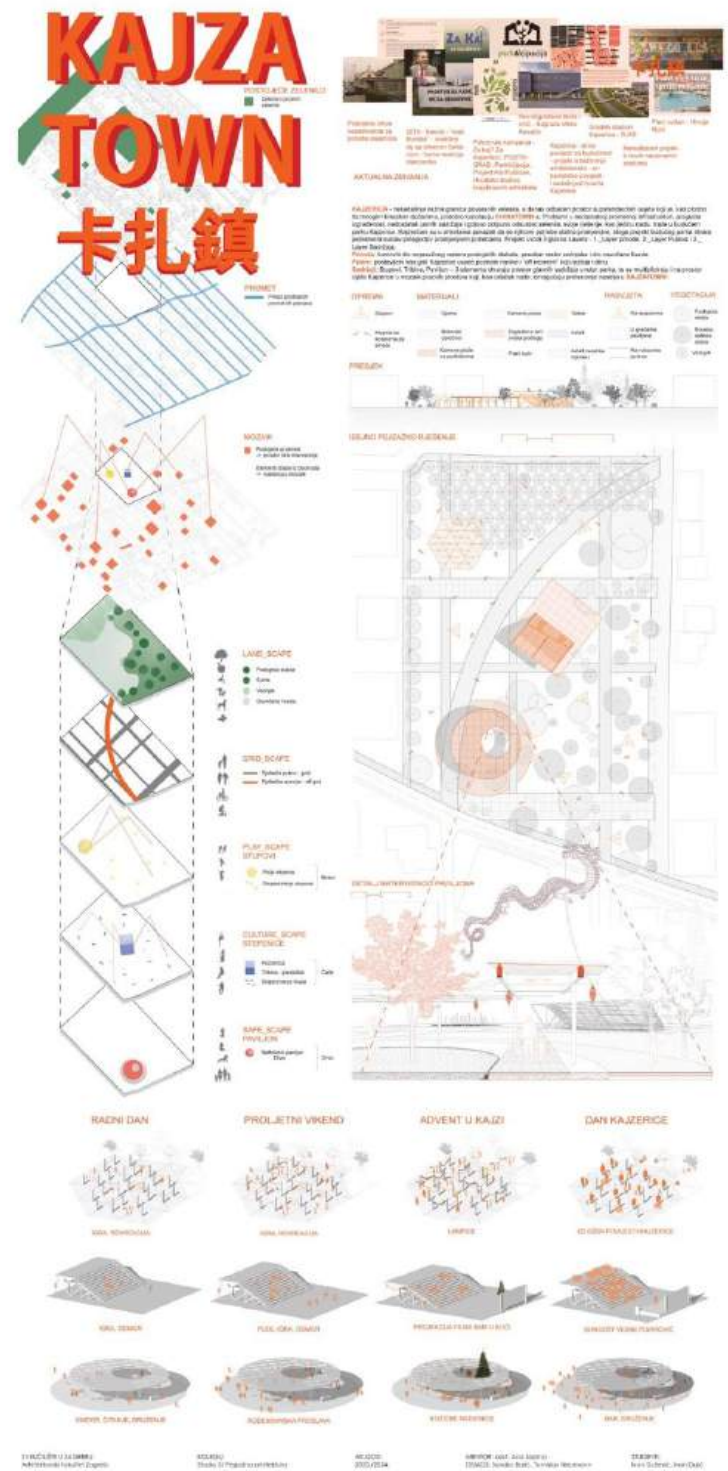
Resulting projects in comparison

NEW ZAGREB WEST
2023./2024.

COMMUNITY PARK KAJZERICA

FoS poster (left)
Students: Katja Bukvić, Ana Erić
mentors: dr. M. Sertić Perić et. al.

FoA poster (right)
Students: Ivan Dušević, Ivan Duić
mentor: dr. A. Sopina



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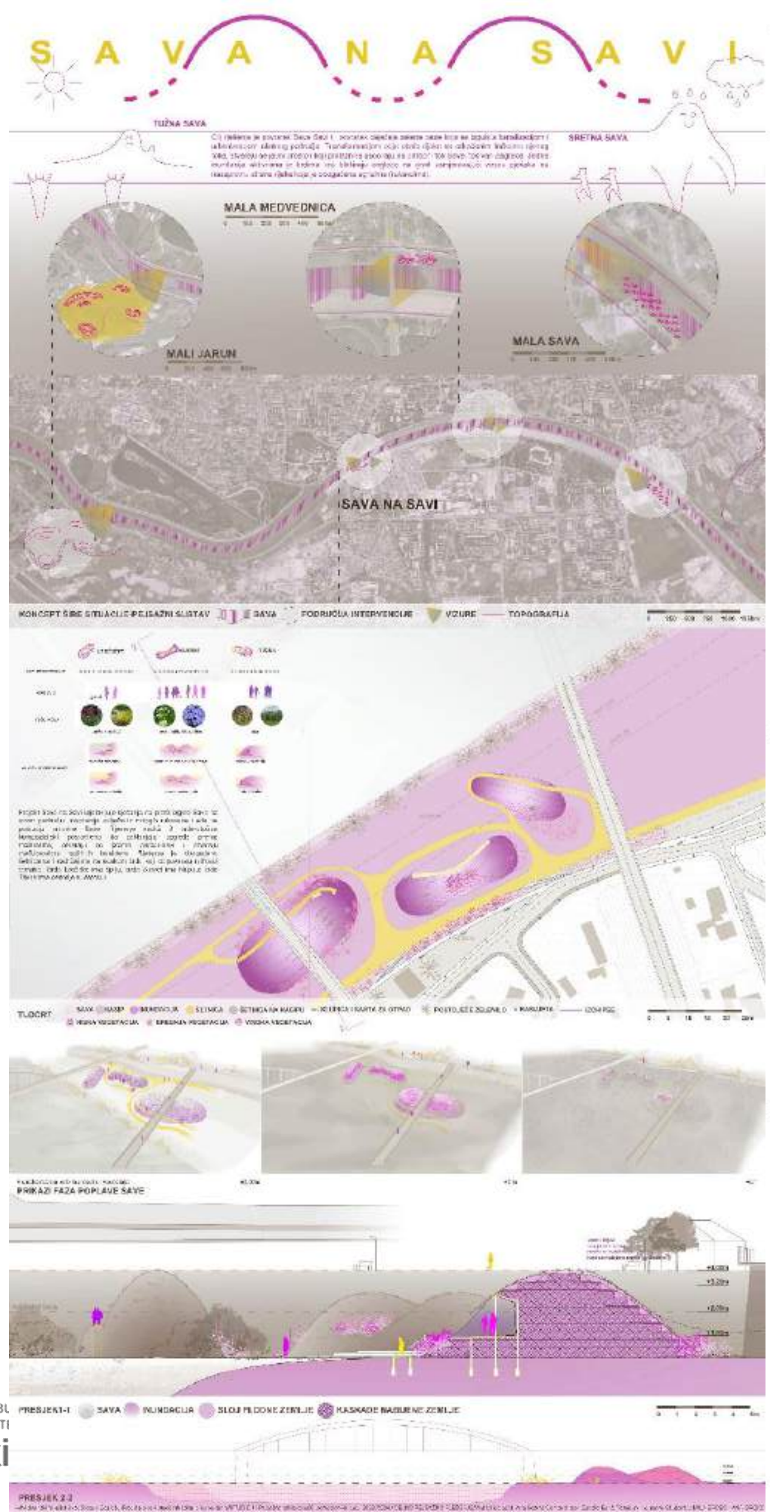
Biološki

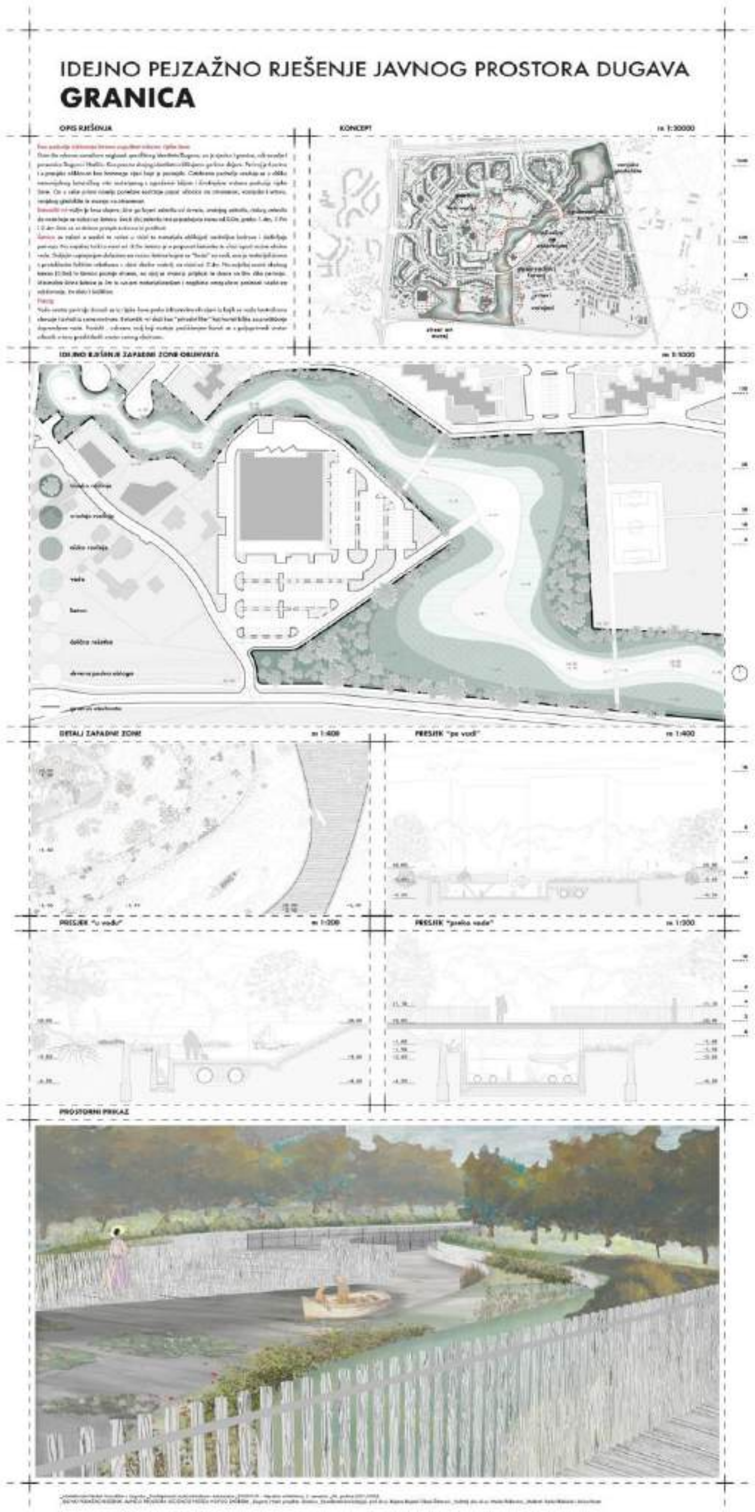
Resulting projects that promote water-energy-food Nexus principles

Student proposals aim to create new systems of open public spaces which combine **water sensitive approaches** with **nature based solutions** by introducing **renaturalisation** principles of waterbed and former backwater of the Sava River.

(left) students: Mila Erceg, Ana Grgić; mentor: dr. A. Sopina

(right) students: Karla Klobučar, Jurica Koren, mentor: dr. M. Rukavina





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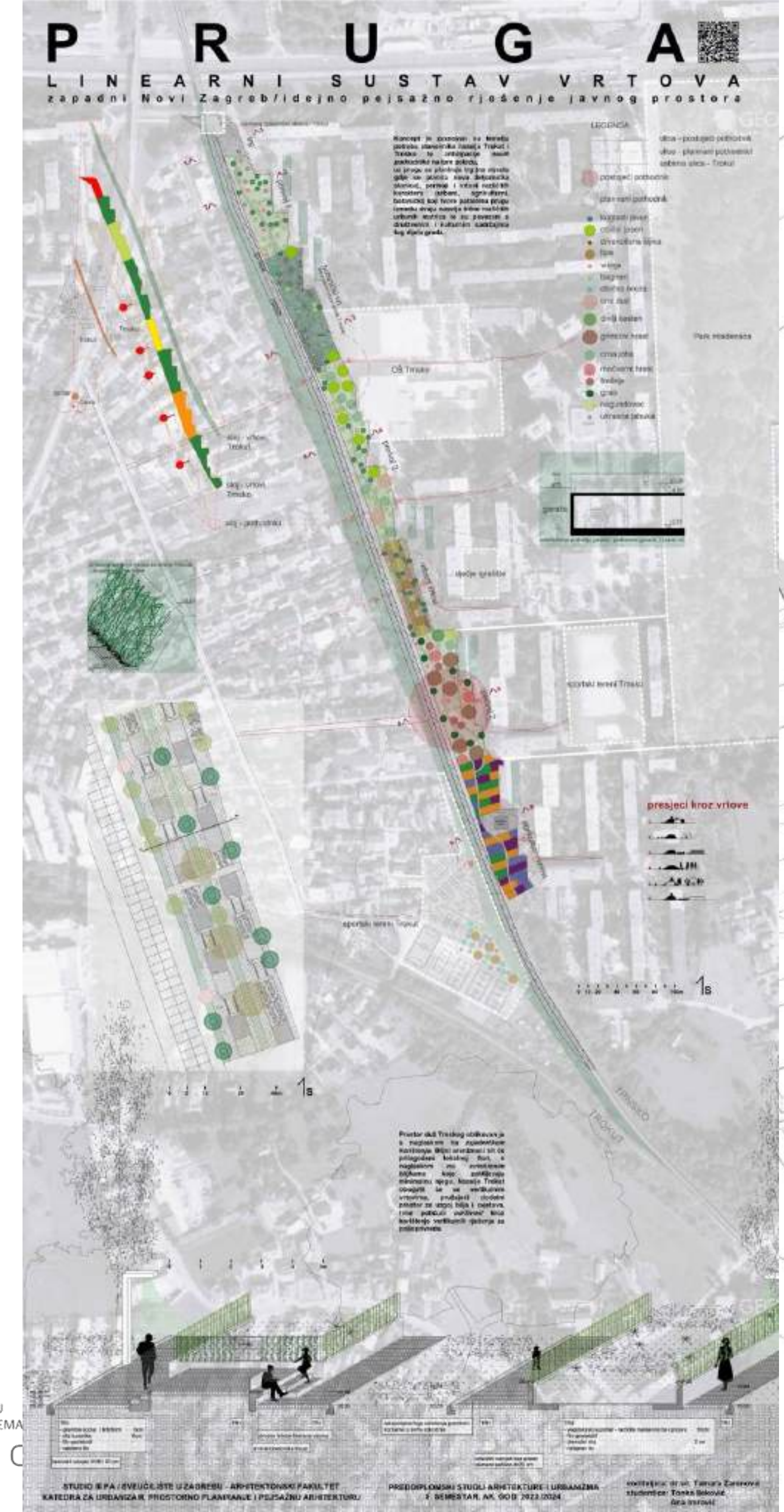
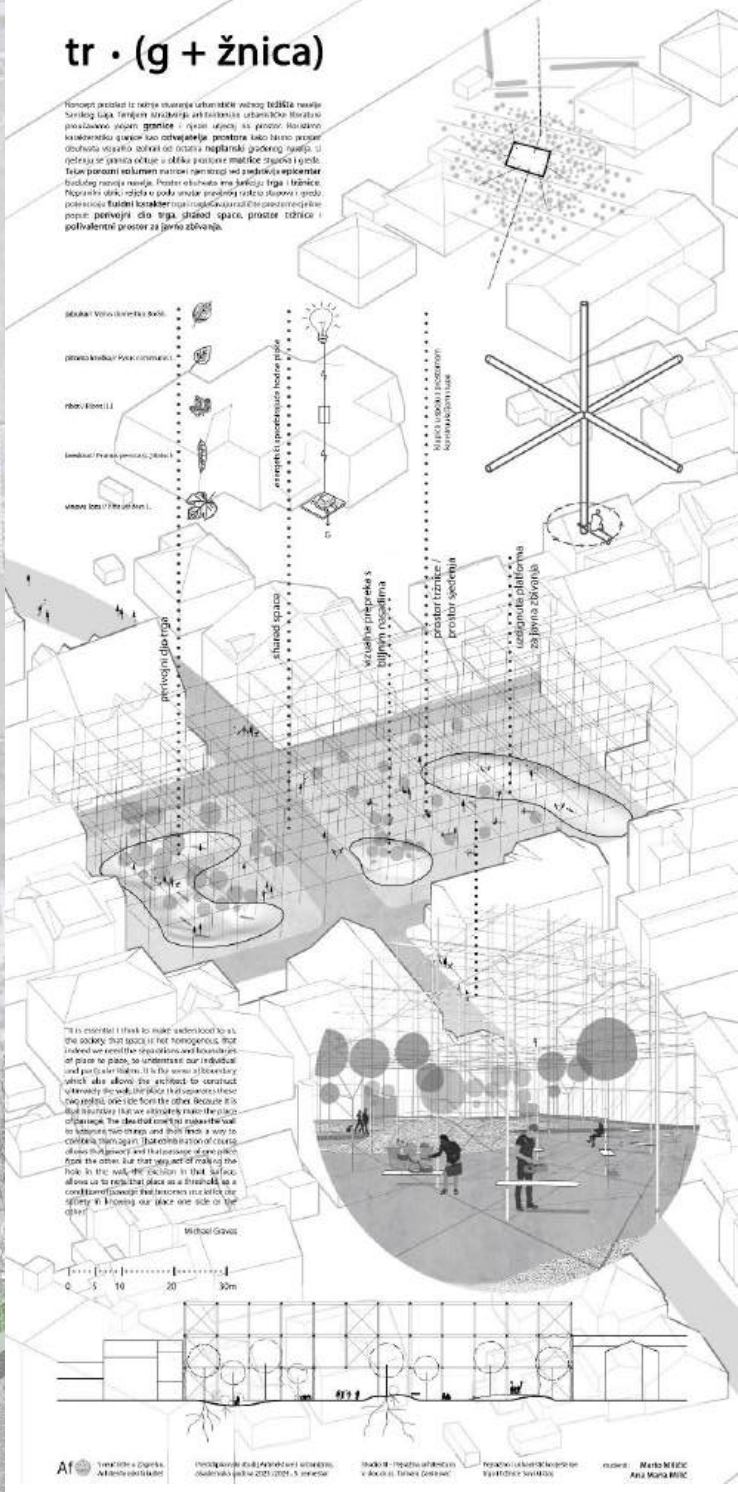
Biološki

Resulting projects that promote water-energy-food Nexus principles

Student projects develop proposals for **integrating landscape design and ecological solutions for creating new open public places** that promote **energy production**, **food production** (urban gardens), **food distribution** (urban market).





(left) students: Tonka Ileković, Ana Imrović; mentor: dr. T. Zaninović

(right) students: Mario Miličić, Ana Maria Milić, mentor: dr. T. Zaninović

KATEDRA ZA URBANIZAM, PROSTORNO PLANIRANJE I PEJSAŽNU ARHITEKTURU
DEPARTMENT OF URBAN PLANNING, SPATIAL PLANNING AND LANDSCAPE ARCHITECTURE
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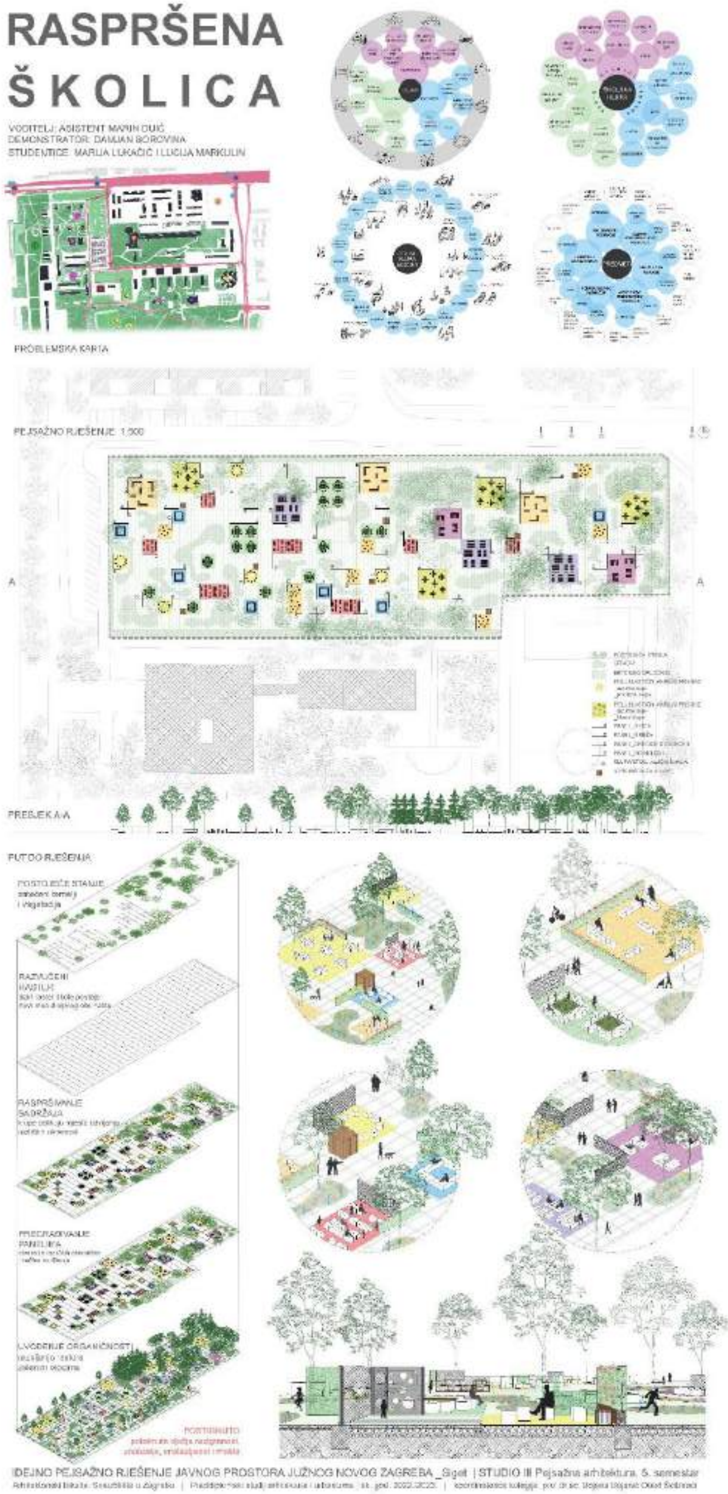
SVEUČILIŠTE U ZAGREBU PRIRODOSLOVNO-MATEMA
Biološki

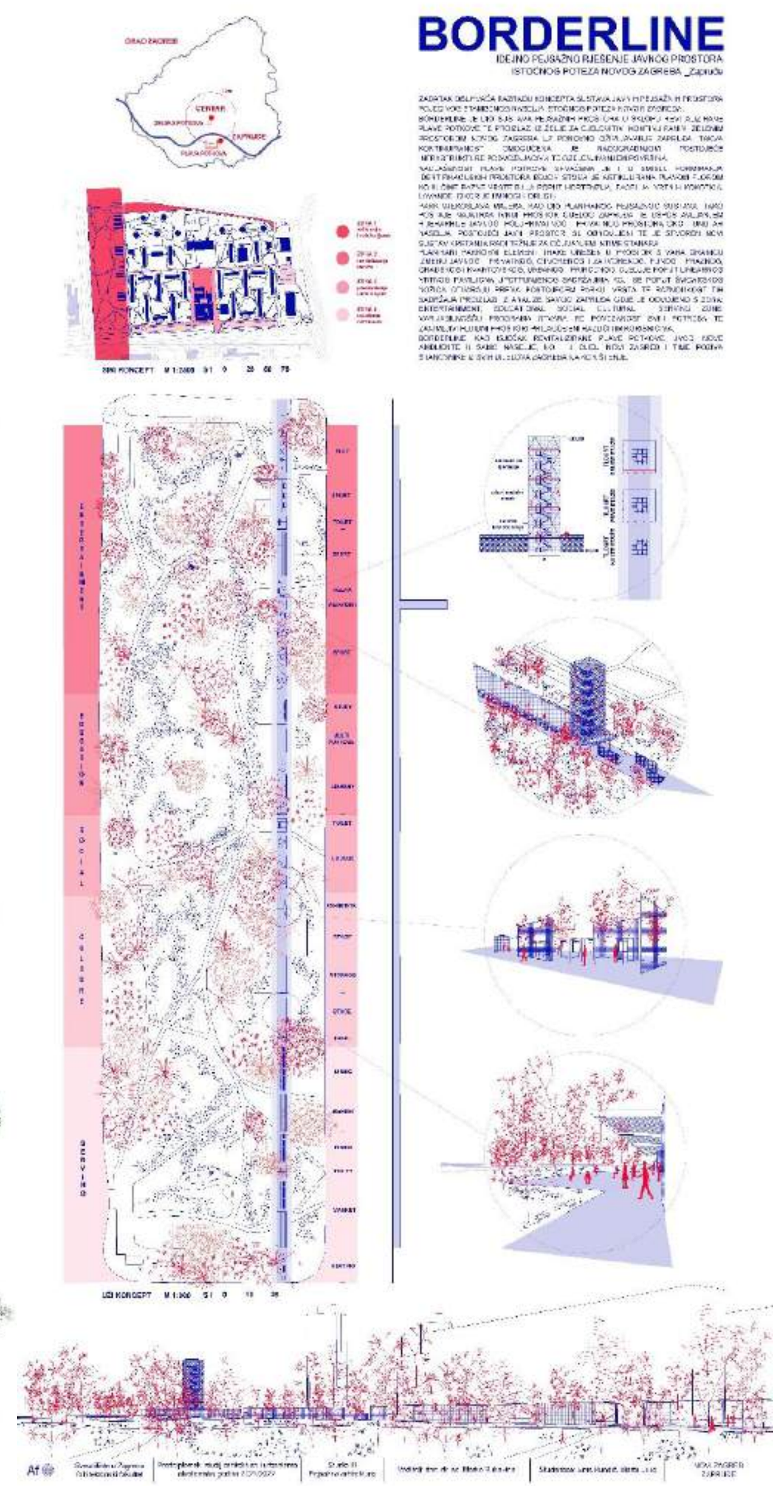
Resulting projects that promote water-energy-food Nexus principles

Student projects illustrate various approaches to **integrating urban planning principles with biodiversity protection** that include the **participation of local communities** and **education of all community members**.

(left) students: Tonka Ileković, Ana Imrović; mentor: dr. T. Zaninović

(right) students: Marija Lukačić, Lucija Markulin, mentor: M. Duić





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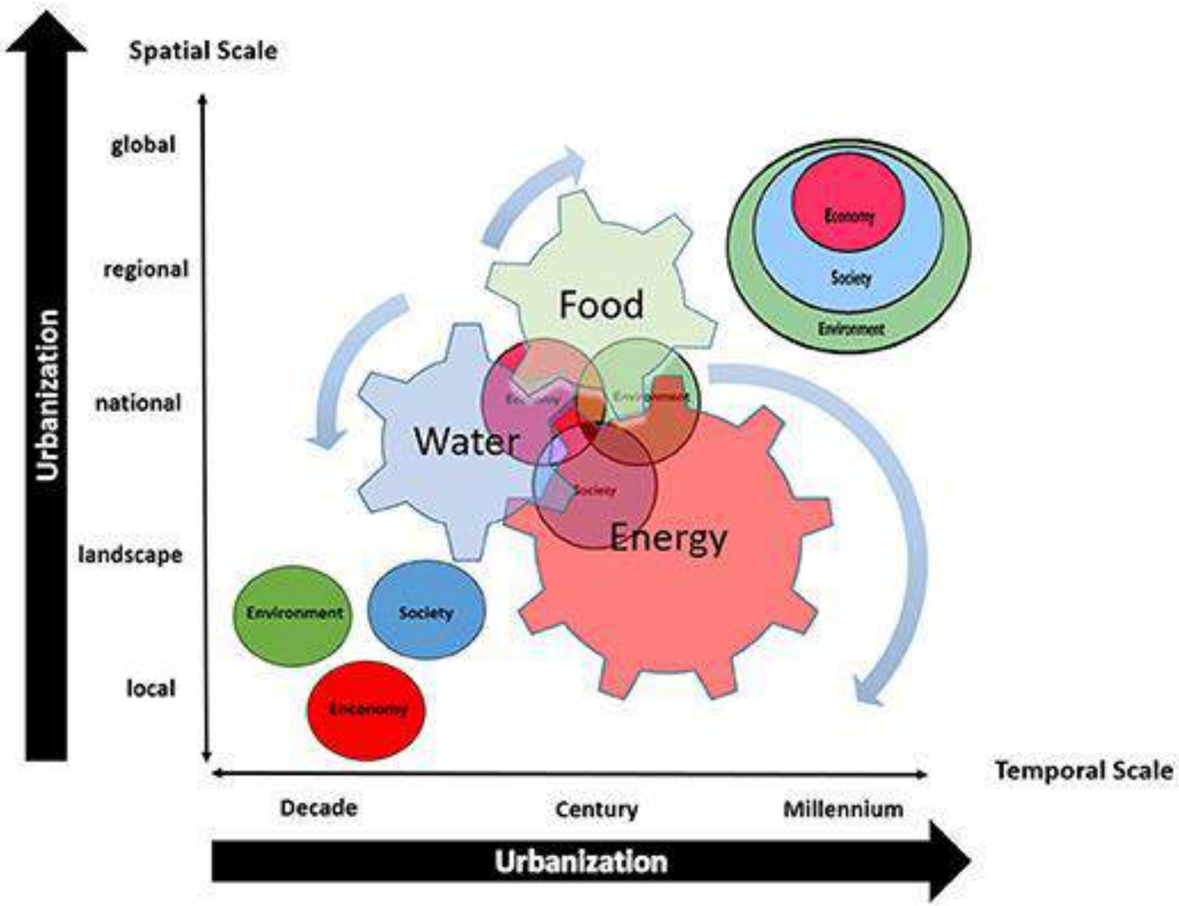
Conclusions…

…Exploring the **relationship between urban and spatial planning, urban ecosystem biodiversity and the WEF+ nexus resources** (Water, Energy, Food, Land & Soil, Climate, Ecosystems, Waste) can provide insights into how urban ecology, urban design and nexus-aware urban planning can **raise awareness of resource dynamics in urban areas**;

…This understanding can significantly contribute to **improving the sustainability, resilience, and vividness of urban areas** as well as balancing the interplay between sustainability and resilience of urban spaces;

Conclusions…



…Our experience highlights the critical role of **interdisciplinary collaboration in advancing education on Nexus issues**;

…By demonstrating how to integrate these approaches into student projects **at the university level**, we emphasise the importance of **preparing future professionals to adopt and promote the Nexus approach** to ensure they are equipped to address complex urban sustainability challenges.

in spe: Synergy of Biology and Urbanism in Teaching

Plan for continued collaboration between the Faculty of Science (FoS) and the Faculty of Architecture (FoA)
The aim is to develop a fully interdisciplinary model for future courses in *Urban Ecology (FoS)* and *Landscape Architecture (FoA)*.

- ❑ Foster collaboration between students from diverse fields to encourage the synergy of ideas and knowledge exchange;
- ❑ Develop students' abilities to address complex problems through an integrated, holistic approach;
- ❑ Prepare students for working in interdisciplinary teams within professional environments.

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PRIRODOSLOVNO-MATEMATIČKI FAKULTET
Biološki odsjek

Empowering Sustainability Research through the Sustainability Nexus Analytics, Informatics, and Data (AID) Programme

Nexus Implementation: Potential and Opportunities

Speakers:

Dr. Mir Matin, UNU Institute for Water, Environment and Health (UNU-INWEH), Canada
Dr. Azin Zarei, UNU Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Germany
Mr. Taha Loghmani, UNU Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Germany
Ms. Ghada Amin, UNU Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Germany

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Introduction of Sustainability Nexus Analytics, Informatics and Data (AID) Programme

Background

Implementing the UN SDGs requires moving from isolated efforts to an integrated strategy, emphasizing the nexus approach that considers the interplay of environmental, social, and economic factors. Data-driven technologies like AI and GIS are vital for environmental management and decision-making, enhancing inclusivity and resource distribution to help achieve the 17 SDGs. However, a gap remains in effectively utilizing the available datasets and tools, partly due to a lack of awareness or skills among stakeholders such as policymakers and community leaders.

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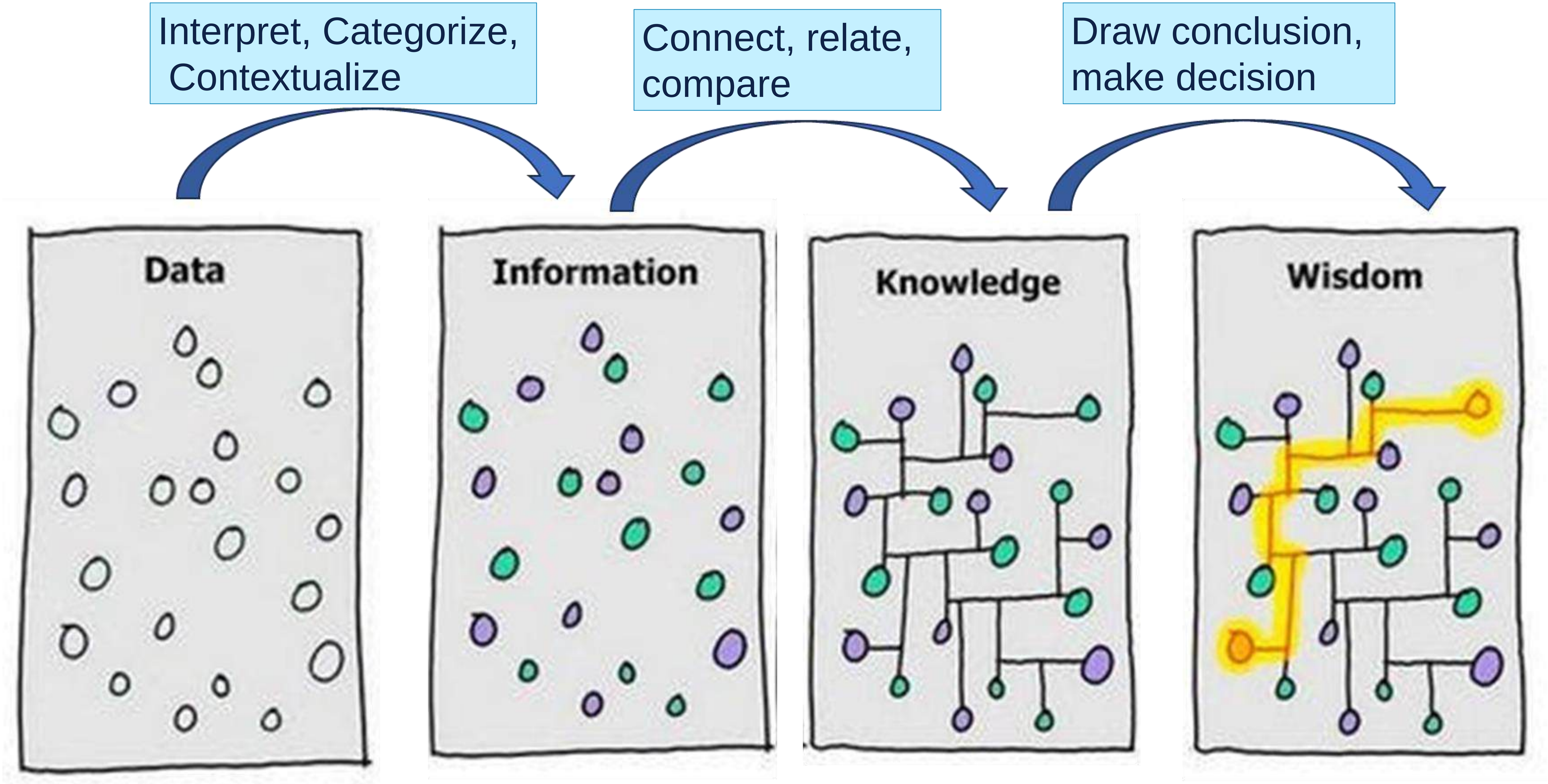
Collecting More data does not automatically bring more wisdom



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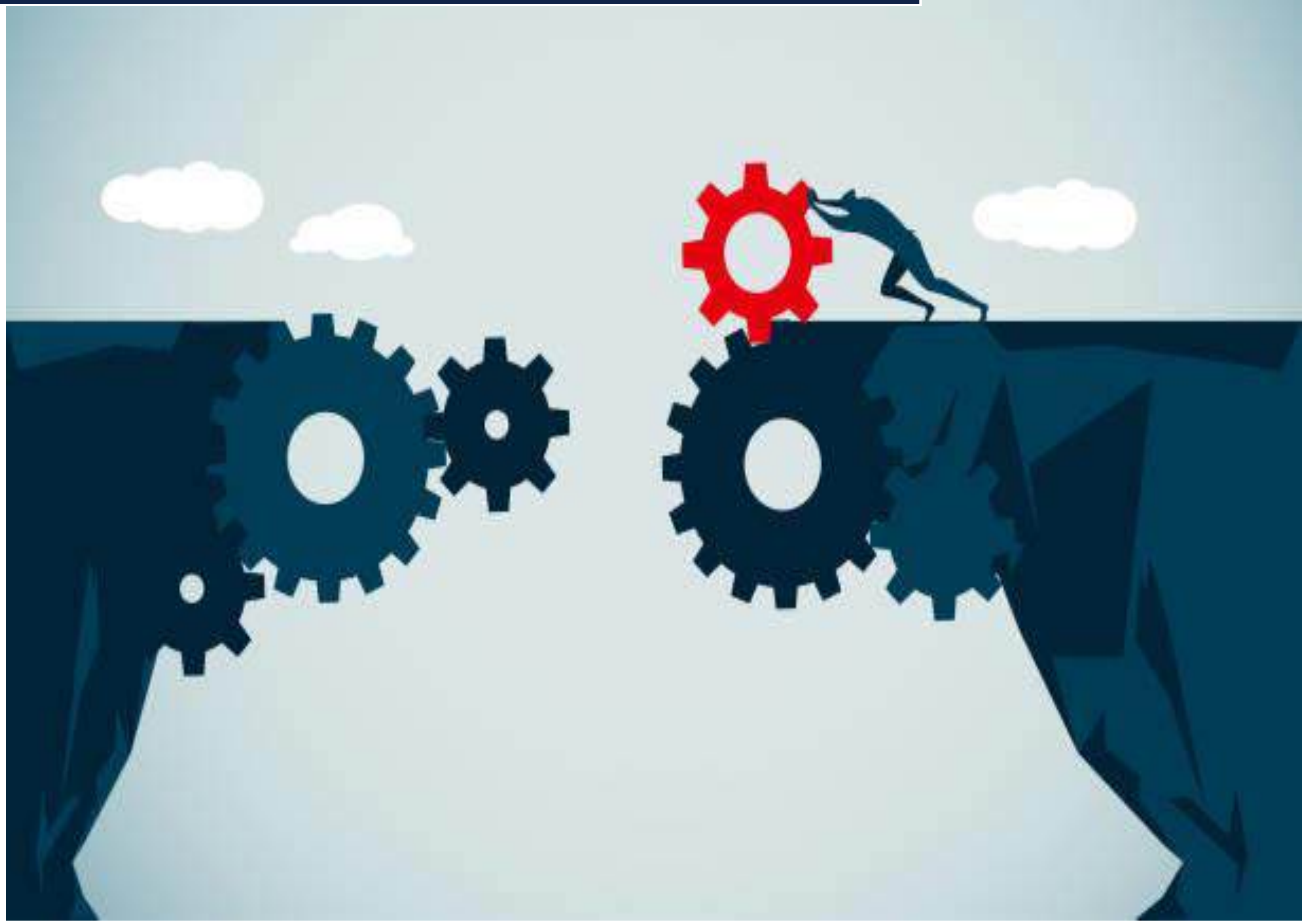
Bridging the Gap

Sustainability Nexus AID

Lack of data, information, computational techniques, and analytical tools for **navigating through complexity** & examining the **interrelatedness** and **interdependencies** of the components of coupled **human-environment systems**



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Goal and pillars of the Programme

Enabling the **Sustainability Nexus Approach** to sustainable development

AID {
Analytics
Informatics
Data

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Whom to AID? Whom We Need?

Science-Policy-Society Interface

- Academics
- Businesses & professionals
- Policy makers & governments
- General public
- UN & intergovernmental agencies

Resource Nexus Data

- The **Data** pillar aims to facilitate data exchange and fill the data gaps for analyzing resource nexus.

- To make inventories of the existing resource nexus data and identifies the data gaps using a **problem-driven approach.**

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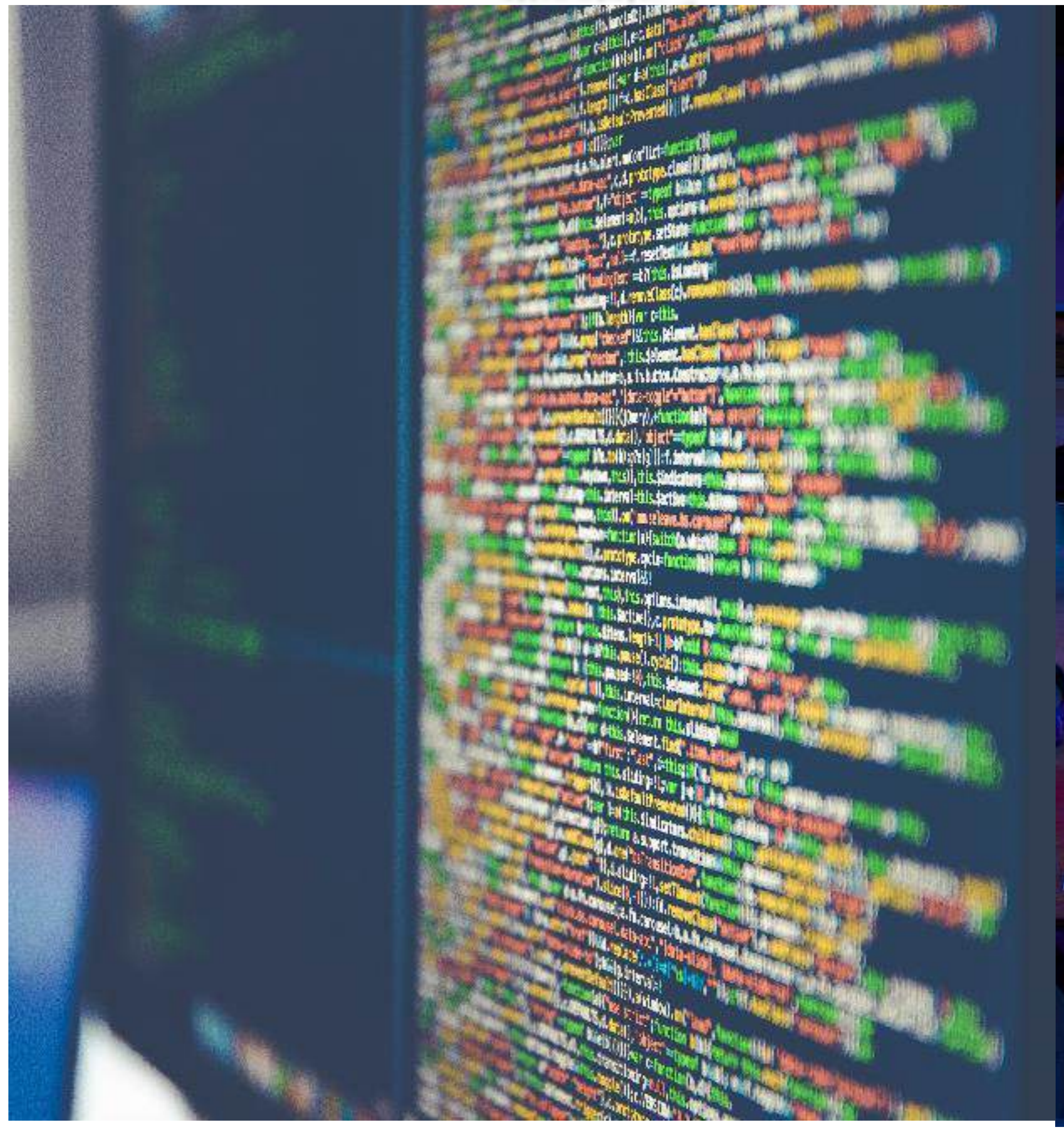
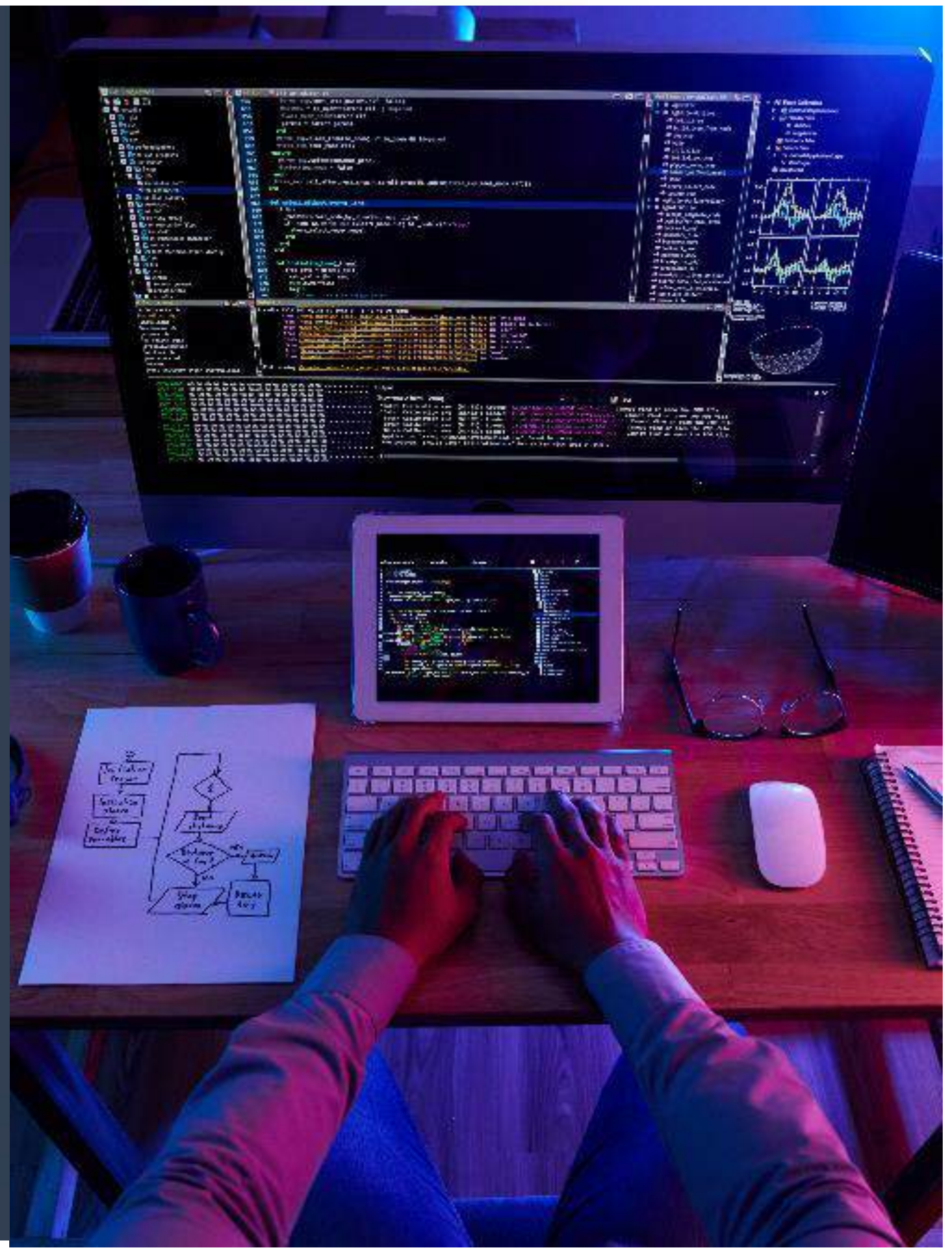
Resource Nexus Informatics





- The **Informatics** pillar aims to build & improve the capacity for computing & **processing** resource nexus data.

- To make inventories, develops & promotes state-of-the-art tools & best practices to **store, process, analyze & manage** resource nexus data.

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Resource Nexus Analytics

The **Analytics** pillar aims to facilitate the **extraction of information** from data & **inform decision-making** by inventorying, developing & promoting state-of-the-art resource nexus **analytical tools and frameworks** using a problem-driven approach & applied research.

Activities

Connect Experts and Implementing Users

One Stop Location for Data Tools for SDG

Capacity development, awareness building

Gap Analysis and policy suggestions

Community of Practice

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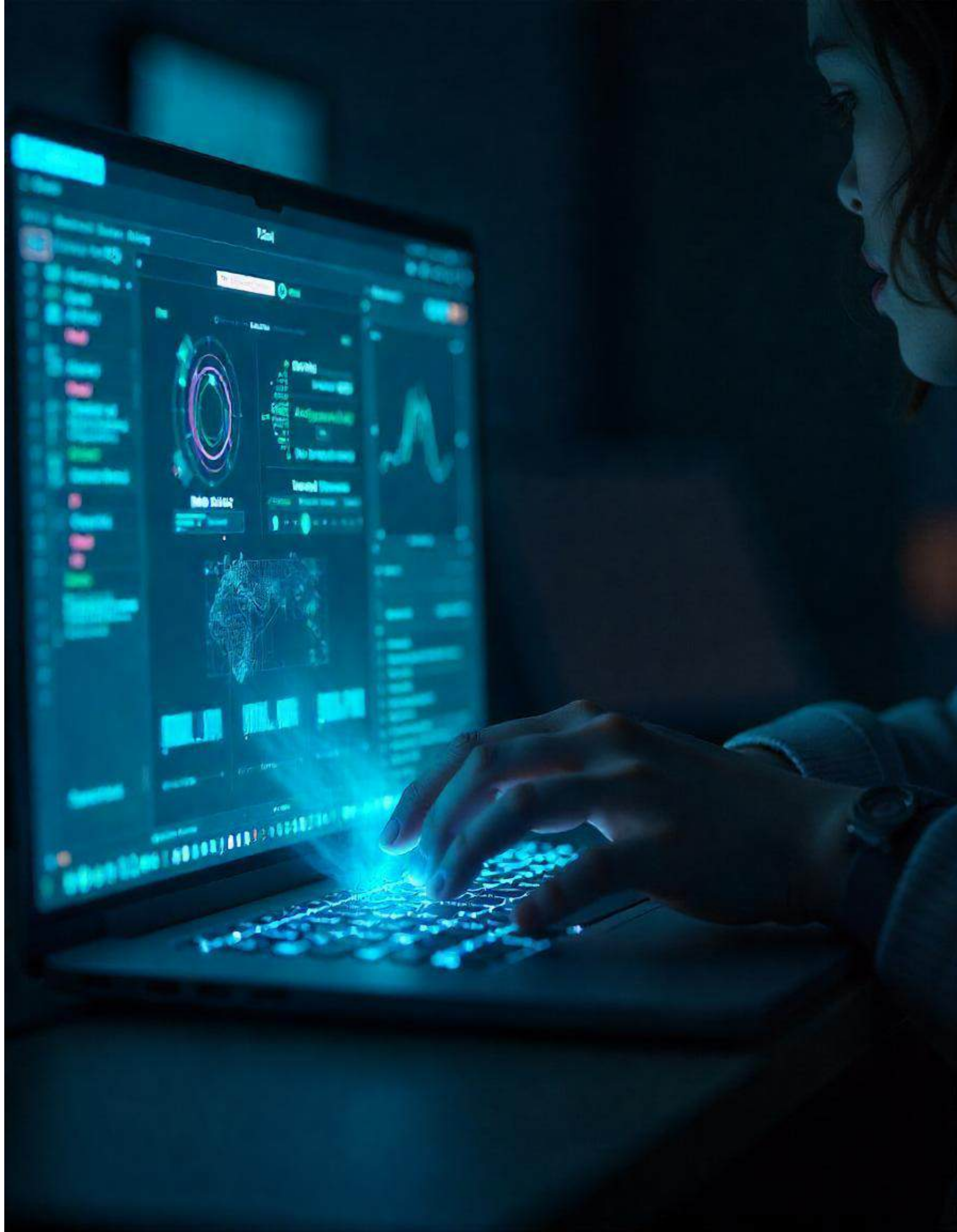
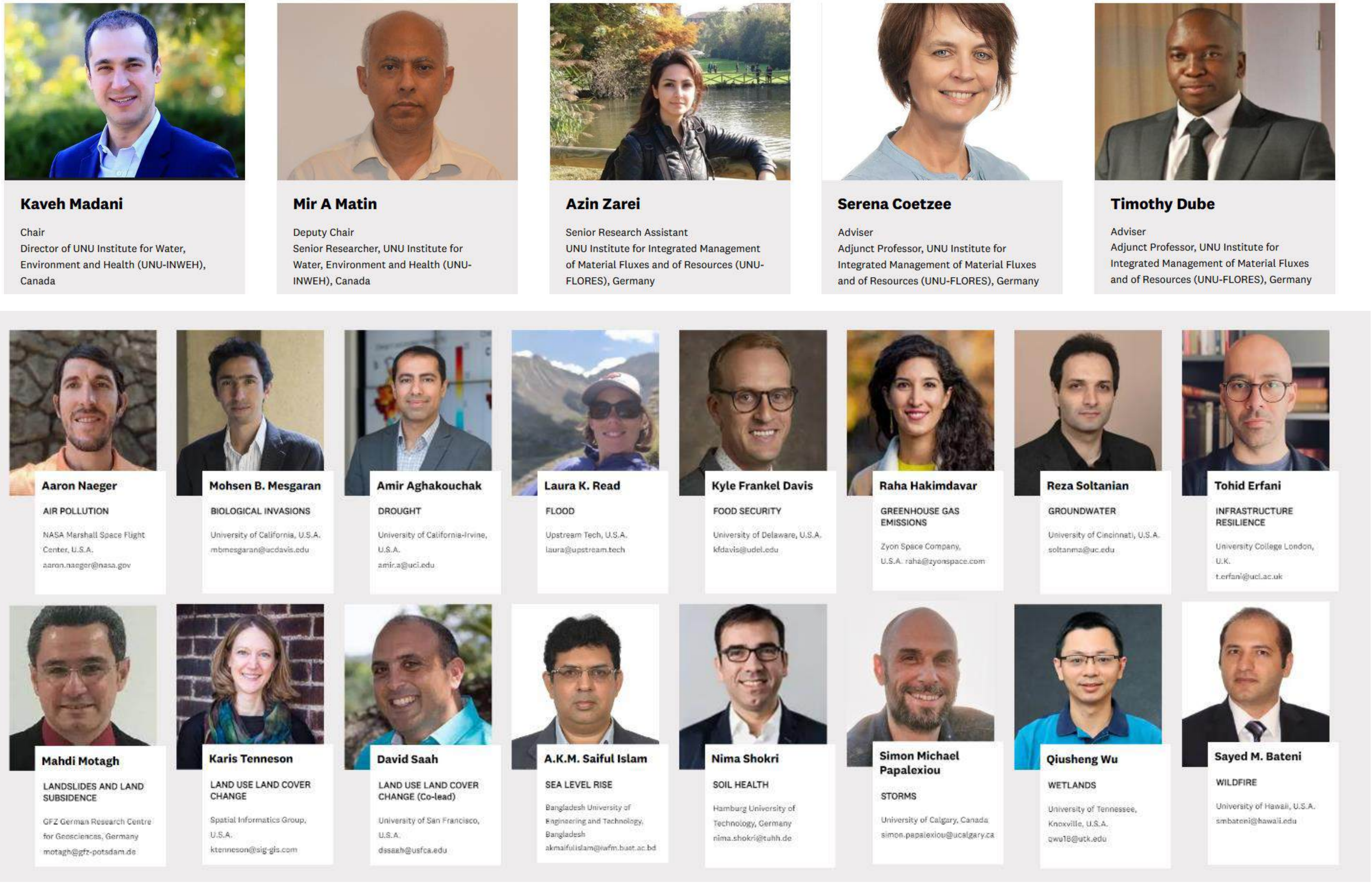


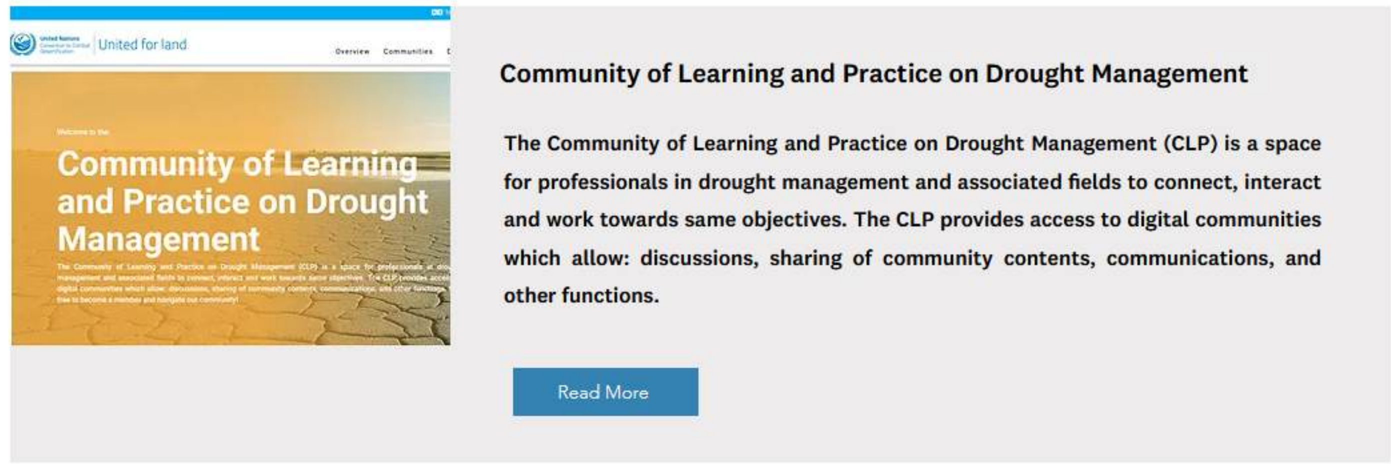
Governing Team



Some upcoming plans for the Sustainability Nexus AID Programme include:

- **Development of New Modules**
- **Enhancing Existing Modules:**
- **Promotion and Outreach:**

Communities of Practice



Cooperation with the United Nations Convention to Combat Desertification (UNCCD)

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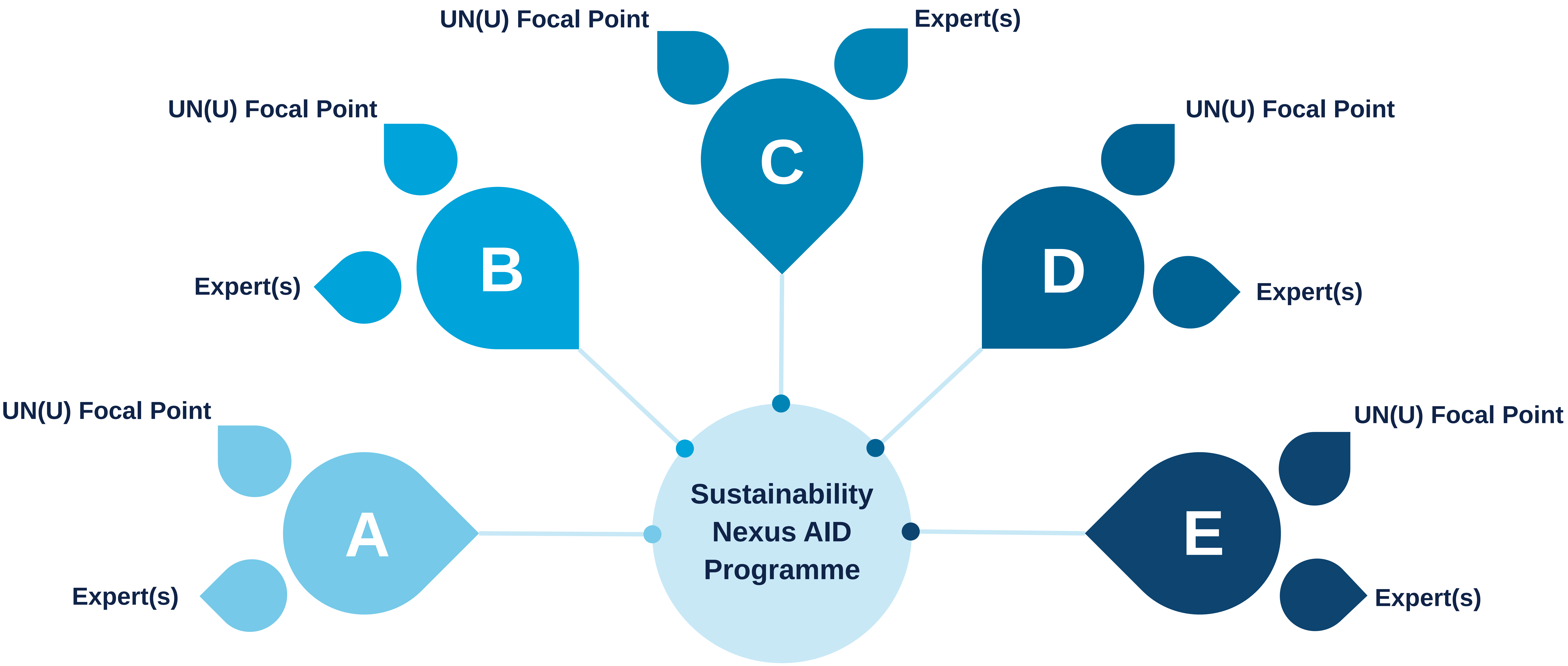
Distributed Structure



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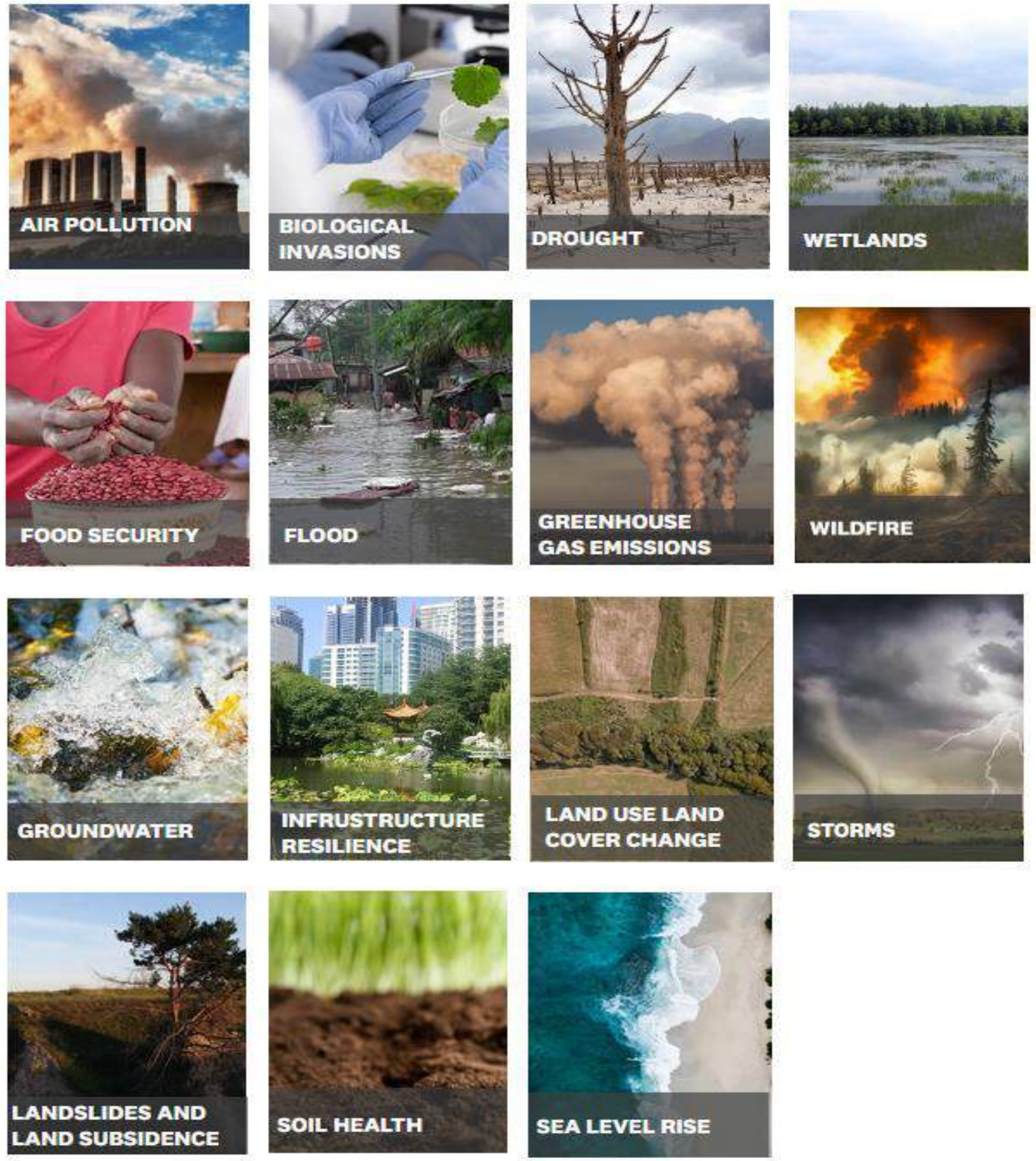
Modules

- Focusing on a specific problem related to sustainability
- Addressing solution based on the Nexus approach
- Working group with recognized researchers
- Identify and list available data, tools, training materials related to the problem
- Develop action plan to identify gaps and work on reducing those gaps
- Capacity development materials to help utilization of the available data, tools
- Produce scientific/policy documents to address the status, gaps and recommendations



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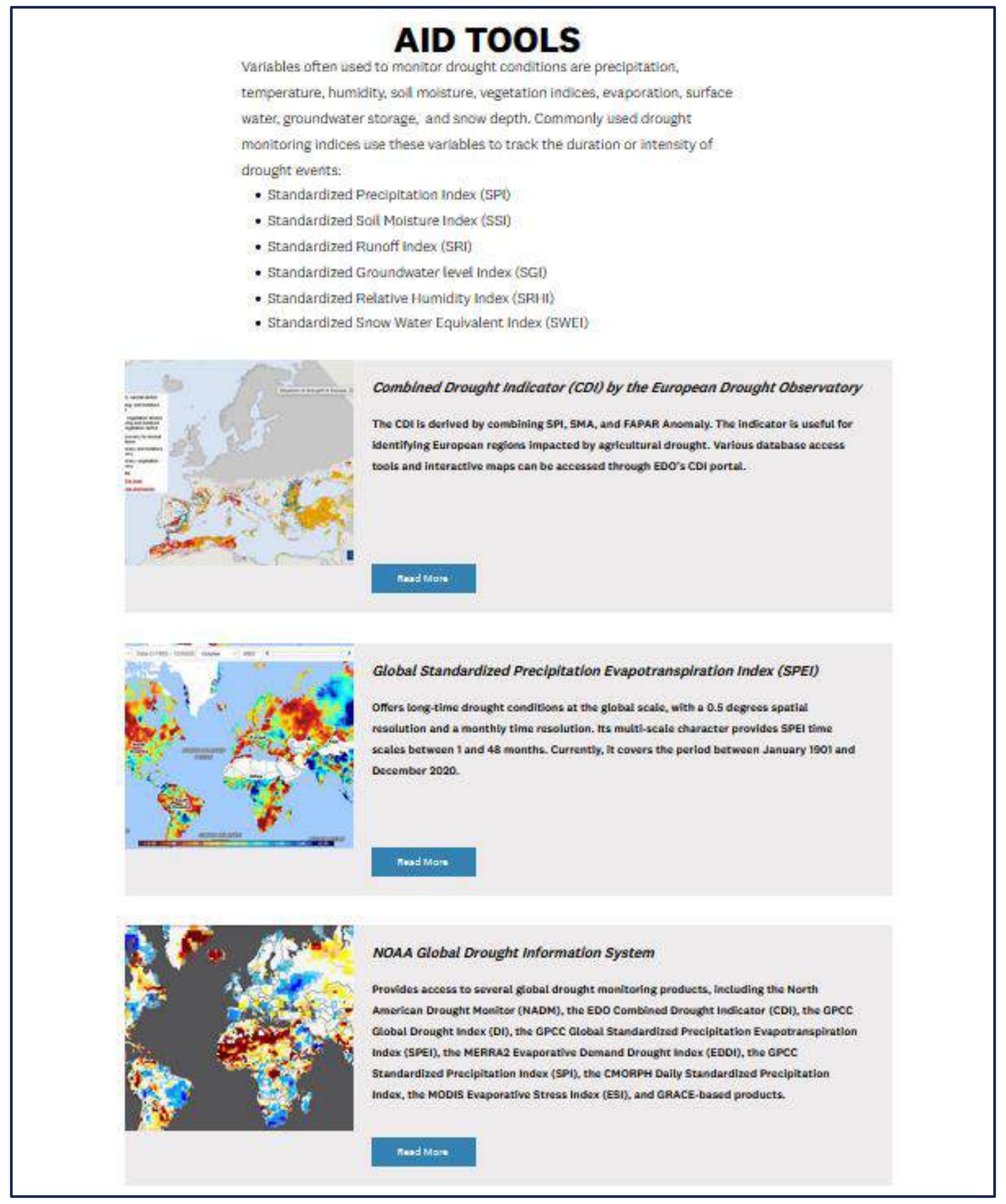
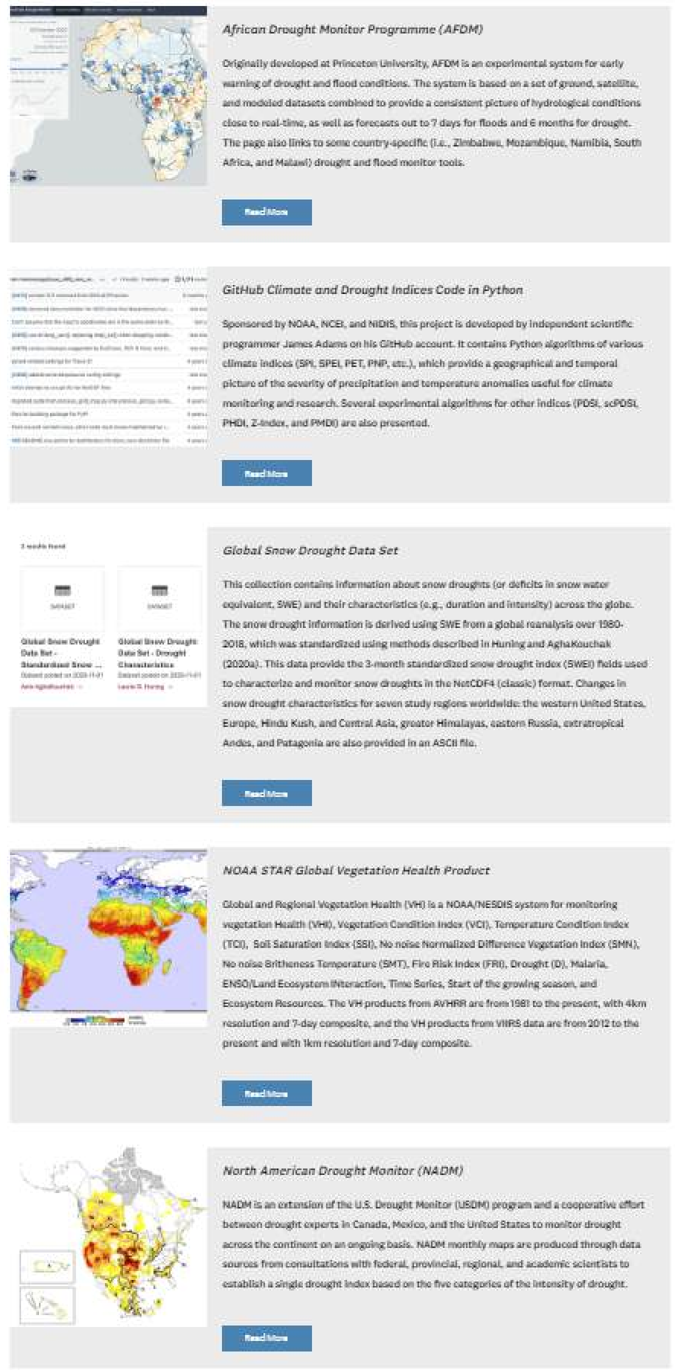
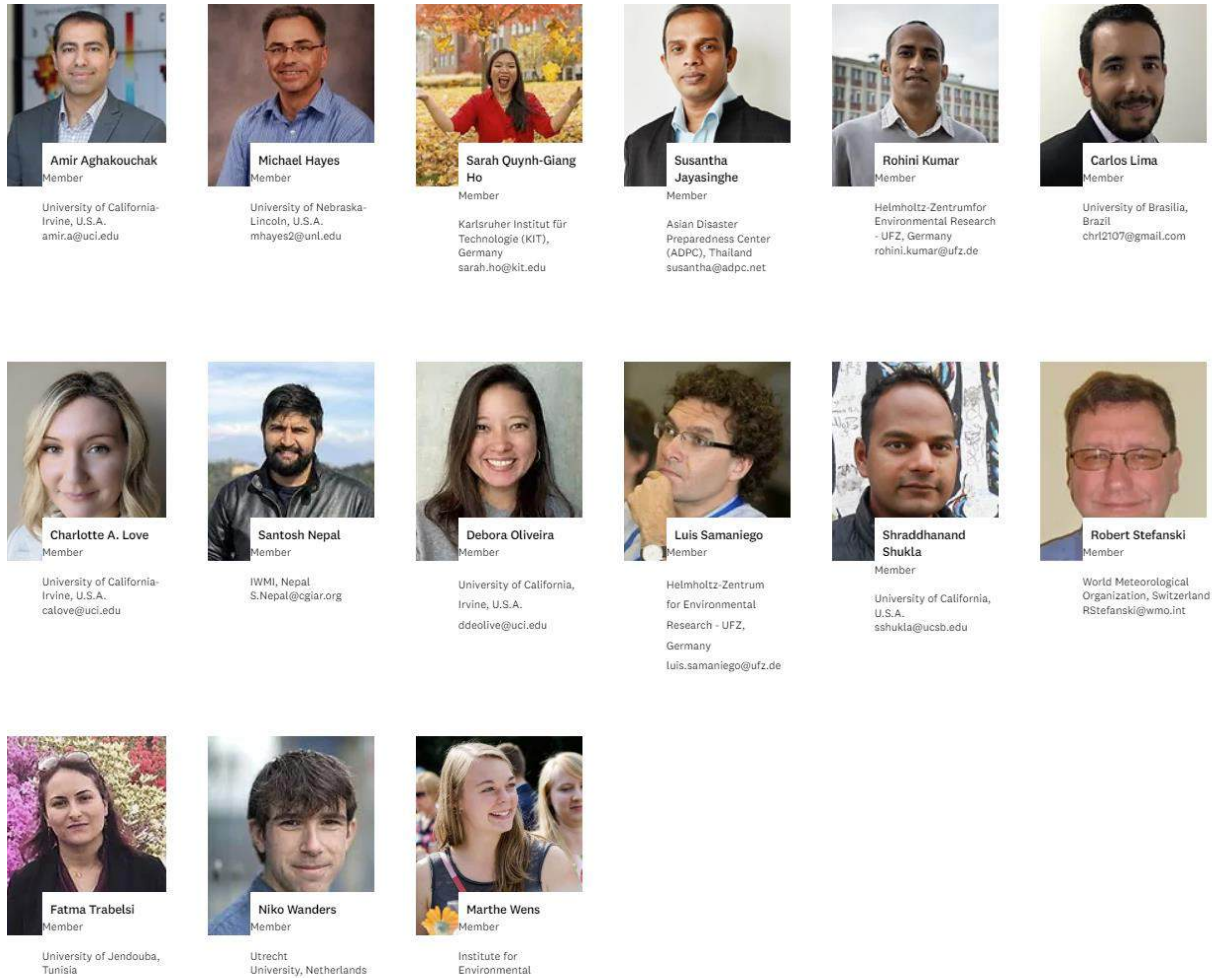
Modules

WHY A NEXUS APPROACH: Drought is a complex phenomenon at the intersection of climatology, meteorology, hydrology, ecology, agronomy, economics, and even politics

WHY DROUGHT MATTERS: Global Disaster. Affects all critical sectors of economy







Lead Amir Aghakouchak

https://www.sustainabilityaid.net/drought

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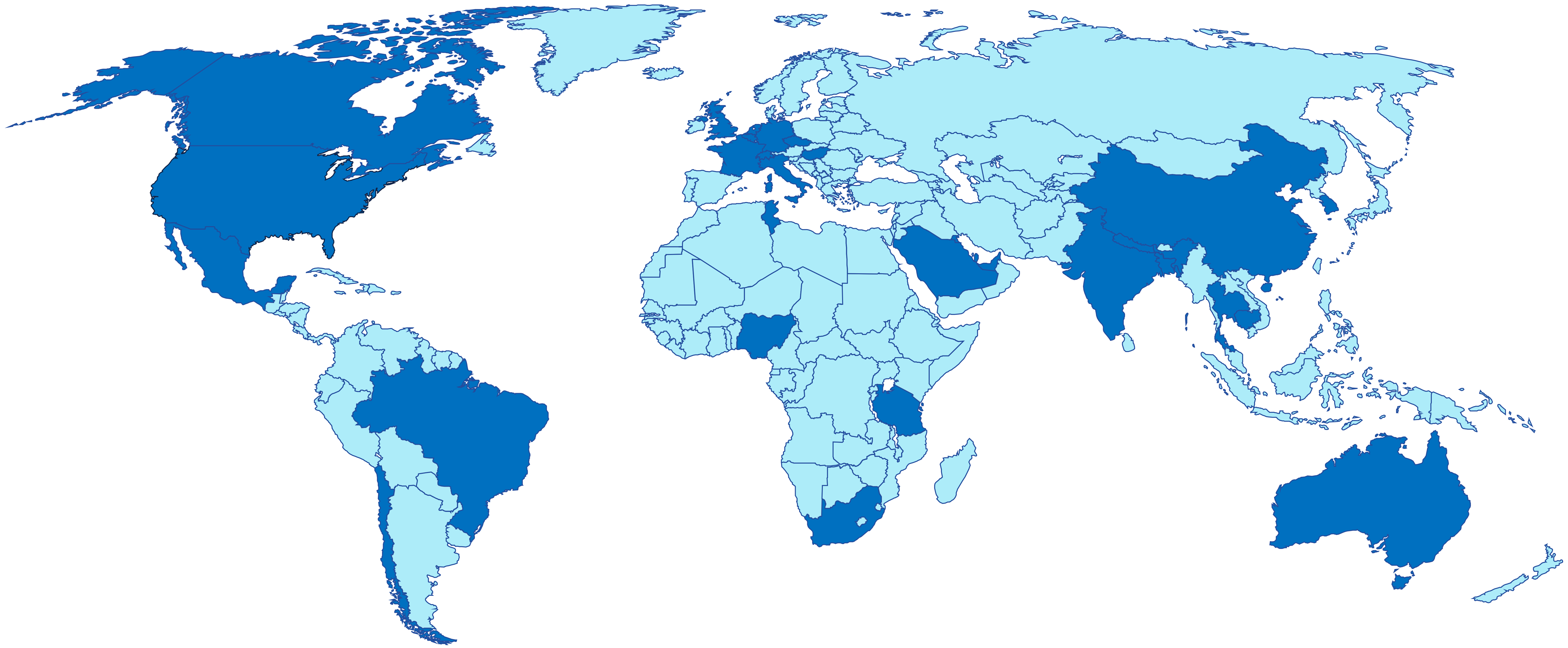
Programme Progress and Achievements

AID – A role model for partnerships



Key Highlights

15 Modules

184 AID Tools

29 Countries

129 Scientists

114 Institutes

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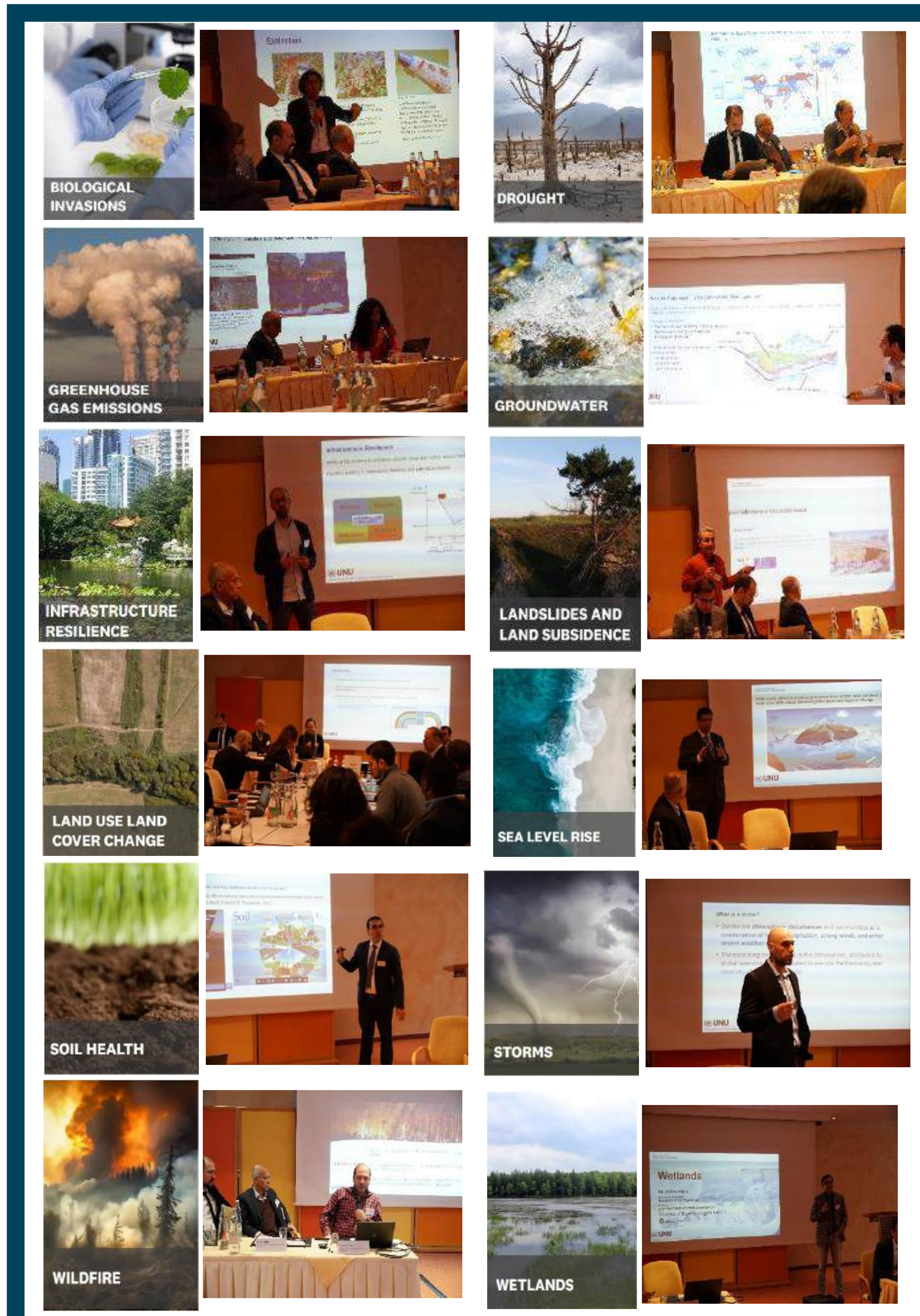
Official Launch, Nov 2023

UNU Rector (Marwala), Chair of the AID Programme and Working Group Leaders (Dresden)



The AID Workshop and Panel Discussion

Memorandum of Understanding on Academic Collaboration signed between the United Nations University (UNU) and the NFDI Consortium Earth System Sciences (NFDI4Earth), Germany

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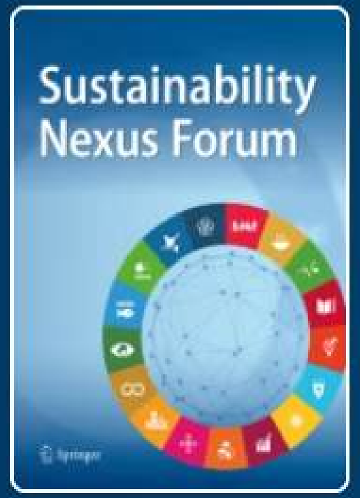
Springer



Sustainability Nexus Forum

Publishing model

Hybrid

Submit your manuscript →

- **Special Collection** "Data for Good: Promoting Data-Driven Nexus approaches to Sustainability"

Sustainability nexus AID: infrastructure resilience

Original Paper | Open access | Published: 22 October 2024

Volume 32, article number 13, (2024) Cite this article

Sustainability Nexus Forum (2024) 32:13
https://doi.org/10.1007/s00550-024-00551-z

ORIGINAL PAPER

Sustainability nexus AID: infrastructure resilience

Tohid Erfani[1] · Mohammad Mortazavi Naeini[2] · Edoardo Borgomeo[3] · Mehrnaz Anvari[4] · Antho
Rasool Erfani[1,6] · Azin Zarei[7] · Mir A. Matin[8] · Kaveh Madani[7,8]

Received: 17 July 2024 / Revised: 23 September 2024 / Accepted: 25 September 2024

Abstract
Infrastructure resilience advanced through nexus thinking is pivotal for societies to handle disruptions
functionality. This interconnected approach understands infrastructure as an interdependent compl
cooperative planning to achieve resilience. However, challenges like data inadequacy, financial limi
issues impede its adoption, especially in developing regions. The United Nations University (UNU
Analytics, Informatics and Data (AID) Programme strives to promote integrated resource mana
development and fulfilling the UN 2030 Agenda. Through its Infrastructure Resilience Module, the i
data platforms and localised capacity building to empower professionals and communities for eviden
decision-making accounting for intersectoral relationships. By supporting context-specific analytica
data gaps, and governance silos, the programme aims to pave the way for resilient and sustainable infra
particularly across vulnerable regions in the Global South, which face disproportionate infrastructu

Keywords Analytics · Informatics · Data · Infrastructure Resilience · Sustainable Development · Dec
Computational Modelling

Sustainability Nexus AID: biological invasions

Science–policy perspectives | Published: 29 July 2024

Volume 32, article number 4, (2024) Cite this article

Sustainability Nexus Forum (2024) 32:4
https://doi.org/10.1007/s00550-024-00542-0

SCIENCE–POLICY PERSPECTIVES

Sustainability Nexus AID: biological invasions

Philipp Robeck[2] · Lior Blank[3] · Mark van Kleunen[4] · Albert Ayeni[5] · I
Adewale Osipitan[7] · Kaveh Madani[8,9] · Azin Zarei[9] · Mir A. Matin[8] · I

Received: 24 May 2024 / Revised: 24 May 2024 / Accepted: 9 July 2024 / Published online: 29 July 2

Abstract
Biological invasions, identified as one of the primary drivers of ecosystem chan
economies, and human health. Globally, with 37,000 naturalized species and an a
addressing the issue of invasive species is increasingly urgent. This paper unde
global approach to preventing, managing, and eradicating invasive species. Ou
within the United Nations University (UNU) Sustainability Nexus AID (Analyti
aligns with the 2030 Sustainable Development Goals (SDGs). This programm
focused on different problems, leverages a range of AID tools to support polic
the Biological Invasions module, we have curated a repository of 56 AID tool
Data Sources; Mapping, Monitoring, and Citizen Science Tools; Modeling an
Management and Control; and Research and Education. We discuss the utilities
decision-making, and strategies for enhancing their adoption, functionality, and u
and user guidance into relevant local and official UN languages. The potential
gap and their crucial role in combating biological invasions are highlighted. Dr
we emphasize the crucial need for proactive stakeholder engagement and inter
this pressing environmental challenge.

Keywords Biodiversity · Analytics · Data · Capacity building · Biological invas
Informatics · Sustainable development

Sustainability Nexus AID: landslides and land subsidence

Forum | Open access | Published: 18 October 2024

Volume 32, article number 12, (2024) Cite this article

Sustainability Nexus Forum (2024) 32:12
https://doi.org/10.1007/s00550-024-00549-7

FORUM

Check for updates

Sustainability Nexus AID: landslides and land subsidence

Mahdi Motagh[1,2] · Shagun Garg[3] · Francesca Cigna[4] · Pietro Teatini[5] · Alok Bhardwaj[6] · Mir A. Matin[7] · Azin Zarei[8] ·
Kaveh Madani[7,8]

Received: 19 August 2024 / Revised: 10 September 2024 / Accepted: 16 September 2024

Abstract
Landslides and land subsidence pose significant threats that are both existing and growing in nature. These complex phenomena should not be considered in isolation but rather as interconnected challenges. To effectively understand and mitigate them, a data-driven nexus approach is necessary. Recognizing the importance of addressing this issue comprehensively, the United Nations University has launched the Sustainability Nexus Analytics, Informatics and Data Programme, a comprehensive initiative that intends to enable the nexus approach to problem solving in coupled human–environment systems. This paper provides a detailed background on the Programme's "Landslides and Land Subsidence Module", underscoring the crucial need for a nexus approach. Additionally, it highlights some of the tools and strategies that can be employed to tackle the challenges at hand. The success of this initiative hinges on active participation from various stakeholders. By embracing a holistic approach and fostering collaboration, we can strive towards better preparedness and long-term resilience against landslides and land subsidence.

Keywords Analytics · Informatics · Data · Landslide · Land subsidence · Remoting sensing · Artificial intelligence · Sustainable development

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The United Nations University (UNU) Sustainability Nexus AID Programme: Advancing a Nexus Approach to Sustainable Development

Show affiliations

Matin, Mir A. ; Zarei, Azin ; Guenther, Edeltraud ; Madani, Kaveh

The scientific and professional interest in the application of data and artificial intelligence tools to address sustainability challenges is on the rise. Yet, significant gaps and challenges exist in terms of access, exchange, and use of these data and tools, leading to major investment inefficiencies and creating a digital divide. This presentation introduces the United Nations University (UINU) approach to foster collaboration among stakeholders to bridge these gaps and challenges.

The Sustainability Nexus Analytics, Informatics and Data (AID) programme, launched by the UNU, focuses on promoting the Nexus approach to integrated resource management for sustainable development and fulfilling the UN 2030 Agenda. This programme focuses on identifying, developing, and promoting data, information, computational techniques, and analytical tools that facilitate sustainable management of water, soil, waste, energy, and geo-resources based on nexus thinking.

The program is structured around three distinct yet interconnected pillars: 1) Data, which streamlines data exchange and bridges resource data gaps; 2) Informatics, focusing on enhancing the capability for data processing, supporting the cultivation and endorsement of cutting-edge tools for managing resource nexus data; and 3) Analytics, which facilitates informed decision-making through advanced tools specifically designed for sustainable resource management.

The programme engages academics, businesses, policymakers, the United Nations and intergovernmental agencies, aiding them in navigating through complex human-nature systems. Operating as a collaborative network of experts across the world, a platform has been set up for knowledge exchange and solution discovery amongst specialized working groups. This presentation describes the current state of the program and provides an overview of the opportunities for the academic community to partner with the UNU to address sustainability challenges through a Nexus approach.

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Pub Date:	December 2023
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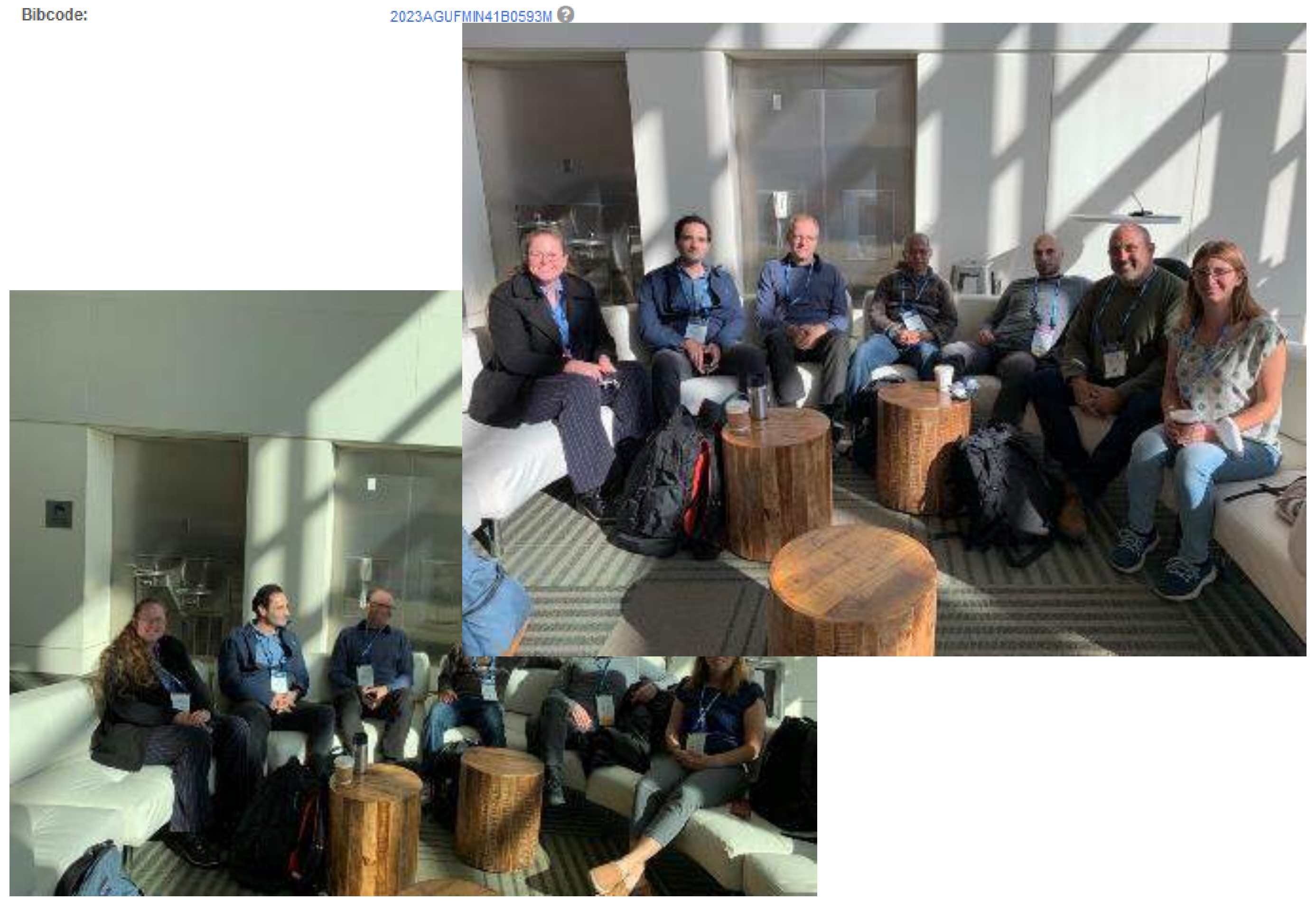

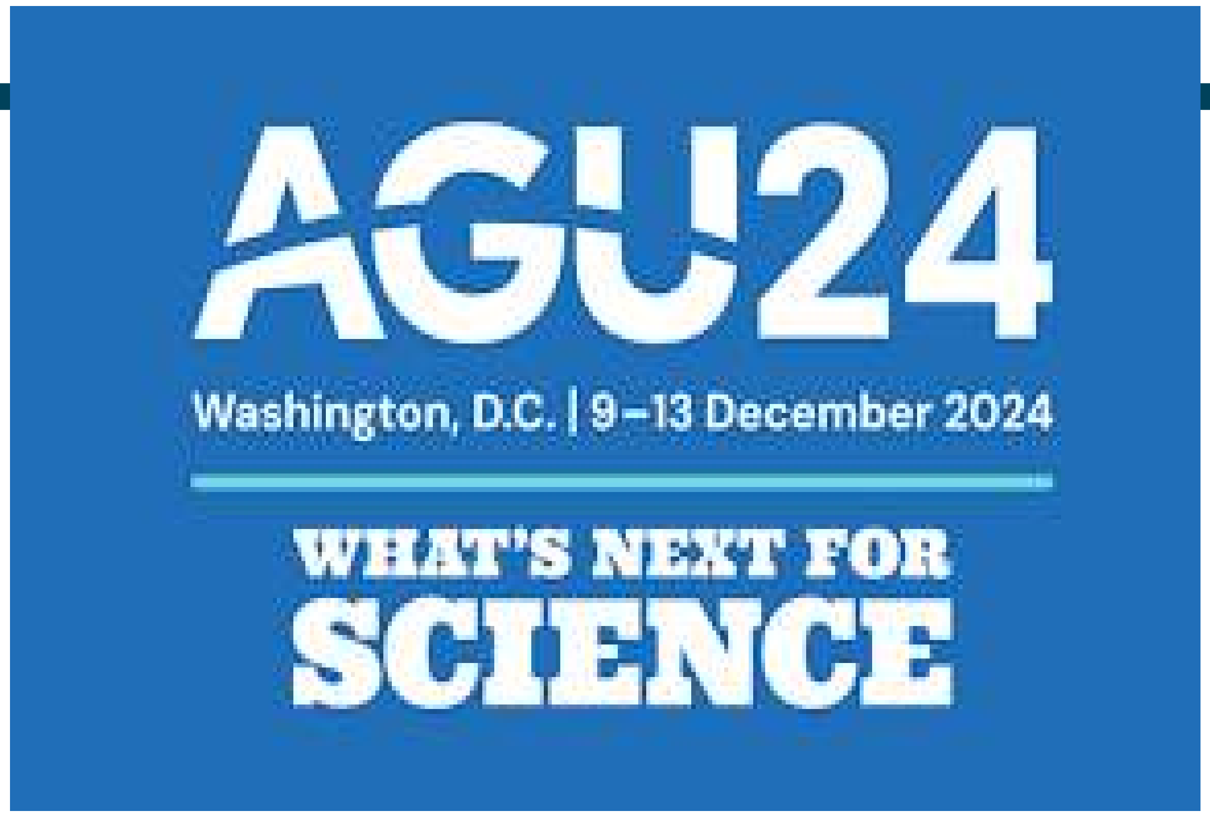

Sustainability Nexus Analytics, Informatics, and Data (AID) Programme: Bridging the Capacity Gap in Data Driven Decision Making for Sustainable Development

Tuesday, 10 December 2024
08:30 - 12:20
Hall B-C (Poster Hall) (Convention Center)

Abstract

The United Nations University's Sustainability Nexus Analytics, Informatics, and Data (AID) Programme focuses on the critical need for comprehensive datasets, sophisticated computational methods, and potent analytical tools to advance sustainable development. Although there is an abundance of environmental data, the challenge of synthesizing these data into practical insights persists. The AID Programme establishes a repository of leading-edge tools through cross-disciplinary collaborations, emphasizing a problem-oriented approach to sustainability issues. It supports data sharing, highlights existing gaps, promotes best practices, and fosters the development of cutting-edge analytical tools for informed decision-making.

The AID Programme adopts a modular structure tailored to specific sustainability challenges, forming a collaborative network of researchers and institutions. Each module targets a distinct issue, applying the Nexus approach to capitalize on the interconnectedness of various resources and sectors. The programme currently addresses challenges such as biological invasions, droughts, floods, food security, greenhouse gas emissions, groundwater preservation, infrastructure resilience, landslides, sea-level rise, soil health, wetland conservation, and wildfire management.

Since its inception, the AID Programme has initiated 15 modules, involved 130 researchers from 115 institutions, and launched a dedicated platform housing 184 innovative AID tools. By promoting interdisciplinary research, technological integration, and a focus on capacity building and knowledge exchange, the programme aims to make substantial contributions to sustainable resource management. These efforts are geared toward creating a more resilient, just, and sustainable future, effectively tackling complex environmental challenges and advancing the 2030 Sustainable Development Goals (SDGs).

ACUNS
ACADEMIC COUNCIL ON THE UNITED NATIONS SYSTEM

The AID programme was presented at the Academic Council on the United Nations System (ACUNS 2024) by Prof. Kaveh Madani, Director of UNU-INWEH, alongside Prof. Edeltraud Guenther, Director of UNU-FLORES.

Case Studies: PhD Students Showcasing Benefits from the AID Platform

Role of participation in achieving sustainable and resilient agri-food systems in the face of emerging external shocks:

A coupled Citizen Science and Nature-based Solutions approach (CS-NbS)

Governance for sustainable and resilient agri-food systems

Taha Loghmani

UNU FLORES
TECHNISCHE UNIVERSITÄT DRESDEN
STAATSMINISTERIUM FÜR WISSENSCHAFT KULTUR UND TOURISMUS
Freistaat SACHSEN
UNU INWEH
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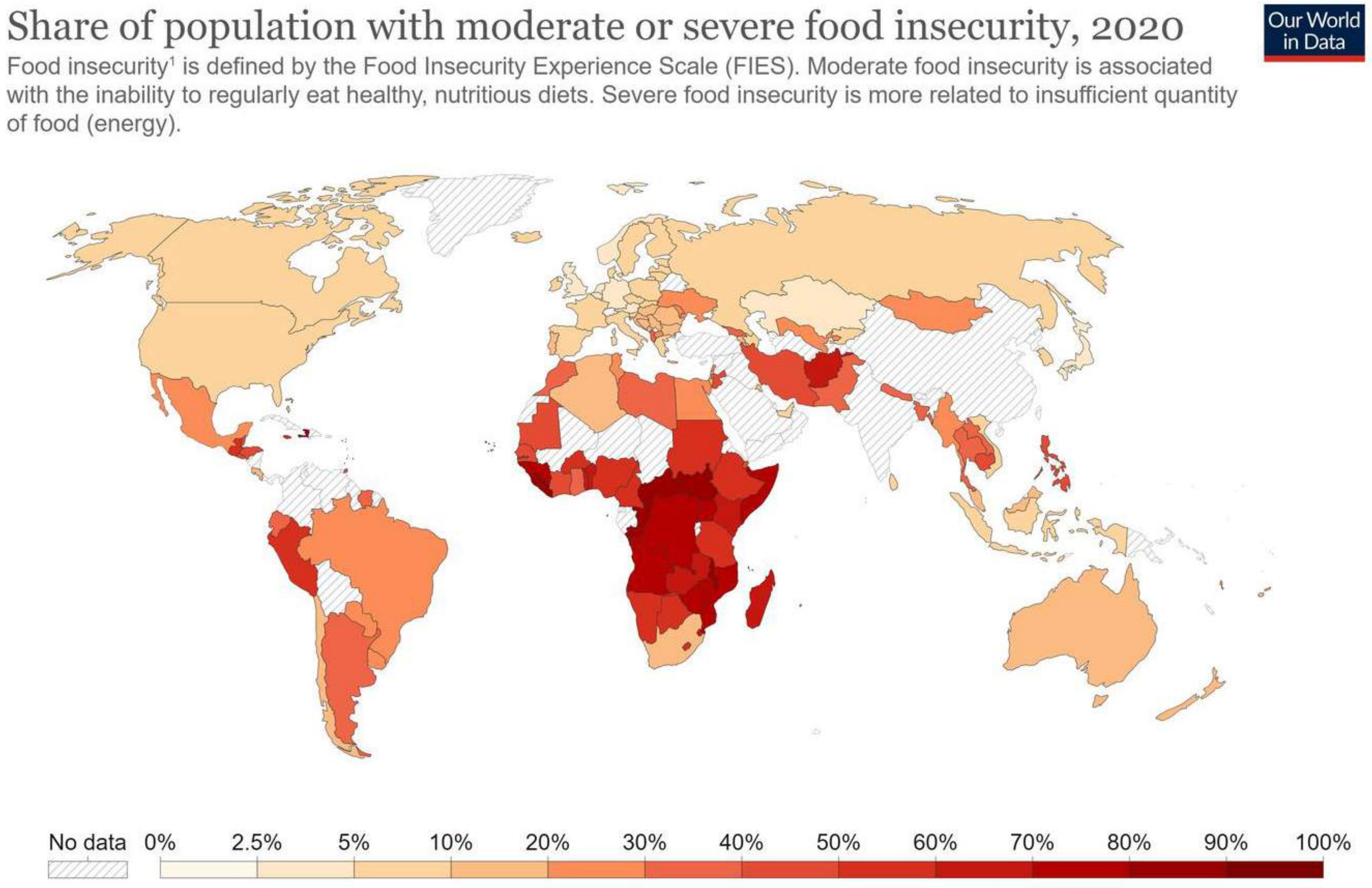
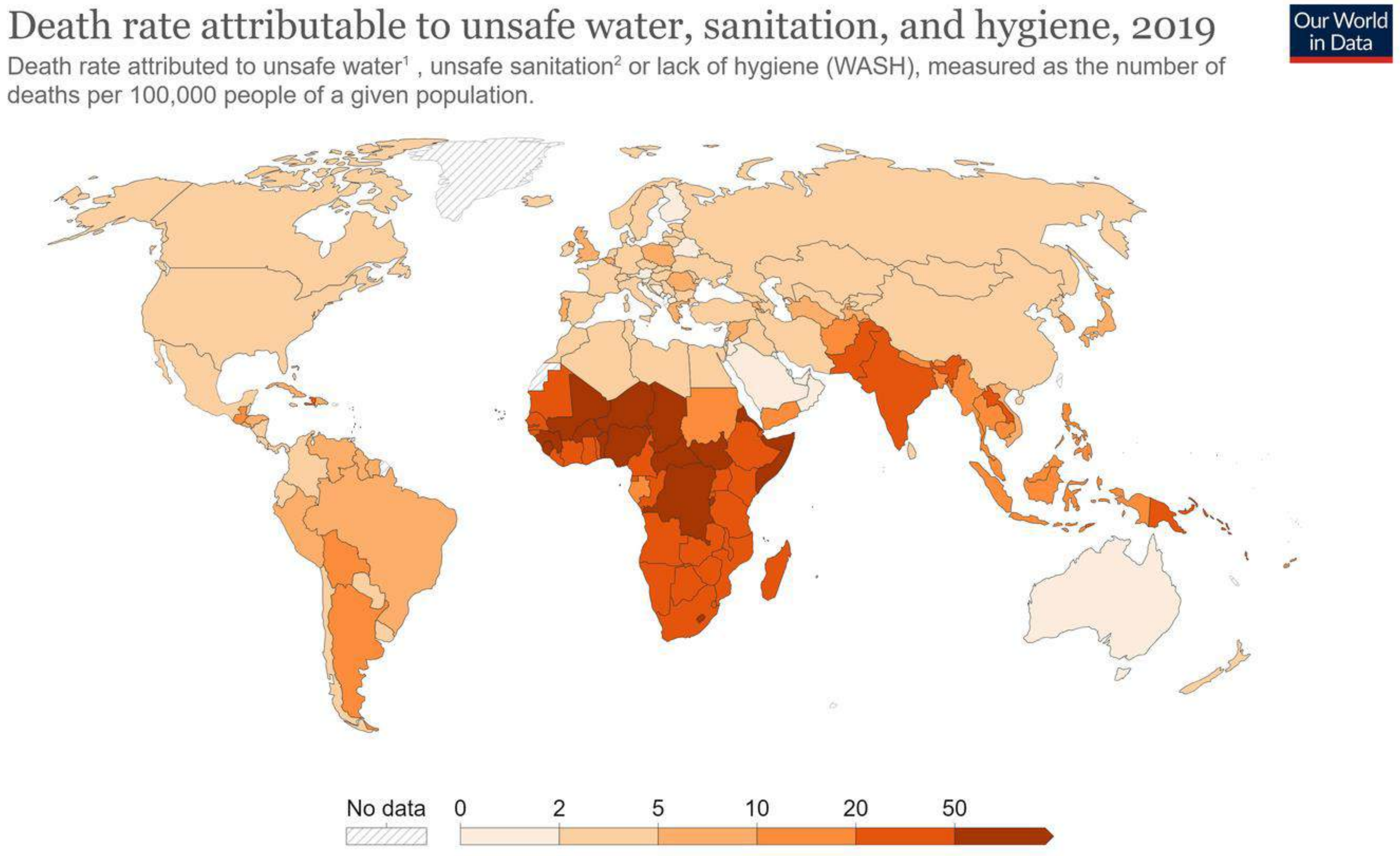
Global Agri-Food & WASH





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Steering
Transformations
Informed decision-making

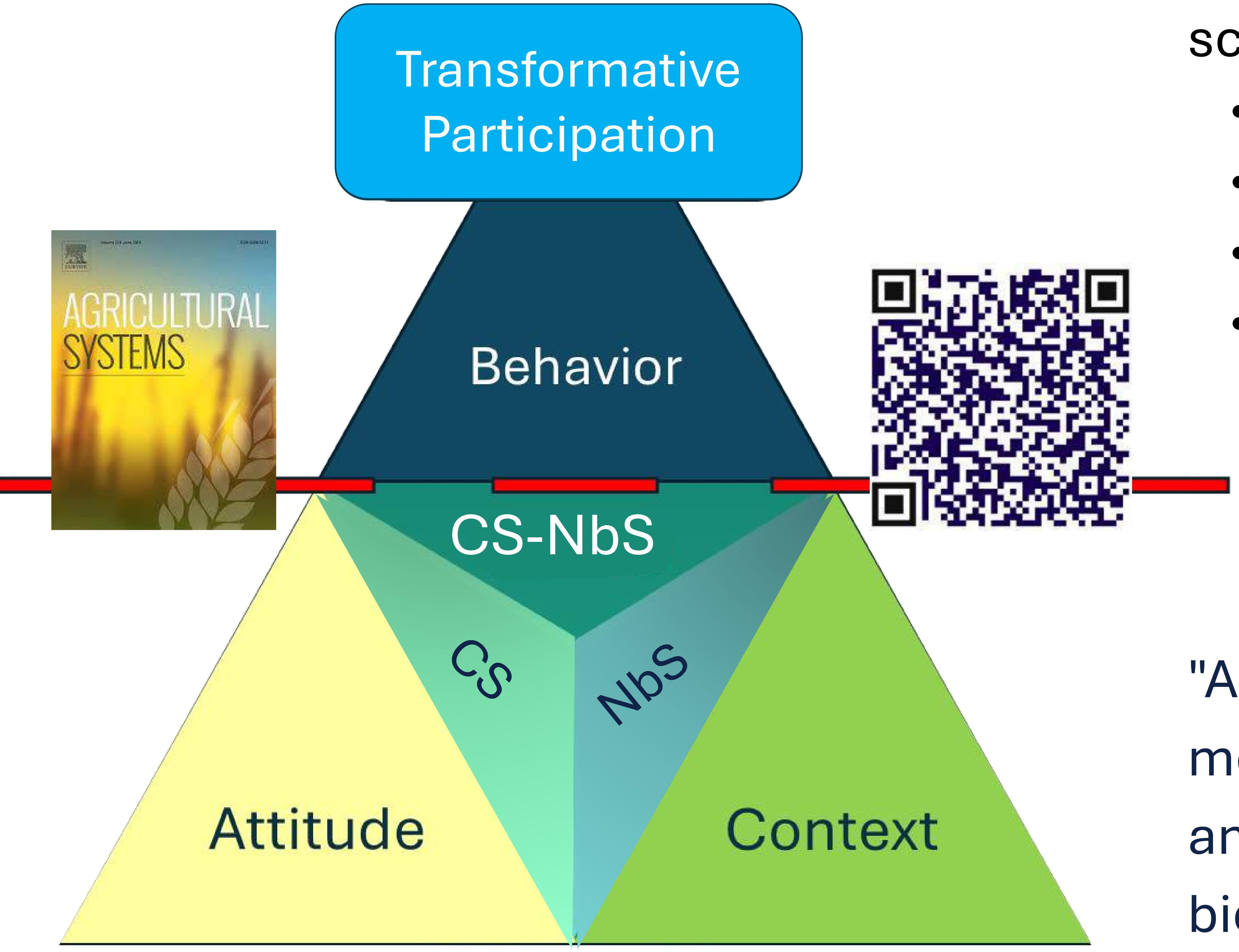
Agri-Food Systems Transformation

- Need for Transformation
- Vulnerability
- Data Gap
- Climate Change Impact
- Food Waste
- Poor Diets
- Affordability

(WEF, 2024; World Bank 2023)

AID identifies systemic problems

Theory



CS-NbS; Adopted from Stern, 2000

CS

A collaborative scientific approach that involves non-professional scientists, or citizen scientists, in the research process.

Fritz et al., 2019

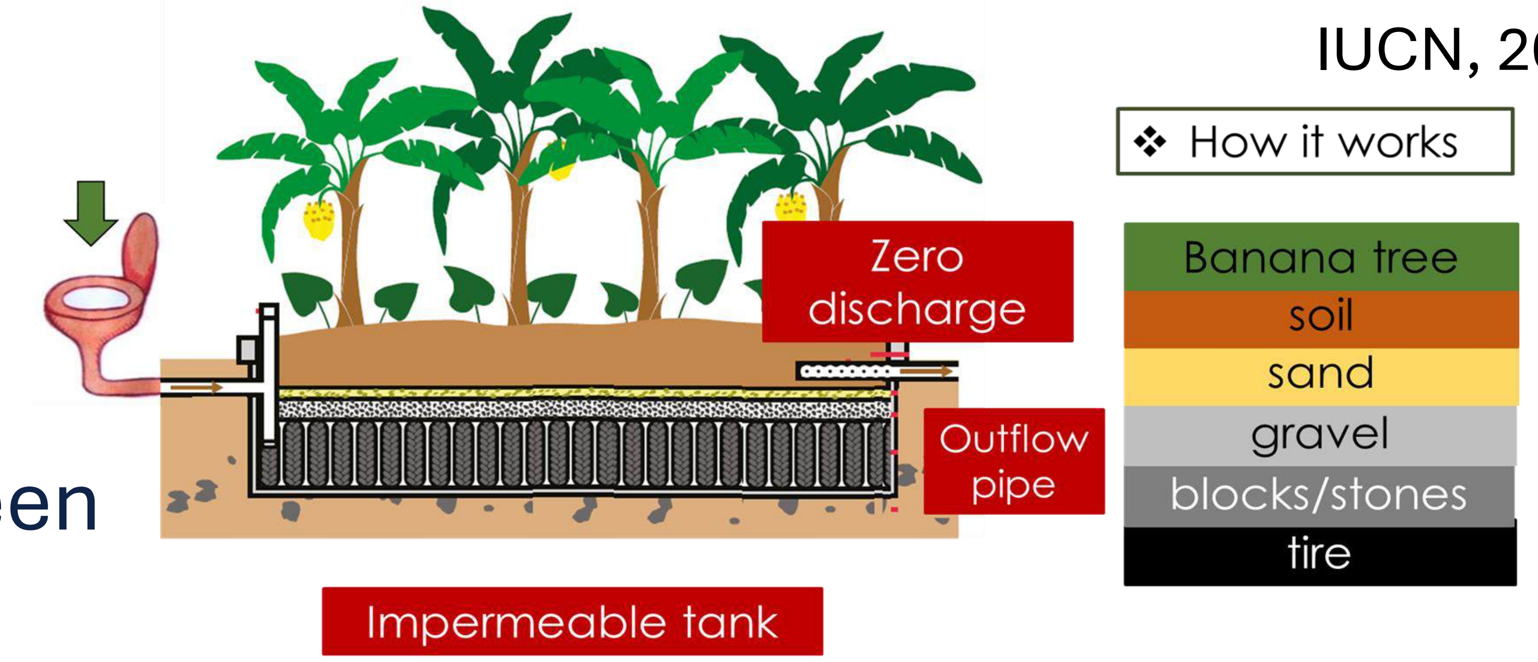
- Data collection & analysis
- Conducting experiments
- Designing research projects
- Sharing knowledge

NbS

"Actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".

IUCN, 2021

- Climate change,
- Water security,
- Disaster risk reduction.
- E.g., constructed wetlands, green infrastructure.



Book: Tonetti et al., 2018 (Tratamento de esgotos domésticos em comunidades isoladas)

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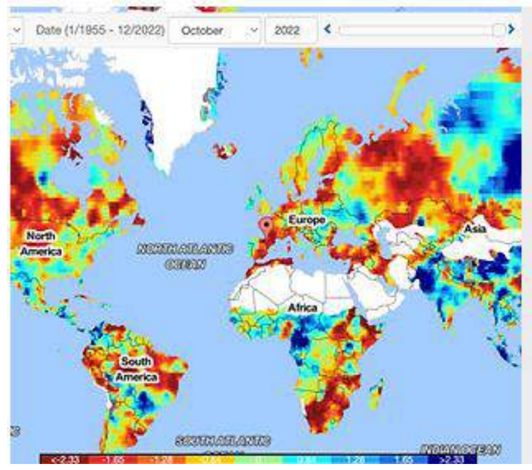
AID and CS-NbS

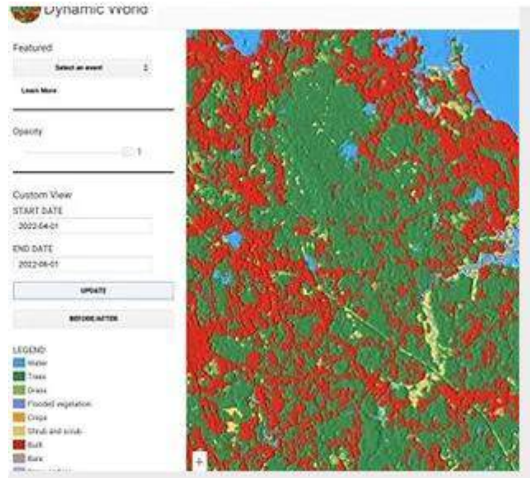


Global Standardized Precipitation Evapotranspiration Index (SPEI)

Offers long-time drought conditions at the global scale, with a 0.5 degrees spatial resolution and a monthly time resolution. Its multi-scale character provides SPEI time scales between 1 and 48 months. Currently, it covers the period between January 1901 and December 2020.

Food Systems Dashboard

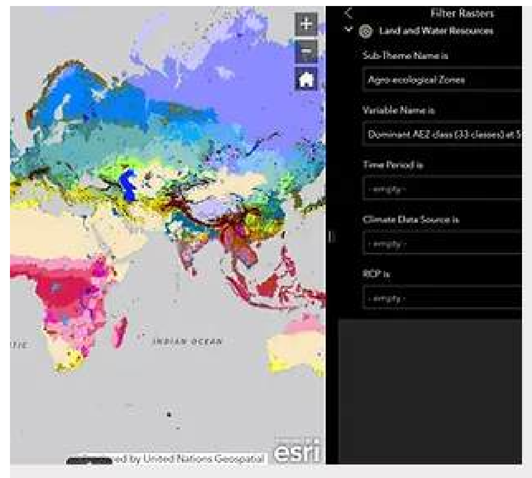
The Food Systems Dashboard gives a complete view of food systems by bringing together data from multiple sources. It's now possible to compare drivers, components, and outcomes of food systems across countries and regions, gain insights into challenges, and identify actions to improve nutrition, health, and environmental outcomes.



Dynamic World

Dynamic World is a near-real time 10m resolution global land use land cover dataset, produced using deep learning, and is freely available and openly licensed. It is produced using the Google Earth Engine and AI Platform. Over 5000 Dynamic World images are produced every day based on Sentinel-2 Top of Atmosphere. The output includes 9 land cover classes, such as water and flooded vegetation, which are related to wetlands.

Read More



FAO - GAEZ

GAEZ v4 is the most ambitious global assessment to date and this Data Portal has been developed to make the database widely and easily accessible for users. It comprises a large volume of spatial natural resources indicators and results of agro-ecological crop analysis. Results are presented in a regular raster format of 5 arc-minute (about 9 x 9 km at the equator) grid cells. Selected maps related to AEZ classification, soil suitability, terrain slopes and land cover are provided at 30 arc-second (0.9 x 0.9 km) resolution. The GAEZ v4 update includes 2010 baseline data comprising land cover, a harmonized global soil database and terrain data, protected areas and areas of high biodiversity value. Climatic

System for Earth Observation Data Access, Processing and Analysis for Land Monitoring (SEPAL)

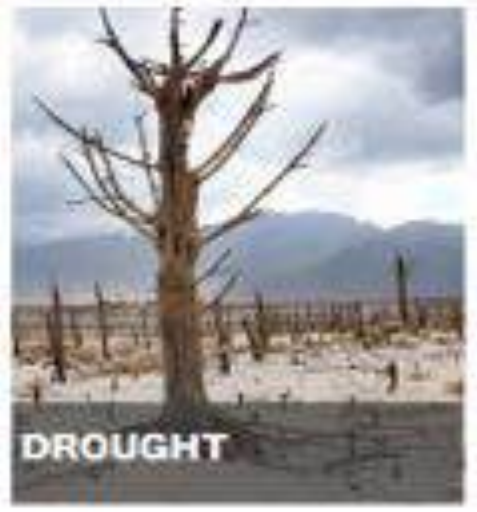
SEPAL (System for Earth Observation Data Access, Processing and Analysis for Land Monitoring) is an open-source project and platform empowering people around the world to gain a better understanding of land cover dynamics by facilitating the efficient access and use of Earth observation data – without the need of coding knowledge.

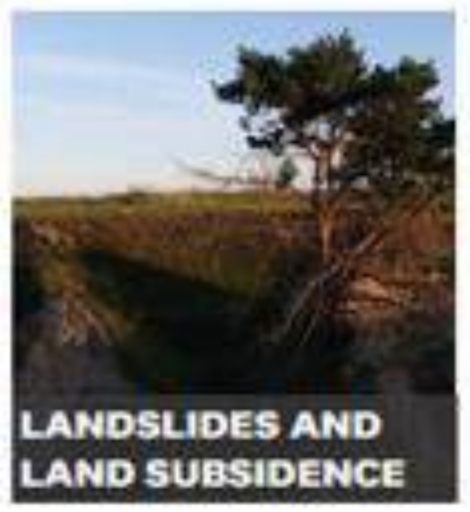
INFER (INsights on Food SystEm Risks)

INFER, developed by ESCAP and the WFP Regional Bureau for Asia and the Pacific, with contributions from UNEP and FAO, offers insights into multidimensional risks affecting three critical food system outcomes: human health and nutrition, ecosystem health and sustainability, and shared prosperity. It assesses risks across six dimensions of food security. Building on 96 indicators, INFER enables tracking of risk and comparison of risk drivers over time, within and across countries, contributing to the tools available for food systems monitoring and for ensuring that food systems resilience-building strategies are risk-informed.

About interactive map of land subsidence in Iran

FAO Soil Portal





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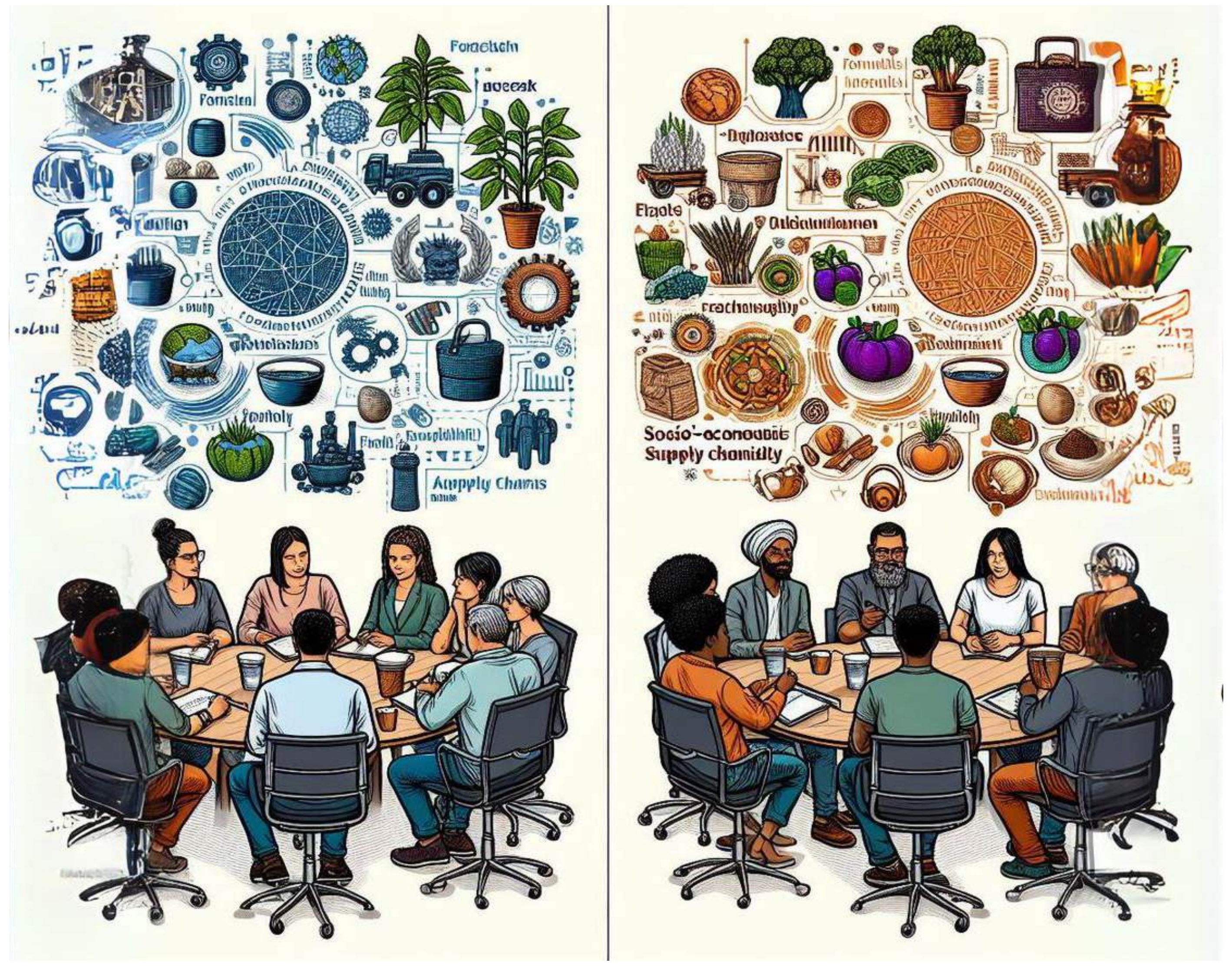
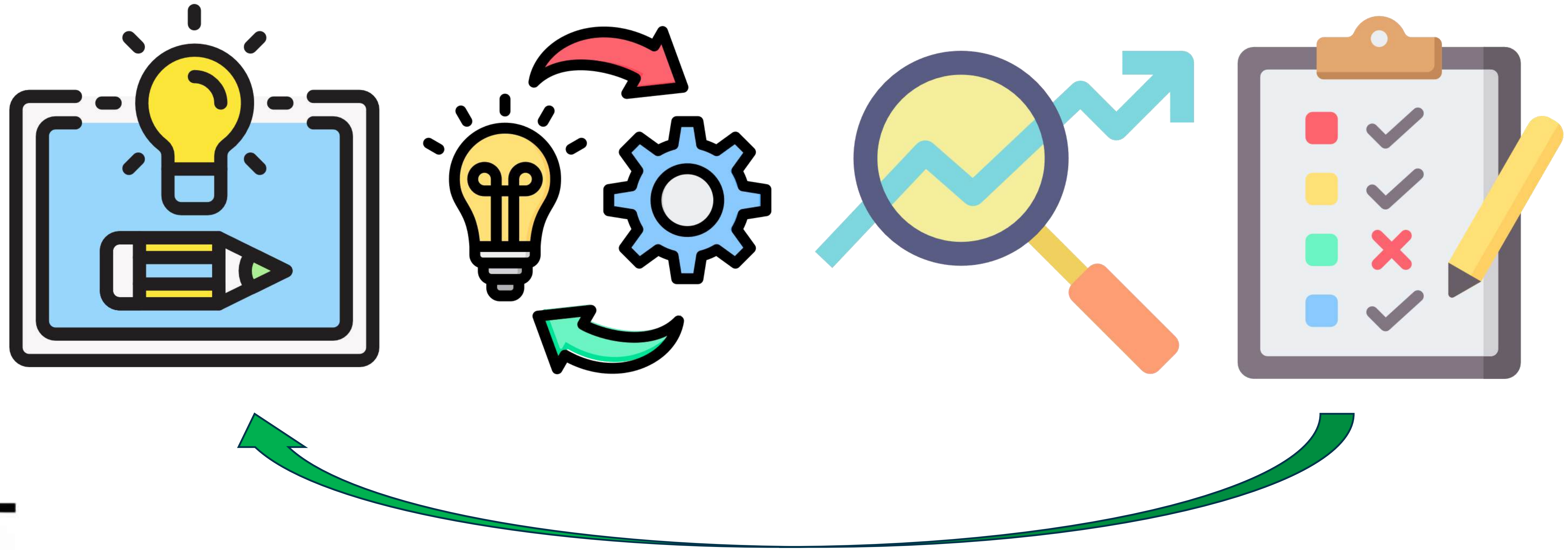
Research

- Systematic Literature Review
- Methodology development
  - Sequential focus groups
  - Facilitated Interviews
- Implementation driver & barrier analysis
  - Social Network Analysis
  - Semi-structured interviews
  - Fuzzy cognitive mapping
- Modeling upscaling scenarios



Development

Design Implement monitor Evaluate



www.unwater.org/publications/who/unicef-joint-monitoring-program-update-report-2023

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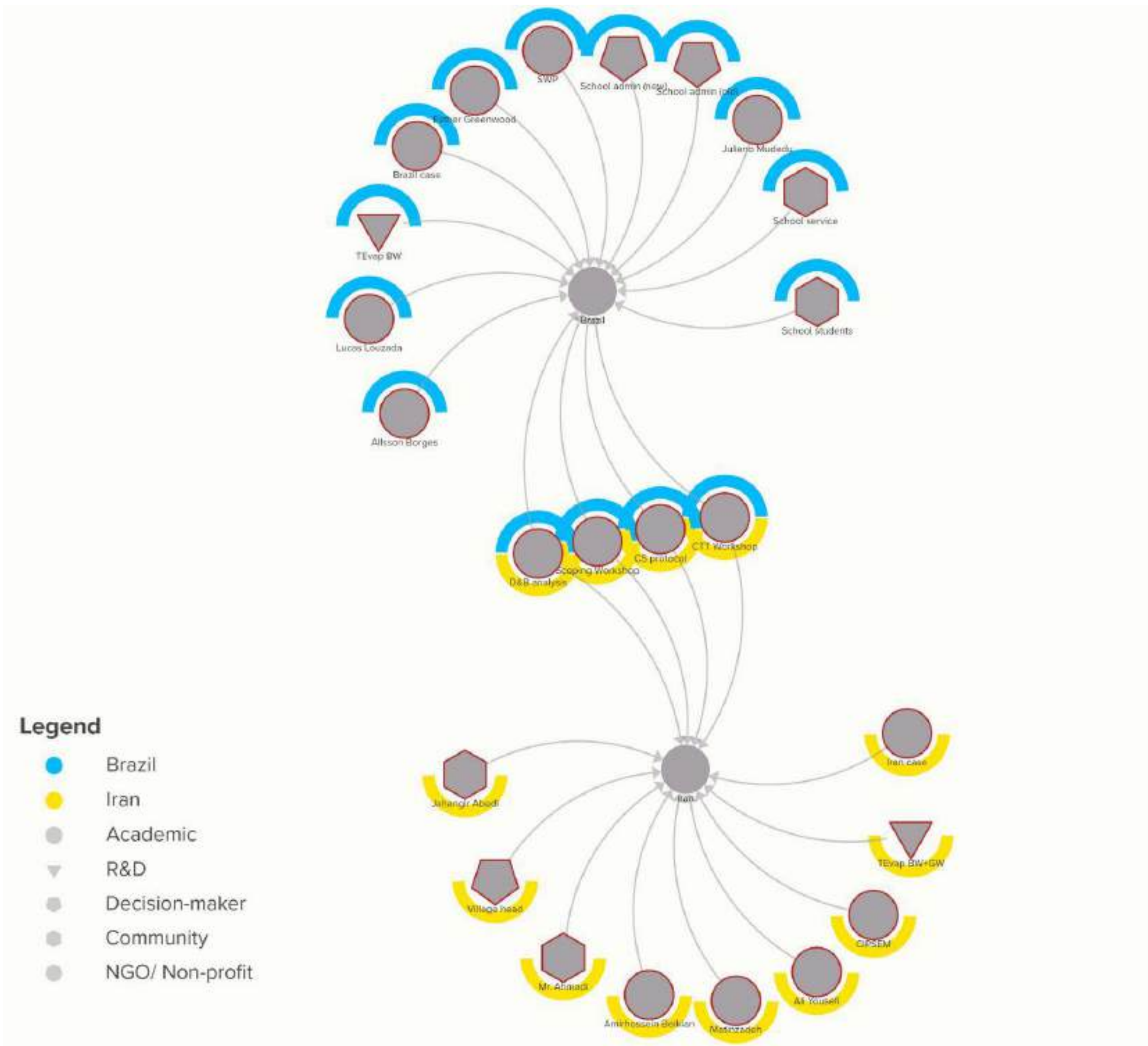
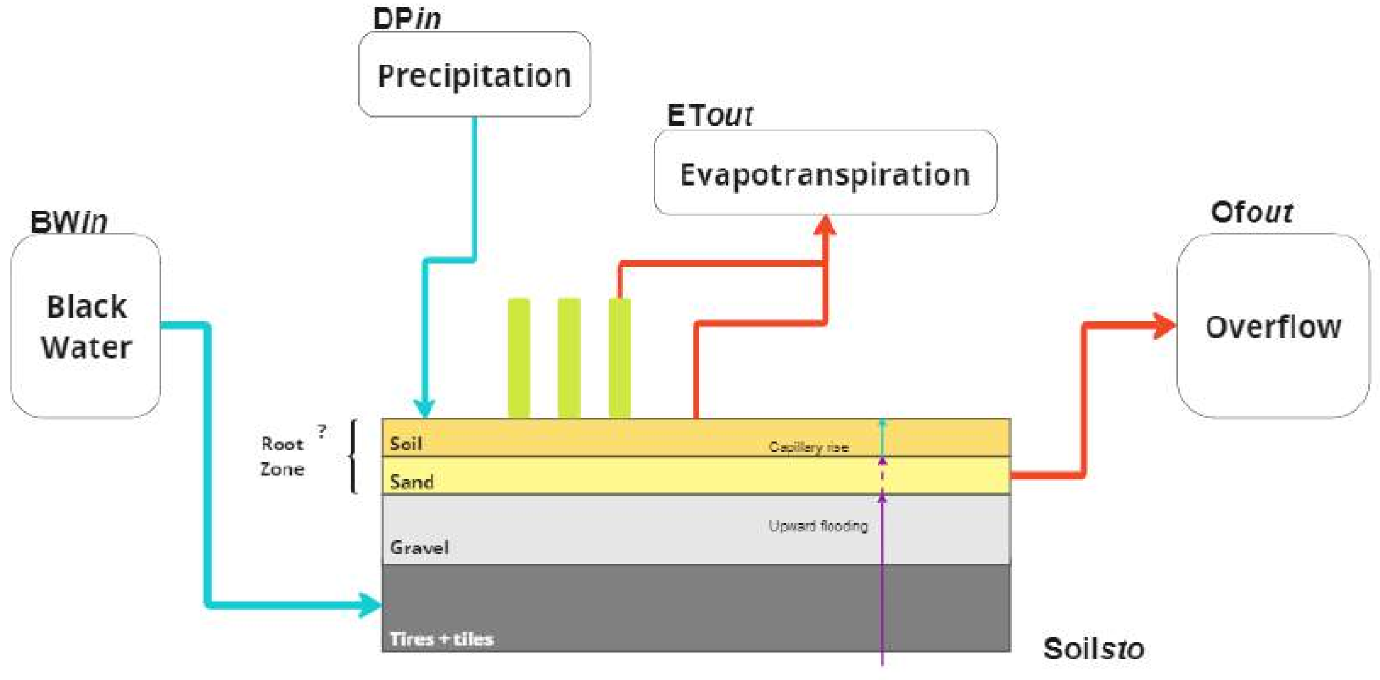
CS



Data collection activity	Frequency	Method
Water-level monitoring	• Weekly/ Bi-weekly	Measuring stick
Visual inspections: • System appearance • Sludge accumulation	• Weekly (1st 3 months)/ • Bi-weekly (3rd Month onwards)	• Visual • Towel and a stick into the inspection pipe
Plant health	• Weekly (1st 3 months)/ • Bi-weekly (3rd Month onwards)	• Visual • Flooding indicators • Suffocation indicators
Climate and weather conditions	• Daily • Event-based	• Rainwater gauge • Weather data (if available)
Documentation	• Monthly • Event-based	• Log-book • Photographic
Water quality: • Clarity • Odour	• Match with other tasks	• Training required • Visual
Sample collection: • Soil • Crops	• Monthly (1st 3 months)/ Tri-monthly (3rd Month onwards) • Seasonal	• Training required: Topsoil mid-depth/ 3 locations/ cup size • Hand-picked/ low-mid-high ranges

CSNbS



Water balance:

BW*in* + DP*in* + dSoil*sto* = ET*out* + Of*out*

The soil is simulated as four different reservoirs, with two process - bottom-up and top-down

<u>Bottom-up</u>
The bottom two reservoirs are assumed to be fully saturated, and follow the following storage equation: storage = *porosity* x *surface area* x *water level*.

<u>Top-down</u>
The top two reservoirs are simulated using the 1D Richardson equation, using paramters from the Van Genuchten model.

Crops evapotranspiration is simulated using the FAO crop coefficients approach, where ET*actual* = Kc x ET*ref*. Surface evaporation maybe included or ignored.

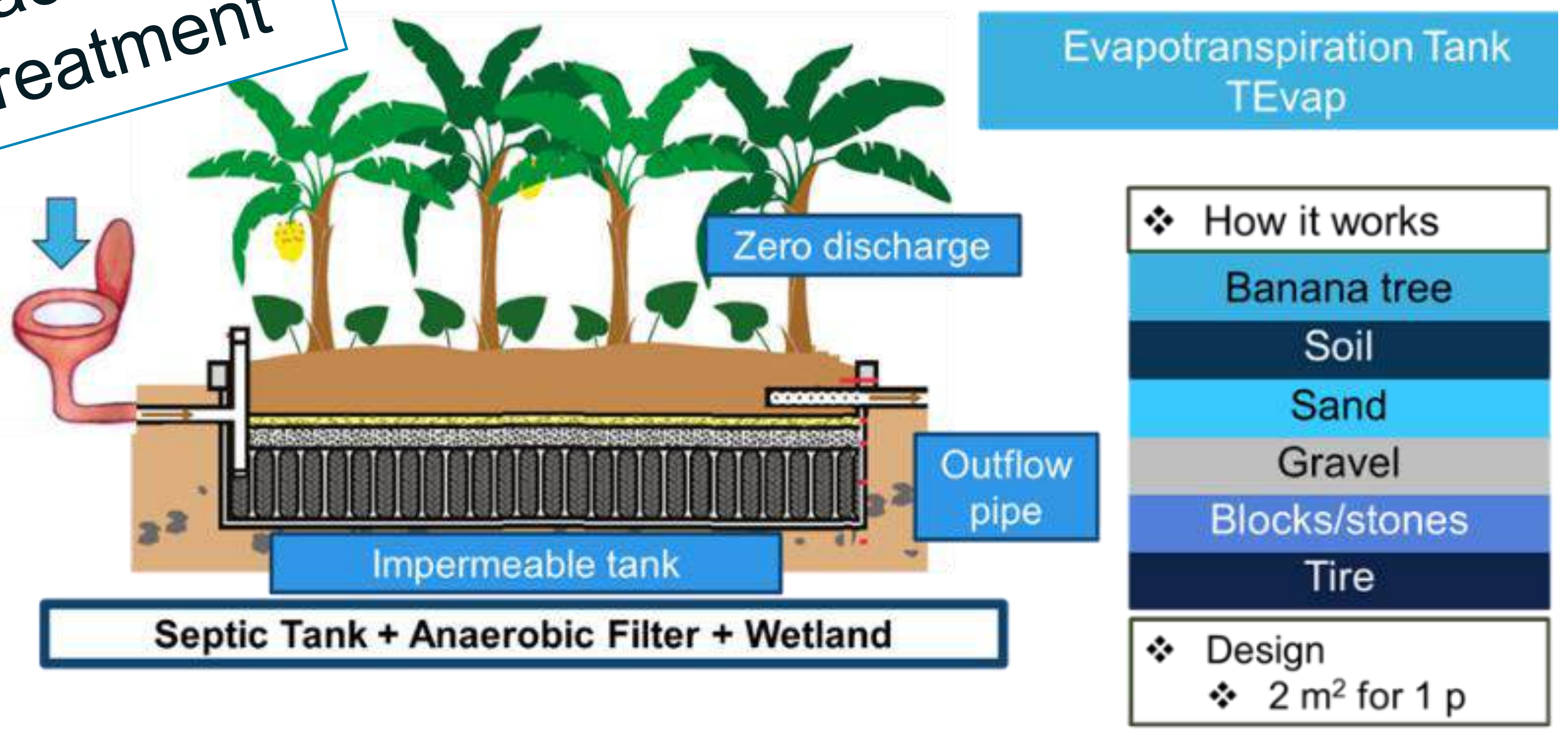
miro

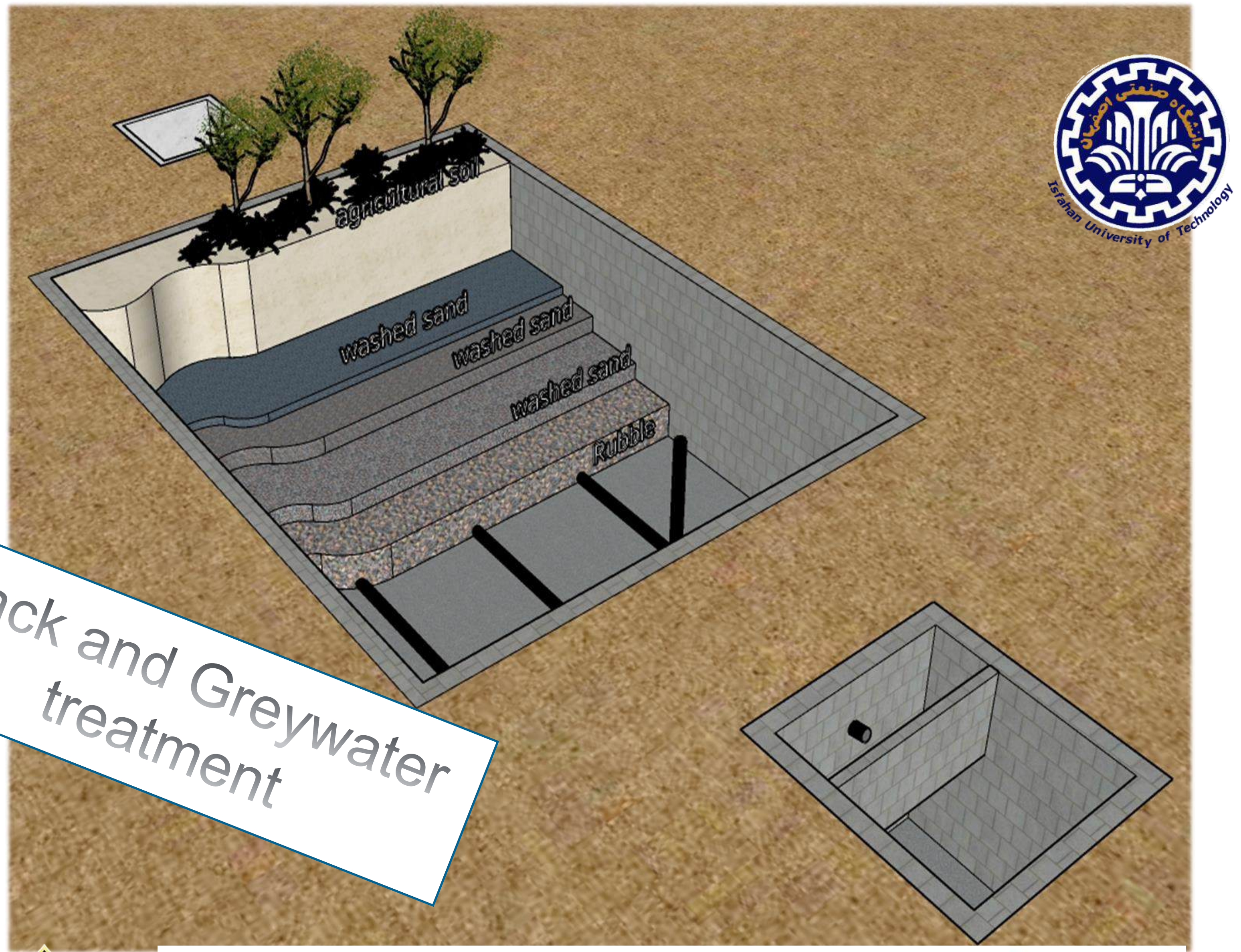
NbS

- Evapotranspiration tank (TEvap)
  - Agri-food and WASH
  - Domestic wastewater
  - Agri-food products

UFV Universidade Federal de Viçosa

Blackwater treatment





Black and Greywater treatment

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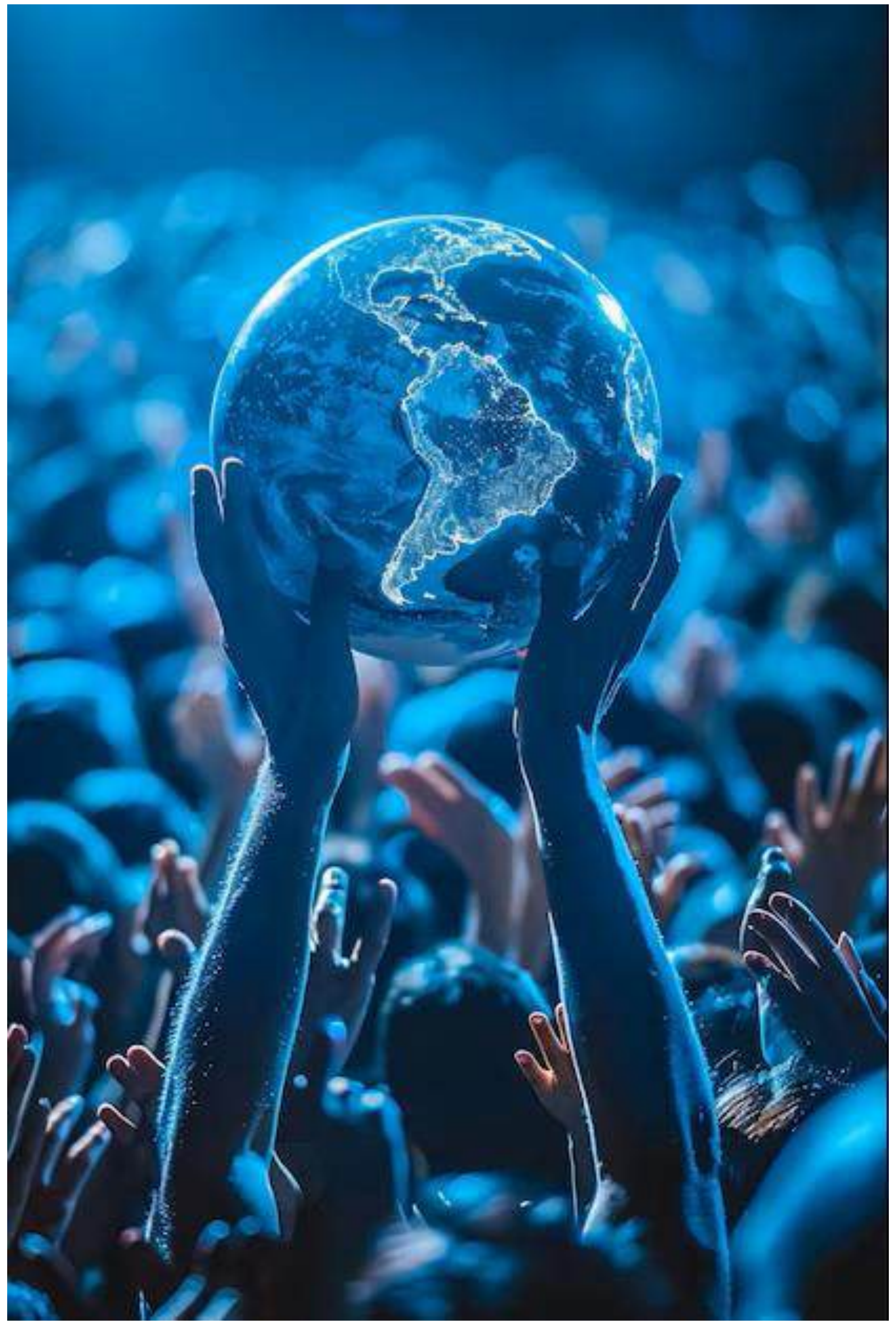
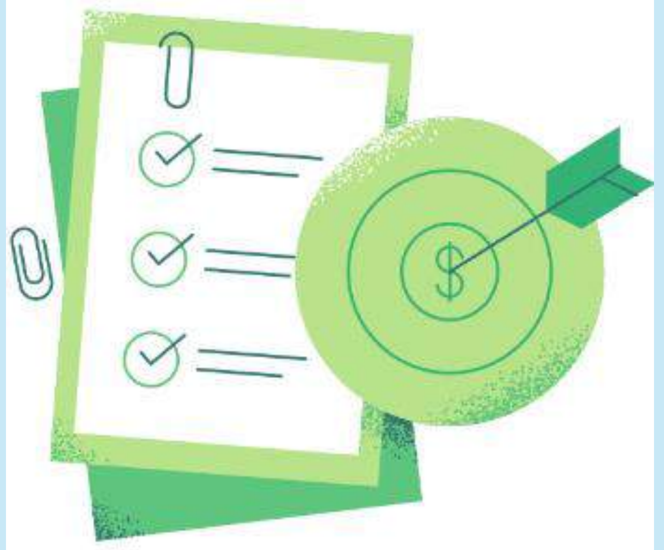
Potential Approaches for Integrating Citizen Science into the AID Programme



There are several potential ways to integrate citizen science into the AID program:

- CS integration into existing modules
- CS as a standalone module/ platform
- AID as a host for real-time CS data input on the global Resource Nexus use and governance





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The Role of Stakeholders in Corporate Biodiversity Management in the Middle East and North Africa (MENA) Region

Ghada Amin

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Research Project Overview

Research Topic: The Role of Stakeholders in Corporate Biodiversity Management in the Middle East and North Africa (MENA) Region

Objectives:

- Ensure that economic flourishing of the sector is achieved while preserving biodiversity.
- Provide full review and Identification of all relevant stakeholders in renewable energy sector and assess their current positions (positive- negative- neutral) .
- Assessment of existing sector policies and legislative framework related to biodiversity management.
- Identification of the gap between the existing sector policies/ legislations and the crucial requirements towards proper engagement of stakeholders for adequate implementation of biodiversity management plans.
- Development of integrated policy brief ensuring clear identification of roles of each relevant stakeholders in prevention of natural capital deterioration risks.

Beneficiaries:

- Governmental organizations.
- Private Sector RE Companies.
- Policy makers.
- NGOs.
- Landowners and communities residing around the renewable energy projects locations.

Source: Green Hydrogen Morocco, 2023

DAAD
Deutscher Akademischer Austauschdienst
German Academic Exchange Service

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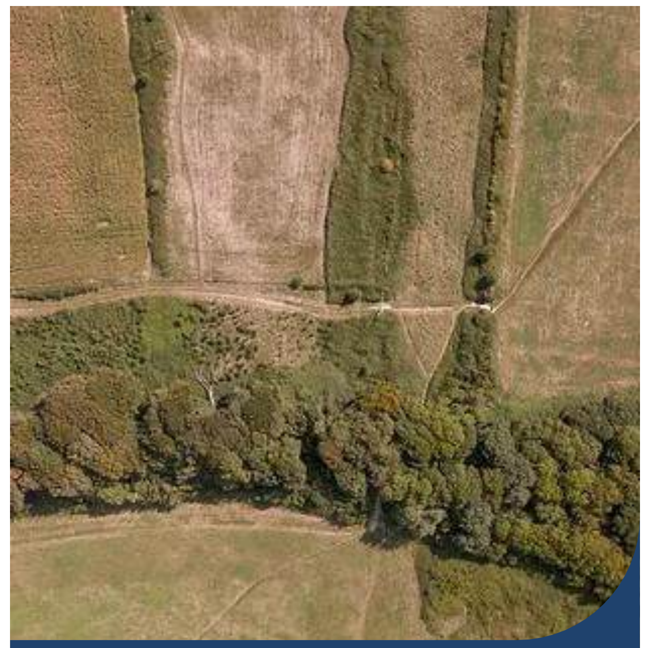
Used Module of Sustainability Nexus Analytics, Informatics, and Data (AID)

Learning for Nature

Learning for Nature is a premier e-learning programme offered by the United Nations Development Programme (UNDP). This programme connects biodiversity policymakers, change-makers, and on-the-ground subject matter experts to promote biodiversity conservation and facilitate the achievement of the Sustainable Development Goals.



Land Use Land Cover Change

Other tools/courses linking Biodiversity, Business and Finance →

Micro-course

An Introduction to Nature, Business and Finance

Micro-course

Connectivity 101: Ecological connectivity for people and planet

Self-paced module

Gender and Biodiversity Decision-Making

Self-paced module

Youth for Climate Action

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NEXOGENESIS

STREAMLINING WATER RELATED POLICIES

Stakeholder co-creation approach to governance of the water-energy-food-ecosystem nexus: transdisciplinary methods & insights from 5 river basins

Caro Mooren, KWR Water Research Institute (The Netherlands) - caro.Mooren@kwrwater.nl

Sabina J. Khan, Helmholtz Centre for Environmental Research – UFZ (Germany) – sabina.khan@ufz.de

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003881.

Agenda

1. Overview of Nexogenesis
    - WEFE Nexus Governance Approach
        - Problem Identification
        - Stakeholder dialogue
        - Realising new governance arrangements
        - Implementation

2. Application in the Lielupe river basin

3. Nexus governance ambitions in other case-studies

4. Next steps: guidebook on NXG approach

5. Reflections for transdisciplinary research

Overview of Nexogenesis

EU Horizon 2020 | Sept 2021 – Aug 2025 | 20 Partners | 5 case-studies | www.nexogenesis.eu

Framework & tools for stakeholders' co-creation of integrated water-energy-food-ecosystems (WEFE) policies & practices

nexus system dynamics | complexity science modelling | artificial intelligence | technology transfer
water diplomacy | governance & policy analysis | transdisciplinary co-creation methods & practice | stakeholder engagement

https://nexogenesis.eu

Overview of Nexogenesis

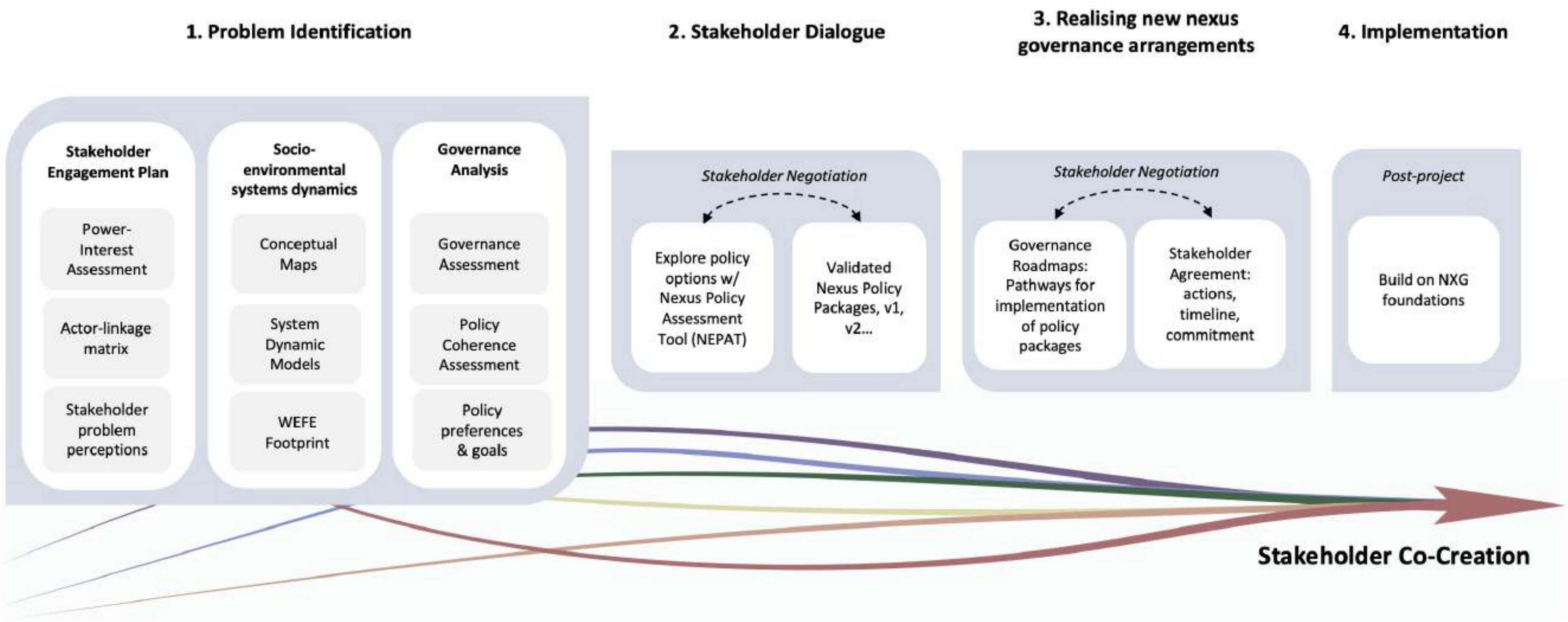
1/ Stakeholder co-creation framework: conceptualizing, analysing and problem-solving nexus governance issues

2/ Artificial intelligence tool: modelling effects of multi-sectoral policies on local biophysical and socio-economic context and achievement of policy goals

3/ Testing solutions: iterative improvement & lessons learned from 5 river basin case studies

NEXOGENESIS
STREAMLINING WATER RELATED POLICIES

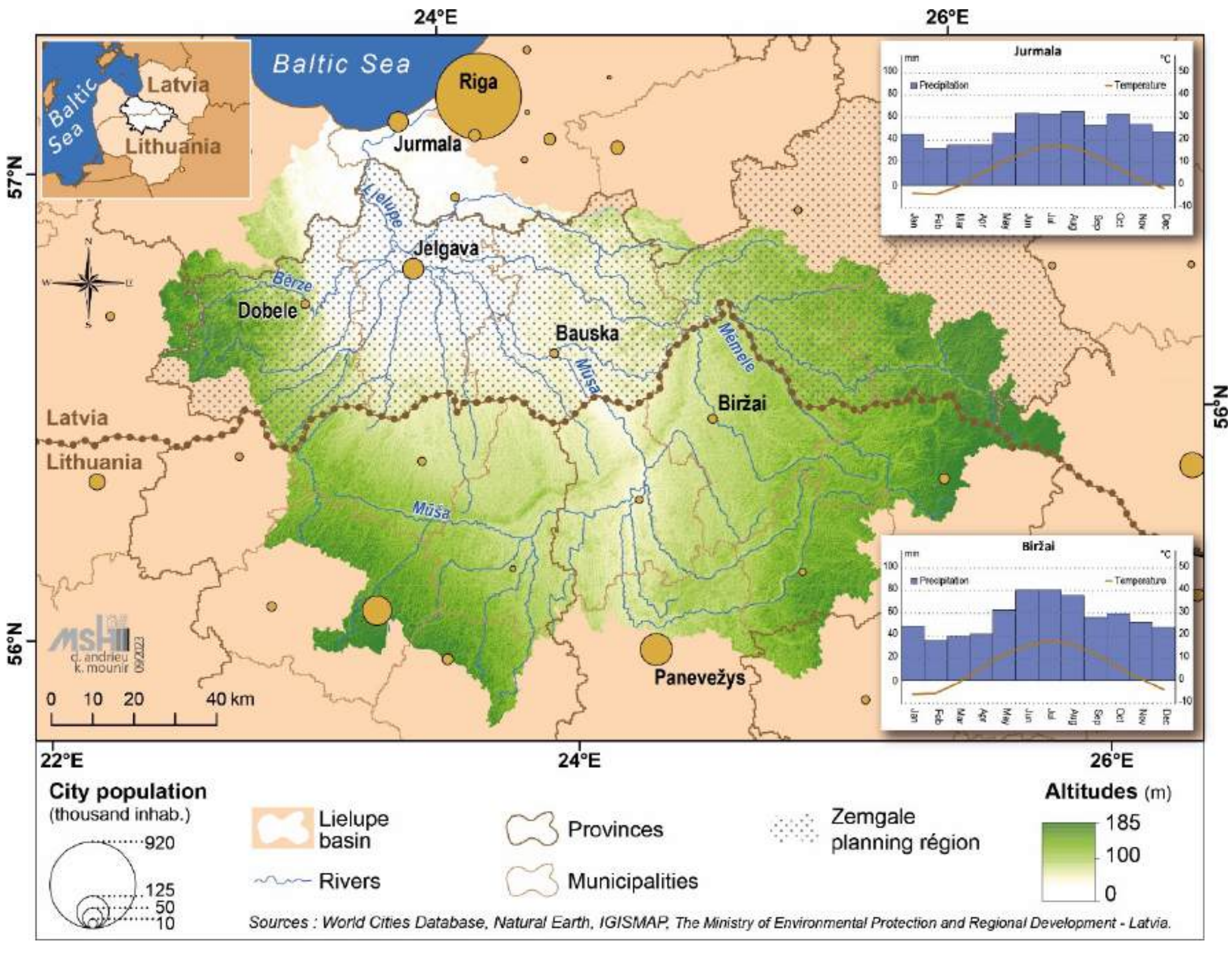
Overview of Nexogenesis



Case-study: Lielupe river basin (Lithuania-Latvia)

- Main nexus issues:
  - Hydromorphical alterations
  - Eutrophication
  - Floods

- Main transboundary interdependence: water quality issues



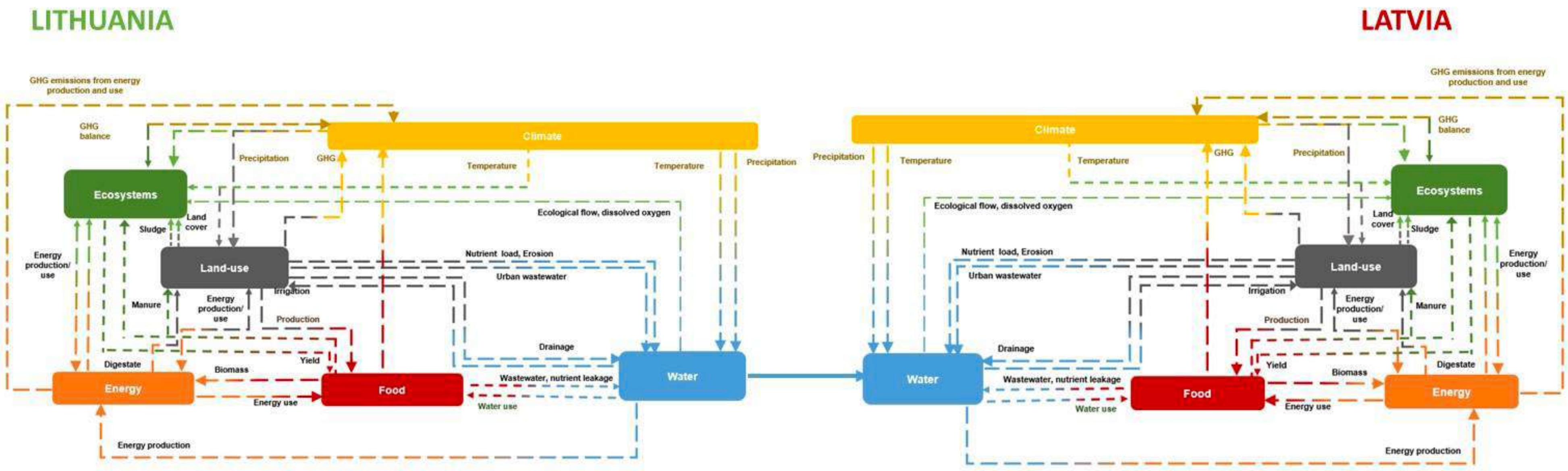
1. Problem identification

Biophysical interlinkages

- Conceptual maps & causal loop diagrams
  - Visualize & quantitatively model nexus interlinkages
  - Co-created with stakeholders
- Shared understanding of nexus issues
- Understand nexus hotspots for trade-offs and synergies
- Identify relevant policies

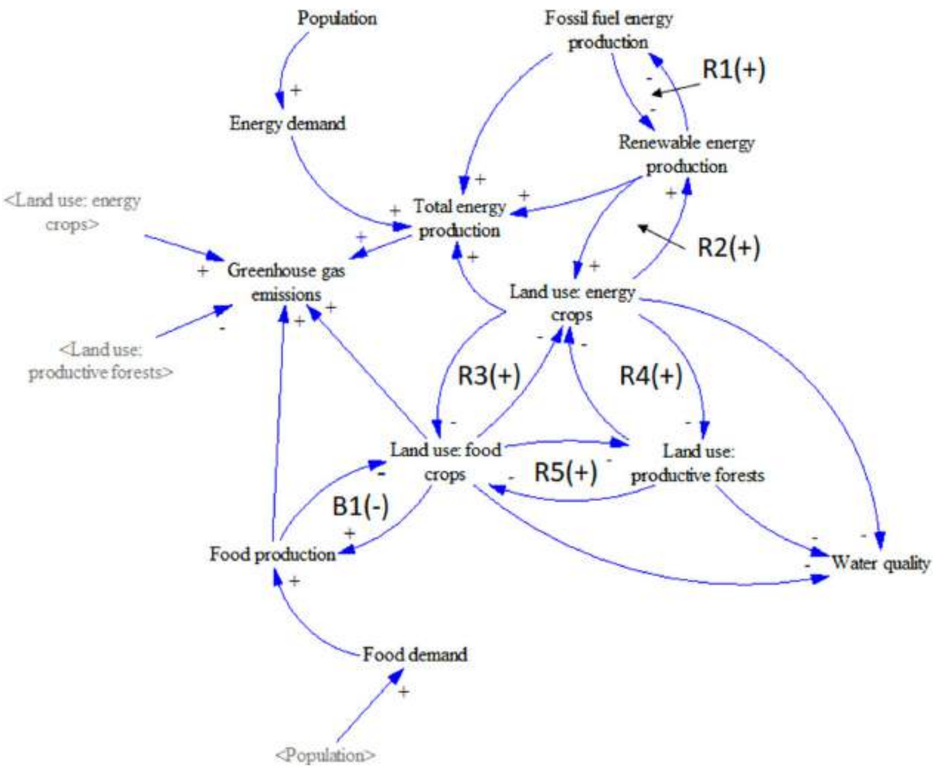
1. Problem identification

Conceptual Map



1. Problem identification

Causal Loop Diagram



Notation	Description	Example
A + B Connector	change in A, causes change in B in the same direction. If A increases/decreases, B also increases/decreases	Temperature + Evaporation Cultivated land + Water demand
A - B Connector	change in A, causes change in B in the opposite direction. If A increases/decreases, B also increases/decreases	Infiltration - Run-off Groundwater table - Pumping cost
R or (+)	Reinforcing or positive feedback loop, if it contains an even number of negative causal links	Birth Rate + R + Population
B or (-)	Balancing or negative feed back loop, if it contains an odd number of negative causal links	Population + B - Death Rate
or	Delay, the situation when the systems respond slowly in certain condition	Number of Plant Growing + Harvest Rate

Purwanto et al., 2019

Causal loop diagram of the 'top level' of the Latvian nexus

Sušnik, J., et al. (2021). System dynamics modelling to explore the impacts of policies on the water-energy-food-land-climate nexus in Latvia. Science of The Total Environment. 775. 145827.

1. Problem identification

Governance Analysis

- **Nexus Governance Assessment (NXGAT): capacity of governance system for WEFE nexus governance**
  - Semi-structured interviews (ca. 1,5-2hrs)
  - Expert judgement (interdisciplinary research team)
  - Validation:
    - Case-study leads
- **Policy coherence assessment: degree policies acknowledge mutual dependencies on other sectors**
  - Desk study
  - Validation:
    - Research team
    - Stakeholders (via focus groups)

Nexus Governance Assessment Tool

	Quality of WEFE nexus governance system				
Governance dimensions	***Comprehensiveness*** *Degree to which governance system includes relevant nexus elements*	***Coherence*** *Degree to which elements of governance system are strengthening vs. weakening each other*	***Flexibility*** *Capacity of governance system to provide different pathways towards nexus governance*	***Intensity of action*** *Capacity of governance system to urge more nexus-oriented actions*	***Fit*** *Degree to which governance system corresponds to ecosystems properties & functions*
Levels & scales	Degree to which relevant actors & networks affected by or affecting nexus domains involved?	Degree to which interactions of relevant actors & networks across nexus domains are cooperative, solid and based on trust?	Degree to which governance system allows inclusion of new actors or shift lead actors when needed?	Degree to which there is pressure from a relevant actor or actor coalition across nexus domains towards behavioral change or management reform?	Degree to which relevant actors & networks across nexus domains are appropriate to deal with ecosystem properties and functions?
Actors & networks	Degree to which relevant levels & scales across nexus domains are involved?	Degree to which relevant levels & scales across nexus domains work together, acknowledging interdependencies & trusting each other?	Degree to which governance system allows changes in levels or scales at which nexus issues are addressed?	Degree to which there is pressure from relevant levels or scales across nexus domains towards behavioral change or management reform?	Degree to which relevant levels & scales of governance system match ecosystem properties and functions?
Problem perspectives & goal ambitions	Degree to which various problem perspectives & goal ambitions across nexus domains are taken into account?	Degree to which problem perspectives & goal ambitions across nexus domains are mutually reinforcing?	Degree to which governance system allows re-assessment of goals across nexus domains & combining multiple goals in package deals as needed?	Degree to which problem perspectives & goal ambitions across nexus domains urge for WEFE nexus orientation?	Degree to which problem perspectives & goal ambitions across nexus domains take into account ecosystem properties and functions?
Strategies & instruments	Degree to which relevant strategies & instruments include nexus orientation?	Degree to which relevant strategies & instruments across nexus domains are mutually reinforcing?	Degree to which governance system allows combinations or use of different strategies & instruments across nexus domains?	Degree to which relevant strategies & instruments across nexus domains urge nexus-oriented behavior or management reform?	Degree to which relevant strategies & instruments across nexus domains take into account ecosystem properties and functions?
Responsibilities & resources	Degree to which responsibilities & resources across domains are clearly assigned to support nexus-oriented management?	Degree to which responsibilities & resources across nexus domains lead to cooperation amongst these domains?	Degree to which governance system allows pooling of assigned responsibilities & resources across WEFE nexus domains without compromising accountability & transparency?	Degree to which responsibilities & resources across nexus domains urge implementation of nexus-oriented actions?	Degree to which assigned responsibilities & allocated resources across nexus domains are appropriate to deal with ecosystem properties and functions?
Overall score	very low / low / high / very high	very low / low / high / very high	very low / low / high / very high	very low / low / high / very high	very low / low / high / very high
Concluding evaluation	highly restrictive / restrictive / moderately supportive / supportive				

NXGAT Results - Lielupe

Latvia

Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity	Fit
Actors and networks	HIGH	LOW	LOW	LOW	LOW
Levels and scales	LOW	LOW	HIGH	LOW	LOW
Problem perspectives and goals ambitions	LOW	LOW	HIGH	VERY LOW	LOW
Strategies and instruments	HIGH	LOW	HIGH	LOW	LOW
Responsibilities and resources	HIGH	LOW	HIGH	VERY LOW	LOW
Overall assessment	HIGH	LOW	HIGH	VERY LOW	LOW
Concluding evaluation	The current governance system is restrictive toward WEFE nexus goverance: justification with barriers and levers				

Lithuania

Dimensions / Criteria	Comprehensiveness	Coherence	Flexibility	Intensity	Fit
Actors and networks	LOW	LOW	VERY LOW	LOW	LOW
Levels and scales	LOW	LOW	LOW	LOW	LOW
Problem perspectives and goals ambitions	HIGH	LOW	LOW	LOW	LOW
Strategies and instruments	HIGH	LOW	LOW	LOW	LOW
Responsibilities and resources	LOW	LOW	LOW	LOW	LOW
Overall assessment	LOW	LOW	LOW	LOW	LOW
Concluding evaluation	The current governance system is restrictive toward WEFE nexus goverance				

Policy Coherence Assessment

Policies scored based on **degree they acknowledge mutual dependencies on other sectors / sectors' policies:**

- **Strong integration**: Prescribes specific measures to ensure that impacts on other sectors are managed and synergies exploited.
- **Weak integration**: Mentions / acknowledges possible impacts / synergies with other sectors but there are no mandatory measures.
- **No integration**: Does not refer to other sectors although impacts and/or synergies exist.
- **Not applicable**: Is not expected to refer to other sectors.

Not applicable	
No integration	
Weak integration	
Strong integration	

Policy Coherence Scoring – Lielupe

Lithuania

Sector	Policy	Water	Energy	Food/ agriculture	Land/Soil	Biodiversity/ ecosystems	Climate
Water	Lielupe River Basin District Management Plan						
Water	Water Law						
Water	Water Development Program 2017–2023						
Water, agriculture	Regulation on the designation of control authorities for the approval and management of the description						
Land-use	Special Land Use regulations						
climate, ecosystems, water	National environmental strategy						
Land-use, food, agriculture	Land Reclamation Law						
Land-use	Natural Resources Tax Law						
Land-use, agriculture	Land law						
Energy, water, land, climate, ecosystems,	Sustaibale development strategy of Lithuania						
Agriculture, forestry, fishery	Law: On Agriculture, food and Rural Development						
Protected areas, including Natura 2000	Law on the protected areas						
Food, agriculture, energy, climate, water	Law on Environmental Protection						
Energy, Climate	National Energy and Climate Plan for 2021-2030						
Energy	Energy Law						
Energy	Renewable Energy Law						
Climate	National climate change management agenda						

Latvia

Sector	Policy	Water	Energy	Food/ Agriculture	Land/ Soil	Biodiversity/ Ecosystems	Climate
Water	Lielupe River Basin District Management Plan and Flood Risk Management Plan						
Water	Water Management Law						
Water, agriculture	Requirements regarding the protection of water, soil and air from pollution caused by agricultural activity						
Food	Action plan for development of biological farming						
climate, ecosystems, water	The 2021-2027 environmental policy guidelines						
Land-use, food, agriculture	Amelioration law						
Land-use, agriculture	Land Management law						
Energy, water, land, climate, ecosystems,	Latvia 2030 - Sustainable development strategy of Latvia until 2030						
Food, Energy, Land use, Climate	Latvian Bioeconomy Strategy 2030						
Agriculture, forestry, fishery	Law: On Agriculture and Rural Development						
Ecosystems, species	Law on the Conservation of Species and Biotopes						
Food, agriculture, energy, climate,	Law On pollution						
Energy, Climate	National Energy and Climate Plan for 2021-2030						
Energy	Energy Law						
Energy	Cabinet of Ministers Regulations N. 560 "Regulations on the Production of Electricity from Renewable Energy Sources, as well as						
Ecosystems, land use	Law On Specially Protected Nature Territories						
Climate, water, agriculture	Latvian National Plan for Adaptation to Climate Change until 2030						
Climate	Latvia's National Climate Change Adaptation Strategy						

Lielupe: barriers towards nexus governance

Top-Down Governance:	Limited involvement and agency of local & regional stakeholder in river basin planning
Policy Discrepancies:	Different nitrogen pollution thresholds in Lithuania (upstream) & Latvia (downstream) complicate consensus on shared water quality & flood risk issues.
Resource Constraints:	Inadequate human capital, expertise & funding for cross-sectoral measures
Sectoral Focus:	National policies are sector-specific, alignment needed for integrated, cross-border governance
Inconsistent Collaboration:	Transboundary collaboration relies on short-term EU-funded projects

2. Stakeholder dialogue

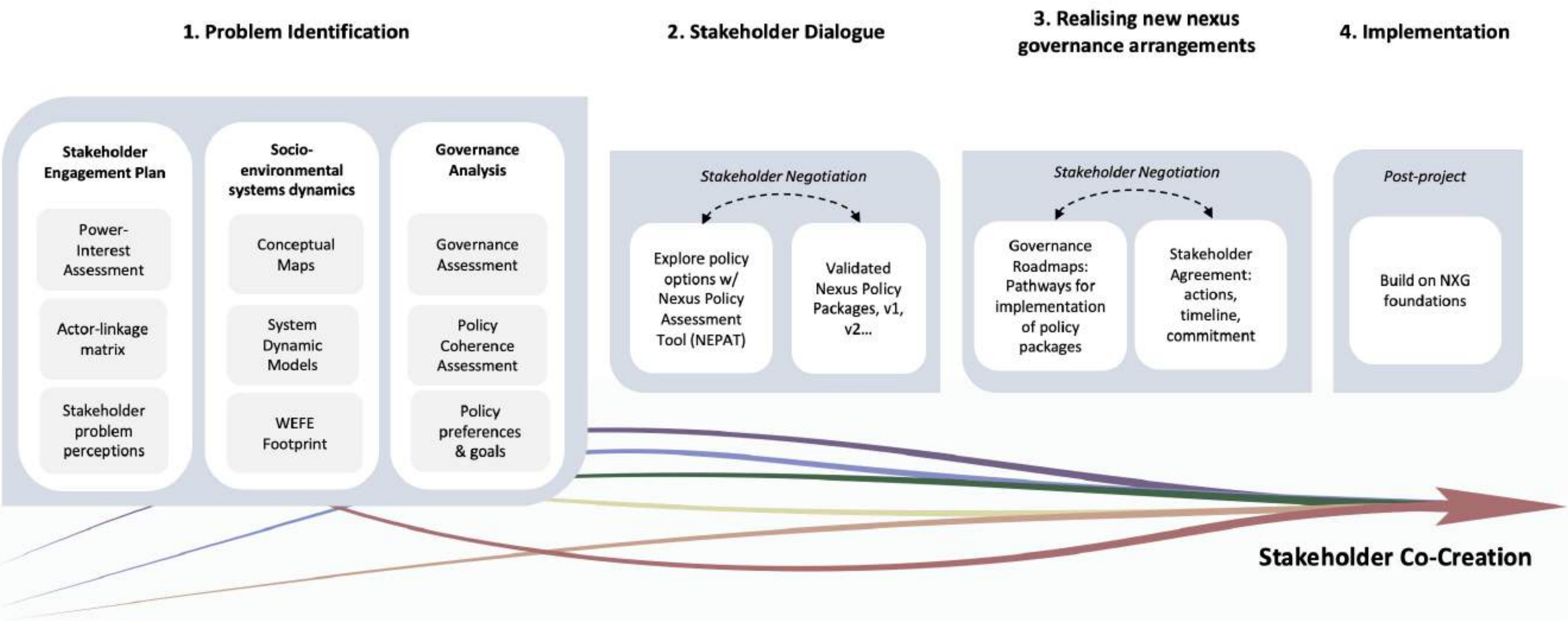
- Aim: to reach an agreed upon set of policy combinations

- Stakeholders explore the impacts of policies through the Nexogenisis Policy Impact Assessment Tool (NEPAT)

  - Artificial intelligence tool

  - Model policy interactions on WEFE nexus
    - Option 1: stakeholder configured
    - Option 2: “decision-support” – tools suggests optimised policy package

Nexogenesis Approach



2. Stakeholder dialogue

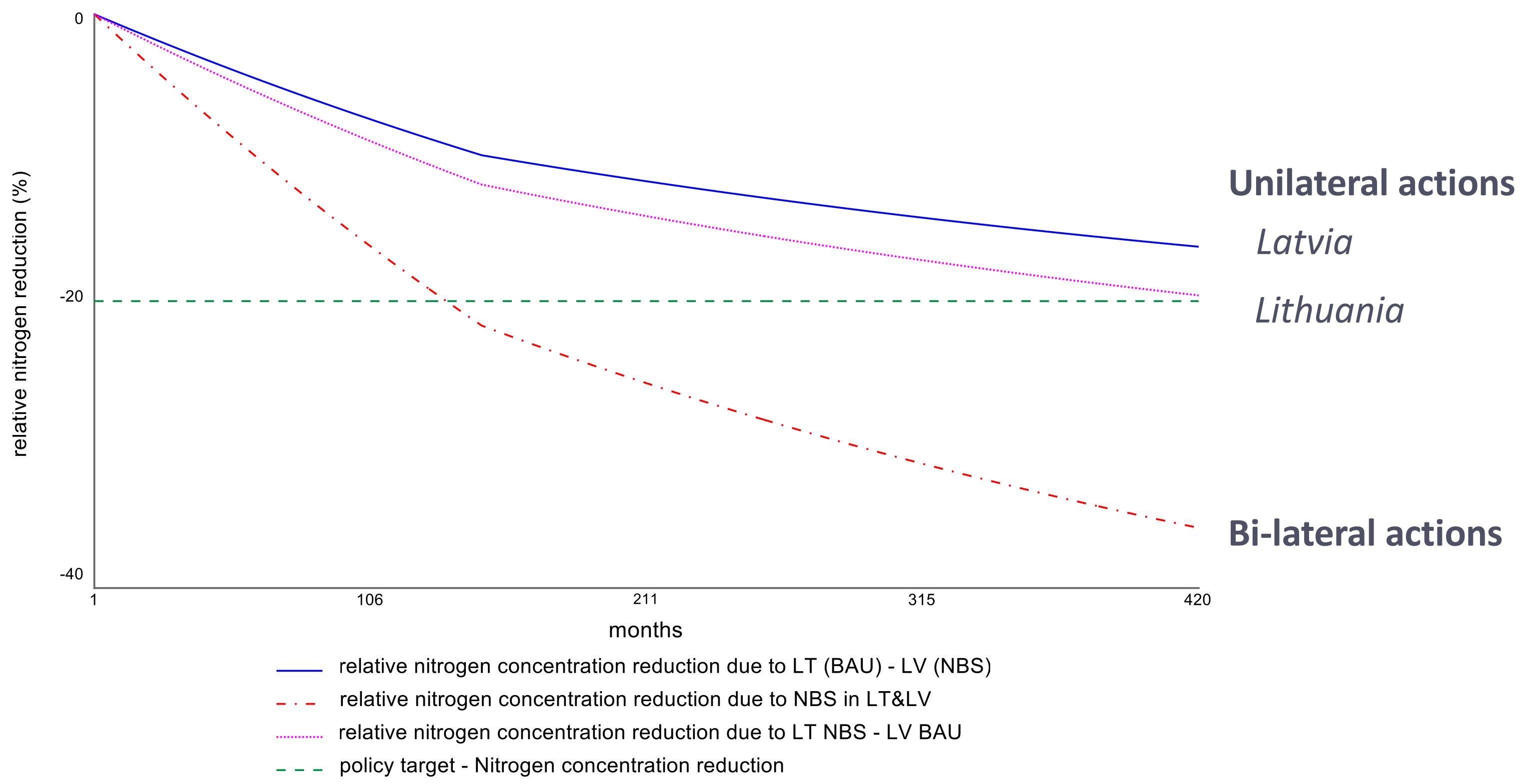
Public interface: https://nepat-dev.nexogenesis.eu/

Use “guest login” to explore all case studies

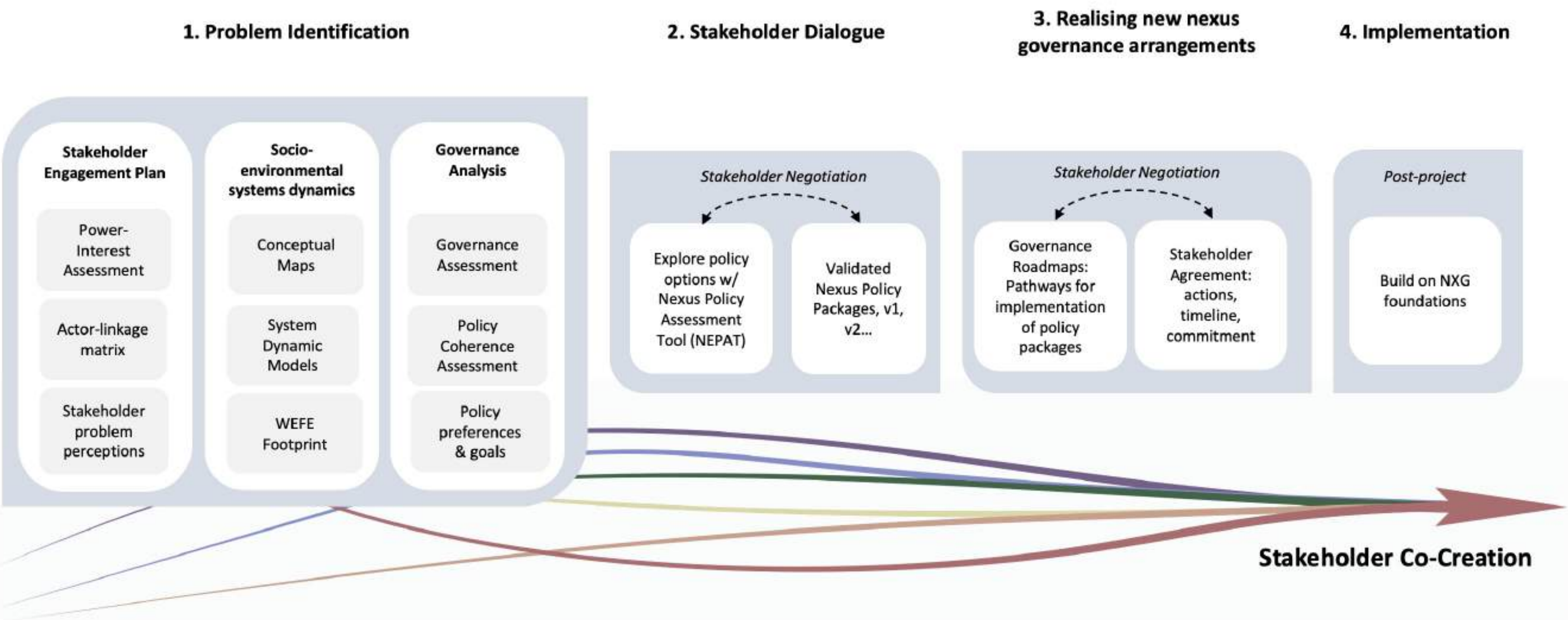
2. Stakeholder dialogue

Upstream-downstream cooperation necessary to meet both countries' policy goals

Policy: 50% of nutrient discharges from arable land treated with nature-based solutions (buffer strips, constructed wetlands)



Nexogenesis Approach

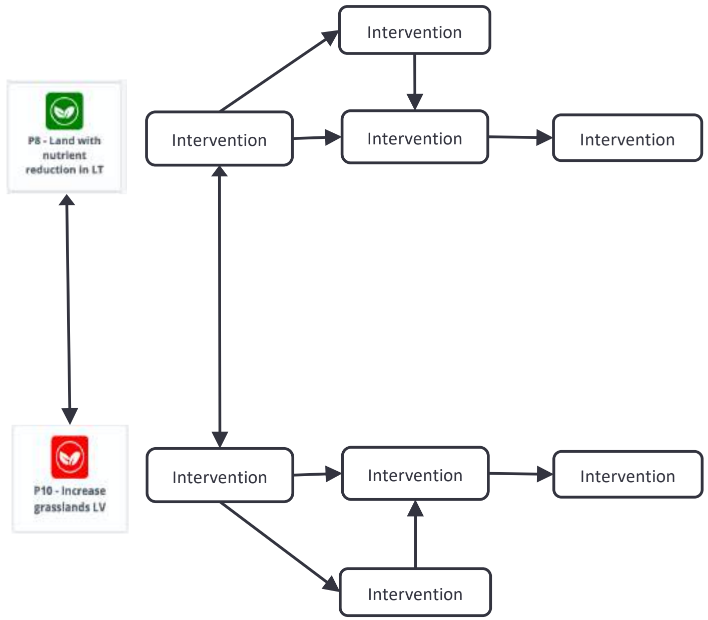


From stakeholder dialogue to new governance arrangements

Sector-focused policies | **Nexus Assessment** | **Nexus Policy Packages** | **Governance Roadmaps**

NEPAT

Goal 1:
Reduce nitrogen concentration in LT by 8% in 2027

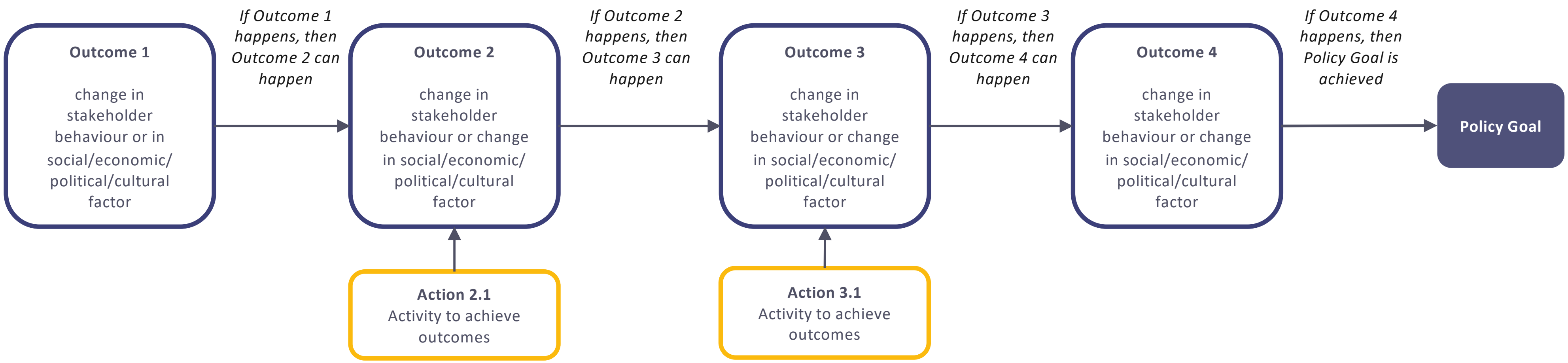


NEXOGENESIS
STREAMLINING WATER RELATED POLICIES

3. Realising new nexus governance arrangements

Governance Roadmaps - pathways to implementing policies

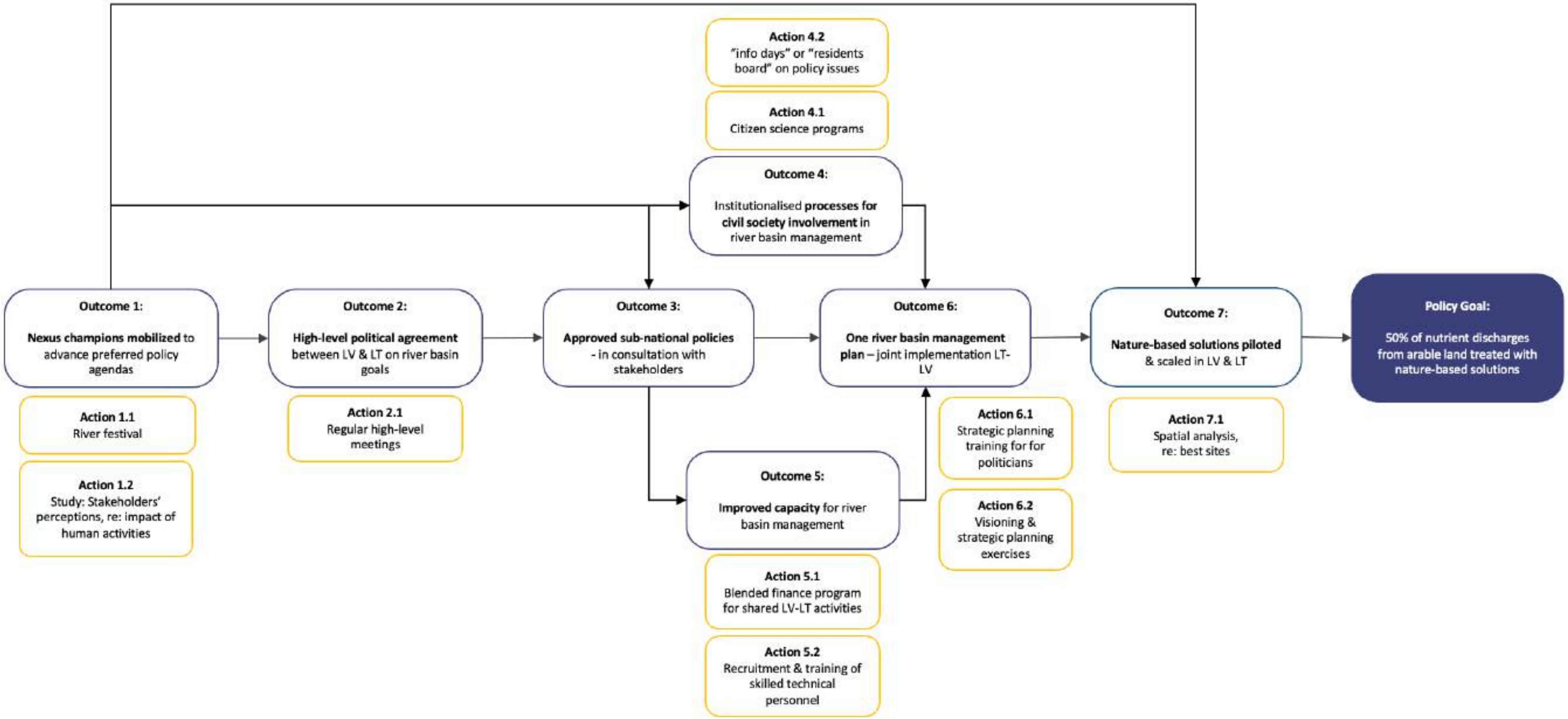
Theory of Change Approach



- **Enabling factors:** Capacity-building, knowledge
- **Technical measures: P**ilot projects, policy development or revision, etc.
- **Participation: R**ange & roles of stakeholder groups (political, social, economic)
- **Blended Financing:** Funding and budget coordination from multiple sources

3. Realising new nexus governance arrangements

Maintain emphasis on necessity of joint action to meet policy goals



3. Realising new nexus governance arrangements

Stakeholder Agreements

A **voluntary, negotiated action plan** developed through a **stakeholders' co-creation** process where relevant SHs across the WEFE sectors identify **actions** for the management of the transboundary, cross-sectoral WEFE resources.

The stakeholders involved in the process **commit** and take **responsibility,** each **within their respective frame of roles and competences**, for the adoption and implementation of a set of agreed **actions** for the integrated management of the WEFE resources in Lielupe basin as well as for the **monitoring** of the implementation.

3. Realising new nexus governance arrangements

Stakeholder Agreements – key elements

- Clearly defined aim of the stakeholder agreement
- Action list
- Level of commitment (e.g., legally binding, declaration of intention, memorandum of understanding, hand shake)
- Balanced representation of relevant stakeholders (sectors, levels)
- Responsibilities, roles and coordination
- Allocated resources (financial, human, etc.)

Nexus governance ambitions in other case-studies

Adige (Italy)

Governance challenge / opportunity

- Different models of watershed dynamics in upper & lower basin
- Disagreement on shared problems & solutions

Ambition for stakeholder agreement

- Development and use of a shared hydrological model for improved water availability predictions

Nexus governance ambitions in other case-studies

Jiu (Romania)

Governance challenge / opportunity

- National policies in development, streamlined with EU Directives
- Newly established National Sustainable Development Department
- Opportunity to influence early in policy cycle

Ambition for stakeholder agreement

- Mainstreaming nexus thinking into newly developing national policies
- NEPAT is a credible tool for evaluating measures in the National Recovery & Resilience Plan (via SDG Dept)

Nexus governance ambitions in other case-studies

Nestos (Greece-Bulgaria)

Governance challenge / opportunity

- Top-down governance, little info flow and decision-making agency at sub-national levels
- No dialogue between countries at regional & local levels
- Regional level best placed to facilitate dialogue vertically, horizontally and & cross-border
- NXG brought stakeholders together

Ambition for stakeholder agreement

- Maintain transboundary dialogue amongst participating stakeholders
- Small-scale cross-border initiatives amongst river basin authorities to establish & consolidate collaboration

Nexus governance ambitions in other case-studies

Inkomati (South Africa)

Governance challenge / opportunity

- Inequality issues (access to resources) neglected & ‘old’ governance structures
- Non-compliance & lack of accountability
- Regional & local govt’s show good potential for cross-sectoral work
- ‘Modernisation’ processes for RBM underway

Ambition for stakeholder agreement

- River basin agency to inject nexus thinking & improved capacity for strategic planning into municipal governance processes
- Use NEPAT as facilitation tool at RBM meetings

Next Steps: Outscaling - via Guidebook *(draft concept)*

Part 1: About this Guidebook

Part 2: Introduction

2.1 Water-Energy-Food-Ecosystem Nexus

2.2 Nexus Governance Issues

Part 3: Stakeholder Co-Creation Process

Chapter 3: Building Blocks

3.1 Preparing the co-creation process

3.2 Initiating the co-creation process

3.3 Facilitating the co-creation process

3.4 Developing the co-creation content

3.5 Implementing the stakeholders´ agreement

Chapter 4: Data & Models

4.1 Biophysical data

4.2 Socio-economic Data

4.3 System Dynamic Models

4.4 Nexus Footprint

Chapter 5: Policy Tools

5.1 Policy Coherence Assessment

5.2 Governance Assessment

5.3 Governance Roadmaps

5.4 Stakeholder Agreement

5.5 Policy Impact Strategy

Chapter 6: Stakeholder Engagement Tools

6.1 Stakeholder Register

6.2 Actor – Influence Matrix

Chapter 7: Nexus Policy Assessment Tool

7.1 Functionalities

7.2 Decision-support system

Part 4: Get Stated with Practical Tools

Cheat Sheet: Rapid Guide to NXG

Templates

Reflections for transdisciplinary research

- **Culture of collaboration in consortium**
  - Tri-weekly consortium co-creation meetings - common working language, mutual understanding of methods, empathy & joint problem-solving
  - Cross-learning mechanisms
    - Learning amongst case-studies leads
- **Stakeholder participation & dialogue**
  - Time for validation & deliberation
  - Trust-building: face-to-face, one-on-one, demonstrated use of inputs
  - Space for apolitical interactions
  - Stakeholders' interest in cross-border settings
  - Limited participation of (powerful) sectoral & high-level stakeholders

Beyond the Grid: Women's Empowerment in Energy and Household Well-being

Muzna Alvi, Farha Sufian, Tushar Singh, Claudia Ringler, Ezaboo Beniwal and Sehrish Raja

01. Introduction

Women's energy access in rural areas is vital for empowerment, economic development, and sustainability. While its importance is recognized, the benefits of women's decision-making in energy remain understudied. Our paper examines how women's empowerment in energy correlates with improved individual and household outcomes, highlighting the link between access, empowerment, and broader societal benefits.

02. Objective

- Constructing a Women's Empowerment in Energy Score (WEES) to measure women's agency and decision making in energy related choices.
- Exploring how measures of women's empowerment in energy are associated with improved individual outcomes for women and overall household well-being using data from South Asia

03. Methodology

Primary farm and household surveys conducted between December 2022 and February 2023

- India- Bihar and Jharkhand
- Nepal- Madhesh and Karnali
- Pakistan- Rahim Yar Khan- Punjab

Intra-household survey covered individual demographics, socioeconomic status, agricultural practices, crop economics, WEAI, and food consumption patterns.

04. Energy Empowerment Framework

1. Access: Women's ability to obtain reliable, affordable, and clean energy sources and energy technologies for both productive and domestic use.
2. Individual Agency: Women's power to make strategic choices about energy use, investments, & management in the household, on & off farm.
3. Capacity: Women's knowledge, skills, and confidence to utilize energy technologies effectively & participate in energy-related decisions within the home & community.
4. Economic well-being: Women's opportunities to generate income, save time, & improve productivity through enhanced energy access.
5. Collective agency: Women's representation & active participation in energy-related governance structures, from community groups to policy-making bodies.

	Indicator	Adequacy definition
1	Has unrestricted access to mechanized productive assets	Adequate if respondent has unrestricted access to at least one ***mechanized*** asset that the household has access to for income generation (tractor, pump, sewing machine, etc.)
2	Has unrestricted access to mechanized consumer durables for domestic use	Adequate if respondent has unrestricted access to at least one ***mechanized*** consumer durable the household has access to for domestic use (television, fridge, cookstove, etc.)
3	Decides on acquiring energy source for domestic use	Adequate if solely or jointly decides which energy source to acquire for cooking, heating, and lighting
4	Decides on acquiring energy source for productive use	Adequate if solely or jointly decides which energy source to acquire for all agricultural and other income-generating activities applicable to the household
5	Decides on changing energy source for domestic use	Adequate if solely decides OR can participate to a medium or high/er extent in decisions about changing from unclean to clean energy sources for domestic use (for all sources needed for cooking, heating, and lighting)
6	Decides on changing energy source for productive use	Adequate if solely decides OR can participate to a medium or high/er extent in decisions about changing from unclean to clean energy sources for productive use (sources for use in all agricultural, post-harvest and non-farm business activities applicable to the household)
7	Acquires energy source for domestic use	Adequate if solely or jointly responsible for acquiring energy source for cooking, heating, and lighting
8	Acquires energy source for productive use	Adequate if solely or jointly responsible for acquiring energy source for all agricultural and other income-generating activities applicable to the household

05. Results

- Significant disparities between men and women in decision over energy for productive use.
- Wealth and energy empowerment negatively correlated in India & Pakistan, opposite in Nepal
- Women with higher WEES are more likely to participate in the labor market
- In Nepal & Pakistan WEES positively correlated with clean energy use, but opposite in India
- Relationship between WEES and time poverty ambiguous
- WEES associated with lower food insecurity in Nepal and higher dietary diversity in Pakistan

06. Conclusion

We develop a metric to measure gendered energy related agency and its impact on individual and household level outcomes. Findings reveal complex context-specific relationships between development outcomes & women's energy agency in South Asia. WEES can track progress, guide interventions, and complement other metrics for a holistic view of household deprivation. Future research will refine WEES by including additional aspects like time spent collecting fuel and health impacts of polluting fuels.

International Water Management Institute

CGIAR

Business and finance models to accelerate the adoption of renewable energy technologies for water and food security: Insight from South Asia

Case study of Solar Lift Irrigation in Nepal’s mid-hills

Shisher Shrestha, Darshan Karki, Mamata Aryal

Nov 06, 2024

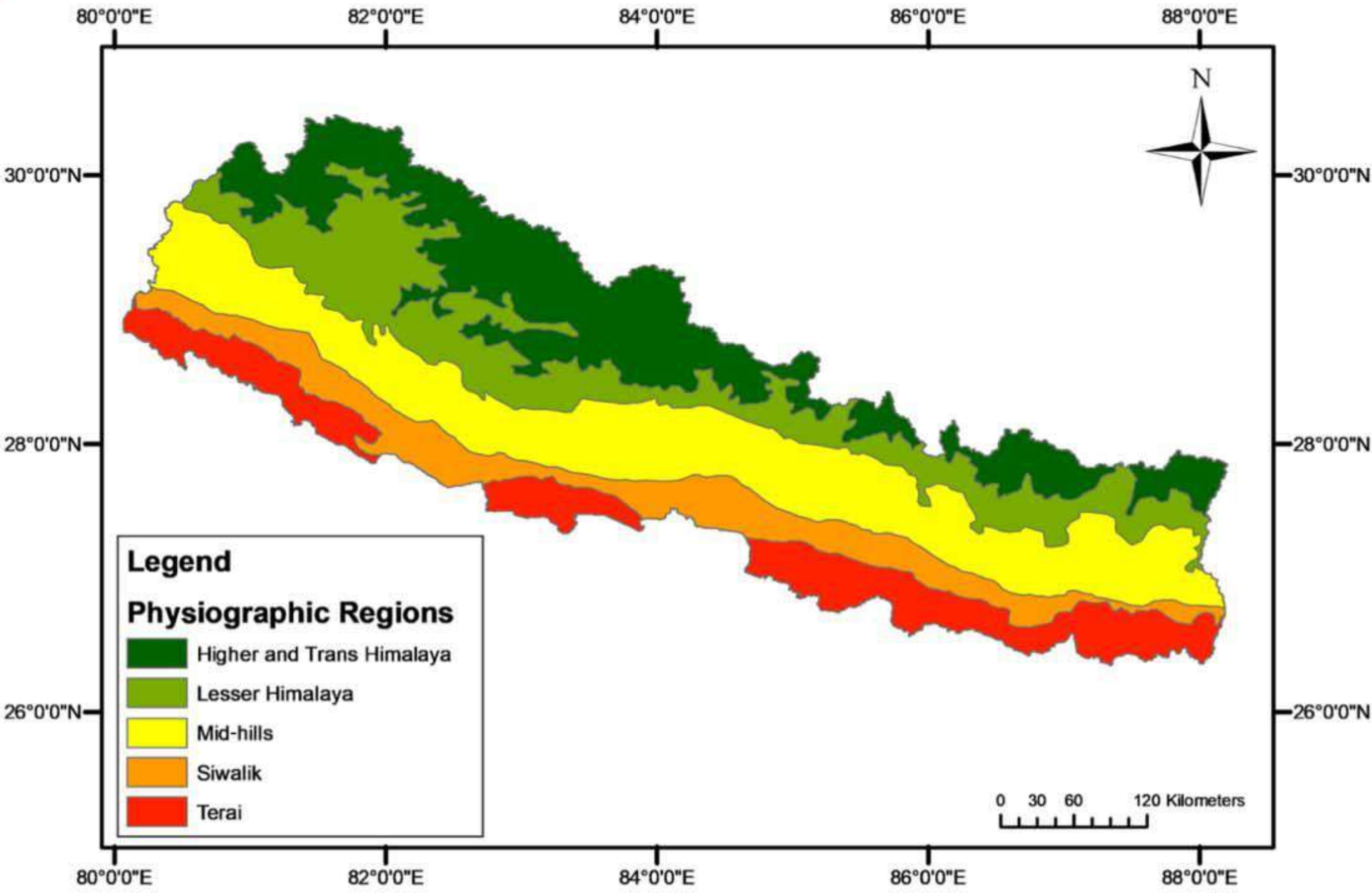
Innovative water solutions for sustainable development

Food · Climate · Growth

CGIAR NEXUS Gains: Realizing Multiple Benefits Across Water, Energy, Food and Ecosystems

Background

- Nepal's mid-hill accounts for **56% of arable land** in the country (IMP, 2019)
- Approximately **30% of irrigable land** in the hilly region (837,000 million hectares) **remains unirrigated** (IMP, 2019)
- **80%** of its **precipitation** during the **summer monsoon season,** which runs from June to September, and only **20% during the other eight months** (Nepal et al., 2021)



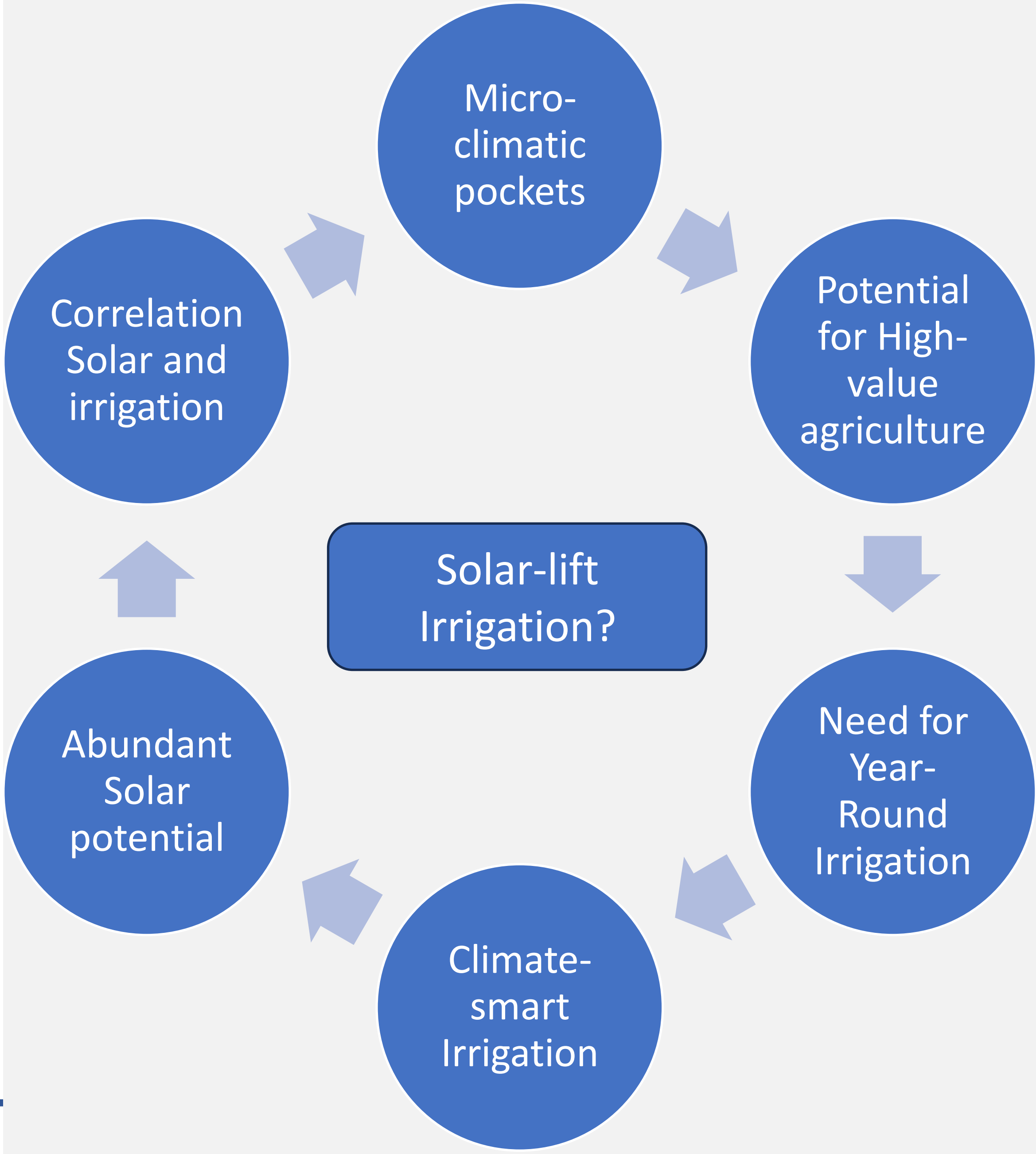
Source: Gurung et al. (2019)

Key challenges in mid-hills

- Many hill district of Nepal has shown **negative population growth** in the last decade (NSO, 2023)
  - One of the driving factors is **Water scarcity**
  - Water scarcity is mainly due to **energy insecurity** and **lack of investment**
- **Climate Change impact** in mid-hills
  - **Diminishing water sources**
  - Increased **precipitation variability**
  - Farmers more **susceptible** to variations in rainfall

Why Solar Lift Irrigation ?

- **Abundant solar** energy potential (Solargis, 2017).
  - Average radiation of 4.4 to 5.5 kWh/m2/day
  - Over 300 sunny days per year
- **Correlation** between **water demand** and **solar** generation is very high (Foster, 2009).
  - SIPs can irrigate at maximum capacity during the dry seasons when the seasonal water requirements are highest
- Potential to be an ideal **climate-smart irrigation technology** for Nepal's mid-hill (Gurung et al., 2016).
  - Reduce **climate sensitivity** during the dry season.
  - **Decentralized** renewable energy system



Methodology

Site Selection for Case study

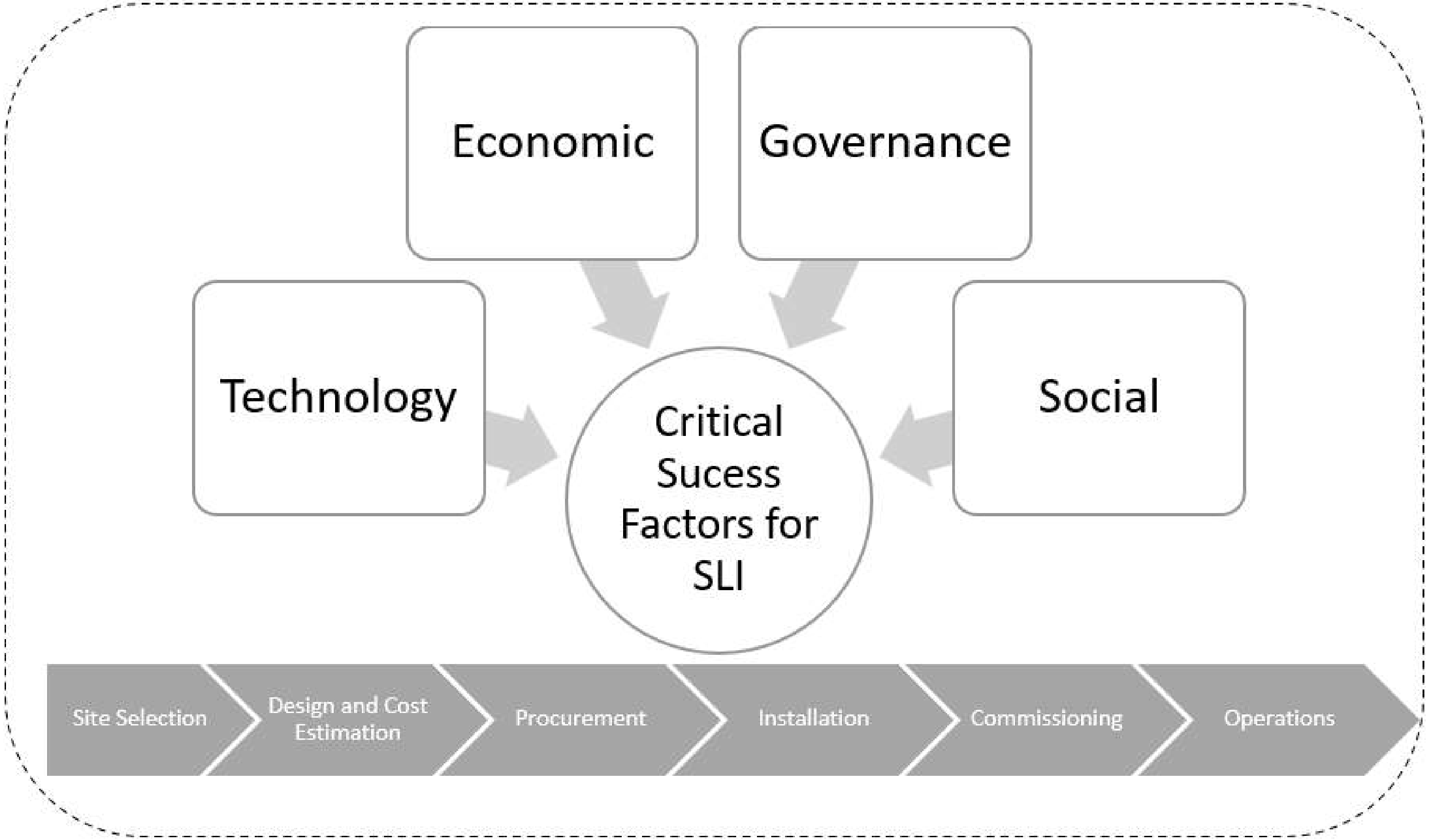
- Nepal's mid-hill region
- Projects at different stages
- Functional and Non-functional

Case studies

- FGDs with male and female members of communities
- KIIs with Local government and Project Developers
- Review of project documents

Expert's interviews

- Private Sectors
- Industry Experts and Academics
- Project Developers
- Local Journalists



The theoretical foundation for the conceptual framework is based on (Bullen & Rockart, 1981) who described **critical success factors (CSF)** as **key areas of activities in which favorable results are crucial** to reach the desired goals.

RQ - What are the CSFs that contributes to the success and failure of SLI projects in the mid-hill of Nepal?

Study Area

- Based on case study of 13 SLI sites in Nepal's mid-hills at different stages of project
- 19 KIIs and 9 FGDs

Assumptions

- SLI can be considered a viable technology for Nepal's mid-hill region in the absence of widespread availability of reliable grid electricity and the unfeasibility of pumped irrigation using diesel pumps.

Why SLI hasn’t scaled?

Despite the high demand for lift irrigation, Solar lift Irrigation hasn’t scaled due to the absence of Business models that address these key issues …

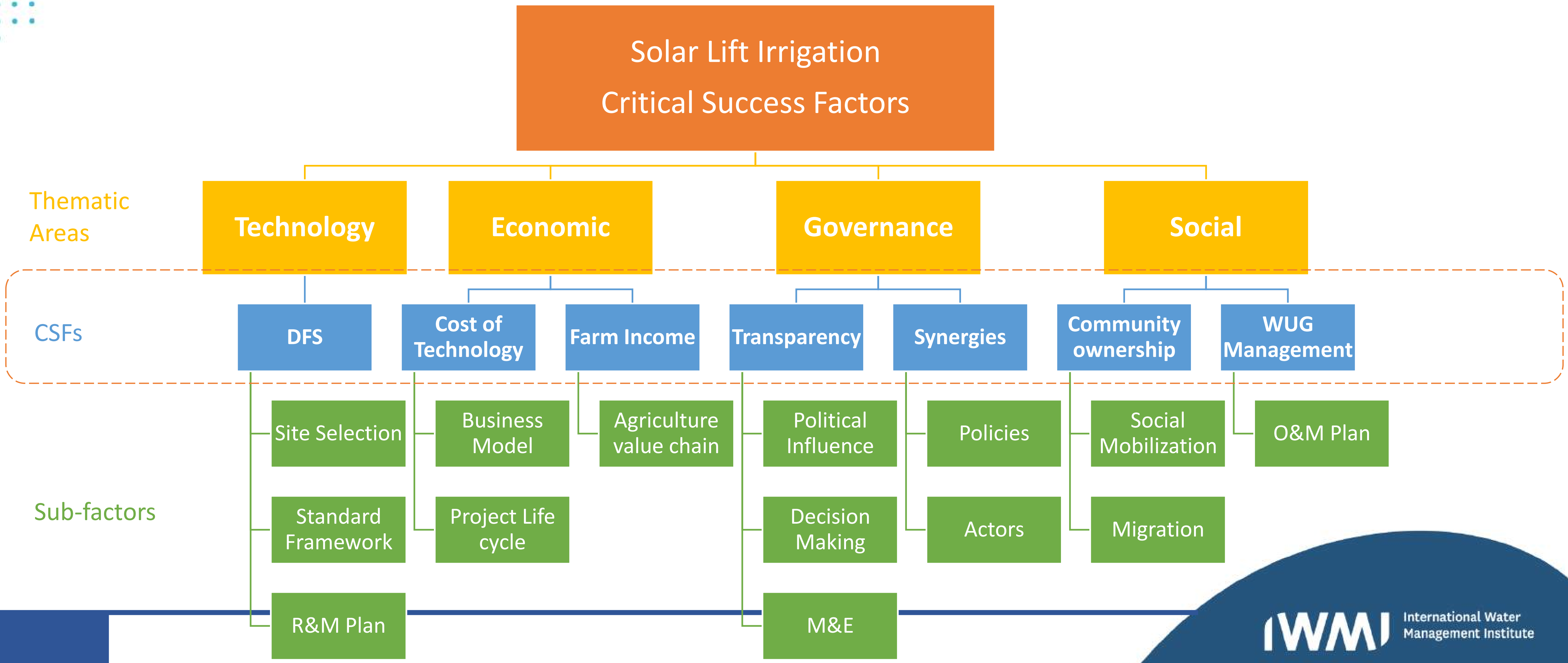
Technology

Economic

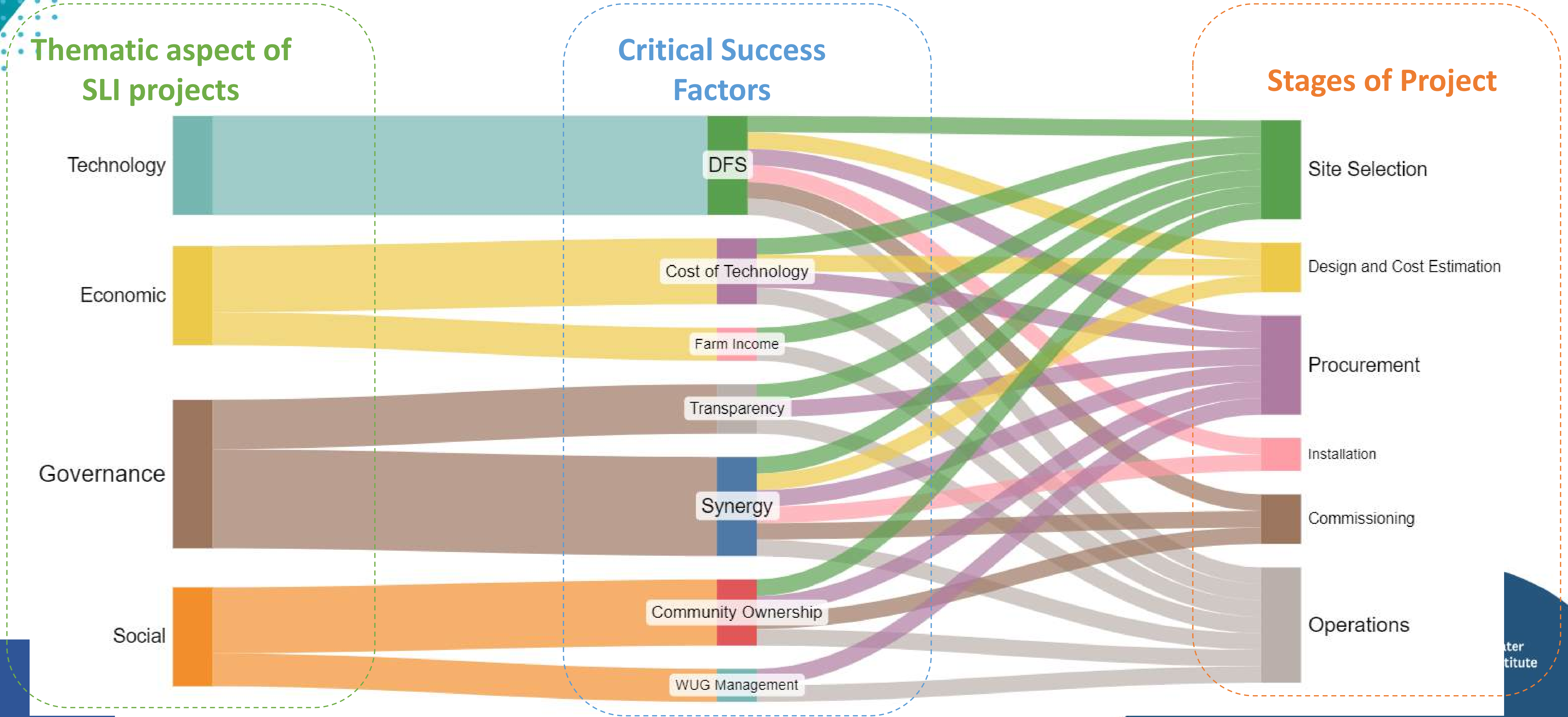
Governance

Social

CSFs for SLI across different thematic areas

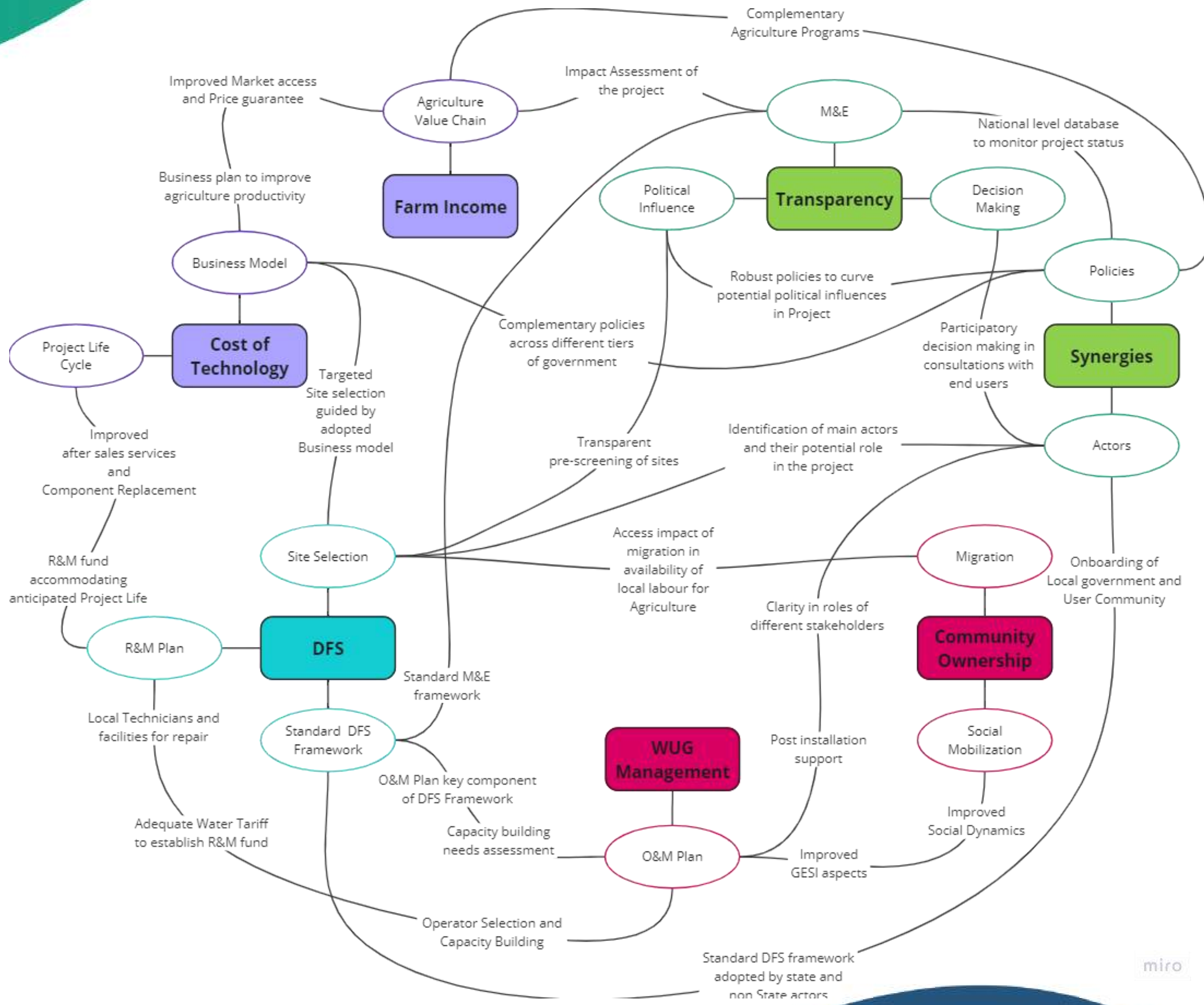


Thematic areas and respective CSF influence different stages of projects



Interdependencies of CSFs

- CSPs and Sub-factors across different thematic areas are interdependent
- Coming back to (Bullen & Rockart, 1981) who described critical success factor (CSF) as key areas of activities in which favourable results are crucial to reach the desired goals.
  - If favourable results in the identified CSFs of SLI projects will ensure project's success?



Summary of Findings

- Current SLI projects are mainly failing due to **collective failures**
  - Is it the technology failing?
    - One cannot see SLI in isolation
  - There are no silver-bullet solutions
    - ELIs may not provide universal solutions
- CSFs are interlinked across different thematic areas
  - CSF impacts different project stages
    - Different actors are involved
    - And they prioritized different aspects of the project
- Project vs Holistic approach

International Water Management Institute

Thank you !

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NEXUS Gains

The business or financial models for Solar Irrigation Pumps: Unveiling Interconnections, Advantages, and Trade-offs

Energizing food and water systems

Presenter: Dr. Mutum Lamnganbi

Studied by: WP3 team, India –

Deepa MPM, Garima Taneja, Mutum Lamnganbi, Philip Kuriachen (IWMI-India)

Claudia Ringler (IFPRI)

Background

PM-KUSUM scheme for installation of clean energy (Solar)

Still extensive use of Diesel and electric pumps

Approximately 0.5 million solar pumps are installed as against the target of 1.34 million

Many business and financial models existing in small pockets

Eastern states of Bihar and West Bengal in the Gangetic Plain- still a non-starter of the scheme

Haryana leads with 69% of its sanctioned pumps installed followed by Uttar Pradesh (48 %) and Punjab (24 %).

Research Questions

What are the effective business and finance models to access renewable energy in ways that strengthen their agency and entrepreneurship?

How can we scale up gender-sensitive equitable business/financial models?

Scaling up

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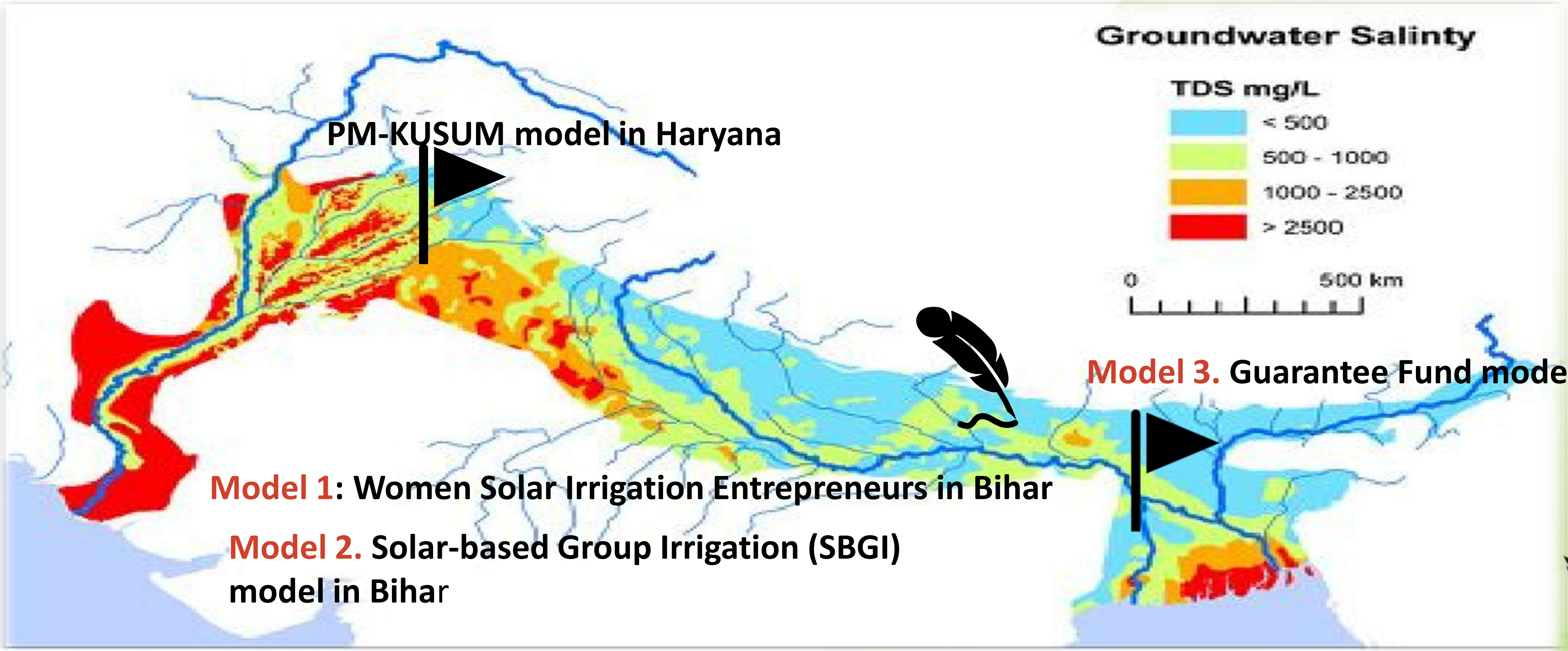
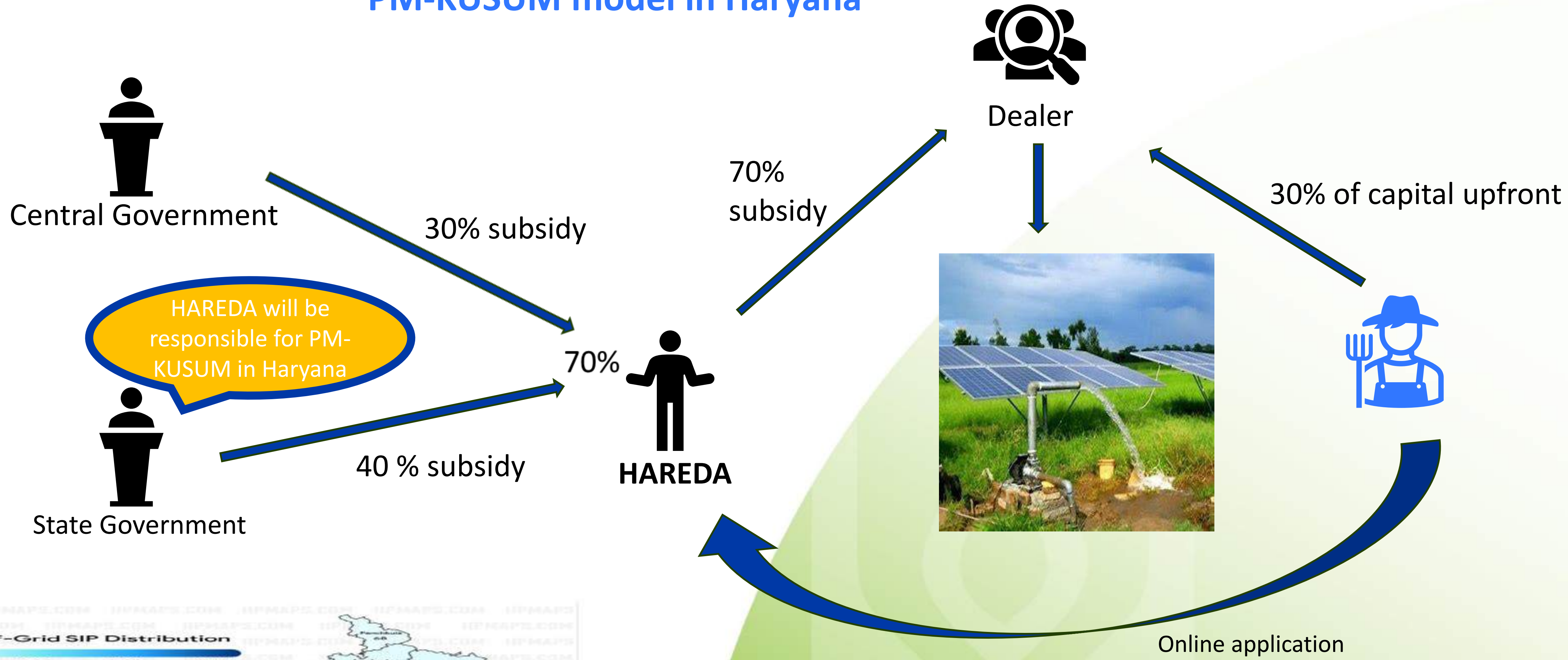
Stakeholders involved: NGOs, beneficiaries, and farmers

Framework conditions:

In our study, there are four different business or financial models to compare and identify the economically viable ones.



PM-KUSUM model in Haryana



Money is no object to large farmers in Haryana.

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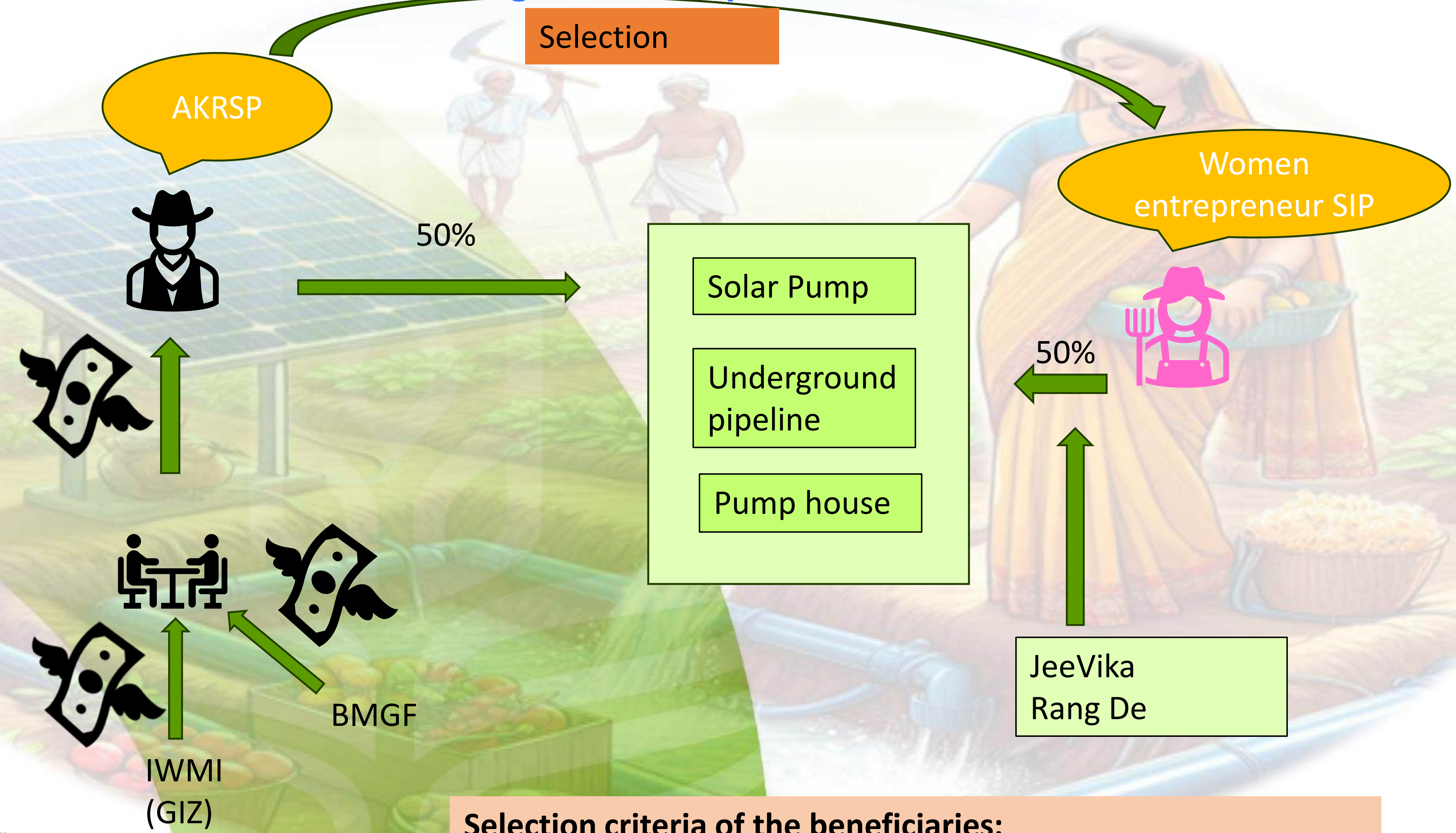
Model 1: Women Solar irrigation entrepreneurs in Bihar



Selection criteria of the beneficiaries:
1. Woman involved with Jeevika (a microfinance institution)
2. Own max 1-2 bigha of land

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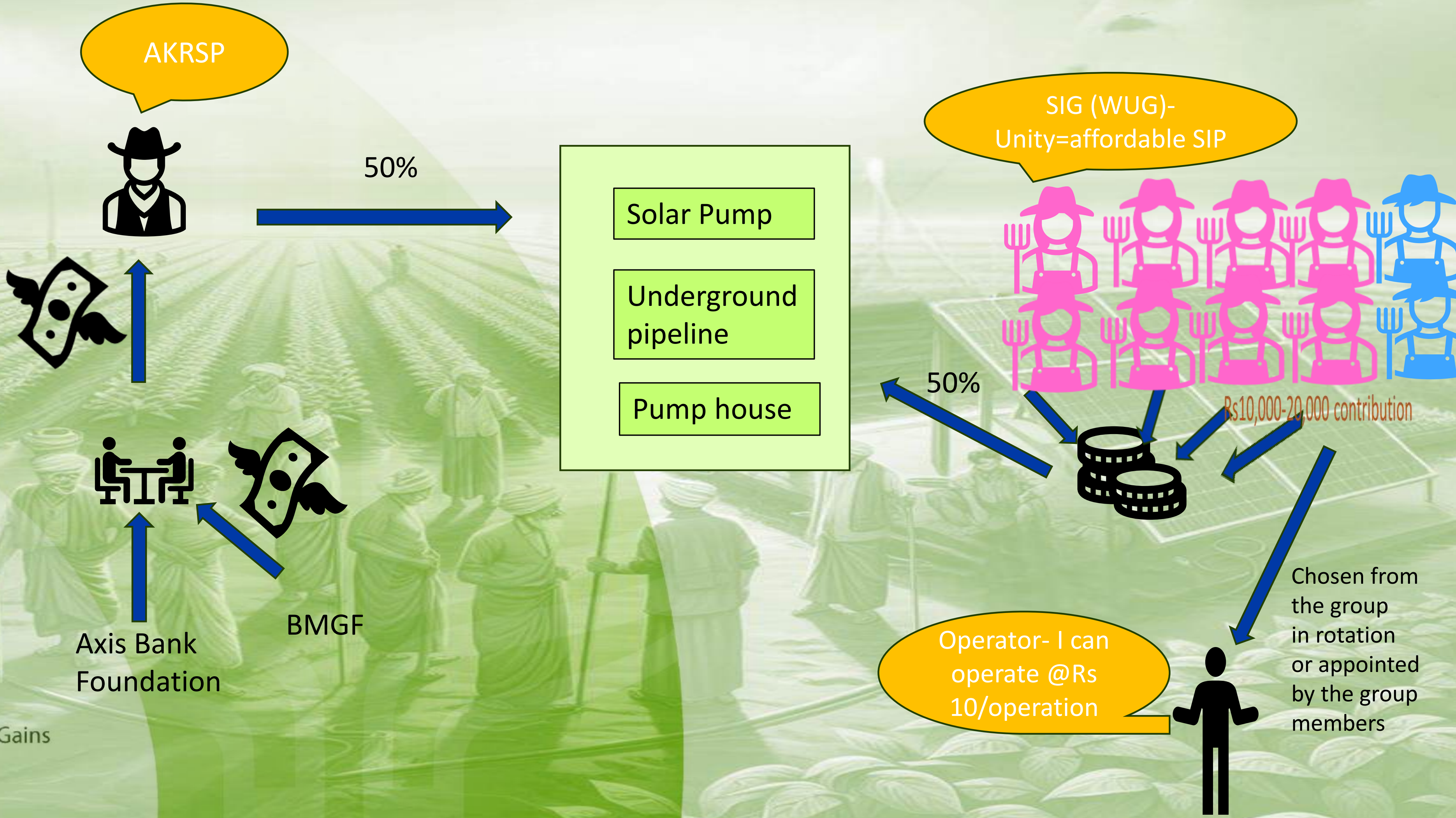
Model 2: Solar based Group irrigation (SBGI) model in Bihar



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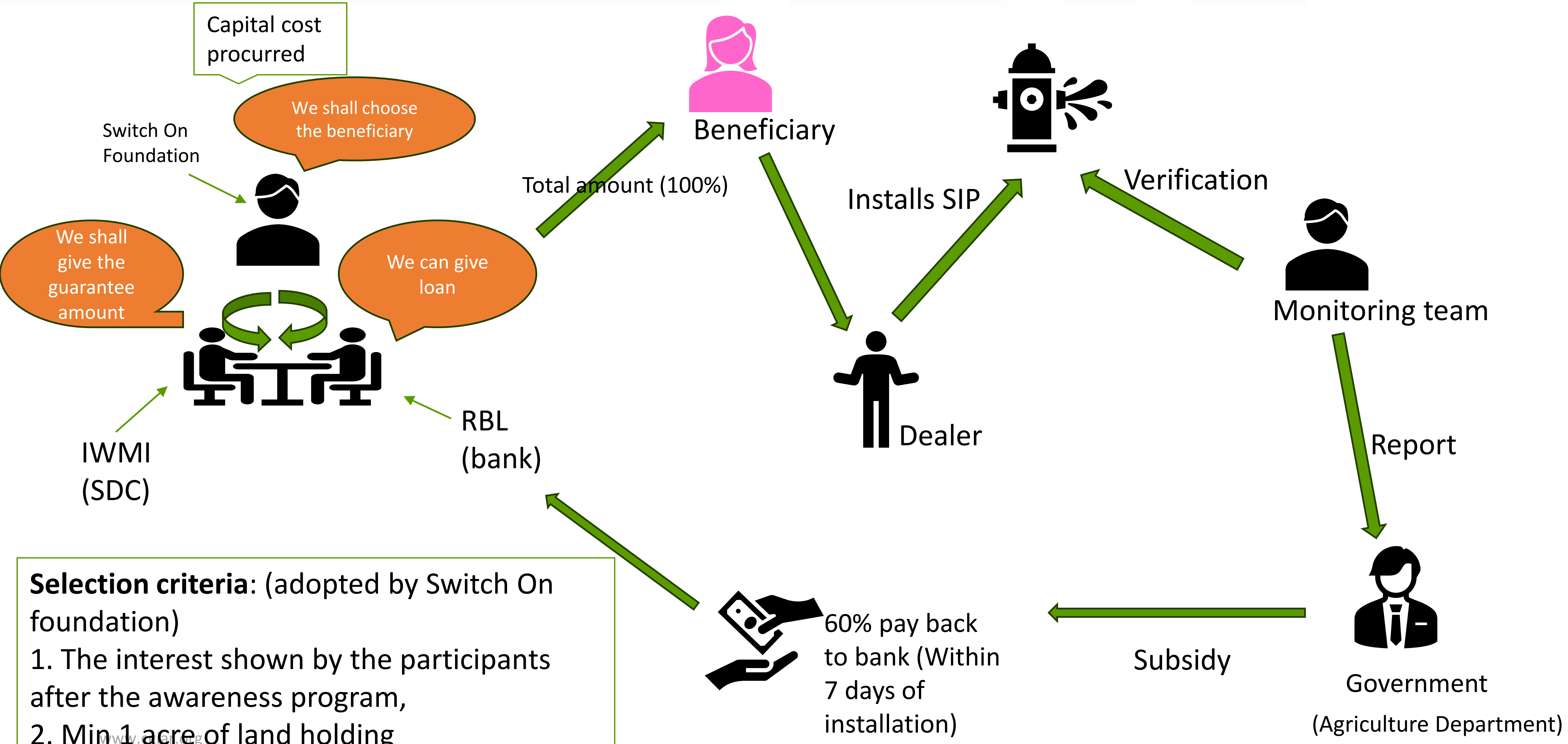
Model 3: Guarantee Fund model in West Bengal



Selection criteria: (adopted by Switch On foundation)

1. The interest shown by the participants after the awareness program,
2. Min 1 acre of land holding

Methodology

Qualitative assessment: Organizing FGDs to draw a **Fuzzy cognitive mapping (FCM)** to understand the interlinkages of the different components within the model.

Steps of FCM:

1. Identification of concepts, interlinkages, and assigning weights to relationships
2. Participatory mapping with a small group of stakeholders
3. Coding FCMs into adjacency matrices
4. Mathematical aggregation of individual cognitive mapping to create social cognitive mapping
5. Qualitative aggregation of social maps
6. Data visualization of condensed social cognitive maps
7. FCM stimulation

Quantitative assessment: Household survey

Interlinkages

Increase

Decrease

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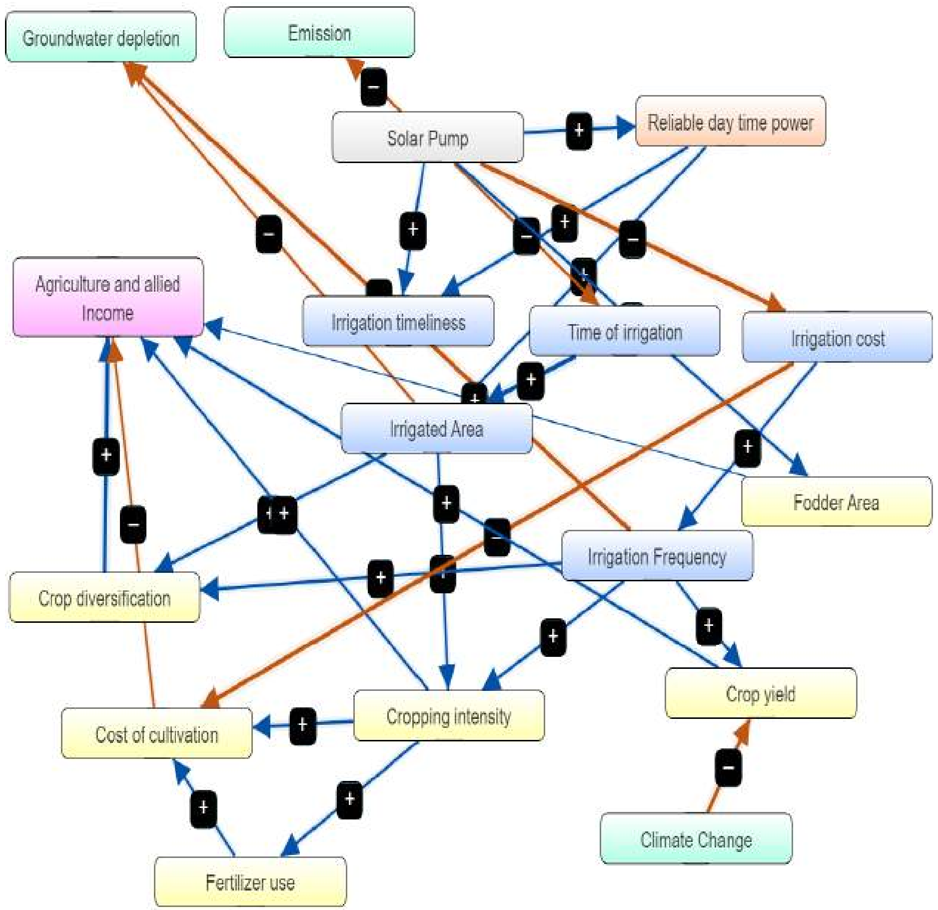
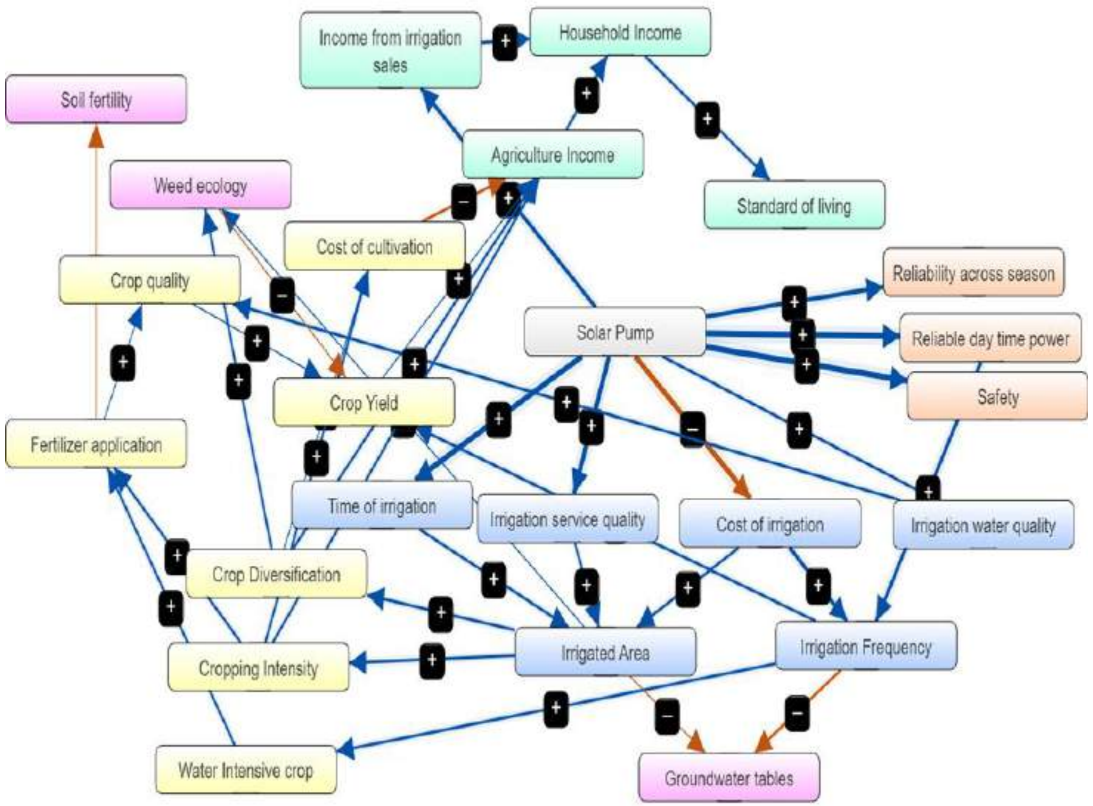
PM-KUSUM model in Haryana



Model 1: Women Solar irrigation entrepreneurs in Bihar

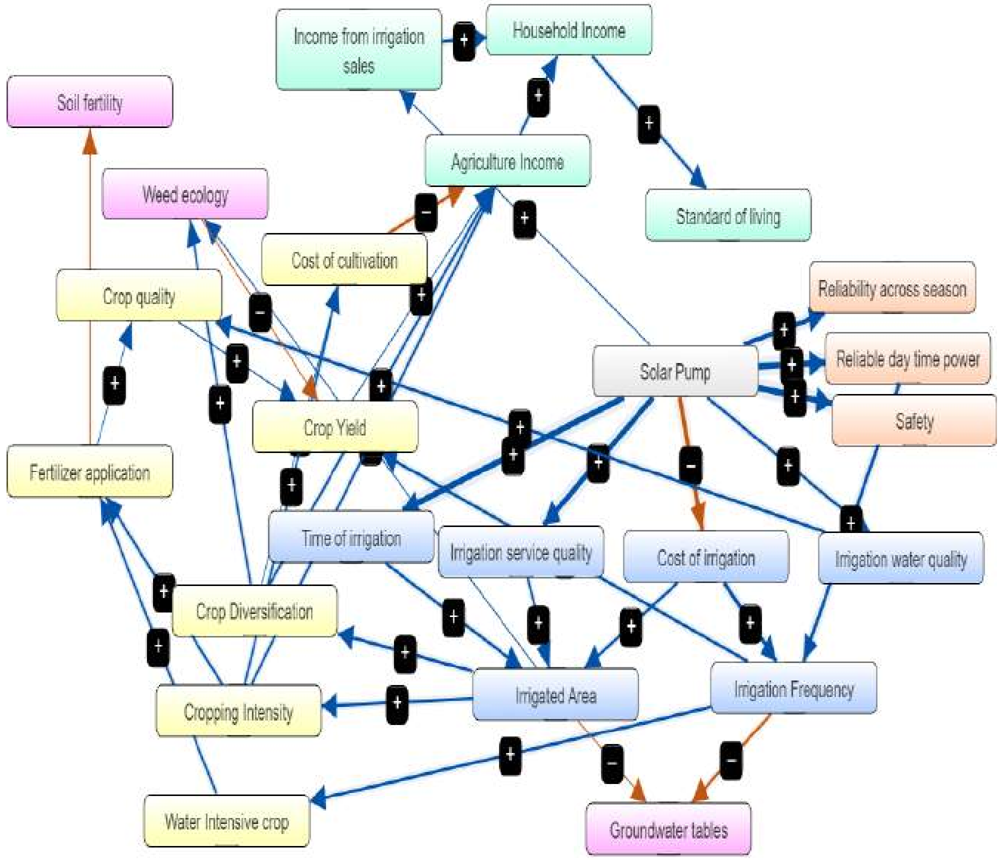


Interlinkages

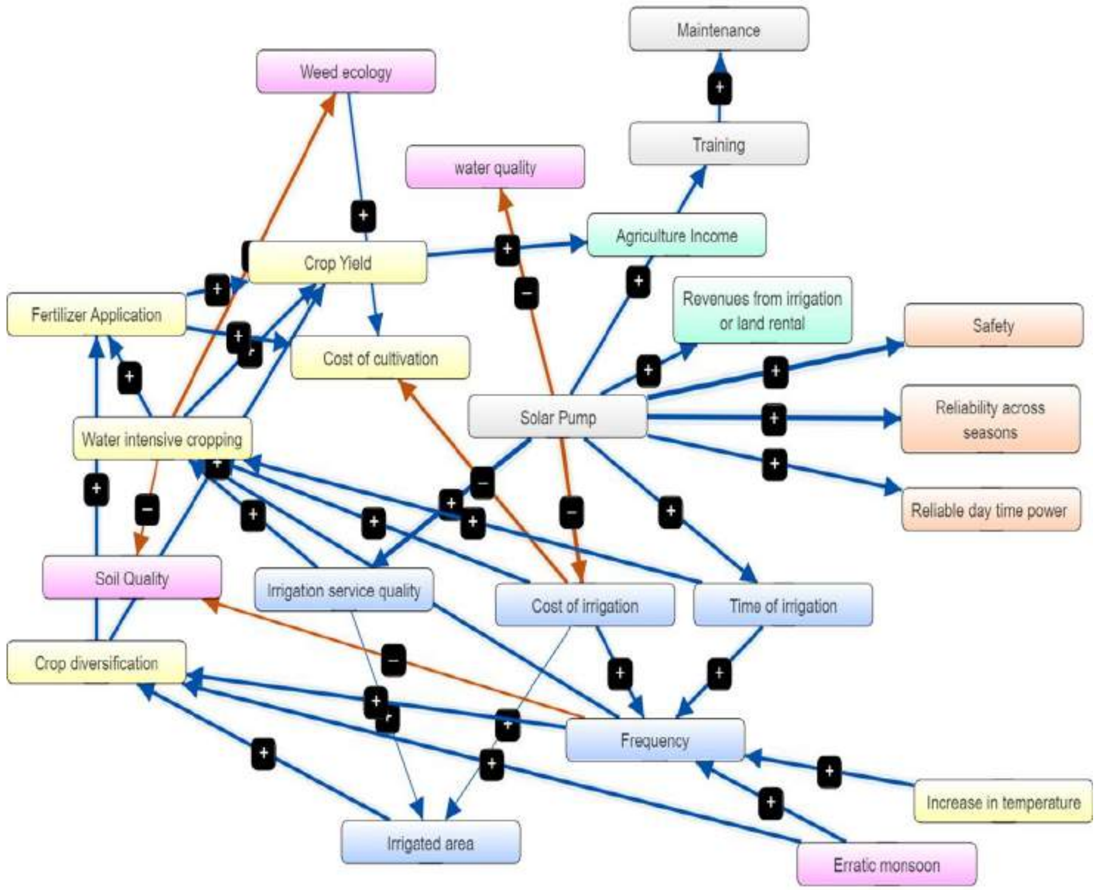
Increase

Decrease

Model 2: Solar based Group irrigation (SBGI) model in Bihar



Model 3: Guarantee Fund model in West Bengal

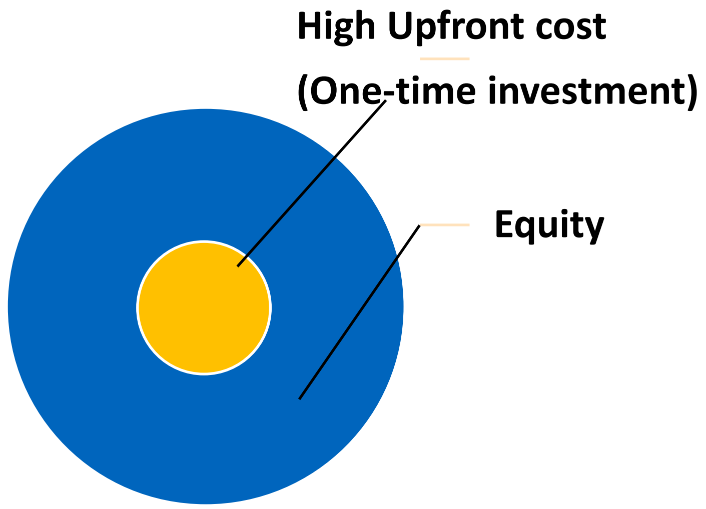


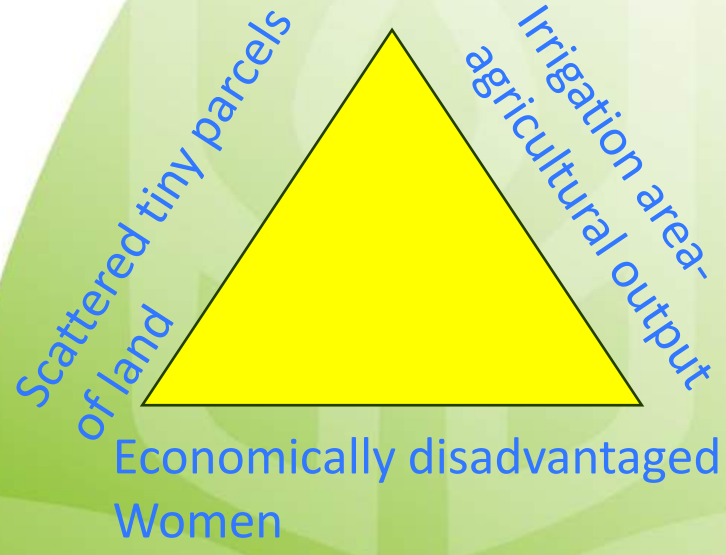
PM-KUSUM model in Haryana

Pros	Cons
A one-time investment for their large field.	The scheme is benefitted only by medium and large farmers
Reducing costs associated with diesel.	Due to its higher capacity, the pump may draw water from greater depths, resulting in withdrawals surpassing recharge rates, leading to imbalance in groundwater storage.
No requirement for an agricultural electrical feeder connection.	No women involvement
Excess water available for fields adjacent to canals.	Only farmers who can afford the upfront capital cost can access the SIP.

Model 1: Women Solar irrigation entrepreneurs in Bihar

Pros	Cons
Benefitted women from economically disadvantaged backgrounds.	As a submersible pump, there is a concern about long-term depletion of groundwater
Optimizing irrigation capacity to boost income through expanding the irrigated area via an underground pipeline network.	Challenging to motivate women for increased social engagement.
Enhances the value of a tiny parcel of land insufficient for farming	Resistance from the husband and other family members.
Empowerment of women's confidence.	Excessive cultivation of water-intensive crops
Rise in agricultural output	More pressure on land, to increase production by adding fertilizer and pesticides.





INITIATIVE ON NEXUS Gains

Model 2: Solar based Group irrigation (SBGI) model in Bihar

Pros	Cons
Advantageous for small-scale farmers who cannot afford individual pumps, requiring only a minimal contribution.	There is a high likelihood of fragmentation and disputes within the group.
There is a set minimum number of buyers, but the actual number can exceed this minimum.	Lower revenue generation as compared to individual Solar Irrigation Entrepreneur model
Employment of one person as an operator	Lack of accountability and maintenance challenges
Increased water accessibility in fragmented lands	Potential moral hazard of the operator to underreport irrigation service fee and pocket a larger share of the irrigation service fees.

Model 3: Guarantee Fund model in West Bengal

Pros	Cons
Assuring the bank streamlines and expedites the loan approval process.	There are fewer buyers because sellers typically own more than one acre of land and lack a delivery system to reach farms more than 500 feet away.
Only surface pumps	The pump capacity is small (2 or 3 HP)
Small farmer-friendly model	Though beneficiaries are women, no involvement of women was observed.
Good coordination between Government departments, NGOs, Bank etc.	No capacity building or training organized

Sharing-minimum contribution

Fixed but not limited buyers

Fragmented land-water accessibility

No burden on single stakeholder-coordination

Guaranteed Loan

CGIAR INITIATIVE ON NEXUS Gains

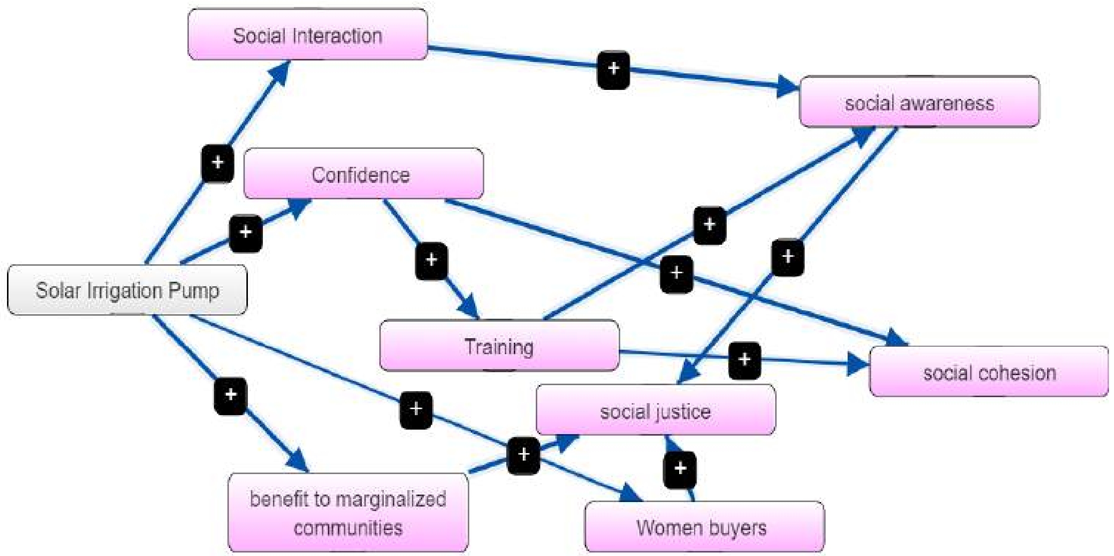
Unique Findings

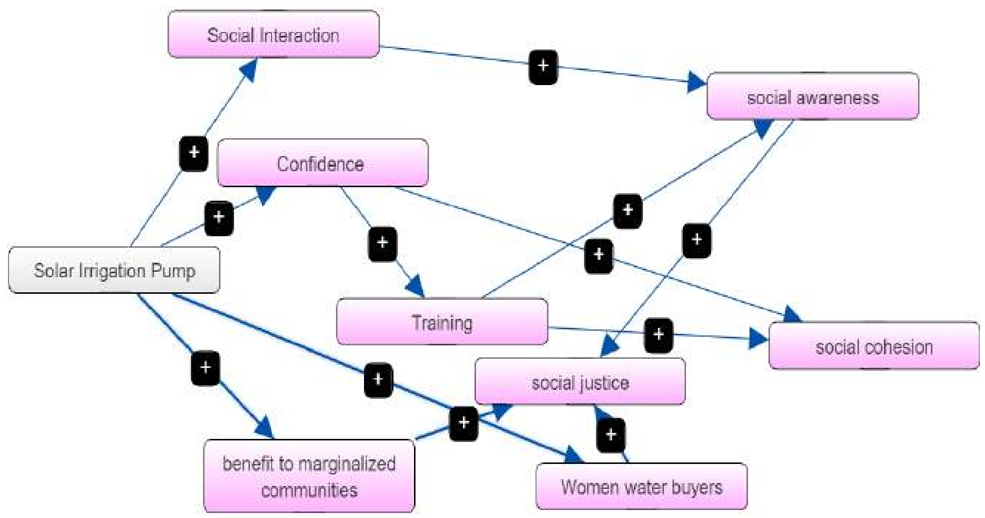
- For increasing operational efficiency some SIE’s have started using mobile-based RMS systems for pump operations
- Tender system for operating the solar Irrigation Pumps
- Several SIE’S have switched to hybrid systems to maximize irrigation sales
- Connection with AC motor, generating domestic electricity when not used for irrigation

Gender Impacts

INITIATIVE ON NEXUS Gains

Comparison across models in Bihar



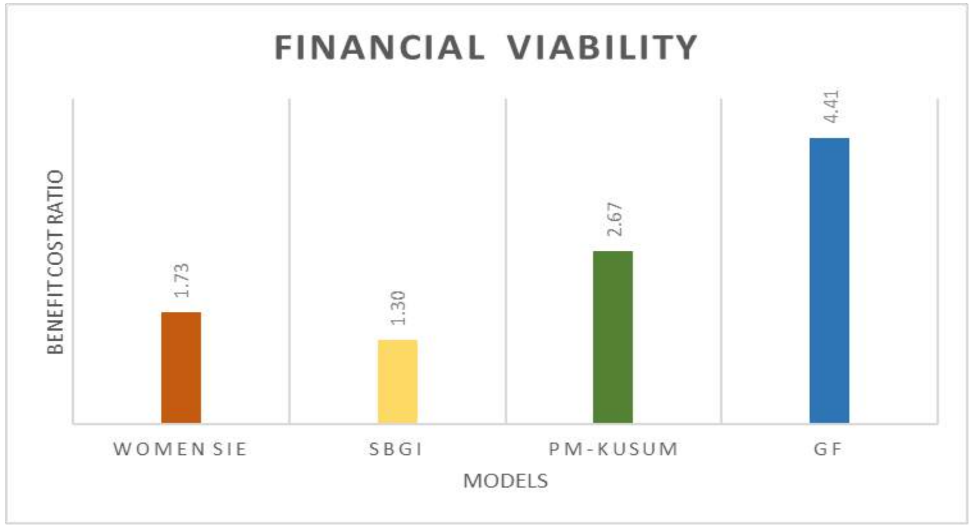


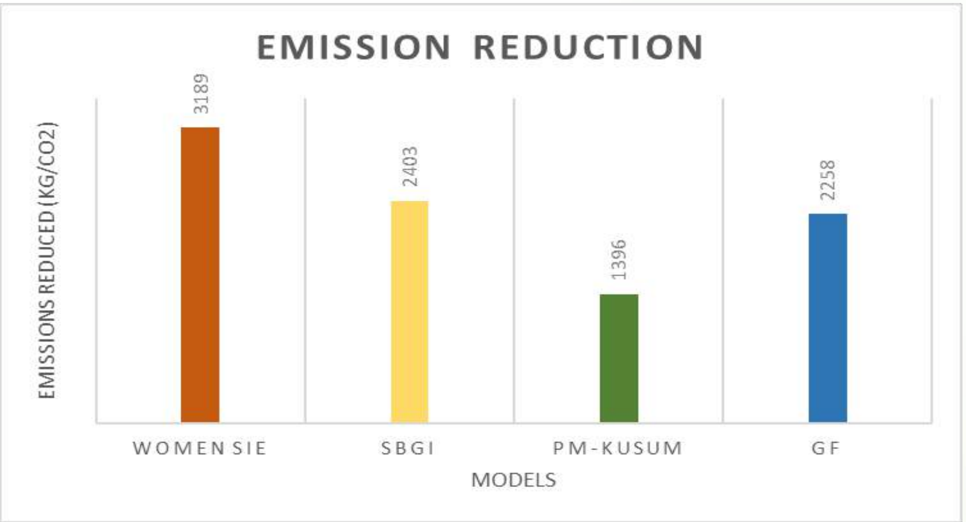
Women solar irrigation entrepreneurs in Bihar

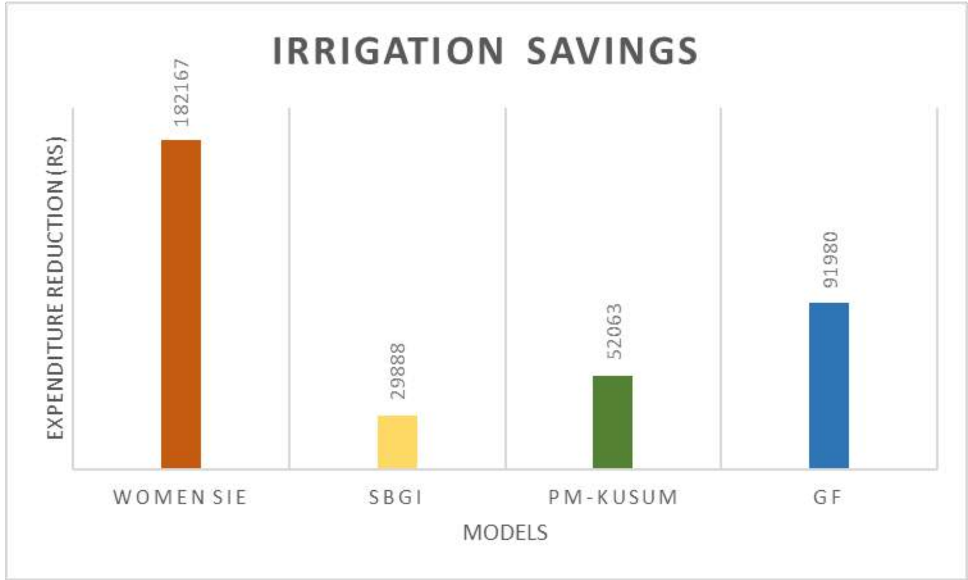
Solar Based Group Irrigation Models in Bihar

Although both models encouraged women's involvement, the social impact carried greater significance for women's solar irrigation entrepreneurs.

Financial Viability







- Guarantee Fund model-most financially viable;
- Emission reduction and irrigation savings in Women SIE are the highest

CGIAR INITIATIVE ON NEXUS Gains

Financial Viability

PM-KUSUM model in Haryana

ATTRIBUTES	FGD 1	FGD 2
System Capacity(KWP)	3	7.5
Time irrigate 1 acre	7	4
No of irrigations (Cotton-Wheat)	7	7
Area served	5	15
Total annual irrigation hours	245	420
Annual diesel consumption	306	735
Diesel consumption per acre	61	49
Annual diesel savings (Rs)	30625	73500
Benchmark Cost of SIP (Rs)	181000	355000
Farmers Contribution	45250	88750
Payback Period (Years)	1.5	1.2
BC Ratio	2.4	2.93
Emission reduction	821	1970
Carbon credit earnings (Rs)	3940	9455

Guarantee Fund Model in West Bengal

	Average of 4 FGD
Area served (bigha)	7-8 (2-2.5 acre)
Cropping Intensity	300+ %
Time required for irrigating 1 acre of land	7
Total hours of irrigation per acre (Rice-vegetables-Rice)	229
Diesel required for 1 hour	2 lit
Diesel per acre annually	459 liter
Diesel expenditure per acre	Rs 45,990
Total Diesel expenditure averted	Rs 91,980
B:C ratio	4.41
Payback period	1.1
Potential annual earnings from carbon credits	Rs 9321

CGIAR INITIATIVE ON NEXUS Gains

Understanding the Gender component

Model 1 and Model 4: Primarily beneficiaries were Women

Model 1 (Bihar); Active participation of women with social impact.

Model 3 (West Bengal): No women knew how to operate and have limited involvement in farming.

What created the difference in involvement?

Capacity building,
Institutional design and
The selection criteria

Conclusion

1. The PM-KUSUM model emerges as optimal for large-scale farmers in regions devoid of groundwater markets
2. The Guarantee Fund Model offers tailored solutions for medium and small-scale farmers.
3. Models SBIG and SBIE in Bihar stand out as viable options for marginal farmers navigating small, fragmented land holdings

To scale up the PM-KUSUM Scheme in Eastern India where adoption is very low, these models have high potential (Guarantee Fund model and SBIG), and considering it under the scheme might help to scale up.

THANK YOU

Screening for environmental hotspots and organizing a field campaign, lab analysis, and data interpretation

Photo:
sampling of the secondary
raw material / industrial waste

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Dr. Alexey Alekseenko
Head of the Resource Nexus Laboratory

Outline

(i) Field sampling procedures

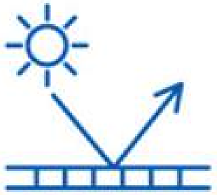
(ii) Desktop analysis

(i) Field sampling procedures

What is an environmental hotspot?

When studying human-affected resources, we may find:

changed physical properties – density, temperature, etc.



changed concentrations of chemical compounds – nutrients, metals, etc.

new substances – radionuclides, PAHs, etc.

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Which resources?

The **transit media** can include the surface layer of the atmosphere, surface and ground water, as well as plant organs that make up the annual litter.

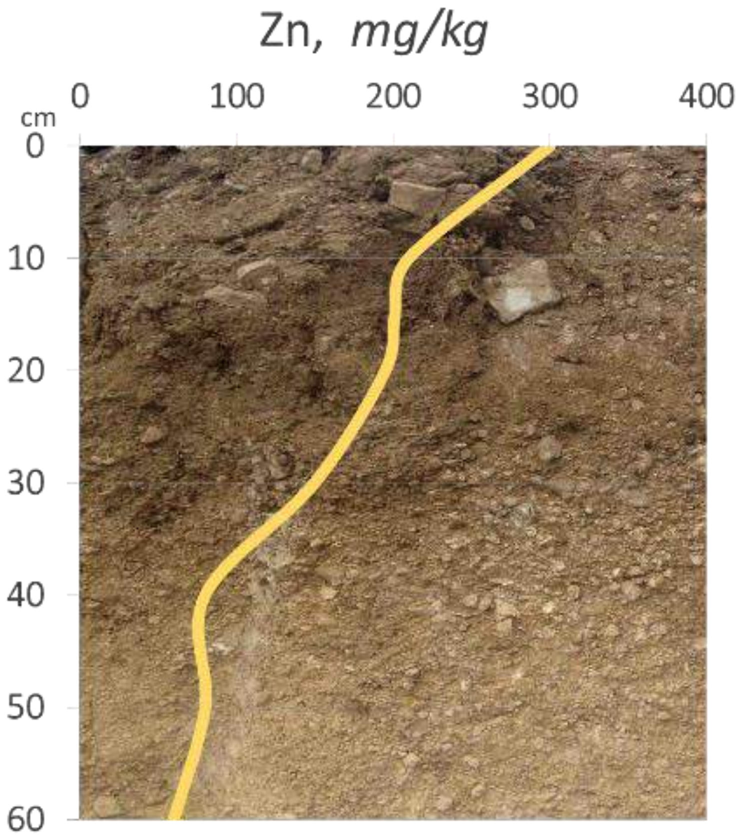
Depositing (accumulating) media include soils, plants, snow, bottom sediments of reservoirs, some human and animal organs.

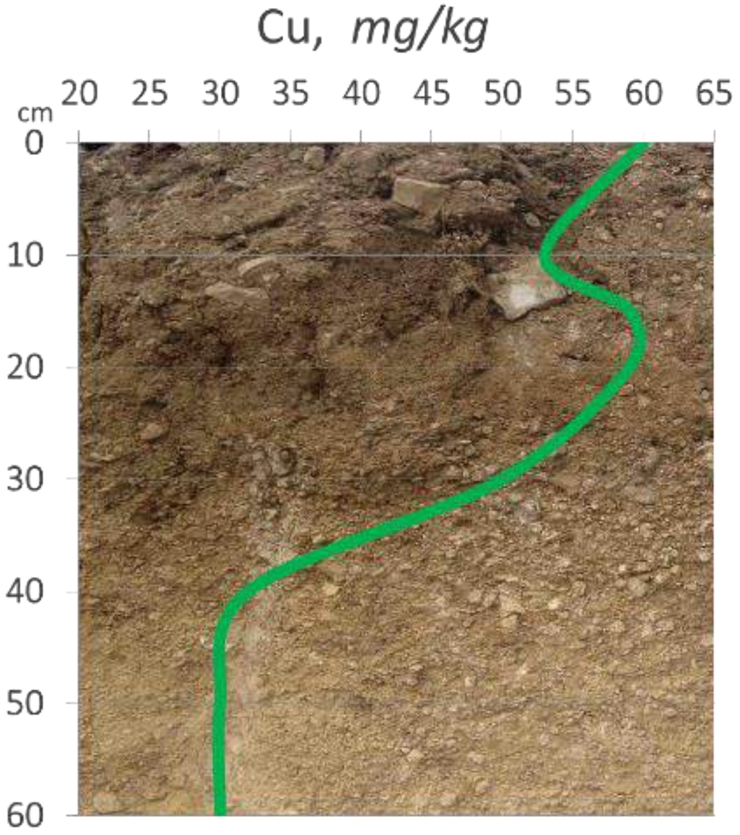
Soil resources

Soil resources

Soil type:
Technosols (WRB)

Sampling depth
may vary a lot!

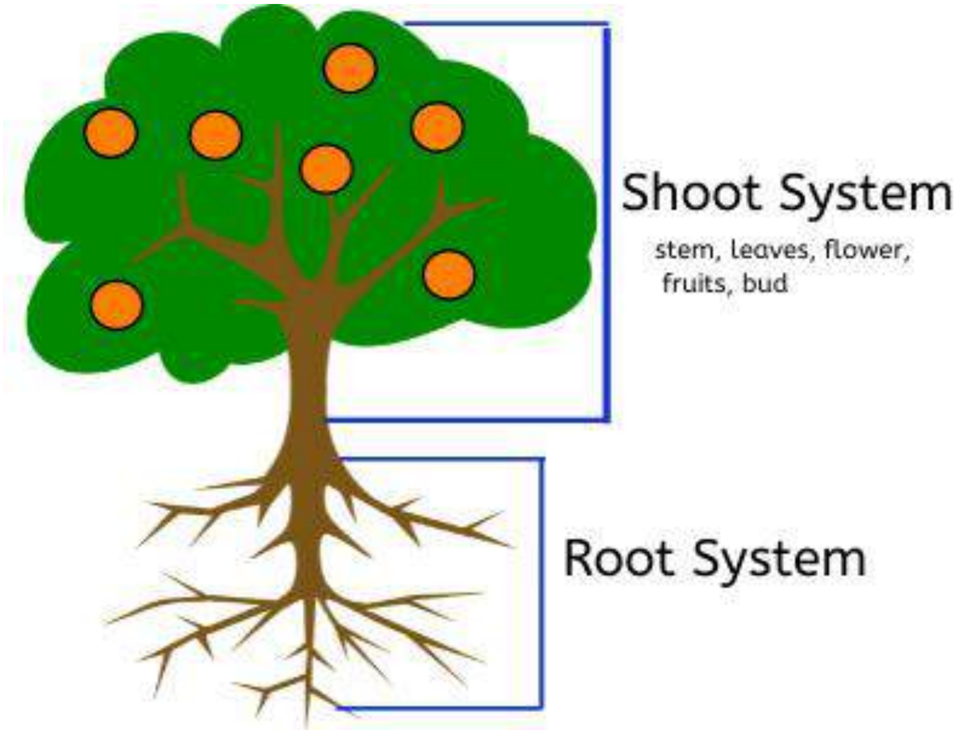




Plants

Root system: part of a plant that grows below the soil is called root system. This grows towards gravity.

Shoot system: Part of a plant that grows above the soil is called shoot system. This includes stem, leaves, fruits etc. Shoot system grows against gravity.



https://smartclass4kids.com/science/plants-facts/part-of-plant

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Water resources

https://www.fondriest.com/ysi-exo3-multi-parameter-water-quality-sonde.htm

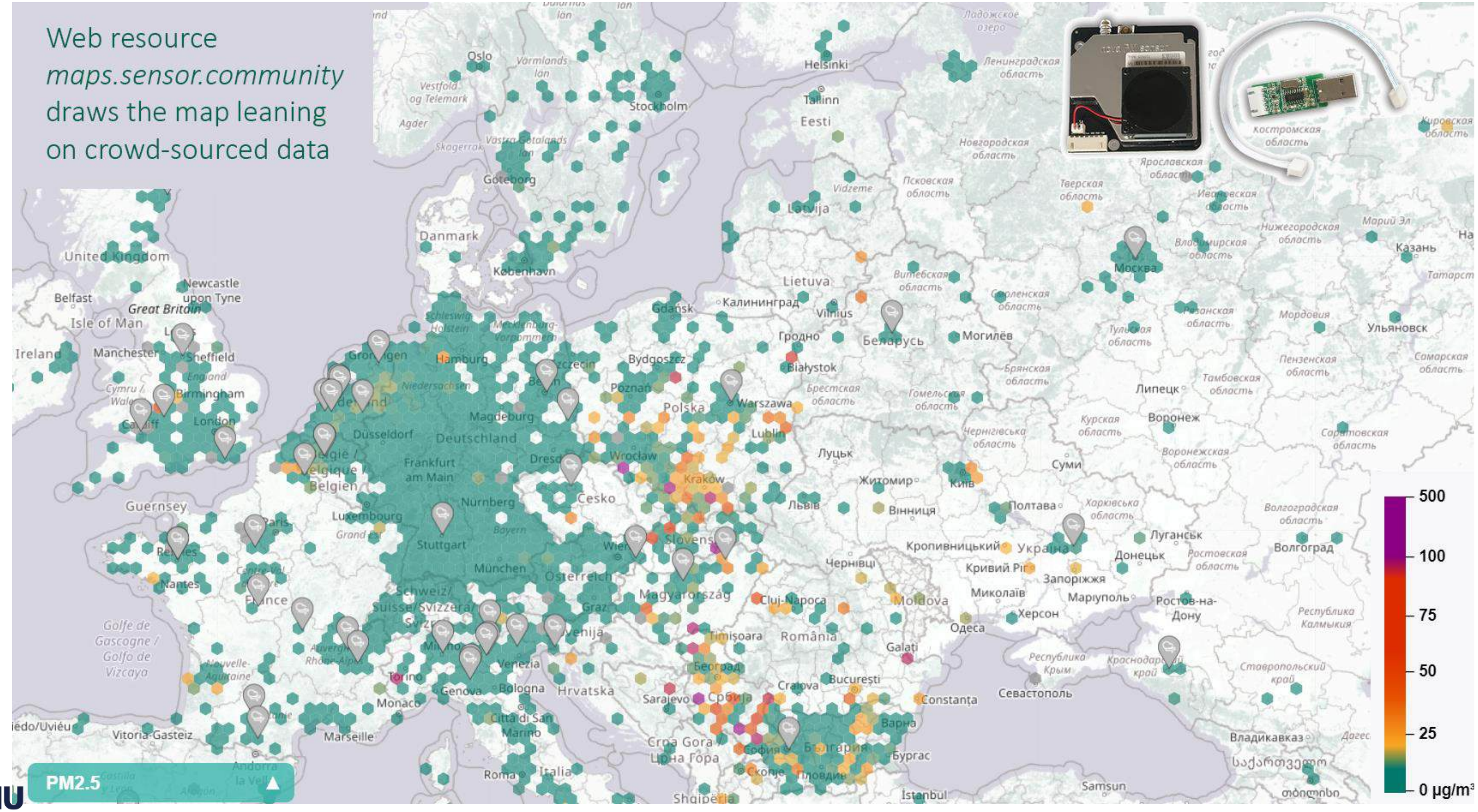
Water resources

http://dx.doi.org/10.21000/JASMR07010589

Air quality

https://tsi.com/products/aerosol-and-dust-monitors/dust-monitors

Air quality: citizen science



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Field sampling procedures

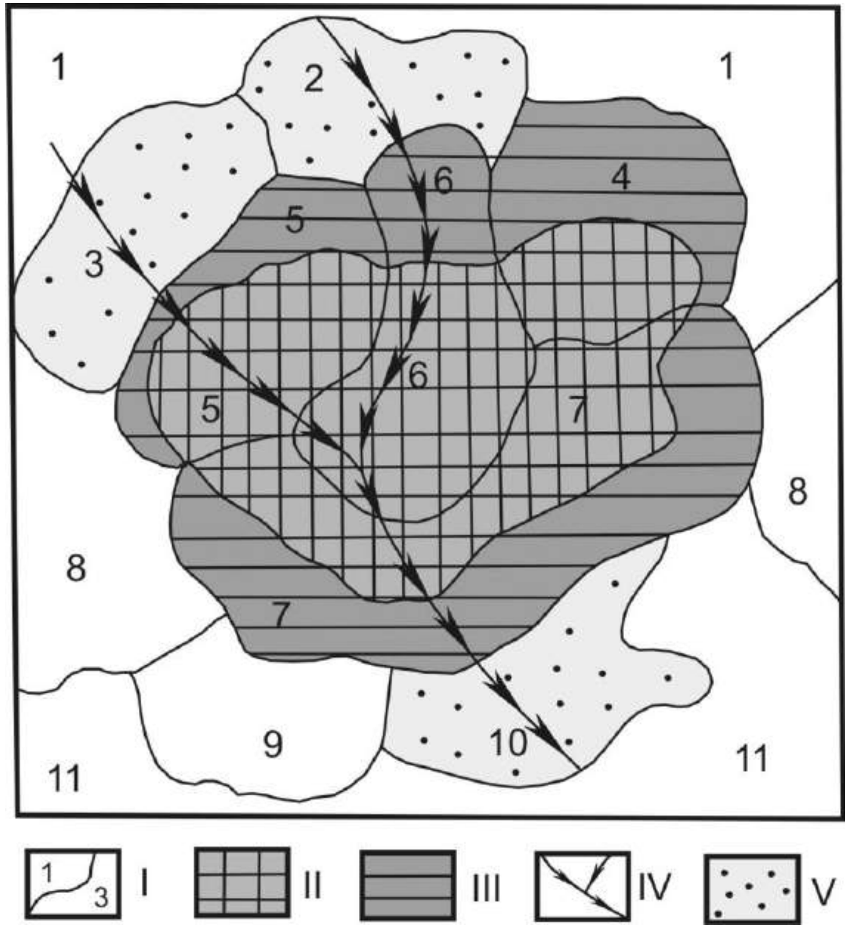
I – borders and conventional numbers of ecosystems

II – main study area

III – remaining parts of ecosystems

IV – material fluxes

V – sites for additional sampling



Field sampling procedures

Ecosystems over
and below
the study area

https://www.alpine-space.eu/projects/trails/pilots/eisenerz/eisenerz.jpg

Three types of samples

(i) ordinary
(ii) additional
(iii) control

Three types of samples

1 – contamination source

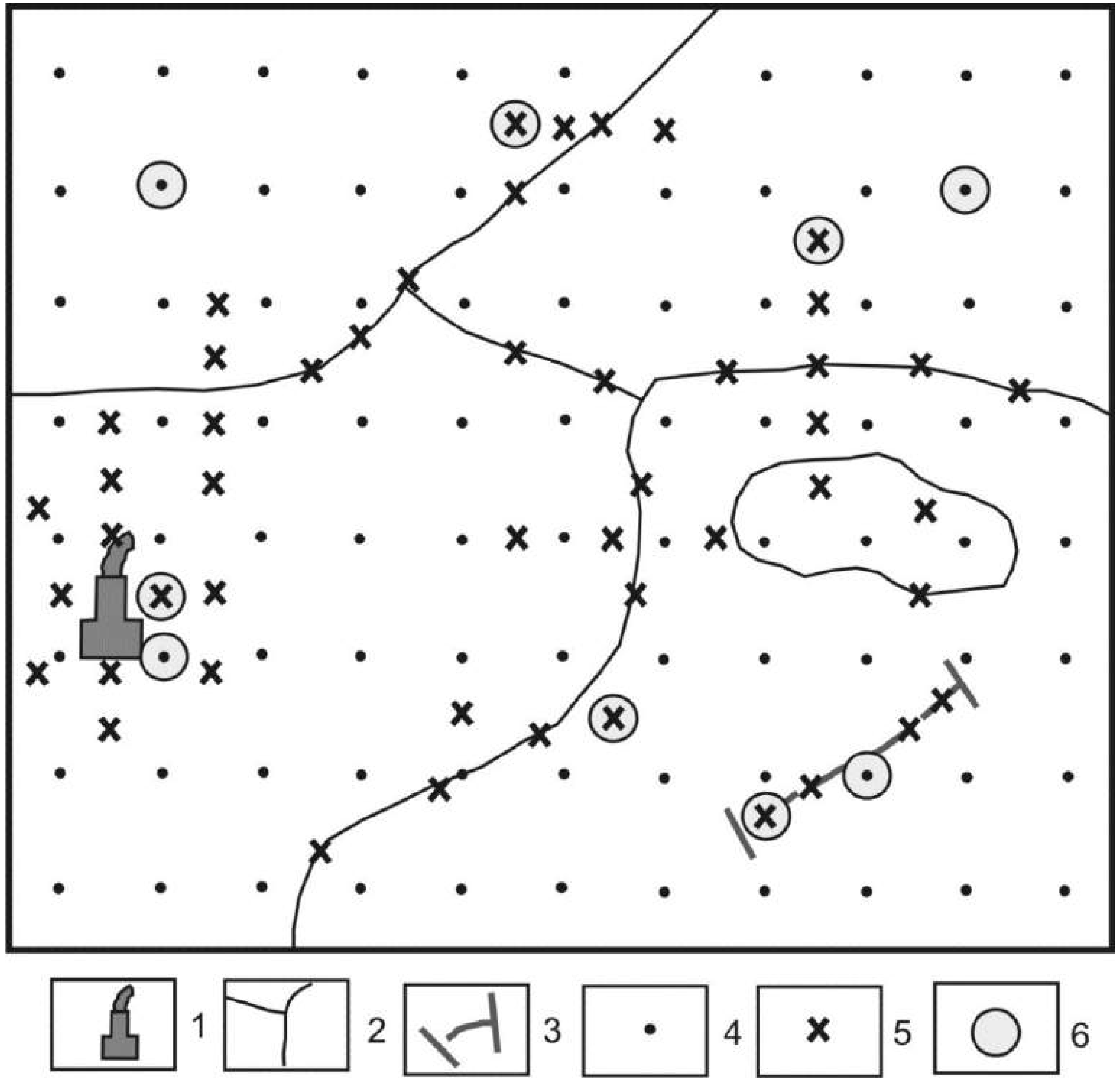
2 – ecosystem borders

3 – geochemical barrier

4 – ordinary samples

5 – additional samples

6 – control samples



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Field survey blanks

ON-SITE RESOURCE INVENTORY

field description of the sampling sites

Sample code	**LS24-01**
Date	
Conducted by	
Coordinates, elevation	Latitude: Longitude: Meters above sea level:
Biota	Dominant trees: Dominant bushes: Dominant grasses: Ground surface vegetation cover: % Canopy cover: %
Water, microclimate	Surface soil humidity, underline: dry (feels powdery) / moist (feels cool) / wet (feels sticky) / saturated (visible water) Nearby water bodies: Recent weather events:
Soil	Soil texture, underline: sand / silt / clay Color: Organic matter (e.g., leaf litter, decomposed material): Catena position, underline: E / TE / TAc / Ac / SAq / Aq Slope steepness: ° Aspect (direction the slope faces):
Space	Current land use: Former land use: Visible landscape disturbance or pollution (e.g., tilling, construction, oil spills): Nearby objects:
Material	Waste:

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Comments

The terms E, TE, TAc, Ac, SAq, and Aq refer to different catena positions, i.e., the sequence of soils that occur down a slope due to differences in erosion and deposition patterns.

Understanding them helps in predicting pollutant redistribution and other landscape processes, which is important for making land management decisions.

Catena positions	Description	Characteristics
E – eluvial or erosional	Hilltop upland positions, where soil material is primarily lost due to erosion.	Soils often have lower organic matter content because the topsoil material is washed or blown away. They are generally shallower and may exhibit signs of leaching, such as a lighter color and reduced clay content.
TE – trans-eluvial	Steep slopes, >15°, where both erosion and limited deposition occur.	Soils may show a mix of characteristics, with some materials being transported away while others begin to accumulate. This results in moderate soil depth and fertility.
TAc – trans-accumulative	Gentle slopes, <15°, where material starts to accumulate but still experiences some movement.	Soils are deeper and more fertile than those in trans-eluvial positions. They show mineral accumulation and increased organic matter content due to the partial deposition of eroded materials from higher slopes.
Ac – accumulative	Base of a hillside, where deposition of soil materials is the dominant process.	Soils are the deepest and most fertile, with high organic matter content. They are formed by the accumulation of materials eroded from upslope, leading to rich and well-developed soil profiles.
SAq – super-aquatic	Floodplains that are seasonally but not permanently saturated with water, above aquatic zones.	Soils may show signs of periodic waterlogging and may support hydrophytic vegetation. They have higher organic matter content compared to drier positions but are less consistently saturated than aquatic soils.
Aq – aquatic	Areas that are underwater or regularly submerged for significant periods.	Soils support aquatic or semi-aquatic vegetation, such as those found in marshes, swamps, and at the bottoms of wetlands and shallow water bodies. The oxygen-deprived anaerobic environment results in gleying, visible as blue-gray colors due to iron reduction. Organic material accumulates due to slower decomposition rates.

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Field survey blanks

ON-SITE RESOURCE INVENTORY
field description of the sampling sites

Sample code	**LS24-01**
Date	
Conducted by	
Coordinates, elevation	Latitude: Longitude: Meters above sea level:
Biota	Dominant trees: Dominant bushes: Dominant grasses: Ground surface vegetation cover: % Canopy cover: %
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Field survey blanks

Soil	Soil texture, underline: sand / silt / clay Color: Organic matter (e.g., leaf litter, decomposed material): Catena position, underline: E / TE / TAc / Ac / SAq / Aq Slope steepness: ° Aspect (direction the slope faces):
Space	Current land use: Former land use: Visible landscape disturbance or pollution (e.g., tilling, construction, oil spills): Nearby objects:
Material	Waste:

(ii) Desktop analysis

Double-check

Tags for samples

Coordinates

Register

Not enough samples!

Stats With Cats Blog

...for when you can't solve life's problems with statistics alone.

Home About

← It's All Greek Purrfect Resolution →

30 Samples. Standard, Suggestion, or Superstition?

Posted on July 11, 2010

If you've ever taken any applied statistics courses in college, you may have been exposed to the mystique of 30 samples. Too many times I've heard statistician do-it-yourselfers tell me that "*you need 30 samples for statistical significance.*" Maybe that's what they were taught; maybe that's how they remember what they were taught. In either case, the statement merits more

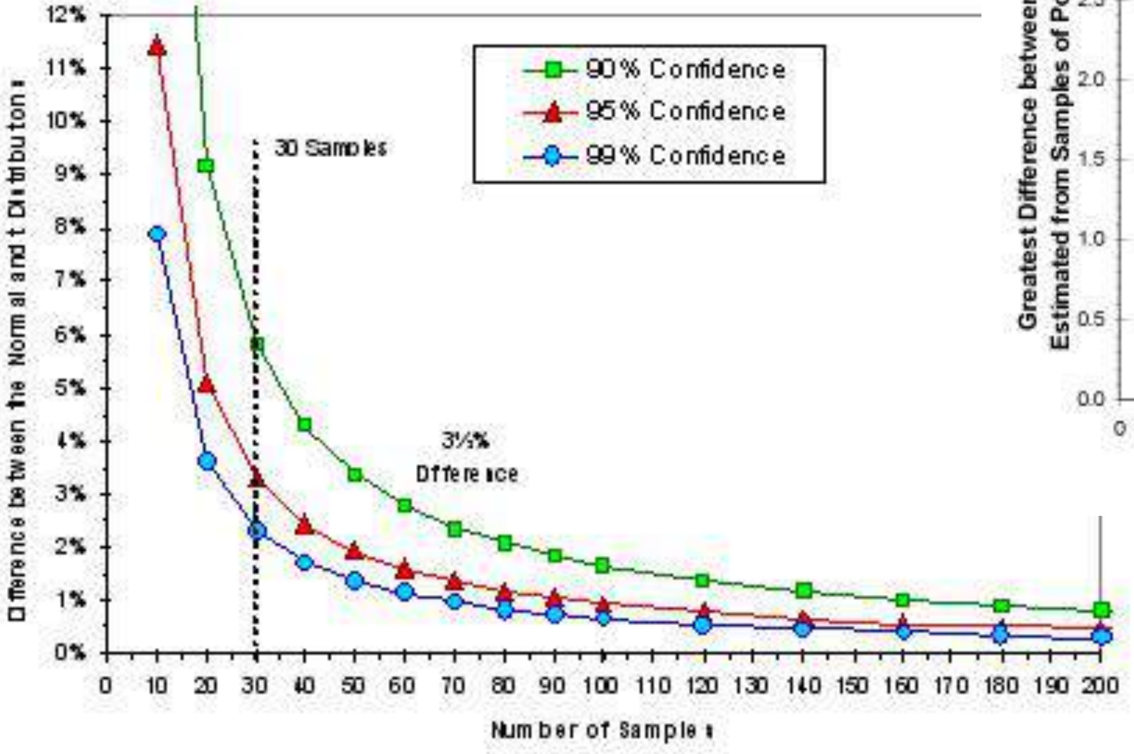
Search

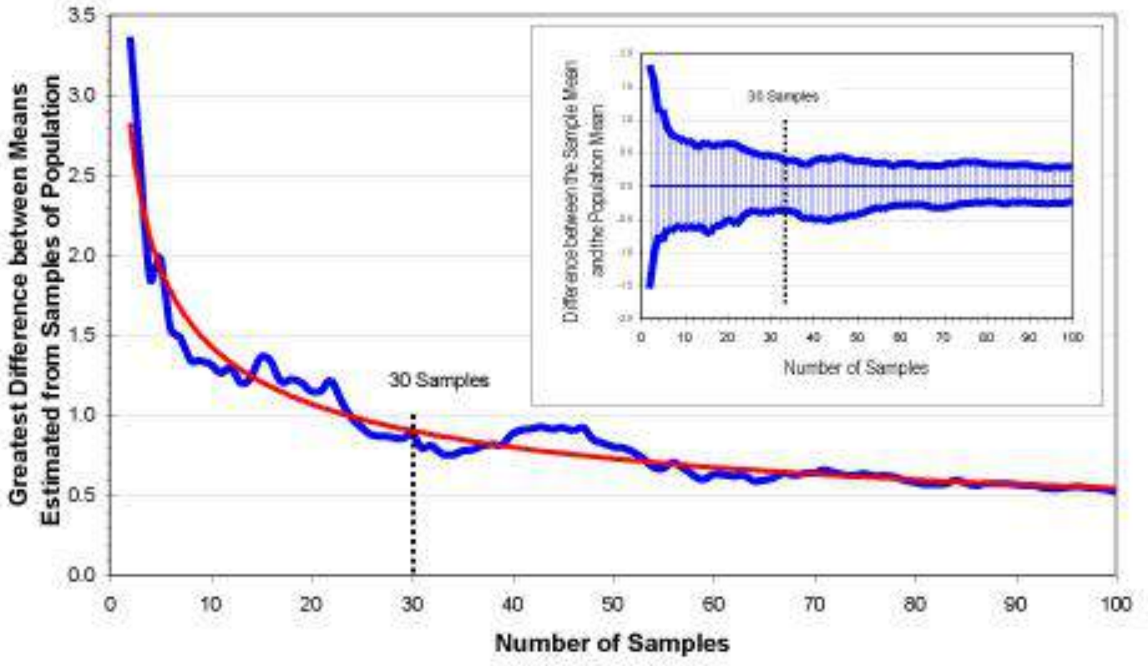
DISCLAIMER

The postings on this blog are my own (except as noted) and do not necessarily represent the positions, strategies or opinions of my current, past, and future employers, cats and other family members, relatives, Facebook friends, real friends, Charlie Sheen, people who sit next to me on public transportation, or myself when I'm in my right mind.

Recent Posts

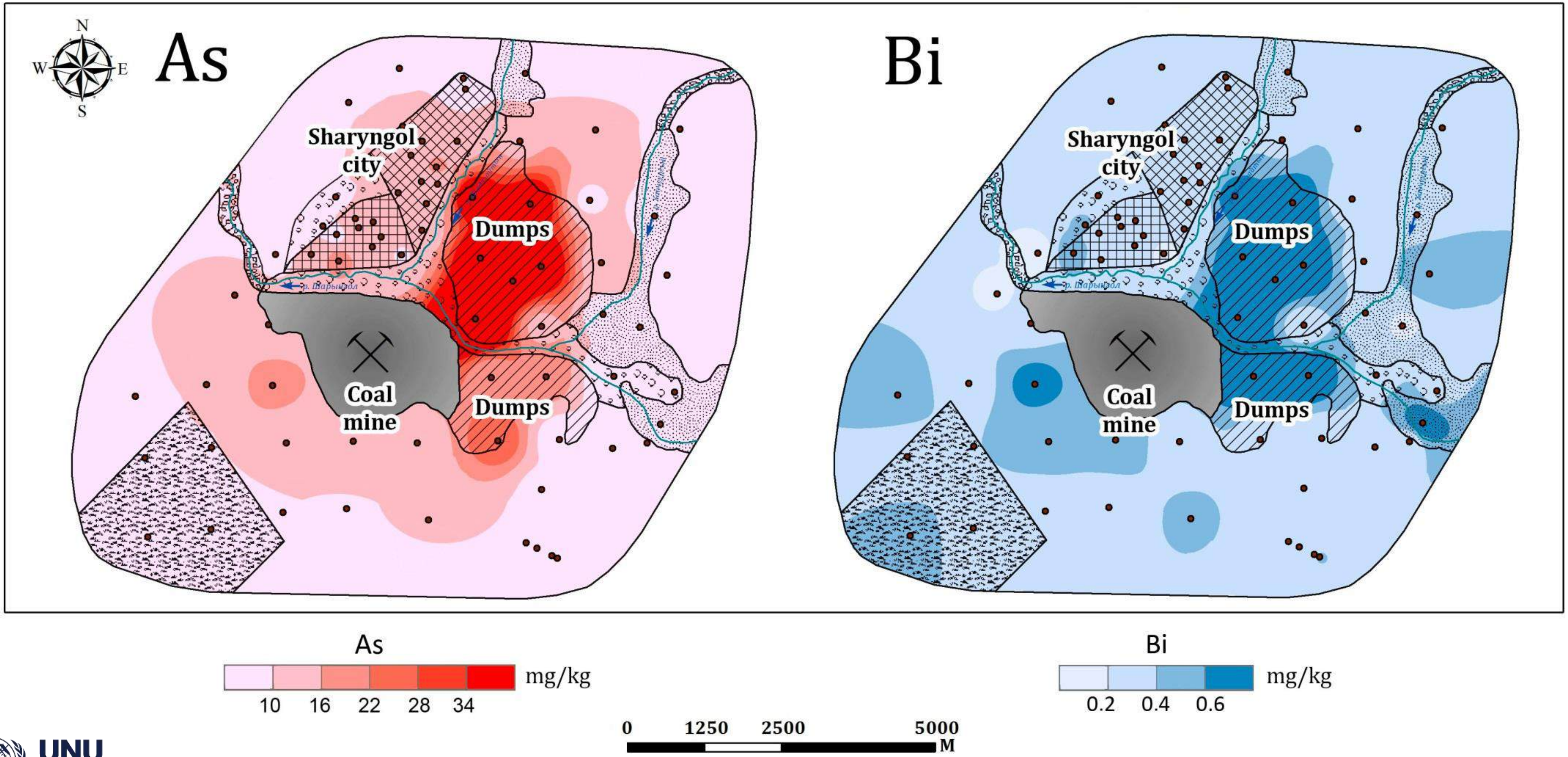
- WHAT ARE THE ODDS?
- WHY YOU NEED TO TAKE





Chang H-J, Huang K-C, Wu C-H. (2006) Determination of sample size in using central limit theorem for Weibull distribution. Inf Manag Sci 17:31–46.

Pollution hotspots around a coal mine



Resource Nexus approach

The checklist to analyze coal era legacies:

Climate:	greenhouse gas emissions
Water:	drainage, contamination
Biota:	biodiversity loss
Soil:	soil degradation
Material:	wasterock piles
Space:	extensive land use
Land:	landscape destruction
Waste:	coal slurry, combustion ash
Energy:	energy intensive extraction
Food:	deterioration of fertile landscapes

Image source:
Brouwer et al., 2024

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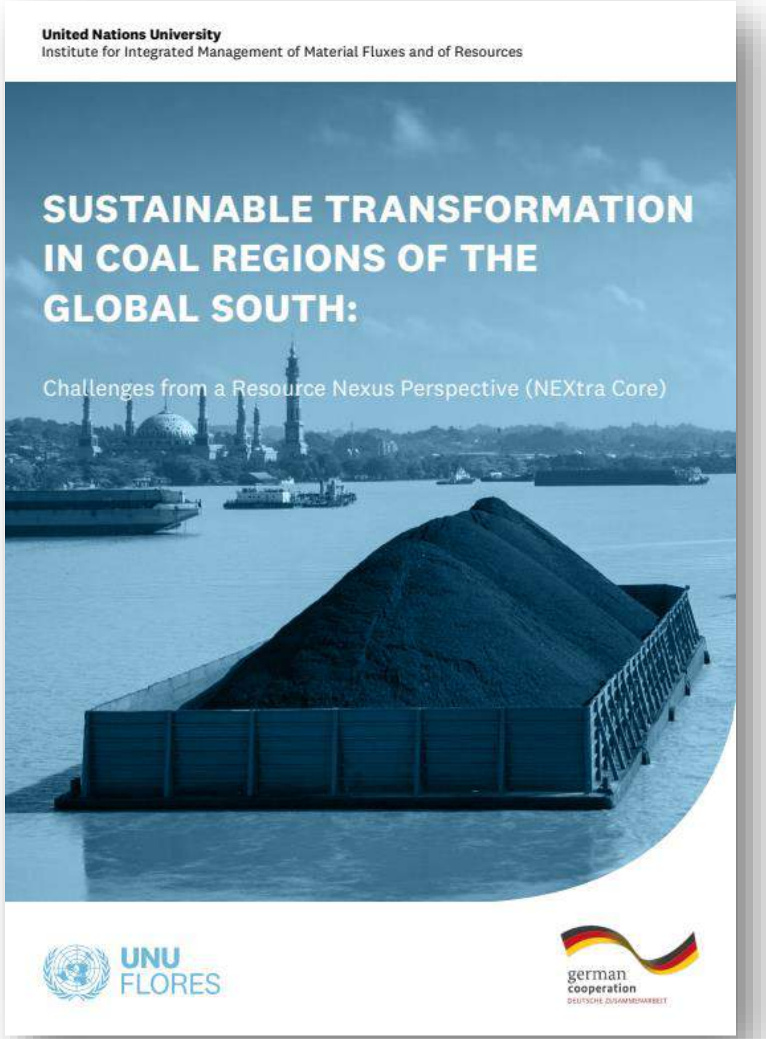
Resource Nexus approach



Post-coal challenges in **the Global South**:

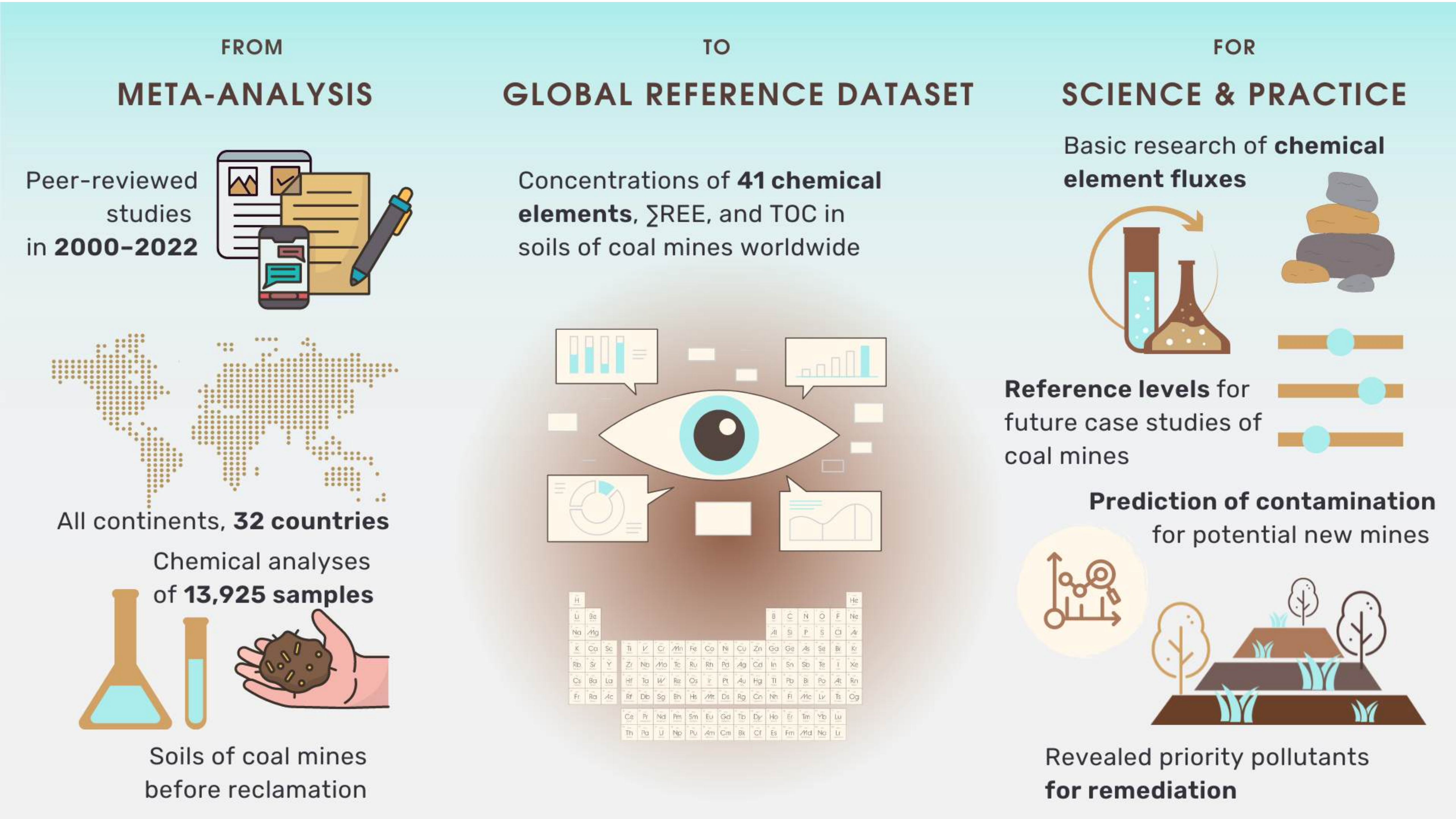
- Environmental legacies
- Energy transition
- Economic restructuring
- Social implications

Download the report:

https://rue.bmz.de/resource/blob/157250/2023-06-20-nextra-core-final-report-finalversion.pdf

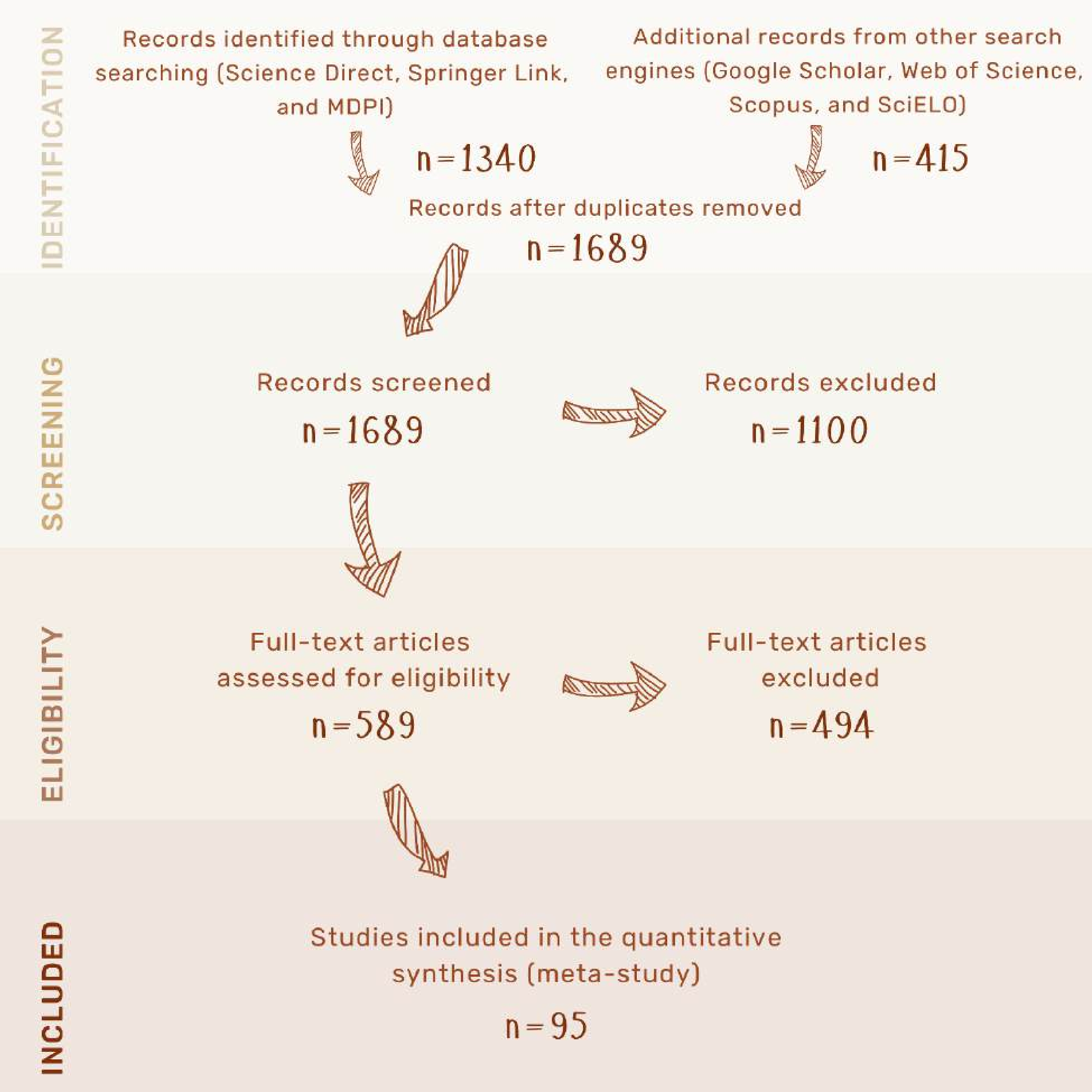
Global Pollutant Concentrations in Coal Mine Soils

Photo credits: A. Dollmeyer


FROM
META-ANALYSIS
Peer-reviewed studies in 2000–2022
All continents, 32 countries
Chemical analyses of 13,925 samples
Soils of coal mines before reclamation
TO
GLOBAL REFERENCE DATASET
Concentrations of 41 chemical elements, ∑REE, and TOC in soils of coal mines worldwide
FOR
SCIENCE & PRACTICE
Basic research of chemical element fluxes
Reference levels for future case studies of coal mines
Prediction of contamination for potential new mines
Revealed priority pollutants for remediation

Workflow chart

The steps of the meta-study taken to collect the statistically reliable dataset on the concentrations of chemical elements in the coal mine soils



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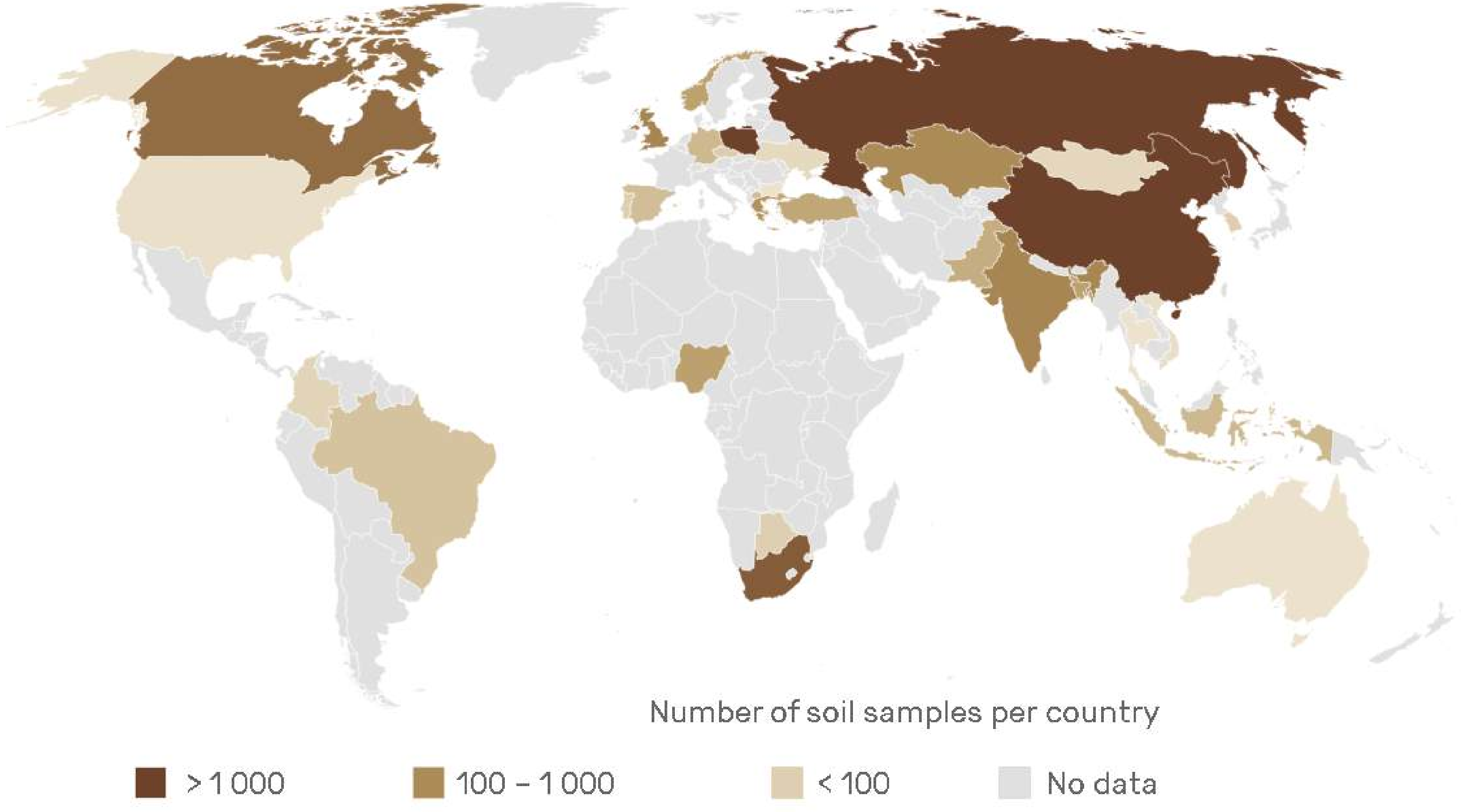
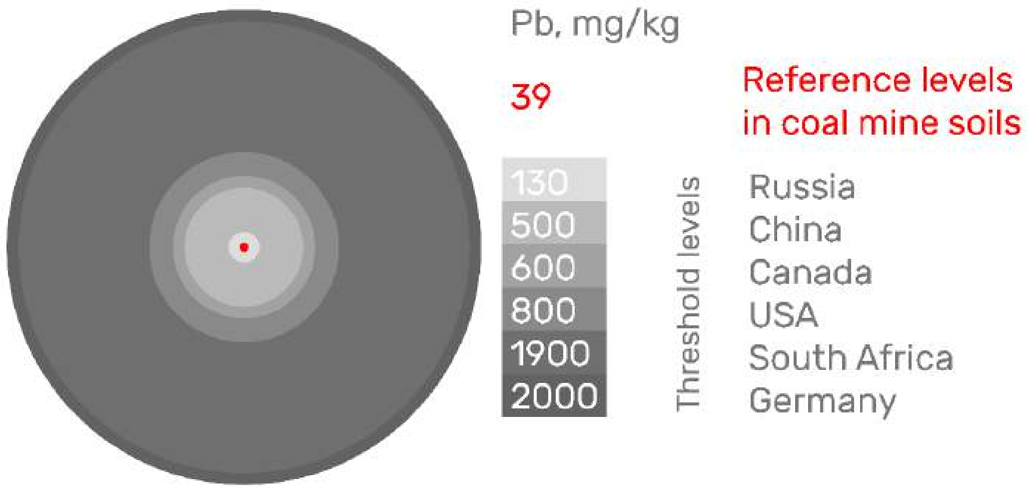
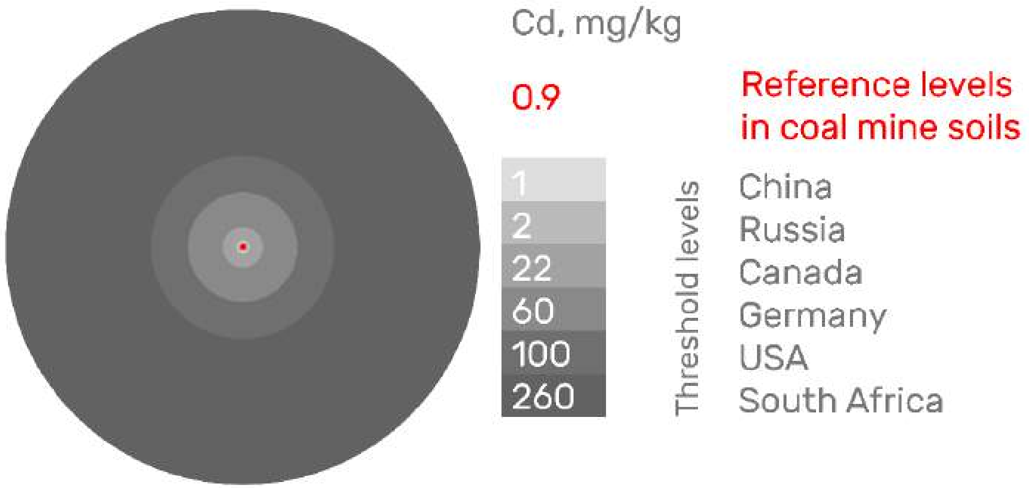
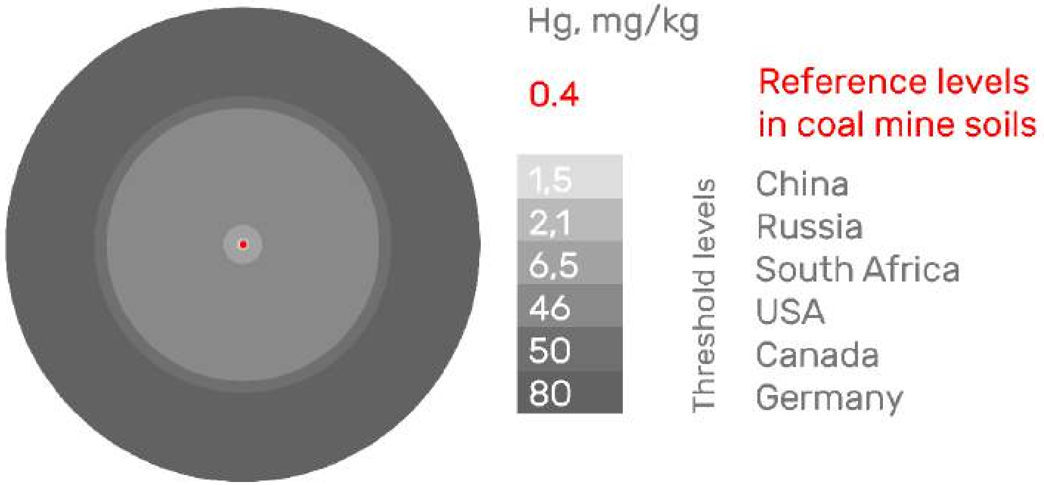
Coal mining regions reviewed



Screening against the national soil quality guidelines of six regions







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Further reading

ISO 18400-104:2018, Soil quality — Sampling
https://www.iso.org/standard/65223.html

ISO 5667-3:2018, Preservation and handling of water samples
https://www.iso.org/standard/72370.html

... and other national documents and standards

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Thank you!
alekseenko@unu.edu

United Nations University
Institute for Integrated Management of Material Fluxes and of Resources

Advancing Resource Nexus Studies through Replication Studies

Floor Brouwer (UNU-FLORES)

Presentation on-line Workshop Nexus Implementation: Potential and Opportunities, 6 November 2024

UNU FLORES

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The Reproducibility Project - Source: https://osf.io/ezcuj/

‘The Reproducibility Project is a collaboration of 270 psychologists, who attempted to replicate 100 psychology studies. In addition, a 2018 report examined studies published in Nature and Science between 2010 and 2015. These efforts find that about two-thirds of studies do replicate to some degree, but that the strength of the findings is often weaker than originally claimed.’ (source: https://theconversation.com/the-replication-crisis-is-good-for-science-103736)

Presentation will focus on four areas:

- What are Replication Studies and why are they used?
- What evidence does the literature offer about using Replication Studies?
- Proposed steps to advance the use of Replication Studies?
- Could Resource Nexus studies also benefit from Replication?

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There are multiple definitions of replications - replication is crucial in research

- A systematic investigation of previously published findings that, over time, can identify limitations from the original effect (e.g., resulting from a curiosity in the original sample or research design) (Edlund et al., 2022).
- New data are analyzed within the original study design or when the original data are reanalyzed – are there any deviations from the original study (Ferraro and Shukla, 2021).
- Replication involves any study whose main purpose is determining the validity of one or more empirical results from a previously published study (Finger et al., 2023).

Is there a rationale for replications?

- There is debate on whether scientists have the right incentives to produce credible scientific knowledge, for exampe to design effective environmental policies (Ferraro and Shukla, 2021). These authors also argue that many empirical studies in the scientific literature are false and fail to replicate (Ferraro and Shukla, 2021).
- If the estimated impacts of environmental regulations are exaggerated, the benefit-cost analysis will exaggerate the benefits of the new regulation as well (Ferraro and Shukla, 2021). Misreporting of statistical significance might occur in response to fears about publication bias against statistically insignificant results. This could also contribute to the problem of false or exaggerated results in the literature. The authors also argue '.. studies are more likely to be published if they report 'statistically significant results'.
- Replication studies are scarce, they tend to be published in journals with less impact. This reduces the self-correcting ability of research.

Population and methodology to differentiate between replications (source: Finger et al., 2023)

- Analyzed population, distinguishing between
  - Using the same data set as in the replicated study;
  - Obtaining new data from a new sample of the same population, for example using data from another survey with a similar group of practitioners in the same region (i.e., water managers)
  - New data obtained from a similar population, for example, using data from another survey with water managers in a similar region
  - New data from a very different population, for example, using data from another survey with water managers in a different and non-comparable region.
- The methodology (e.g., survey method, data preparation, and specification, type of analysis), distinguishing between:
  - Exactly the same methodology as in the replicated study;
  - A slightly modified methodology (e.g., changing the set of explanatory variables);
  - A somewhat different methodology (e.g., choice experiment versus an alternative econometric method);
  - A completely different methodology (e.g., system dynamics modelling versus Integrated Assessment Modelling).

Classification of replication studies is proposed from the above (Finger et al., 2023)

- Replications for assessing ‘repeatability’ (using the same data or new data from the same population, the same methodology as described above.
- Replications for assessing ‘internal validity and robustness’, using the same data but a different methodology.
- Replications for assessing ‘external validity and generalizability’. If a study lacks internal validity, there is a need to assess external validity.

When might there be a need for Replication Studies?

- Replication might be needed when an original study flashy findings that are hard to believe, counterintuitive, or controversial. It should ideally be done before the publication of any data (Edlund et al., 2022).
- If the research does not use a rigorous scientific methodology, it could fail to make precise predictions and be unreplicable (Edlund et al., 2022).

Ways to incentivize replications by the responsible party (source: Edlund et al., 2022)

Responsible party	Approach	Details
Journals	Formally support replications	Journals should formally support and encourage replications as the publication of replications does not adversely affect the impact of the journal or articles.
	Adopt 'Pottery Barn Rule' (You break it, you remake it). An actor creating a problem is also obliged to provide the resources necessary to correct it.	Replications should automatically be considered to be impactful in a journal in case the research was considered to be published
Funder	Adopt replication policies	Funders should require some level of replication in their funding portfolio.
	Require publications of null findings (there is no relationship between variables) in open repositories	Many studies with null findings often remain unpublished. Funding agencies may require brief reports to be submitted in open-sourced opportunities.
University	Explicitly value replications	Hiring and tenure committees could value high-qualities replications as much as novel findings.
	Incorporate replications into undergraduate and graduate curricula	Demonstrate the value of replications by teaching young scientists the value of replications and incorporate replications into the curriculum.

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Other recommendations to strengthen replication studies (source: Ferraro and Shukla, 2021)

Recommendation	Explanation
More emphasis on the design of a study	It is recommended to put more emphasis on the design of a study and on research questions than on results, and to recommend the reporting of confidence intervals (in statistical analysis) and statistical power. Similarly, researchers are encouraged to distinguish between exploratory and confirmatory analyses. Exploratory analyses – offering hypotheses that cannot be tested with the available data – should not be undervalued compared to confirmatory analyses.
Encourage and reward replications	Currently, replications offer low rewards and are costly. It is recommended that journals publish replications regardless of whether they confirm, qualify or contradict the original study. Authors should also be recommended to report everything (e.g., posting in an online repository, data sets and code files, including results that may not have been reported in the manuscript).
Raise awareness about Research practices	Does the research aim to enhance the quality of the research or just increasing the likelihood of publication?

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Why could Resource Nexus studies also benefit from replication?

Resource Nexus studies face features that are considered relevant for replication:

- Data – (i) (non) availability of data; (ii) uncertainty and/or unreliability of existing data from multiple sources and different focus (qualitative and quantitative data), (iii) challenges for quantification of environmental resources related to assets like biodiversity and soil features.
- Trade-offs and synergies connected with the Resource Nexus might be intangible in nature (i.e., biodiversity) and robust methodologies to quantify their interconnections need advancement.
- Different methodologies and tools are used to assess the impacts of policies (e.g. System Dynamics Modelling, Integrated Assessment Modelling).

Literature

- Edlund JE, Cuccolo K, Irgens MS, Wagge JR, Zlokovich MS. Saving Science Through Replication Studies. Perspect Psychol Sci. 2022 Jan;17(1):216-225. doi: 10.1177/1745691620984385. Epub 2021 Mar 8. PMID: 33682522.

- Finger, R., Grebitus, C. and Henningsen, A. (2023). Replications in agricultural economics. Applied Economic Perspectives and Policy, 45(3): 1258–1274.

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Experiences from the SustainFood USA-Africa-(Europe) Network of Networks Project

Michael Jacobson
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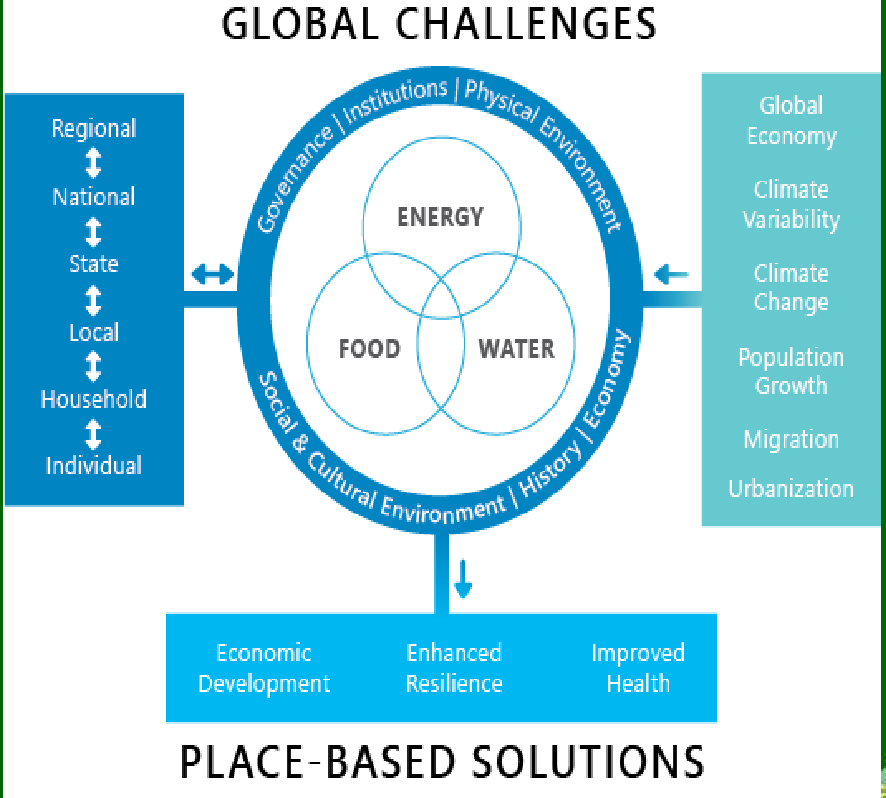


US-Africa Sustainable Food Systems through Water-Energy-Food Nexus Networking (SustainFood)

- Collaborative platform
- Transdisciplinary teams of researchers, students and practitioners across US, African, and European networks
- Network-to-network research, education, and community outreach activities.

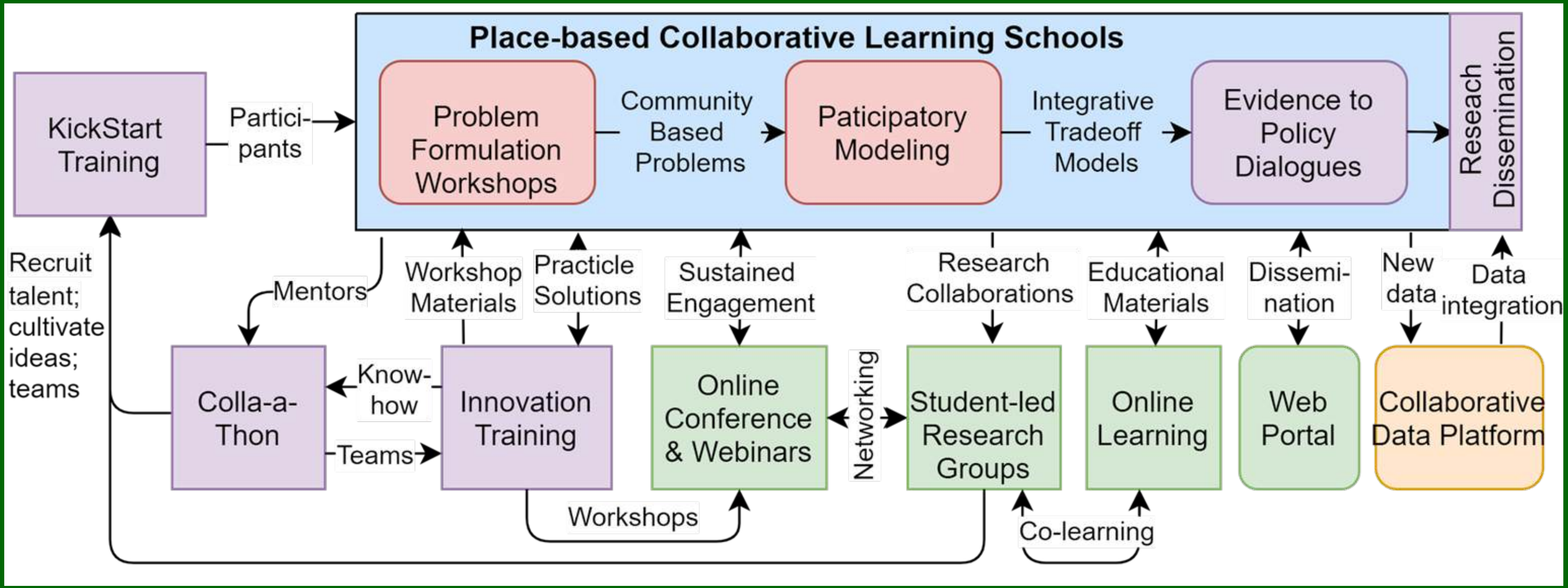
PennState SEI MICHIGAN STATE UNIVERSITY

NSF

https://sustainfood.psu.edu/

#SustainFood

Activities for Students, Early Career Professionals, and Network Partners



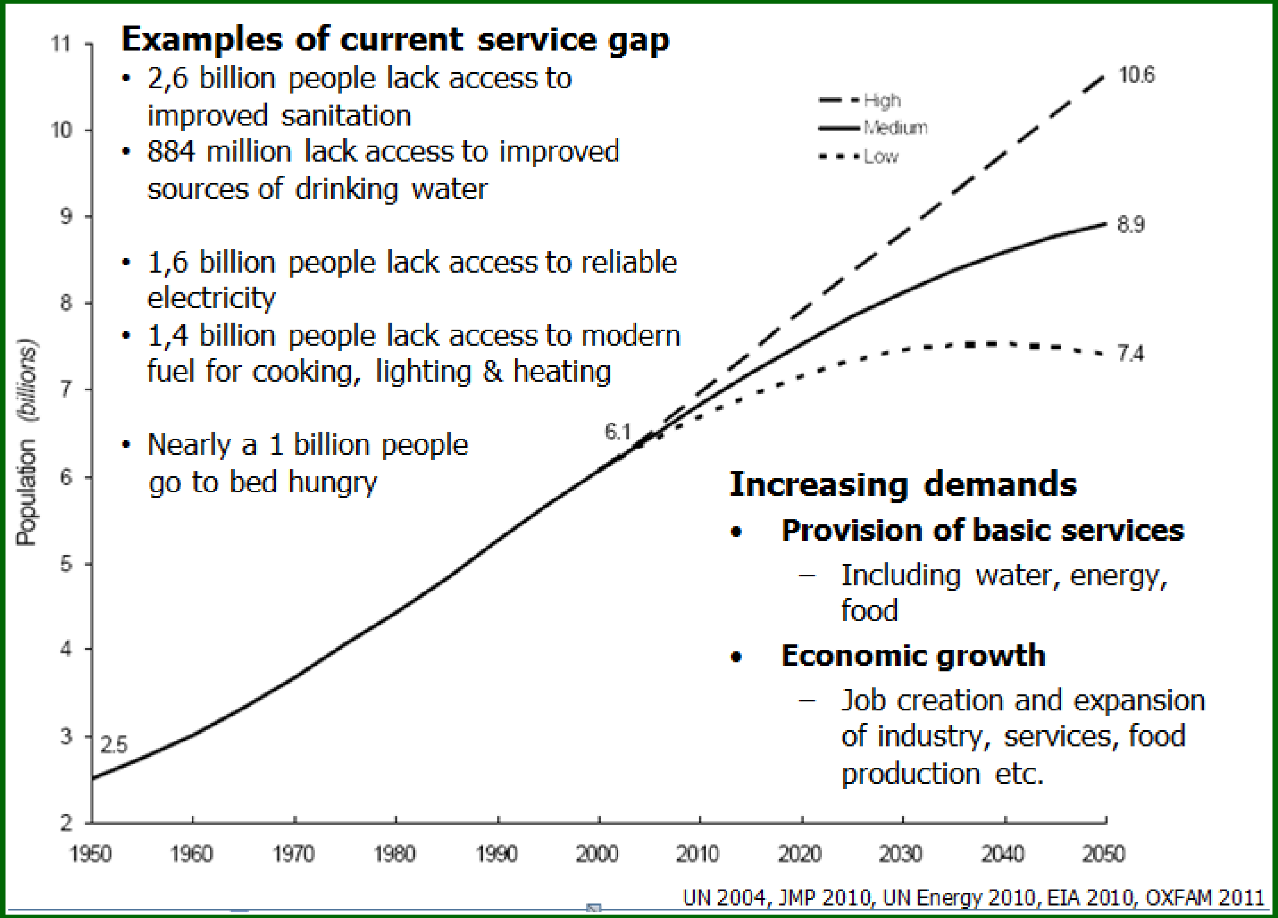
4 Working Groups:

- Collaborative Learning schools
- Early-Career Researchers and Student Community (SECP)
- Entrepreneurship and Innovation
- Collaborative Data Platform

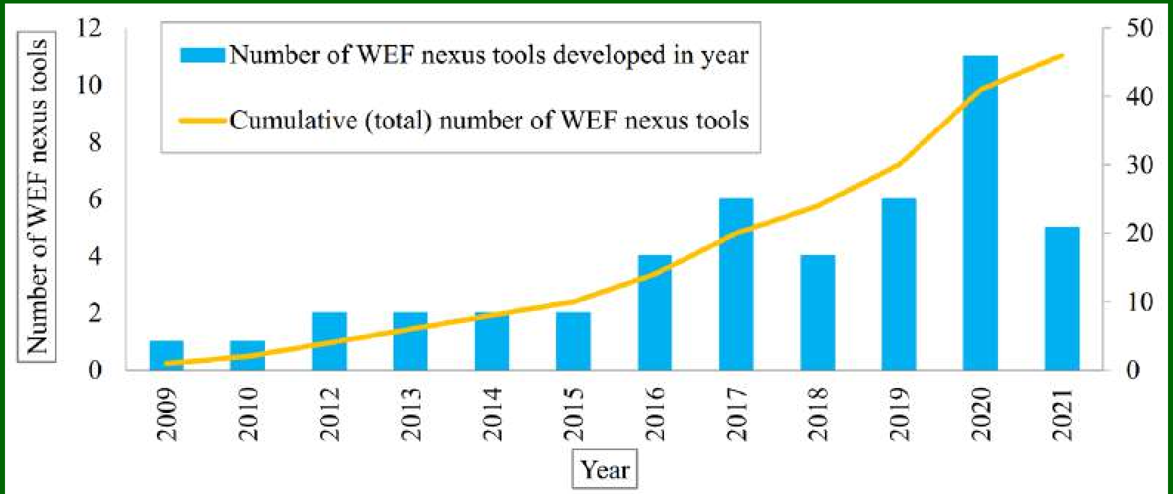
Newsletter –over 900 contacts

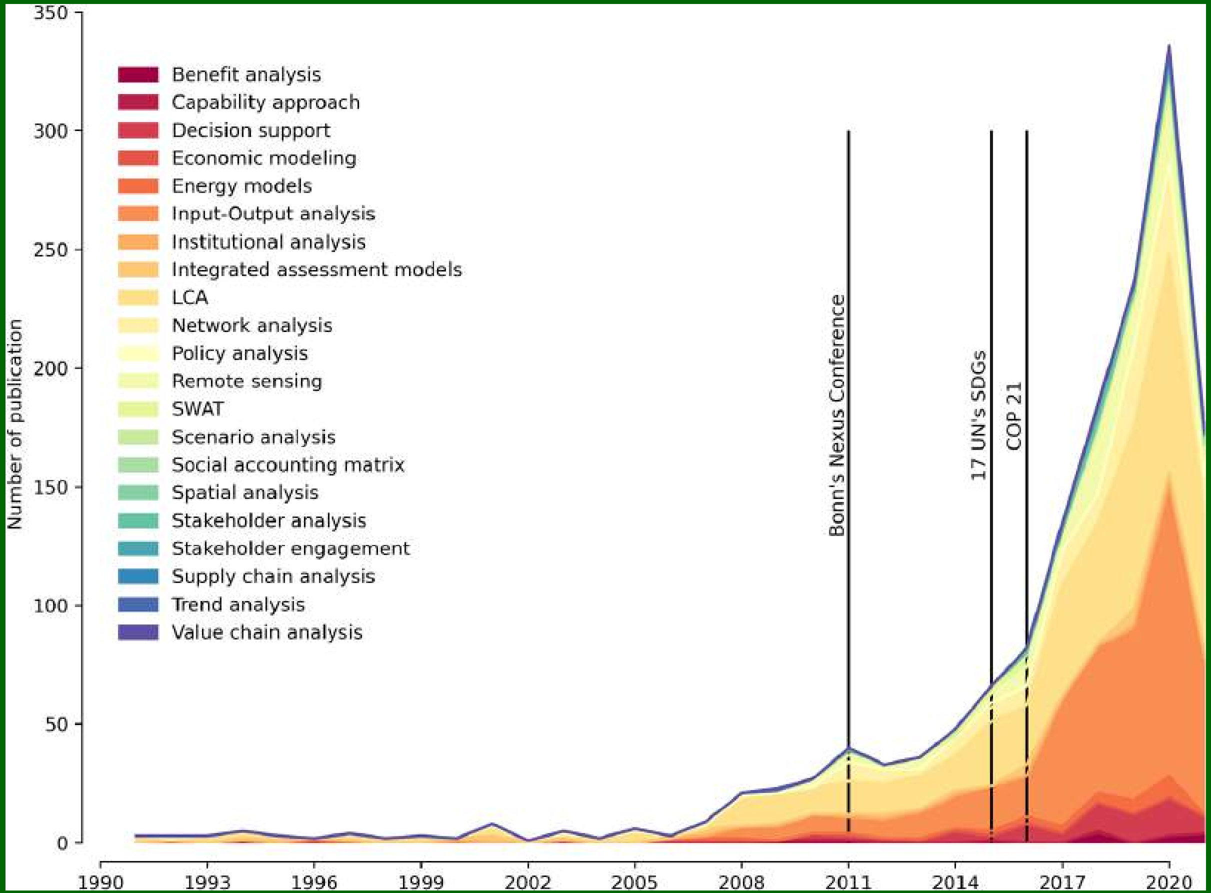
Why WEF nexus? Two key pieces in my mind:

1. Trade-offs in use of the resources (including biophysical and social-economic factors) with a transdisciplinary approach
2. Governance and policy coherence; decisionmakers needs



WEF Nexus Tools Trajectory





Taguta et al 2022. Water-energy-food nexus tools in theory and practice: a systematic review. Frontiers in Water

State of WEF Nexus Research (ala Albrecht 2018, Susnik 2022)

- Lack of specific and reproducible <u>methods</u> for nexus assessments
- Focus more on <u>two-way</u> interrelations between the three WEF domains
- Assessments mainly used <u>quantitative</u> approaches; issues with <u>scale and data</u>
- The use of <u>social science</u> methods is limited
- Disconnect between WEF nexus output (science) and governance processes (practices and outcomes)

Operationalising the WEF nexus

Renewable and Sustainable Energy Reviews 149 (2021) 111416

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

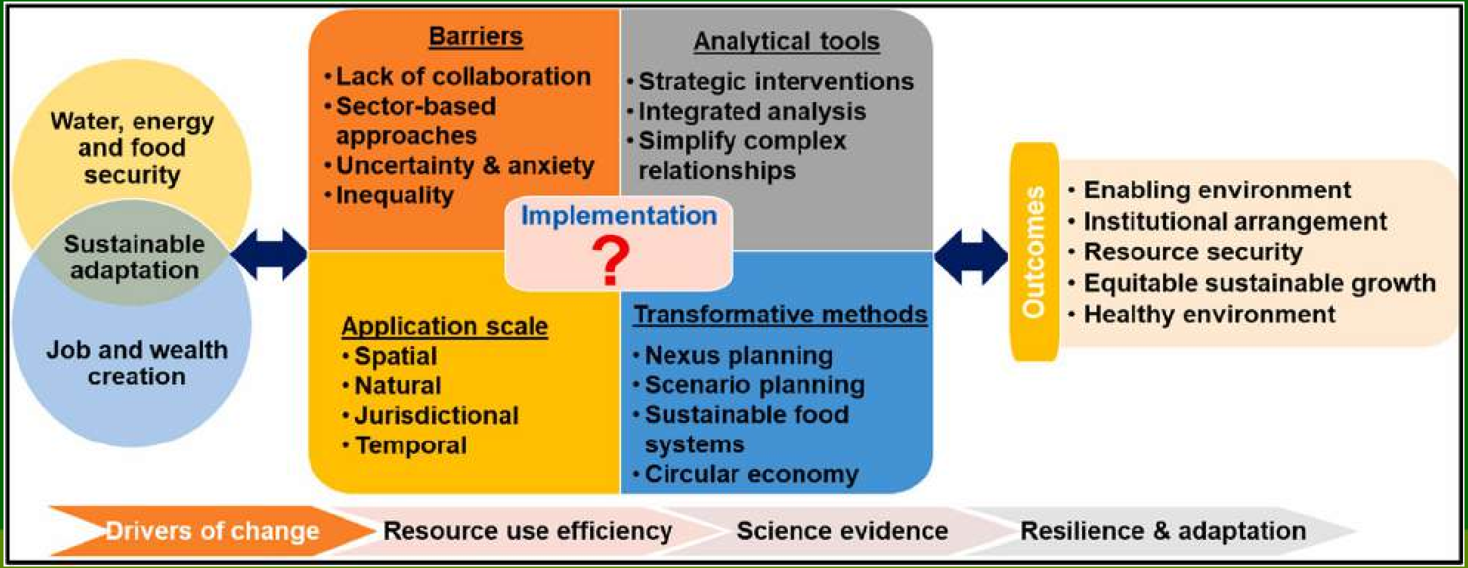
journal homepage: www.elsevier.com/locate/rser

ELSEVIER

Operationalising the water-energy-food nexus through the theory of change

Dhesigen Naidoo, Luxon Nhamo, Sylvester Mpandeli, Nafisa Sobratee, Aidan Senzanje, Stanley Liphadzi, Rob Slotow, Michael Jacobson, Albert T. Modi, Tafadzwanashe Mabhaudhi

- Significant knowledge gaps
    - empirical evidence, real-world application, case studies, capacity, awareness, and operational pathways
- How can it deliver tangible social economic development outcomes?
- WEF nexus approaches have focused more on inputs (the dimensions in the model)



Science–policy–practice interface

- Disconnect between WEF nexus output (science) and decision making/governance processes (practices and outcomes)
- Gaps exist in relationships between policies and the governance system, as a whole.
  - Unrealistic
  - Funding
  - Coherence
  - Understanding
  - Heterogeneity vs comprehensiveness

Africa's Debt Crisis Has 'Catastrophic Implications' for the World

Crushing obligations to foreign creditors that have few precedents have sapped numerous African nations of growth and stoked social instability.

Listen to this article · 7:54 min Learn more | Share full article | 299

Proposed tax increases resulted in deadly protests in Kenya this summer. Brian Otieno for The New York Times

- Worst famine in the century and 2 million people - third time in the past 20 years
- UN has declared a full-blown famine
- 150,000 people killed and capital has been razed
- Strategic region UAE/Russia vs Turkey, Egypt and Saudi Arabia

SUSTAINFOOD

Is the world ready for 3 billion Africans?

1/5 of world’s land mass

Demographic predictions

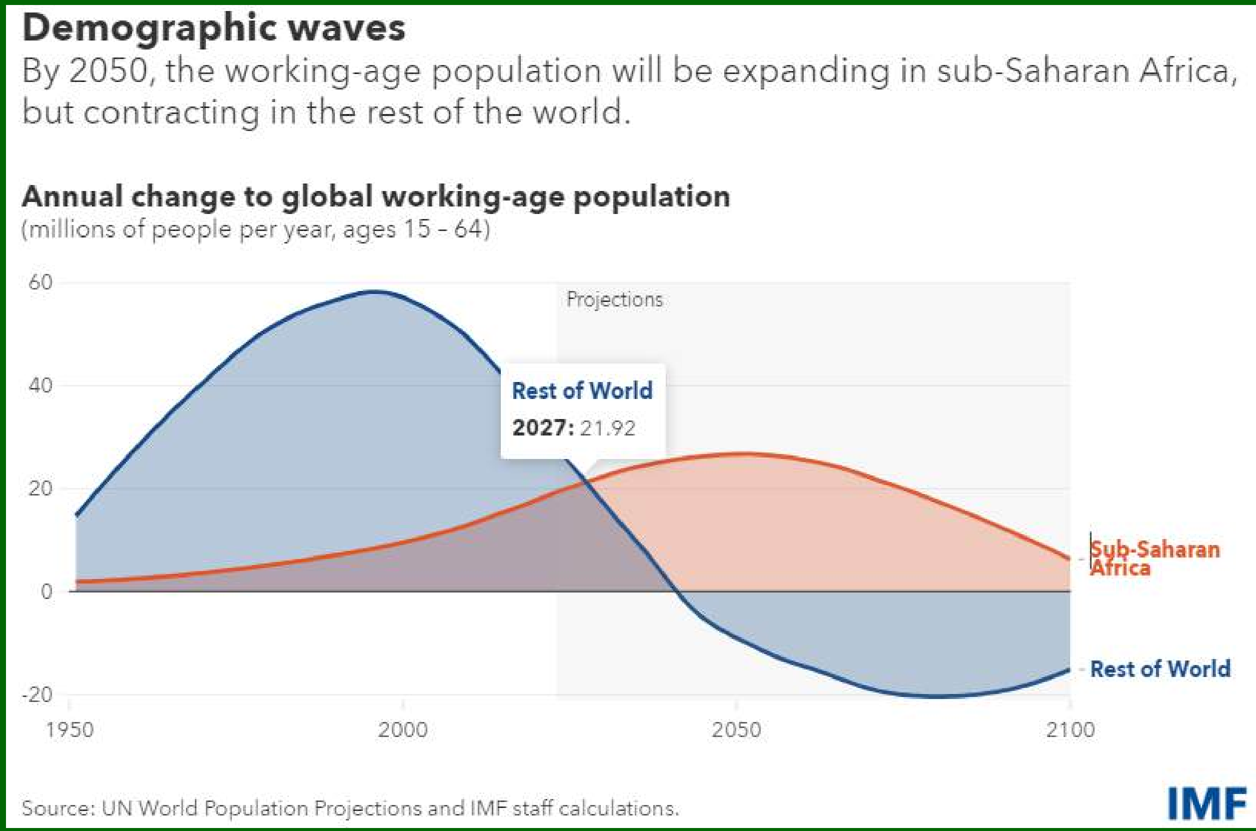
Today

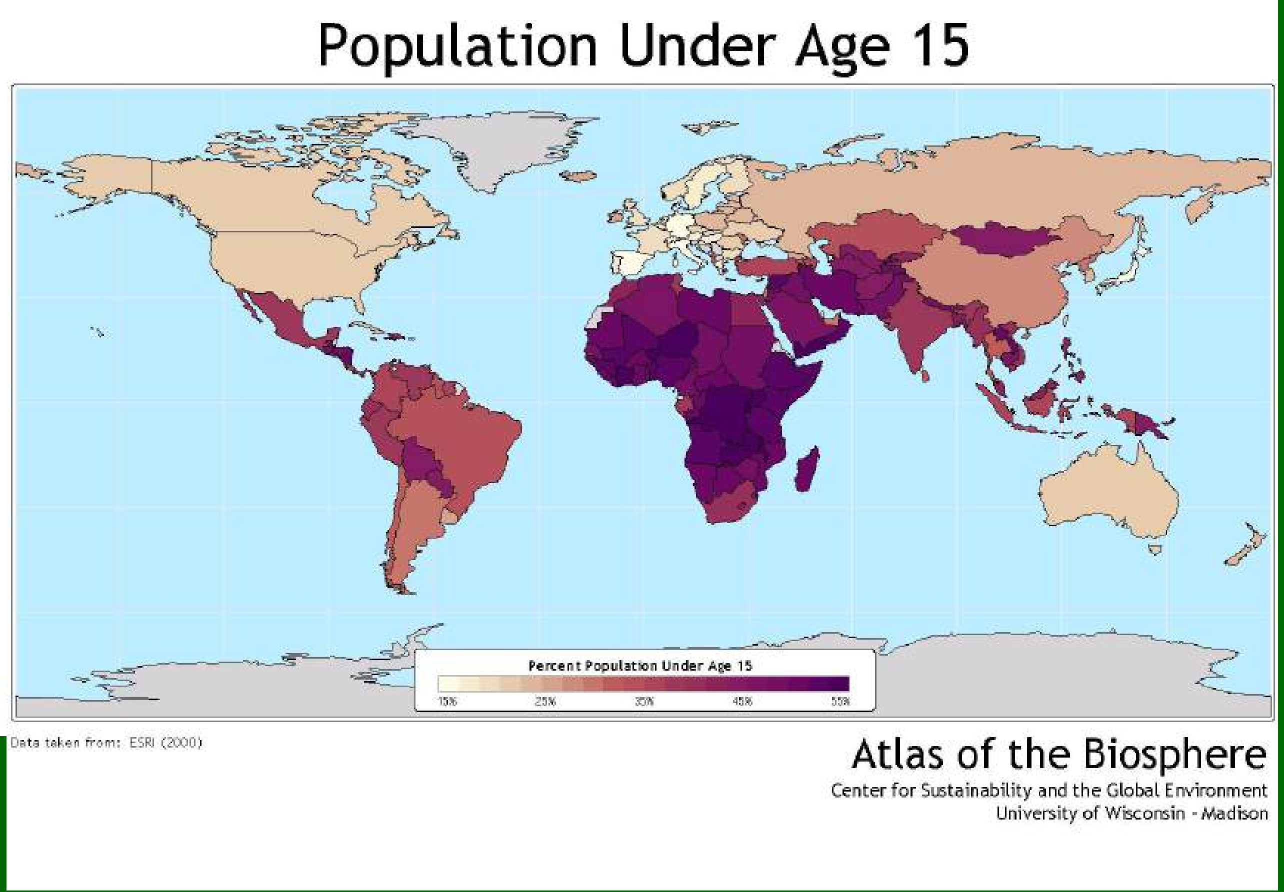
- Median age is 20
- 60% of population under 25

2050

- 2.5 billion people (about 1/4 of global population)
- 40% of global births
- 1/3 of world’s youth

Source: UNDP World Population projections (2019)





Nearly three in 10 school-age children do not attend school
For primary school students, the completion rate is around 65%
Compared with a world average of 87%

Corruption/governance is lacking

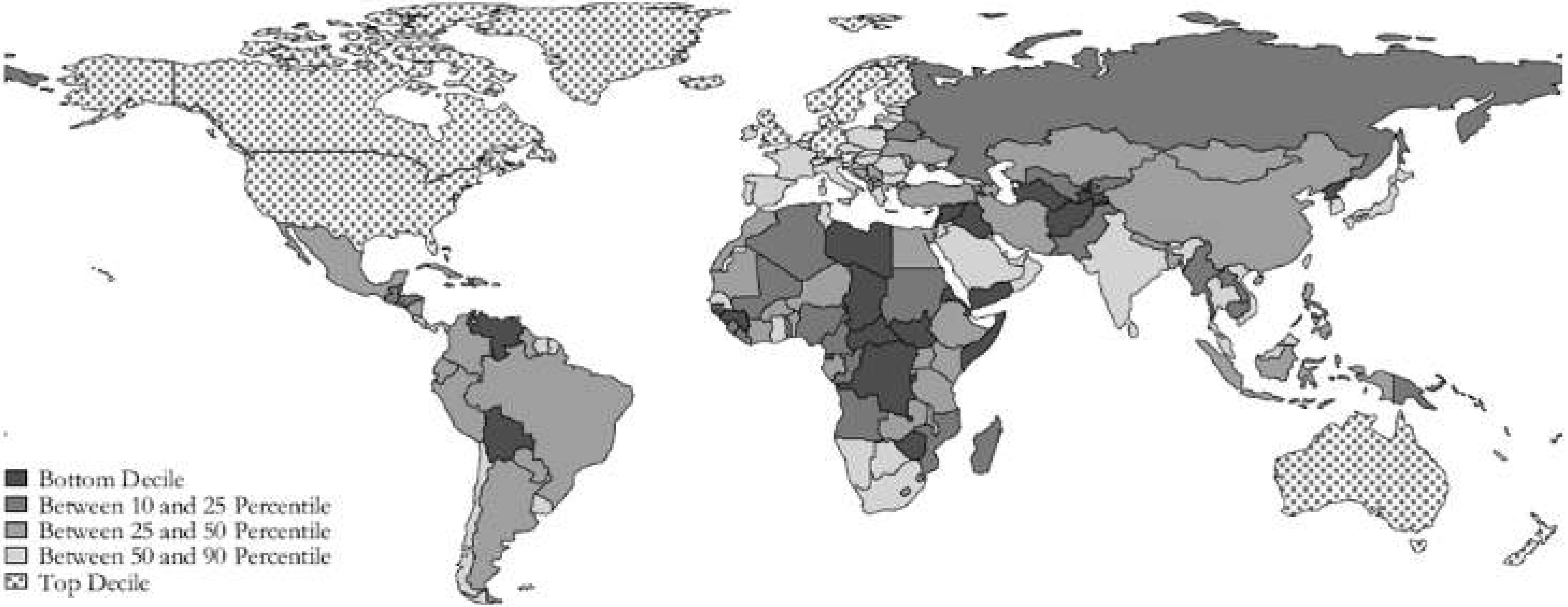
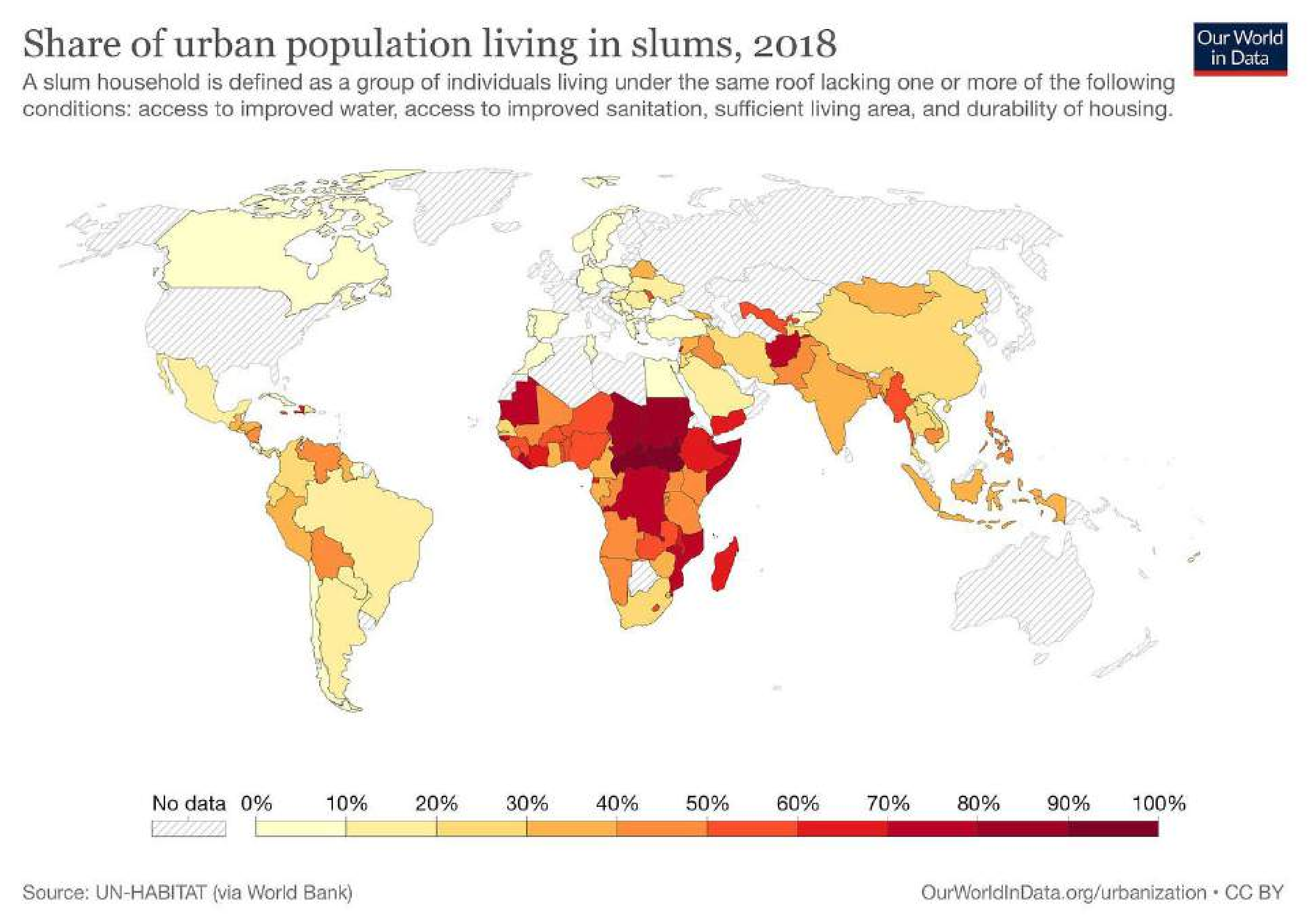


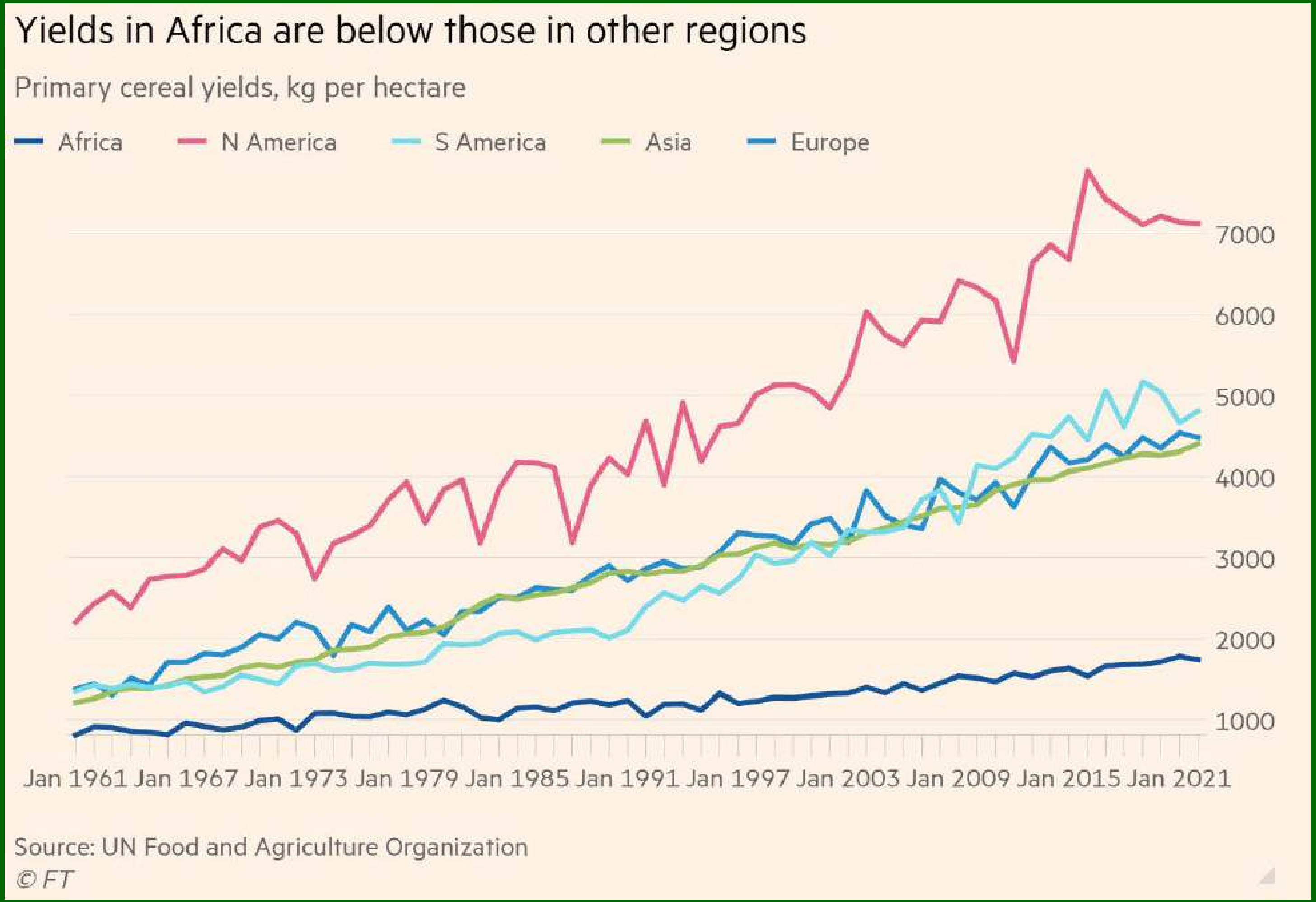
Figure 3.3 Rule of law index, 2017

Data source: Kaufmann, Kraay, and Mastruzzi (2011). Data available at https://info.worldbank.org/governance/wgi/#home.

Infrastructure is lacking



Roads - 43% paved – many potholed
– of 43% paved – 30% in South Africa

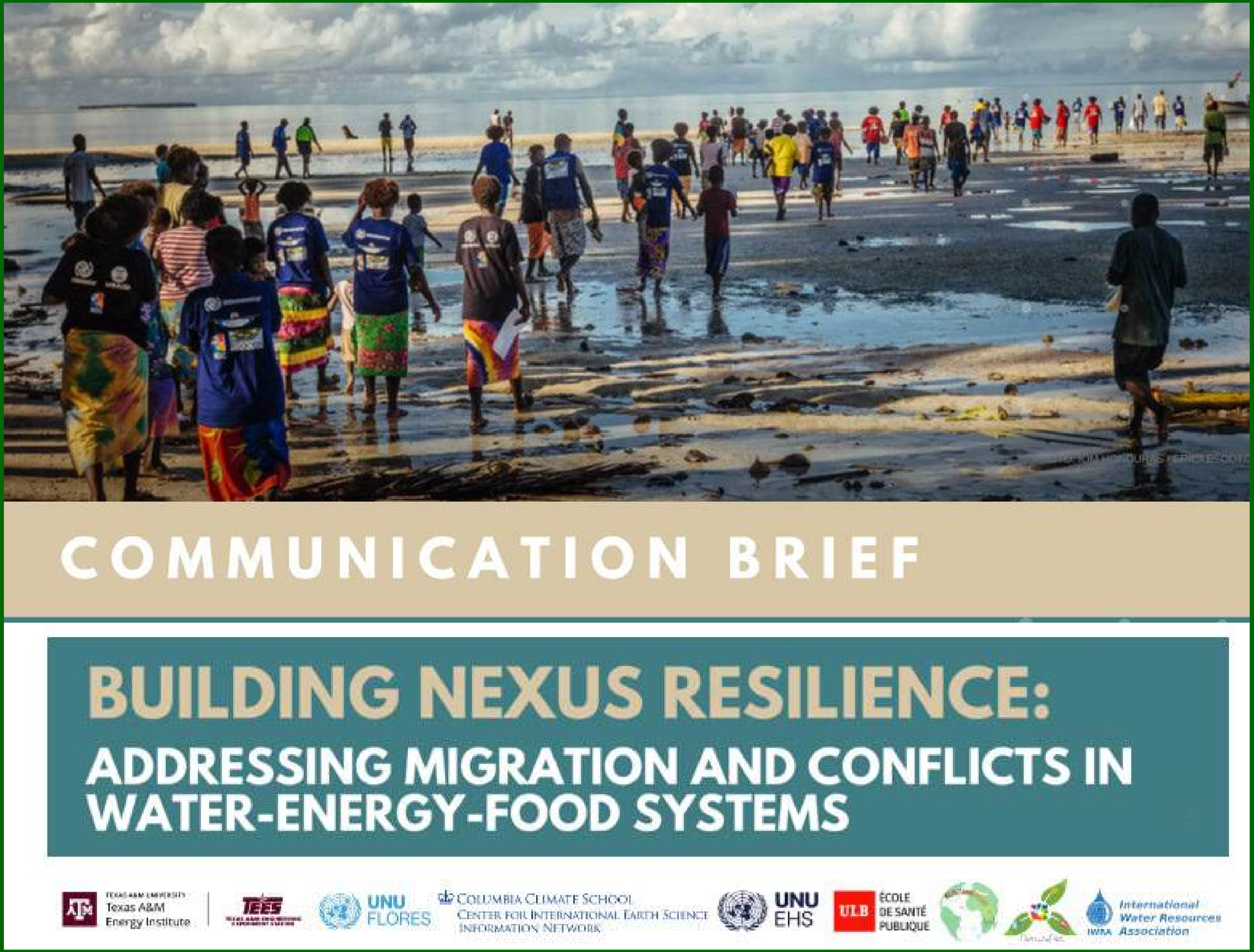


Yield gap

Not to mention lack of electricity

or water abundance or scarcity

- Piping water from Congo to No Africa?



Webinar 1
MAY 30, 2024
Introduction to Migration and Water-Energy-Food (WEF) System Interconnections

Webinar 2
SEPTEMBER 10, 2024
Integrating Migration Models and WEF Nexus Assessments

SUSTAINFOOD

SDG 17 : Partnership for the goals (Network building)

- ‘Strengthen the means of implementation and revitalize the global partnership for sustainable development’
- ‘limited coordination, resource flow to developing countries, capacity-building needs, systemic barriers and insufficient data for progress tracking and decision-making’ https://reliefweb.int/report/world/sdg-17-partnership-goals
- North-South vs South-South cooperation
- Capacity strengthening versus development
- Equitable and inclusive versus just beneficiaries

Entrepreneurship and Innovation Activities

Objective: To close the gap between research and practice by training faculty and students in innovation and entrepreneurship skills

Zero Hunger Student Idea Competition

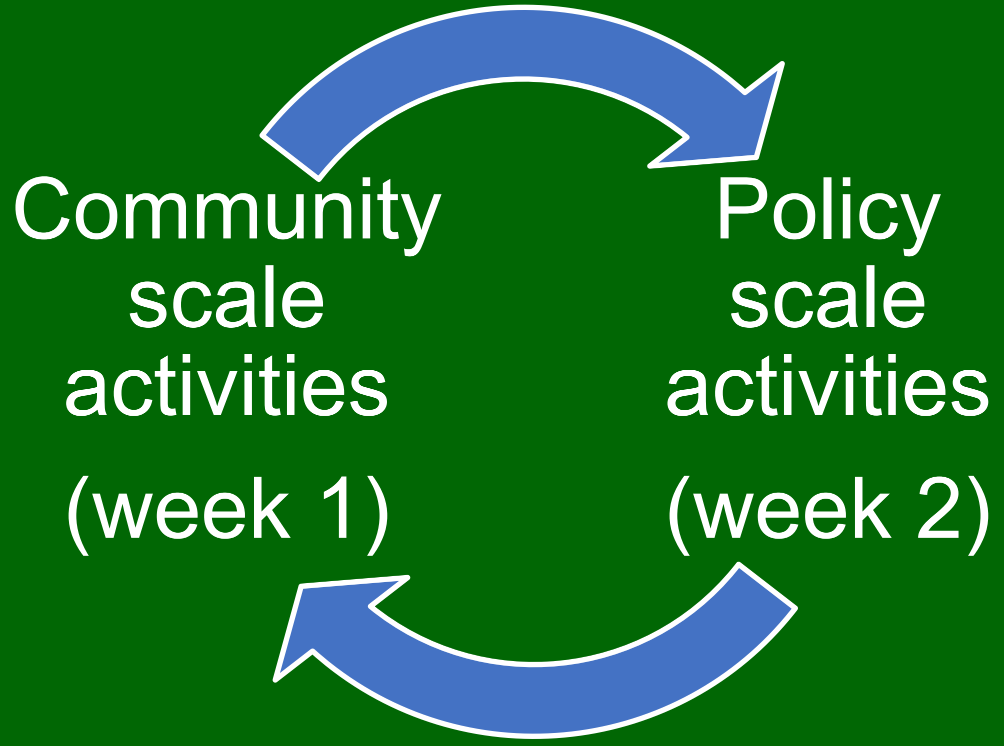
- 61 student teams from 21 countries in 2024
- > 100 judges
- Top three teams received 5 week on Customer Discovery to test their ideas (NSF I-Corps training)

Entrepreneurship Conversations

- Webinar Series focusing on entrepreneurship in Africa
- Featured educators and entrepreneurs

The CLS Bridging the Science–Policy–Practice Interface

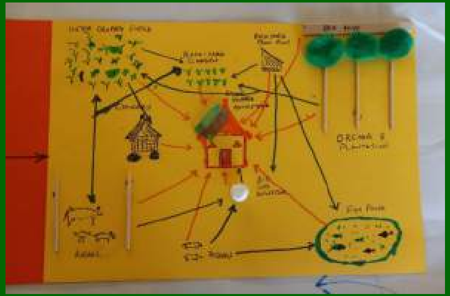
- *A critical component of the CLS is the interlinkage between the community and policy levels to ensure* ***collaboration, inclusivity, and co-creation***



Week 1: Community focus
- Design thinking: feasible, relevant solutions to community-based problems
- Systems thinking: how do these solutions affect the system over time?

Week 2: Policy focus
- Policy and political economy analysis and tools for scaling up solutions for policymakers

In December 2022, SustainFood Zimbabwe we held a Pre-CLS in Zimbabwe at Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)



CLS July 2023: Central Uganda

Local engagement with farmers

WEF Nexus policy support

CLS 2024 Chesapeake Bay, USA


Dickinson organic farm


Water quality and environmental condition of rivers flowing to the Chesapeake Bay

Four key themes

- Waste Management & Agriculture
- Agricultural Management Practices on Soil Health
- Biogas/ Anaerobic Digestion for Livestock and Food Wastes
- Livestock Management Practices & Water Quality


WEFN solutions with state policy makers

SustainFood Future Outlook

Collaborative Learning School 2025 – Nigeria (May 25) and Morocco (Dec 25)

Other events/opportunities for ECRs and WEF nexus practitioners

Strengthen network-to-network links

- US-Africa
- Europe COST Action NexusNet
- within-US WEFN networks
- Asia and Latin America networks

Better integrate WEF Nexus approach to specific

More actionable solutions

SDG 17 - Partnerships are the way forward - not one way partnership

What makes an impactful NEXUS project?

Mirela Sertić Perić, Dimitris Kofinas, Nikos Mellios, Agnieszka Cuprys, Vesna Gulin Beljak, Hetty KleinJan, Thibault Moreels, Aleksandra Kulić Mandić, Naomi Timmer

EUROPEAN JUNIOR WATER PROGRAMME

NexusNet

Our goal...

...present results of a **pilot-study** conducted by participants of the EJWP (European Junior Water Programme*) over a period of three months;

...**enhance discussions** on Nexus project ideation and management, and provide **recommendations** for international cooperation in shaping impactful Nexus projects;

...demonstrate how **bringing COST Action initiatives together with capacity building programs** such as the EJWP can equip young European water professionals with essential professional and technical skills through collaborative and interdisciplinary work on targeted case studies.

***European Junior Water Programme (EJWP)** - an integrated 2-year, part-time program where EJWP enables development of participants' key skills: network building, communication & diversity, technical advancements and more to empower water-sector careers and their social contributions. EJWP development activities take place along with participants' continued work in their current positions.

The aim of the pilot-study...

...gather the opinions of NEXUSNET community members on the question **„What makes a Nexus project impactful?"**

...to achieve this, the EJWP participants conducted:

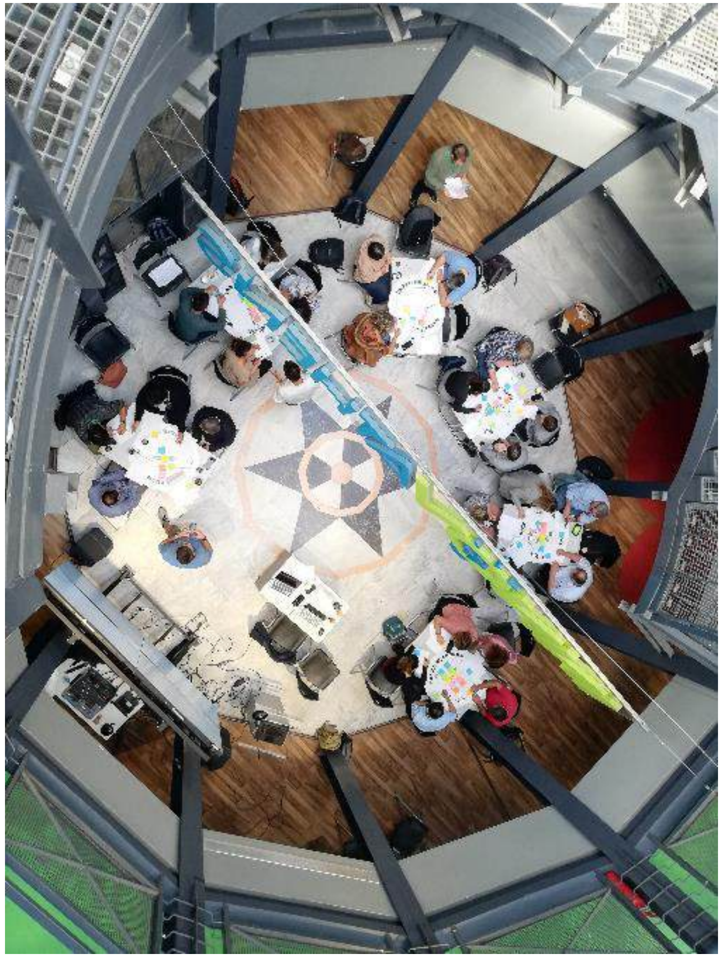
(i) workshop during the NEXUSNET annual meeting in September 2022 in Athens, Greece;

(ii) interviews with available NEXUSNET community members to get their views on the needs, gaps, criteria and performance indicators of Nexus projects.

(i) workshop

The findings from the workshop resulted in:

1) a **mind map** illustrating the complex relationships between **different factors** that participants believe **influence the impact** of Nexus projects;
2) an overview of how the NEXUSNET community perceives the **impact of Nexus projects on specific SDGs / SDG categories**;
3) the **animation** reflecting the outcomes of a **deep democracy game**, where participants collaboratively explored and debated the **key aspects** of the NEXUS project's impact **emerging from the mind map**.



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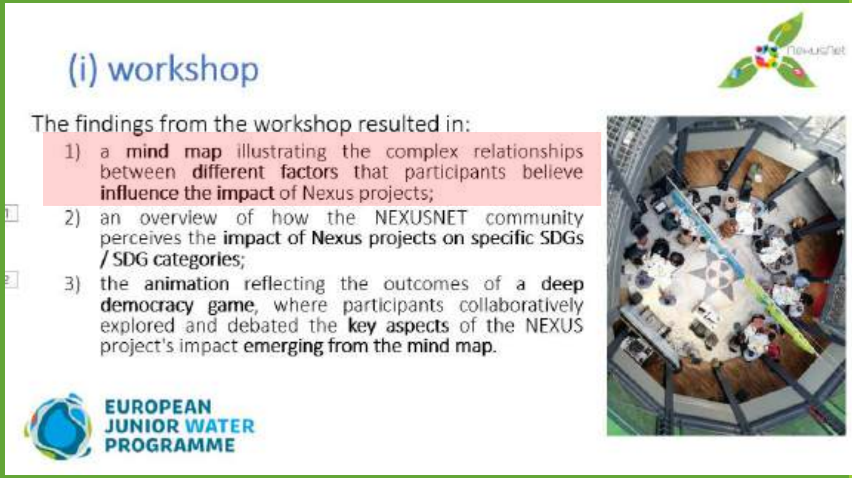
Shaping a mind map

- 24 participants
- Mentimeter word cloud



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How would you describe an impactful Nexus project? Answer in a way to list 5 words you would attribute to an impactful Nexus project.

Mentimeter

24

NexusNet

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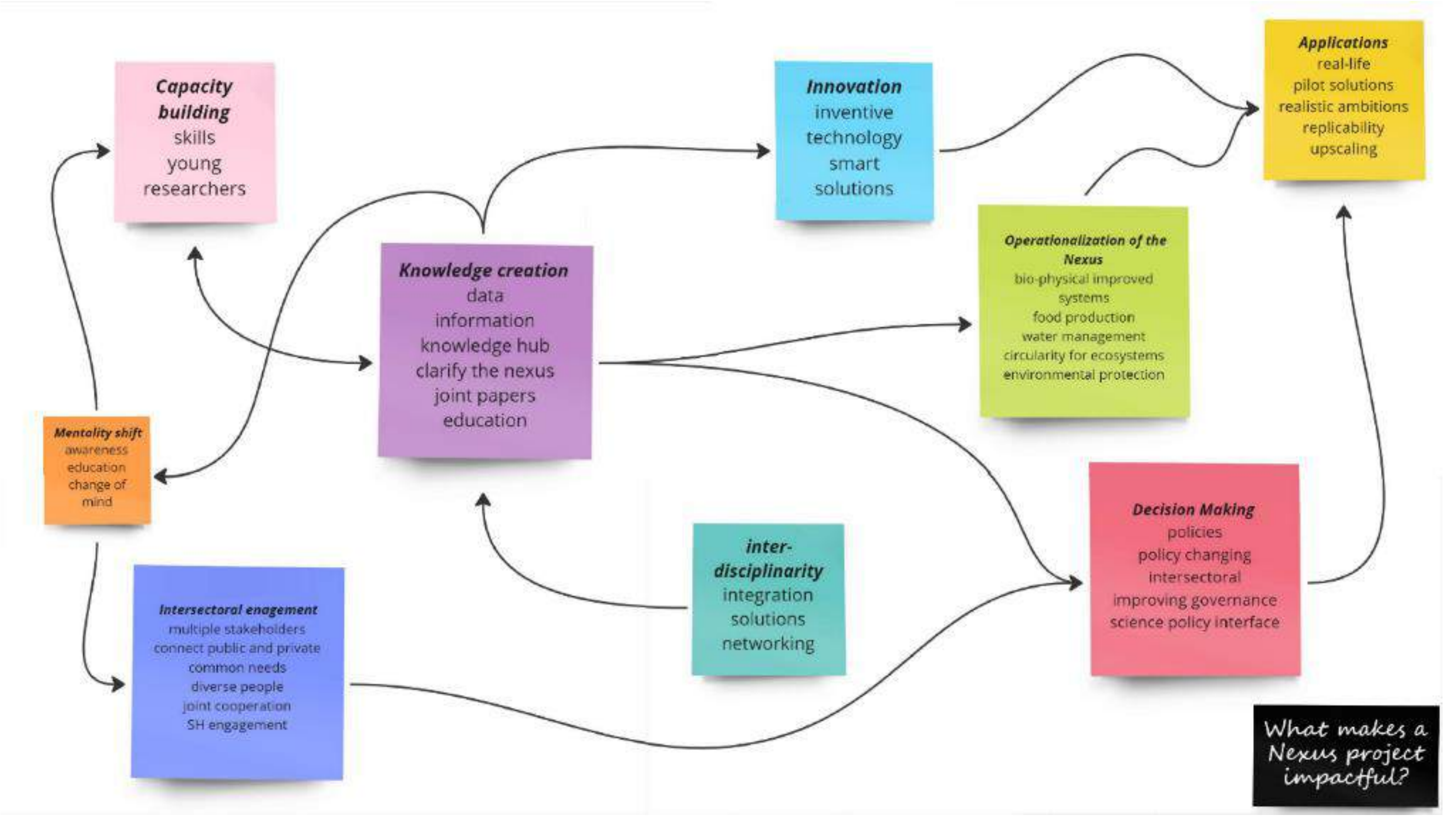
Mind map

Finding interconnection using MIRO board



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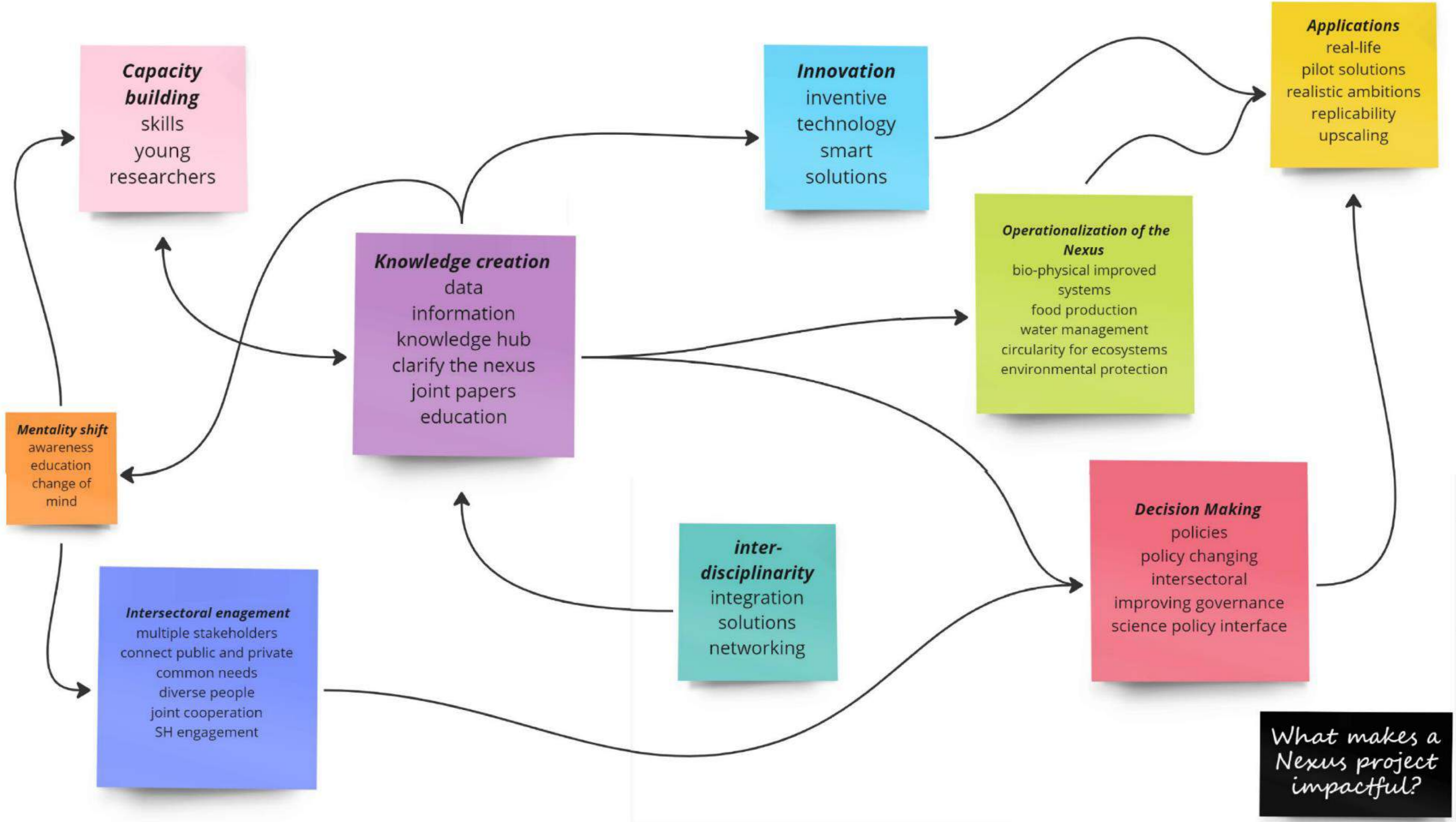
Capacity building
skills
young
researchers
Innovation
inventive
technology
smart
solutions
Applications
real-life
pilot solutions
realistic ambitions
replicability
upscaling
Knowledge creation
data
information
knowledge hub
clarify the nexus
joint papers
education
Operationalization of the Nexus
bio-physical improved systems
food production
water management
circularity for ecosystems
environmental protection
Mentality shift
awareness
education
change of mind
Decision Making
policies
policy changing
intersectoral
improving governance
science policy interface
inter-disciplinarity
integration
solutions
networking
Intersectoral enagement
multiple stakeholders
connect public and private
common needs
diverse people
joint cooperation
SH engagement
What makes a Nexus project impactful?

Perceiving the impact of Nexus projects on specific SDG categories

(i) workshop

The findings from the workshop resulted in:

1) a **mind map** illustrating the complex relationships between **different factors** that participants believe **influence the impact** of Nexus projects;
2) an overview of how the NEXUSNET community perceives the **impact of Nexus projects on specific SDGs / SDG categories**;
3) the **animation** reflecting the outcomes of a **deep democracy game**, where participants collaboratively explored and debated the **key** aspects of the NEXUS project's impact **emerging from the mind map**.

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NexusNet

World Café:
Impact of Nexus projects on the Sustainable Development Goals / SDG categories

Education, gender and inequality

Health, well-being and demography

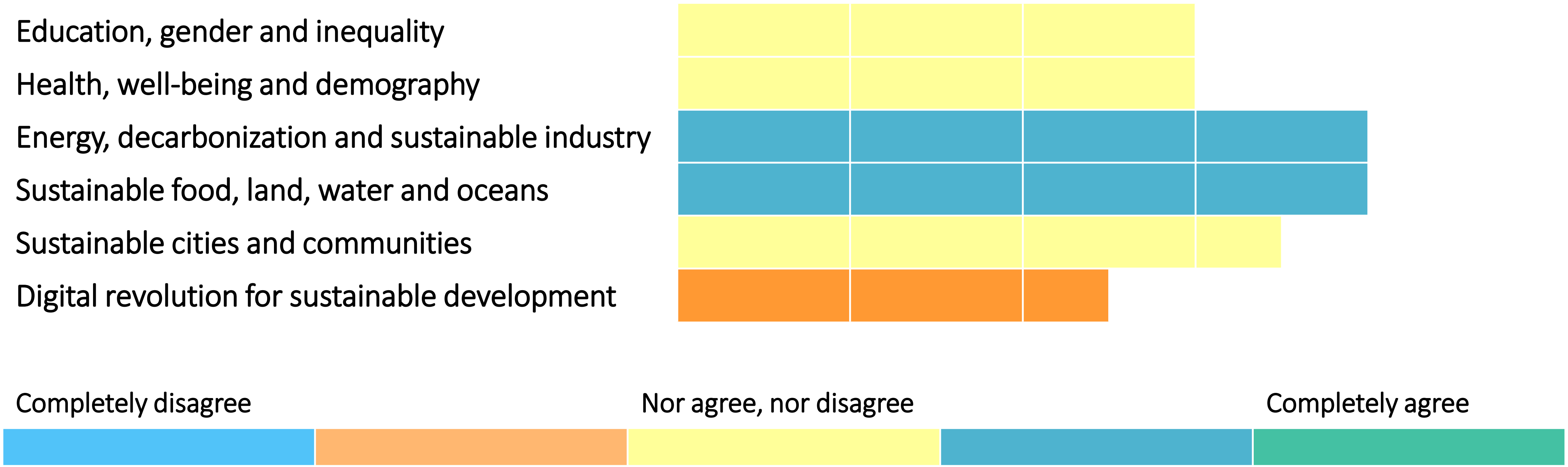
Energy, decarbonization and sustainable industry

Sustainable food, land, water, and oceans

Sustainable cities and communities

Digital revolution for sustainable development

Nexus projects highly impact…



Different stakeholders from diverse professional and regional backgrounds often have **varying interpretations of the impact** of Nexus projects on the SDGs.

An animation resulting from Deep Democracy Game conducted during the workshop

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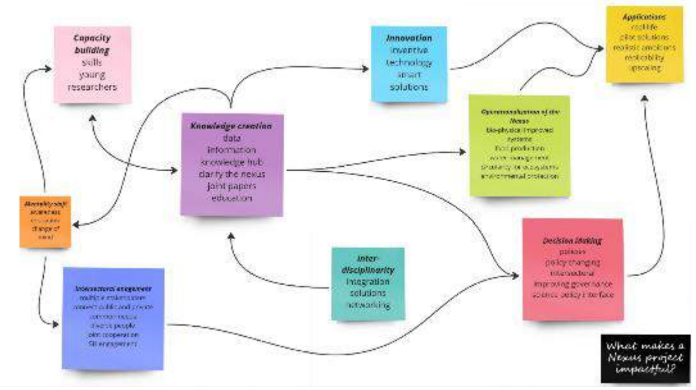
- **Deep Democracy Game**: a **lively discussion** prompted by a conflicting/provocative statement based on the conclusions of the Mental map



- Deep Democracy Game results were presented in the form of an **animation** showing the changing opinions of workshop participants regarding key aspects of an impactful NEXUS project

What is needed for an impactful Nexus project (based on the Deep Democracy Game results)?

AGREEMENT

a compromise must be established where all levels (supranational to people) agree with each other

CO-CREATION

co-creation occurs between representatives of all relevant sectors involved

ENGAGEMENT

all stakeholders are actively engaged

INCLUSIVENESS

stakeholder groups are inclusive and balanced

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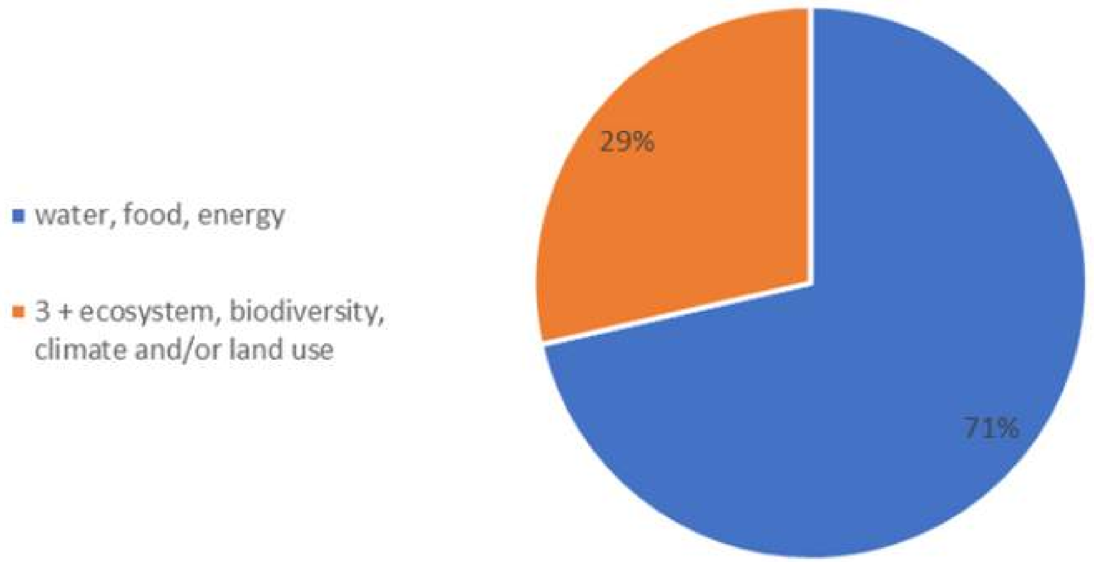
(ii) interviews

(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

- Interviews revealed that the impact of Nexus projects is ensured through:
    1) an **interdisciplinary approach** between different stakeholders and sectors;
    2) the inclusion of **biophysical assessment**, **stakeholder engagement** and **policy coherence** in Nexus projects

- According to interviewees, **water, food and energy** have been well covered by Nexus projects so far, but **biodiversity, ecosystems, climate and land use** need to be taken more into account in future projects.

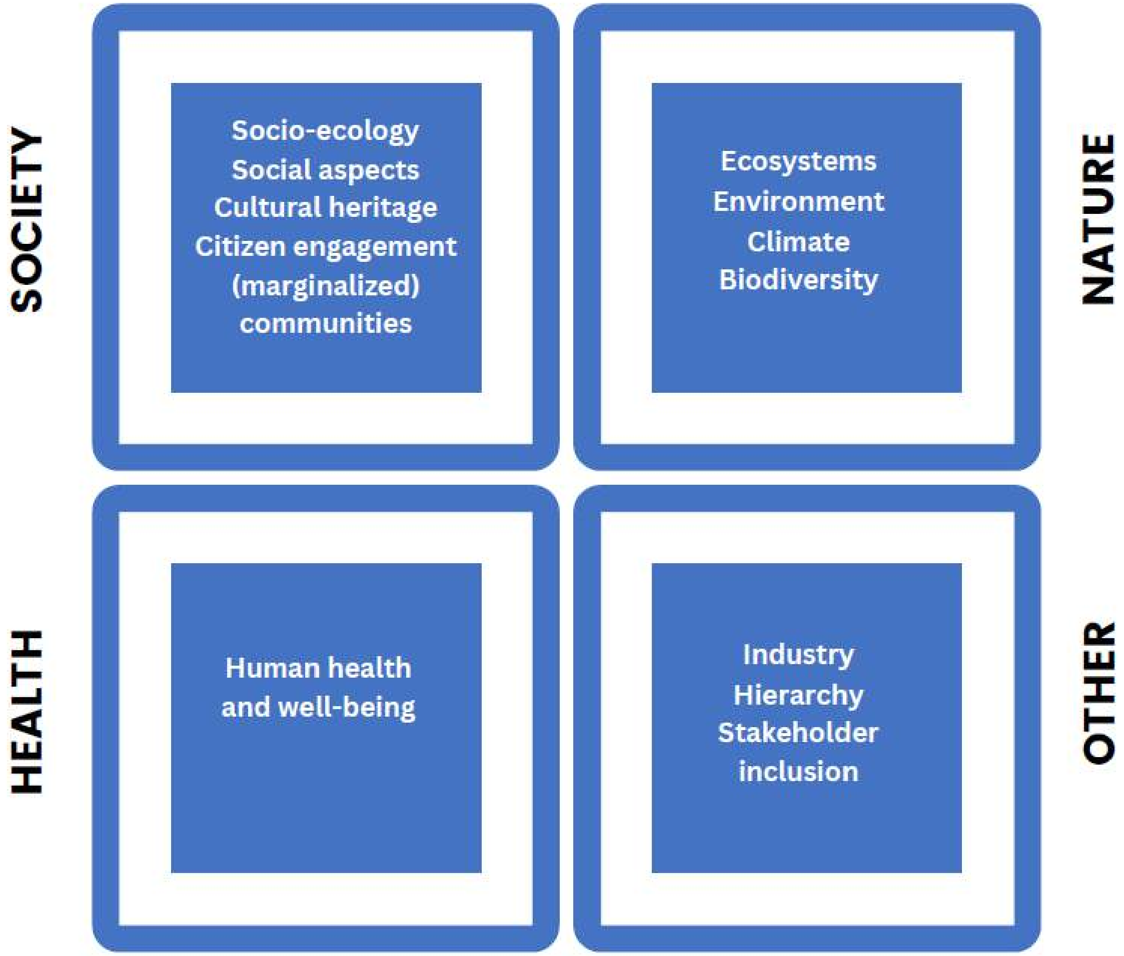


EUROPEAN JUNIOR WATER PROGRAMME

(ii) interviews

(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

- Respondents were asked for their opinions on components **that are** missing from the NEXUS projects initiated so far.
- The social aspects and cultural heritage were mentioned as **most underrepresented** in NEXUS projects, followed by human health/well-being and nature-related dimensions.

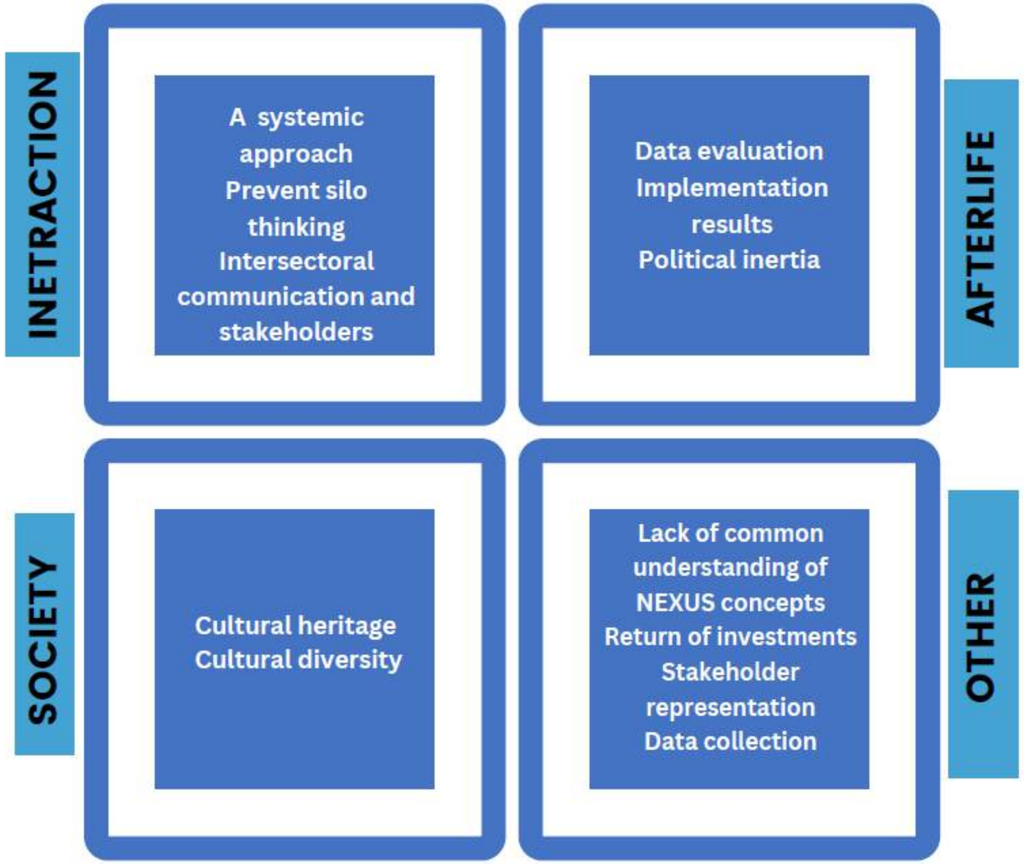


EUROPEAN JUNIOR WATER PROGRAMME

(ii) interviews

(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

- The most frequently highlighted <u>barriers to the success of NEXUS projects</u> were:
  - silo-thinking and communication between different stakeholders (e.g., science *vs.* policy/academia *vs.* policymakers), which can encounter difficulties when working together;
  - lack of afterlife of NEXUS projects.



EUROPEAN JUNIOR WATER PROGRAMME

(ii) interviews

(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

NexusNet

- When asked about the gaps in NEXUS projects that respondents have encountered so far, two main categories were identified: (mis)understanding the NEXUS framework and (the lack of) data integration;
- The other gaps mentioned relate to cross-project collaboration and again the lack of a project afterlife.

- **Which characteristics lack to make the NEXUS projects more impactful after the project ends?**

A common understanding of NEXUS concepts with standardized methods
Proper representation of NEXUS
Size of NEXUS community and nexus maturity

1. FRAMEWORK

Development of data-driven techniques
Data integration

2. DATA

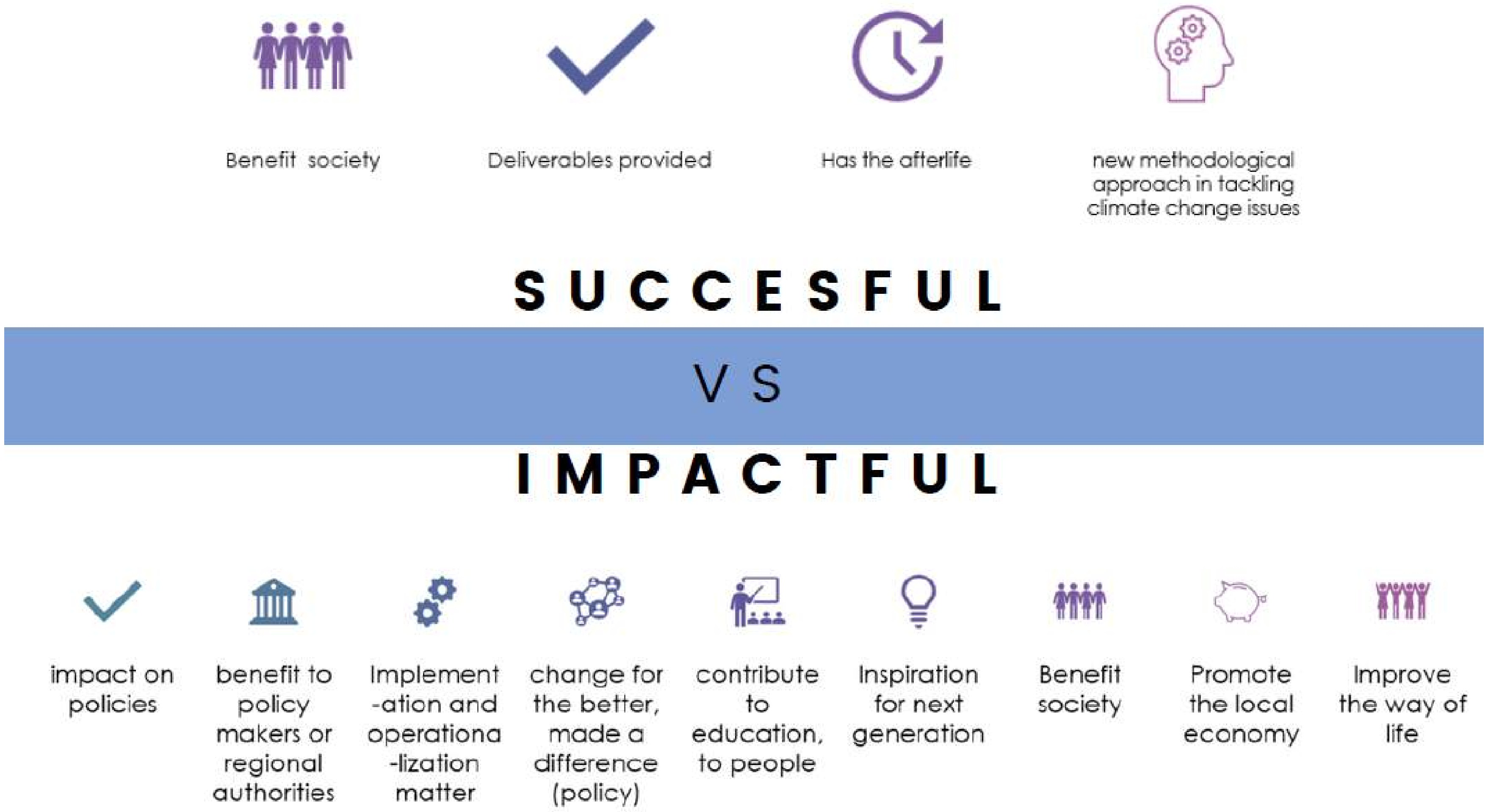
- implementation of NEXUS project results
- awareness of project results
- integration of project results and conclusions into policy
- project visibility (and dissemination activities)
- adequate presentation of NEXUS data
- funding for project afterlife activities

EUROPEAN JUNIOR WATER PROGRAMME

(ii) interviews

(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

How would you describe the difference between a successful NEXUS project and an impactful NEXUS project?



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(ii) interviews

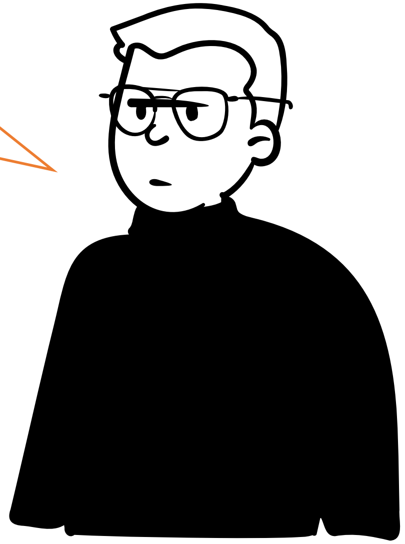
(with members of the NEXUSNET community to get their perspectives on NEXUS project needs, gaps, criteria, and key performance indicators)

NexusNet

Additional thoughts regarding NEXUS projects...

Nexus net should involve the **UN system**. Hopefully, Nexus will also be a **part of university courses**.

NEXUS is not sustainable, because it is an **open system**.



There is a need for calls for the future, especially considering **social aspects** and **government involvement**.

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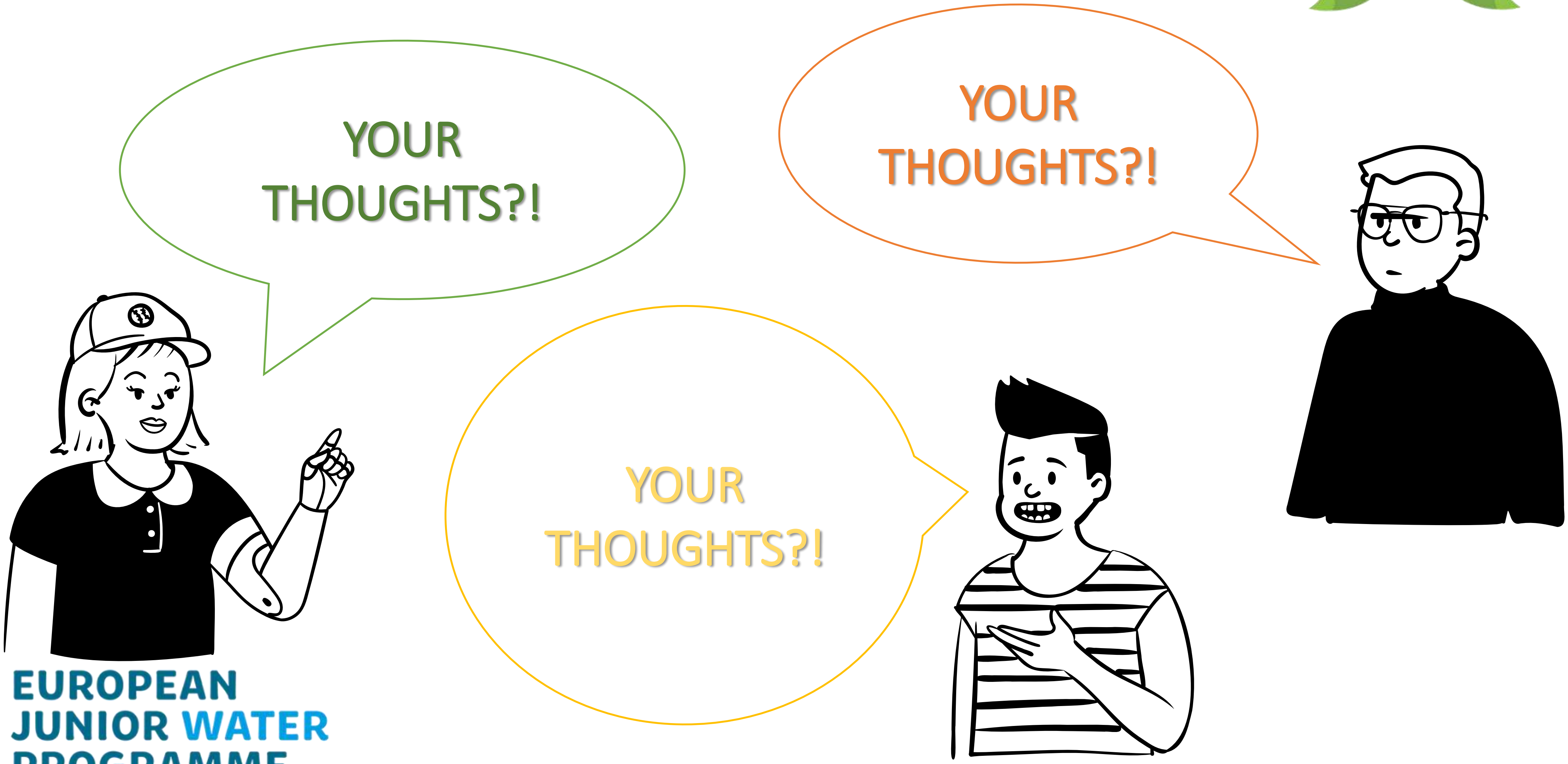
Additional thoughts regarding NEXUS projects...

NexusNet



EUROPEAN JUNIOR WATER PROGRAMME

WATER and ENERGY for FOOD

Companies with Conservation:

Deep Dive into NEXUS Innovators with a Cause

Dresden Nexus Conference 5 – 6 November 2024

08.01.2025

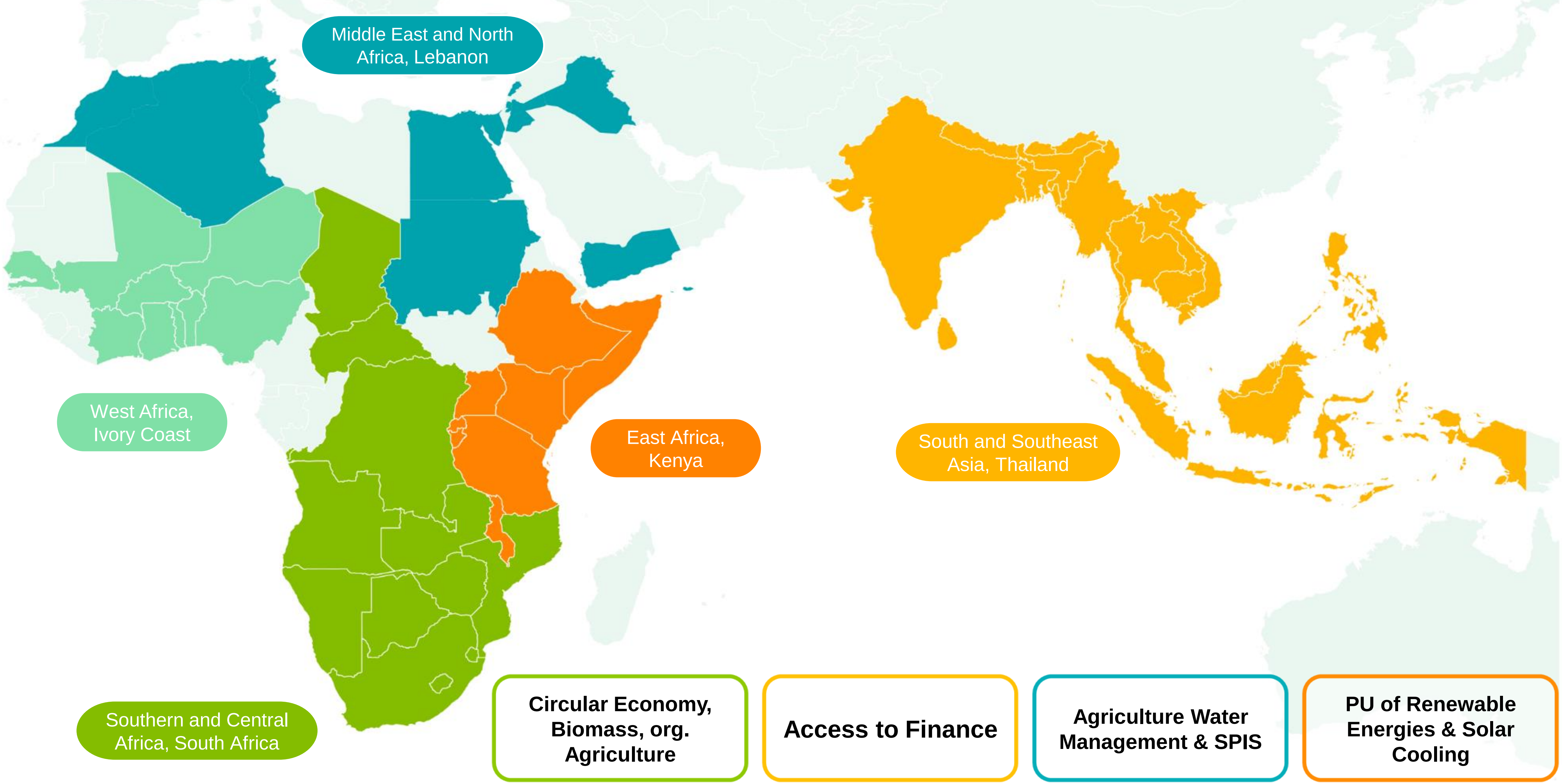
Total Budget WE4F - $88 Million

for 3 focus areas

WE4F aims to support innovations that impact the water-energy-food nexus, leading to increased sustainability in agricultural production and food value chains, as well as increased economic opportunities and gender equality in developing countries and emerging markets.

1. Water/Food
2. Energy/Food
3. Water/Energy/Food

Regional Innovation Hubs and Partner Countries



WE4F Areas of Interventions

- IDENTIFICATION OF INNOVATORS
- TECHNICAL ASSISTANCE
- FINANCIAL ASSISTANCE
  - iDPP
  - RBF
  - (Grants)
- ENABLING ENVIRONEMENT
- UPSCALING OF INNOVATIONS
- KNOWLEDGE GENERATION

Private Sector as Partner

Within 5 years, across 5 regions…

5 Million End-Users

Smallholder farmers & other end-users
using WEF Nexus innovations

> 200 Mio USD

Investment leveraged
by Innovators

135 Innovators

Scaling ground-breaking
water-energy-food
innovations

From words to actions

13 Million Tons

Food produced

17 Billion liters

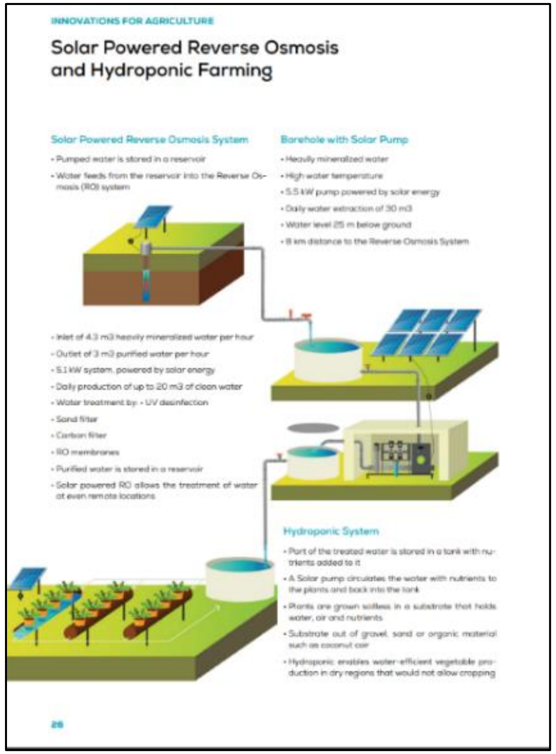
Water saved

4 Billion kWh

Energy saved

Innovator Compendium

- Highlights the collaborative efforts and achievements of WE4F and its partners across 15 African countries
- Detail descriptions of business models and impacts made throughout program along the WEF nexus/gradient



INNOVATIONS FOR AGRICULTURE

Solar Powered Reverse Osmosis and Hydroponic Farming

Solar Powered Reverse Osmosis System

- Pumped water is stored in a reservoir
- Water feeds from the reservoir into the Reverse Osmosis (RO) system

Borehole with Solar Pump

- Heavily mineralized water
- High water temperature
- 5.5 kW pump powered by solar energy
- Daily water extraction of 30 m3
- Water level 25 m below ground
- 8 km distance to the Reverse Osmosis System

- Inlet of 4.3 m3 heavily mineralized water per hour
- Outlet of 3 m3 purified water per hour
- 5.1 kW system, powered by solar energy
- Daily production of up to 20 m3 of clean water
- Water treatment by: - UV desinfection
- Sand filter
- Carbon filter
- RO membranes
- Purified water is stored in a reservoir
- Solar powered RO allows the treatment of water at even remote locations

Hydroponic System

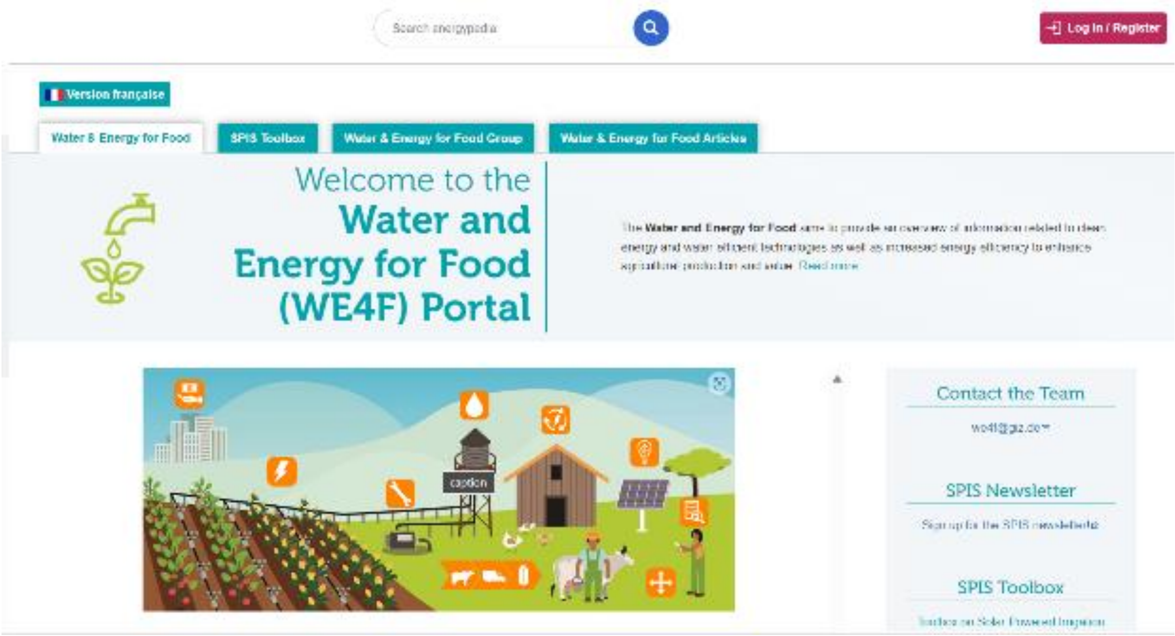
- Part of the treated water is stored in a tank with nutrients added to it
- A Solar pump circulates the water with nutrients to the plants and back into the tank
- Plants are grown soilless in a substrate that holds water, air and nutrients
- Substrate out of gravel, sand or organic material such as coconut coir
- Hydroponic enables water-efficient vegetable production in dry regions that would not allow cropping

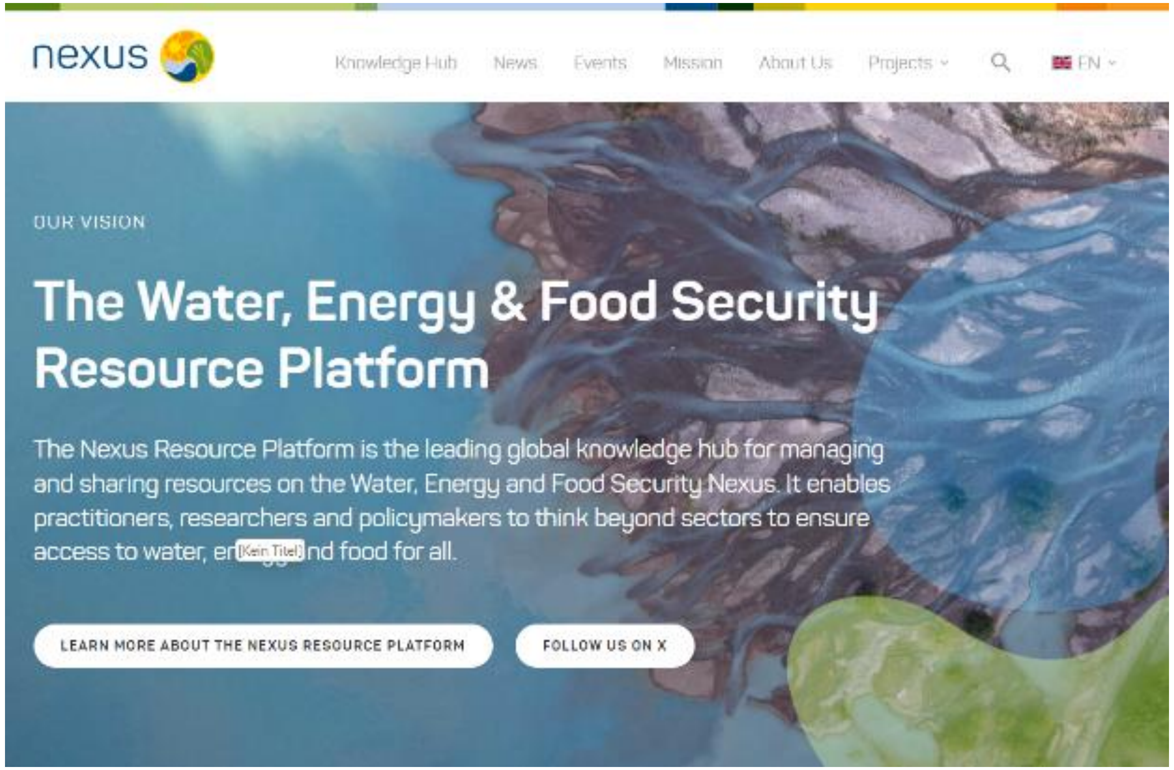
28

[Technology Compendium]

- Showcases a variety of technologies in East and West Africa, that were scaled and disseminated by (GIZ)
- Divided sectorially: Agriculture Water Management & Irrigation, Energy Efficiency and Productive Use of Energy, Circular Economy & Biomass, and Digital Innovations

International Leverage

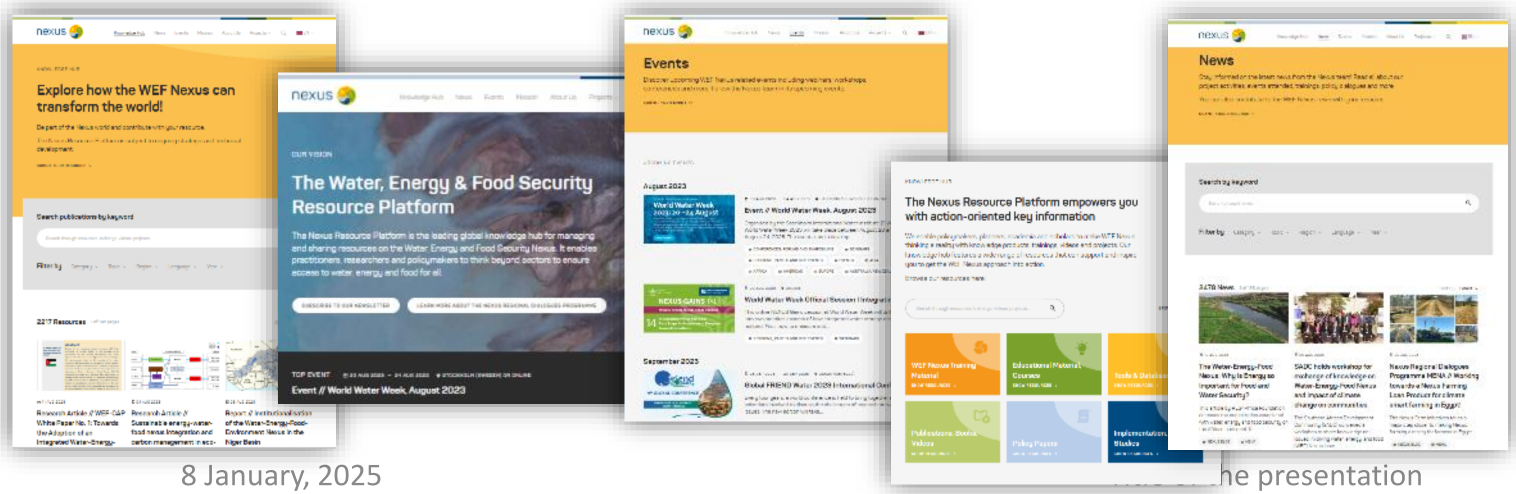


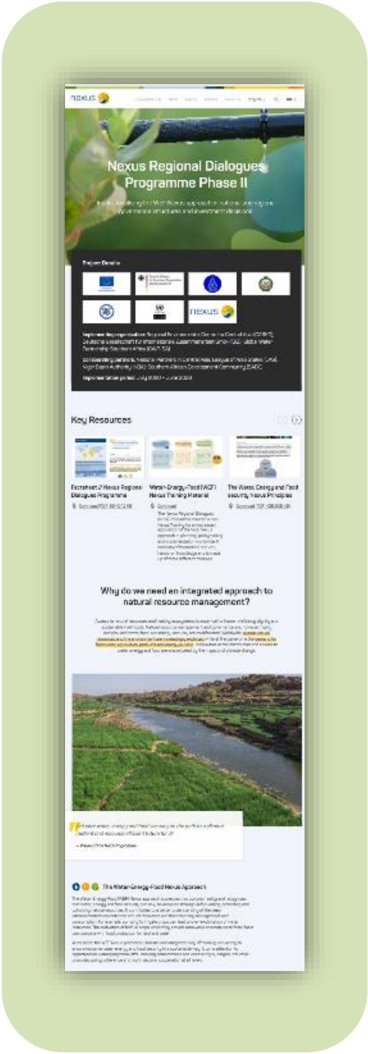


The Nexus Resource Platform

www.water-energy-food.org

- Online since 2011 – the NRP is the leading global knowledge hub for managing and sharing resources on the Water, Energy and Food Nexus
- Enables practitioners, researchers and policymakers to think beyond sectors to ensure access to water, energy and food for all.
- Knowledge Hub includes: Online repository WEF Nexus resources (publications, policy papers, videos, training material, tools, case studies, and more)
  - Option to submit your own resource and highlight upcoming Nexus events.





KEY FEATURES

- ✓ #1 Google search ranking for„WEF Nexus“
- ✓ Available in 5 languages: AR, EN, ES, FR, RU
- ✓ 5000+ resources uploaded
- ✓ 3500+ visitors per month
- ✓ Clean & modern design with an easy navigation
- ✓ Free access

Thank You!

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