

Water-Energy-Food Nexus and Sustainable Water Futures and Implications for the IGWCO COP and GEO Water

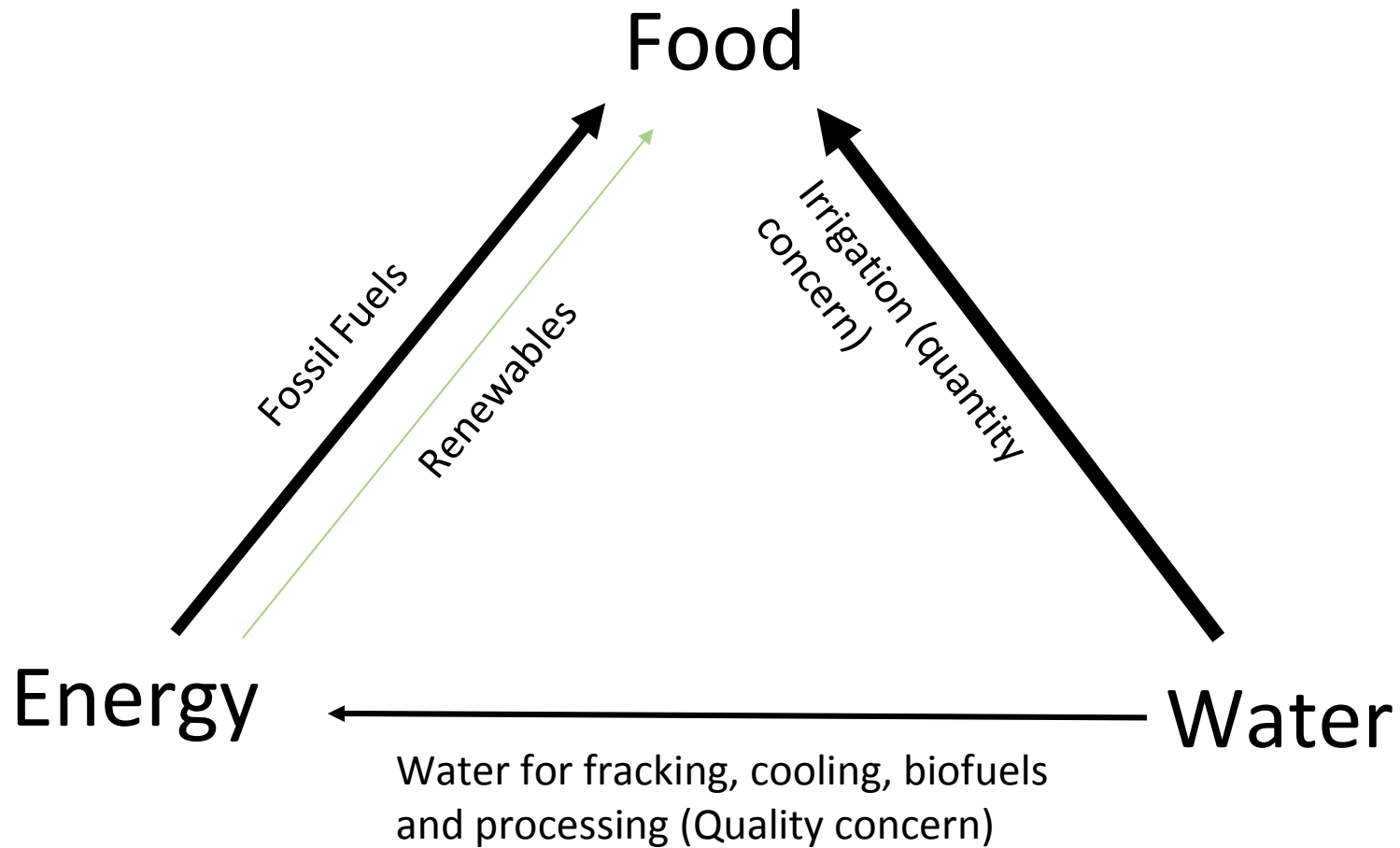
Richard Lawford

IGWCO COP Meeting

Tokyo, Japan

May 30, 2014

Major Interactions in the Nexus

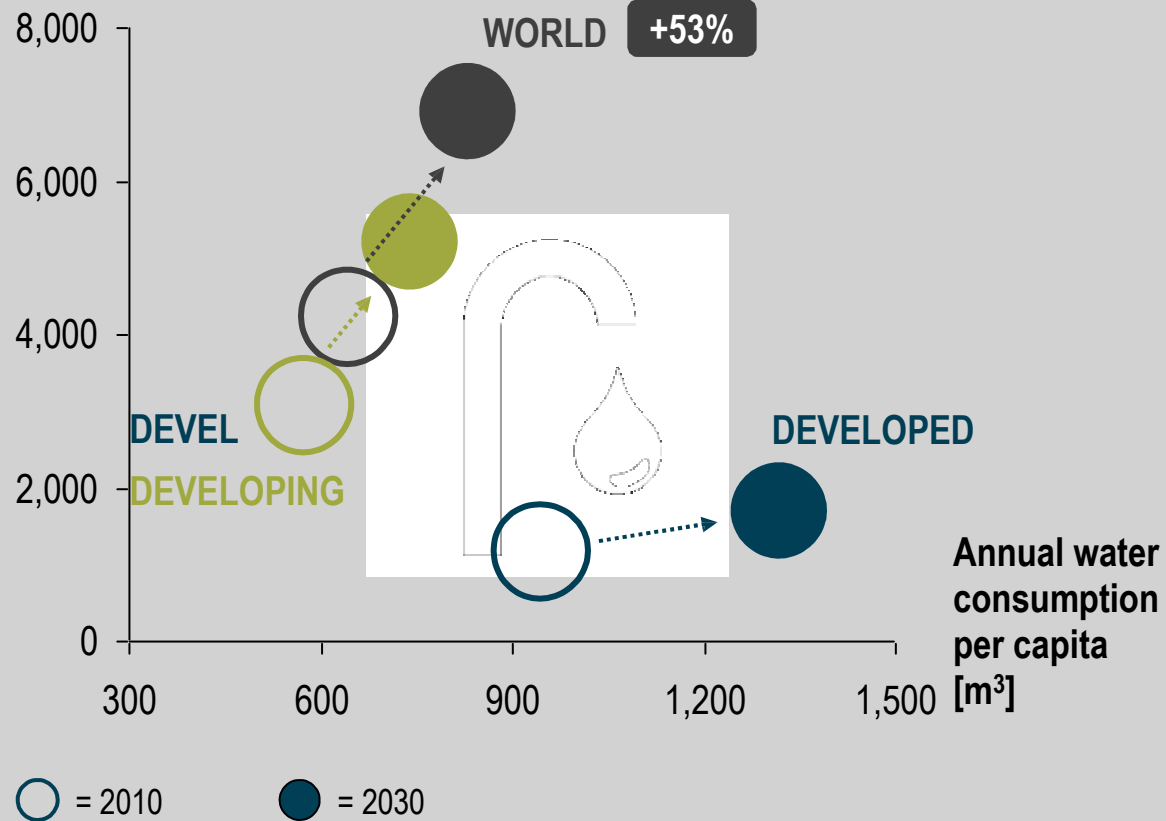


Trends in the Nexus Components

Total daily food consumption

Total annual demand for primary energy

Total annual water demand [bn m³]



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Introduction to earth observations:

Earth observations include:

Satellite data (global, periodic)

In situ measurements (local, frequent)

The cusp:

Survey information

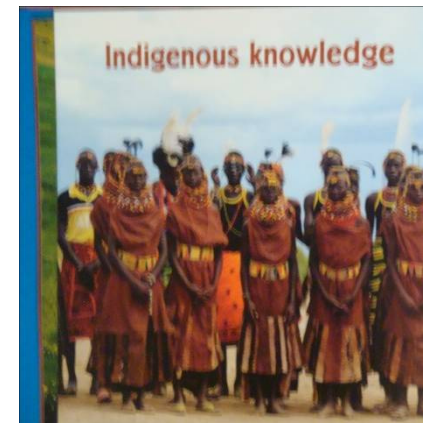
Data Assimilation outputs

Model outputs

When we include humans then it will

be other important data (health data):

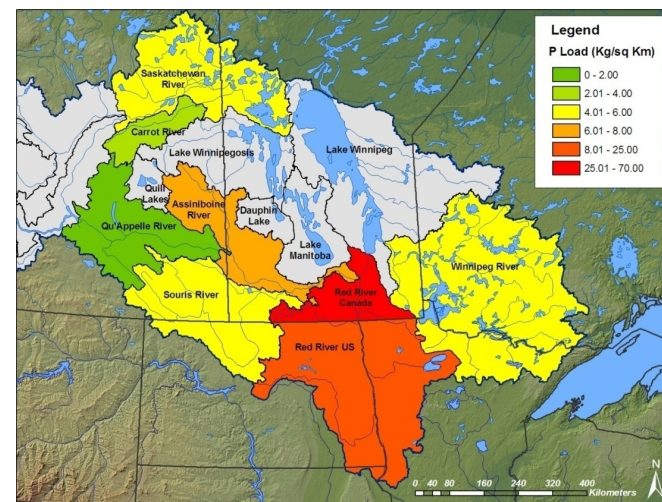
Socio-economic data and traditional knowledge



The Agriculture and Water Dilemma in the Lake Winnipeg Basin:

In order to maintain high production rates farmers often add excess fertilizer to their crops. These nitrates and phosphates enter the rivers, especially in times of large runoff and find their way to Lake Winnipeg.

Over the past two decades the effects have been an increasingly large algal bloom on Lake Winnipeg during the summer. While the agricultural industry reaps the benefits of this intensive agriculture, it is the public who must pay for the cleanup.

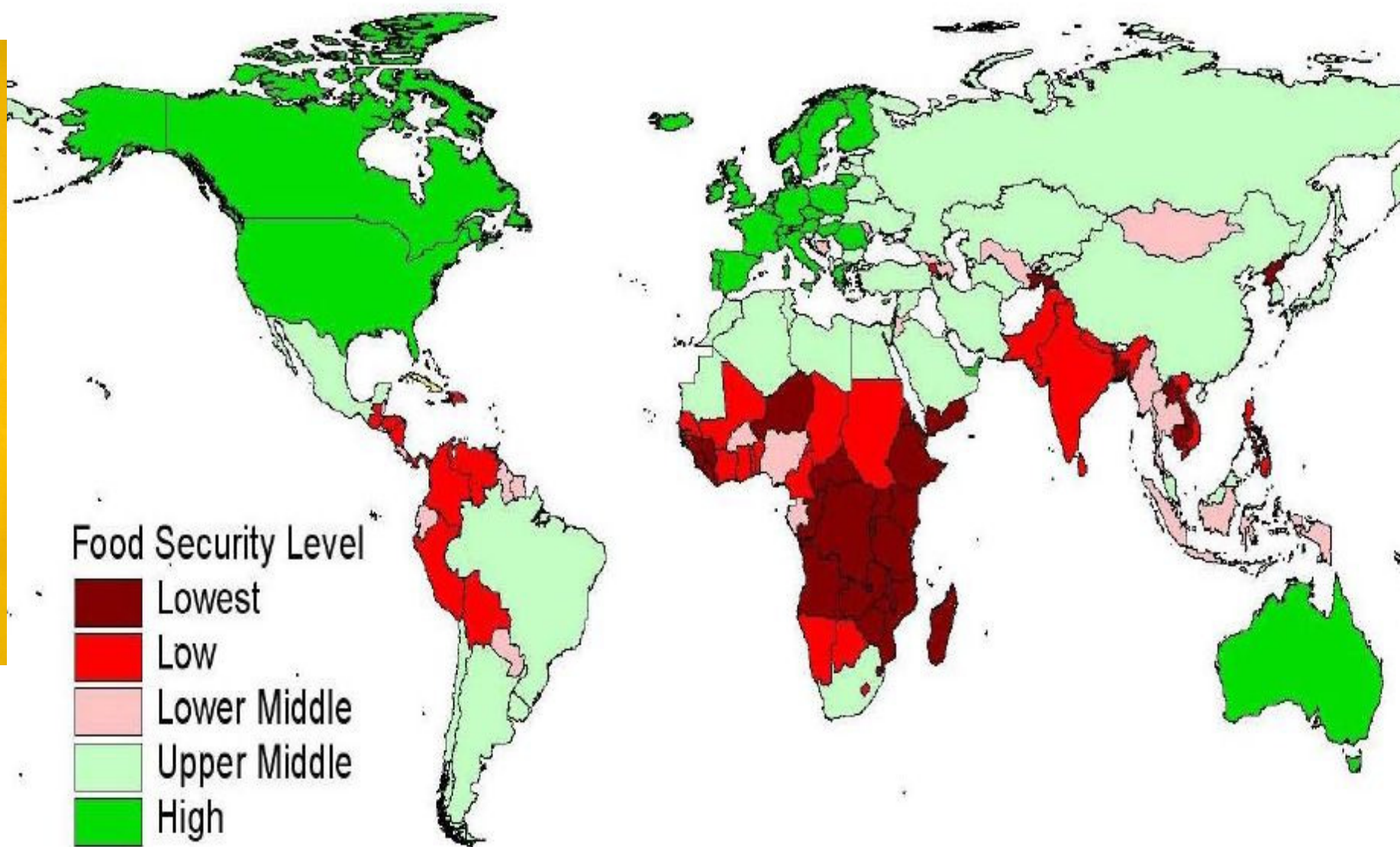


In 2007, the bloom covered 15000 km² on Lake Winnipeg.

Satellites are effective means of identifying and monitoring the development of the growth of these blooms.



Analysis of national inputs cannot provide a full understanding of many aspects of the Nexus interactions.

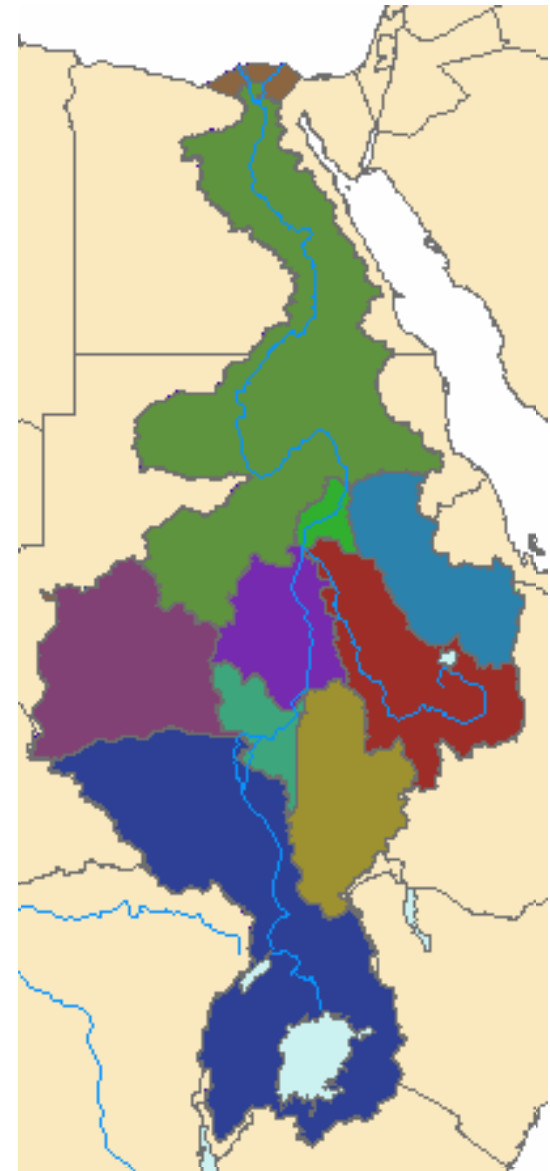


Special opportunity area of transboundary waters.

Light experiment:

If we were to develop a WEF project in the Nile Basin we would encounter a problem in mapping fields and running models because not all countries exchange data (although improving thanks to the Nile initiative)

Generated data products using satellite data as their base could be used to support basin-wide decisions. They are spatially continuous and while their quality may suffer from lack of in-situ data they would provide continuous data. The fields would allow prediction and tracking of flows for WEF purposes. Planning could proceed with quite a high degree of reliability and reluctant countries could see the benefits of sharing their data to produce better products.



Sub-basins

Some areas for improvement in the WEF Nexus where EO could play a role:

Irrigation could be used more effectively (more crop per drop) with better planning of applications.

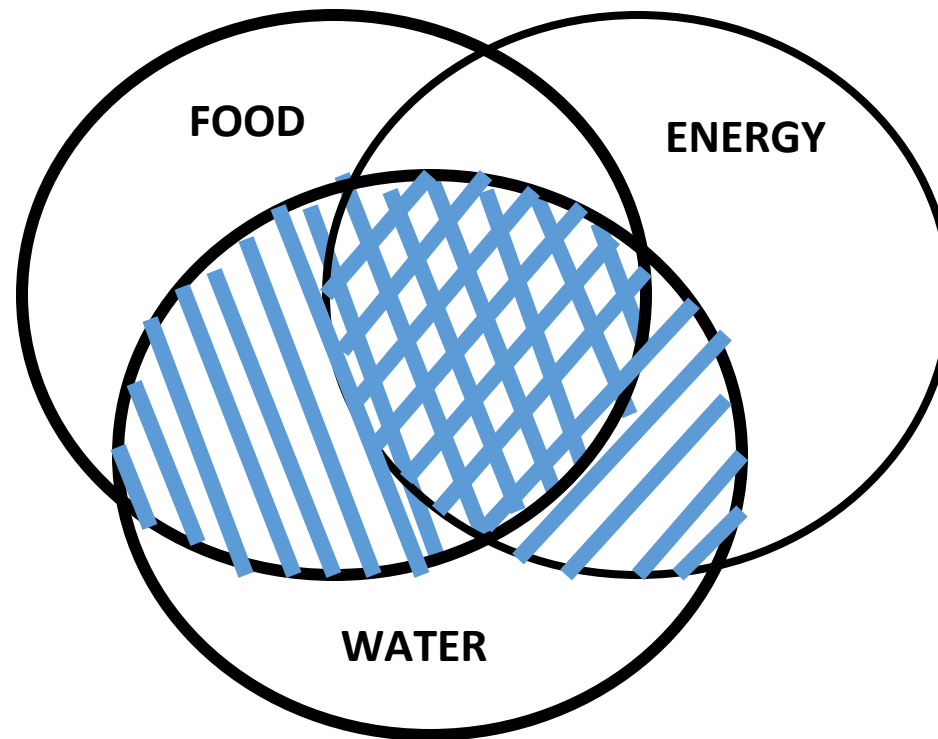
Greater efforts could be made to **keep good arable land in production**.

The water needs of land and ecosystems should be considered along with agriculture

Renewable energy could play a larger role in meeting the energy needs of agriculture

Earth observations can enable the realization of these improvements. At this moment this is our hypothesis but it needs to be tested in demonstration projects).

Significant areas of overlap exist between the management needs of water, energy and food. Efforts to jointly utilize EO data should be done in collaboration with other Nexus issues



Some areas where joint risk should be addressed:

- **Climate change (trends, shifts and extremes)**
- **Economics/ investments**
- **Links to environmental services**
- **Pressures from increasing consumption due to demographics.**

Key Recommendations from the FAO-GWSP-ESA Workshop

1. More effectively integrate users from the WEF community into the design of observational services.
2. Select an area where the WEF framework can be implemented on a voluntary basis and use Earth observations to expand the information available to this framework. Carry out an analysis of the ways in which Earth observations can be used to bring benefits to the management of the Nexus and the degree to which sharing of data opened up opportunities for collaborative approaches in other areas.
3. A working group should be established to develop ideas, approaches and project proposals that could advance work on the application of Earth observations to the WEF framework.

What is Future Earth?



A **global platform** for international scientific collaboration

- Enables **integrated research** on grand challenges and transformations to sustainability
- Strengthens global **partnerships** between researchers, funders and partners of research
- **Communicates** science to society and society to science

Why an international GEC platform?

1. Heavy research **infrastructure**

- Earth observations and data

2. **Internationalisation** of science and engagement

- Secular trend across science

3. **Epistemic fit**

- The scale of research needs to align with the global scale of the problems and solutions

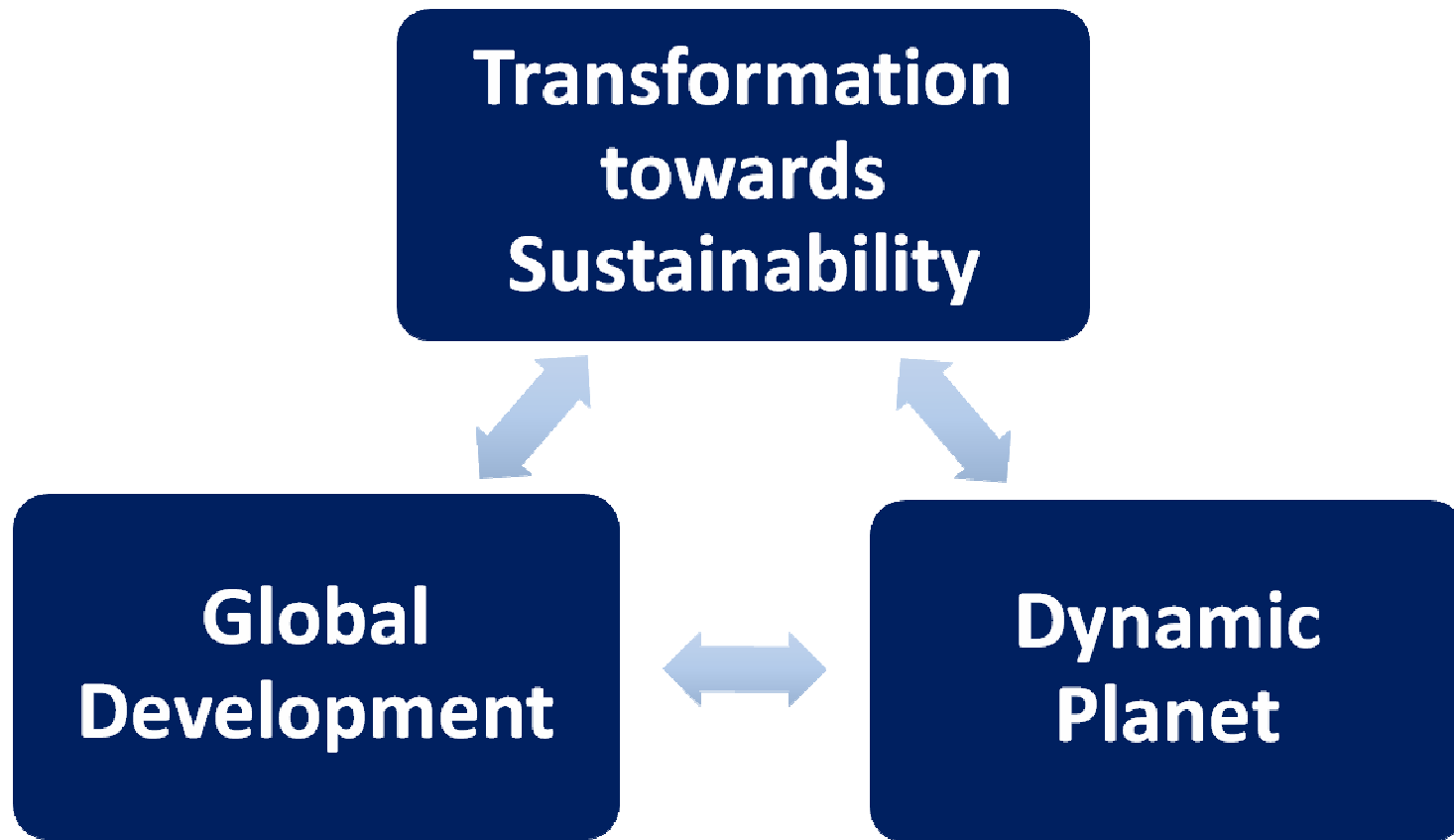
4. **Leveraging** resources

- To leverage research across science systems in period of pressure on science budgets

Future Earth's Objective

To **build** the **knowledge** required for **societies** in the world to face **risks** posed by global environmental change and to seize **opportunities** in a **transition** to global sustainability

Future Earth Research Themes



And cross-cutting issues: Observing systems, models, theory development, data management, research infrastructures

Modelling and observations

Modelling should be considered in the context of the question(s) to be addressed. Engagement with users is important in defining these questions (**co-design of solution-oriented research**).

It rarely makes sense to separate modelling and observations. Modelling and observations **need to be considered together** to answer questions about the 'real' Earth System.

Diverse approaches

Modelling and observations are naturally distributed amongst Core Projects. The diversity of models and observations are connected to a **diversity of research questions.**

➔ **Rationales for a cross-cutting modelling and observations effort under Future Earth**

Future Earth: Observations and Modelling

Extension

- Filling gaps
- Extending scope and precision

Integration

- Biophysical observations
- Biophysical and social data
- Real-time, crowd-sourced and open data

Access

- To enable more integrated Earth System Science
- To enable 'extreme' citizen science

Introducing the Sustainable Future Water Programme

...and its links to the NEXUS

*Charles J. Vörösmarty, Claudia Pahl-Wostl (co-Chairs)
Anik Bhahuri (Executive Director) et al.*



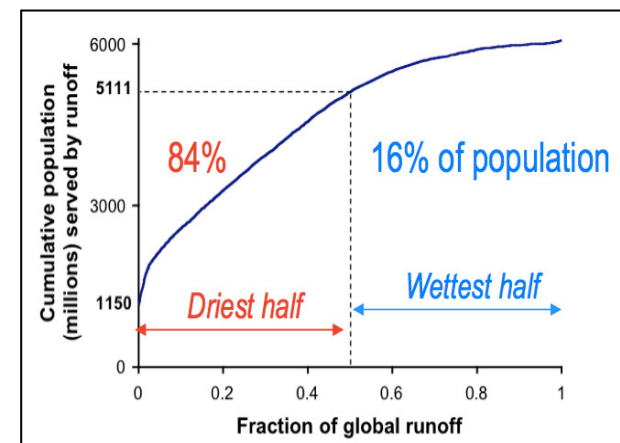
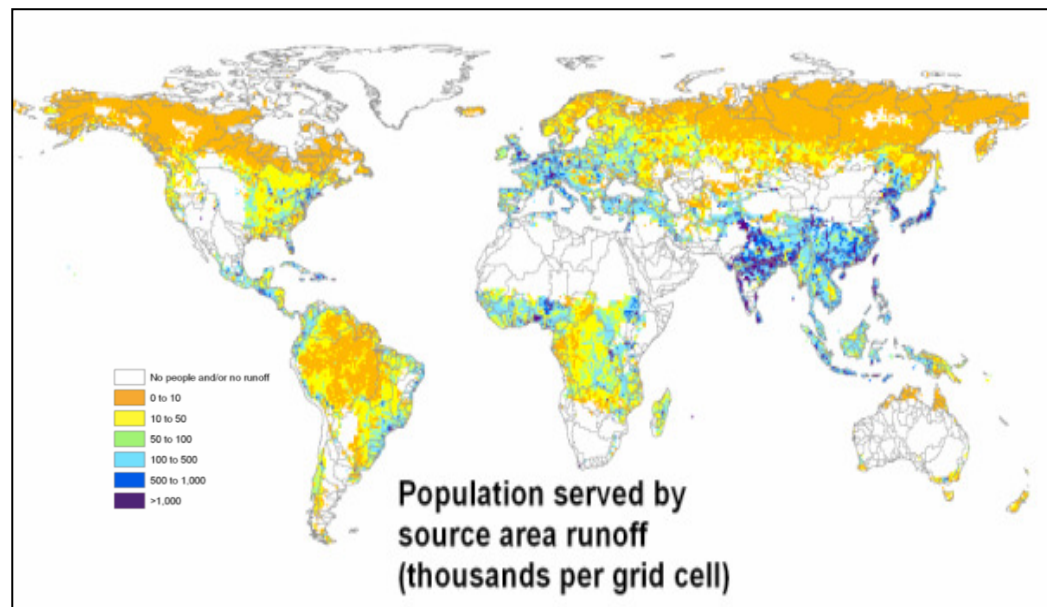


CENTRAL TENET OF THE GWSP (ca. 2004)

Humans are changing the global water system in a globally-significant way

without.....adequate knowledge of the system and thus its response to change

- Spearheaded the “acceptance” of fully global scale perspectives, not only from the biogeophysics but also human dimensions



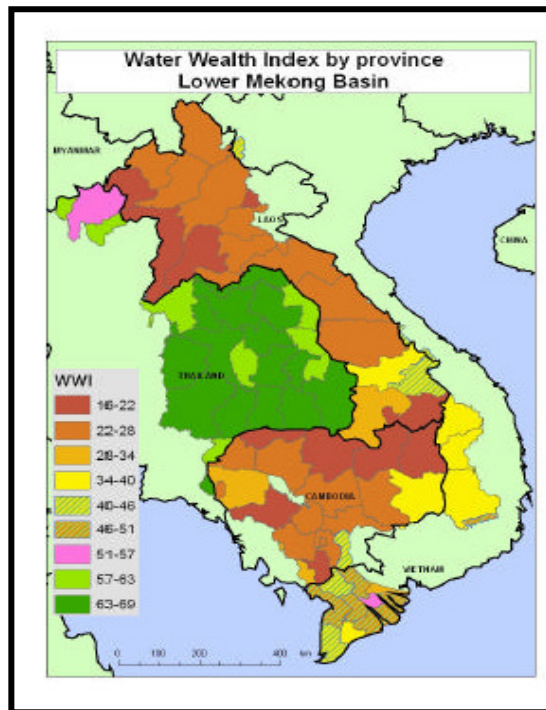
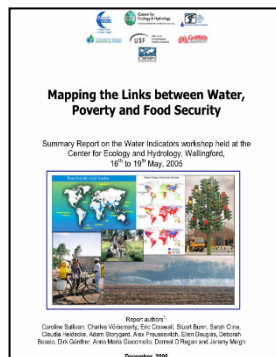
Extreme fraction of human population served by renewable water resources generated by the driest half of the planet

From: Vörösmarty et al., 2005

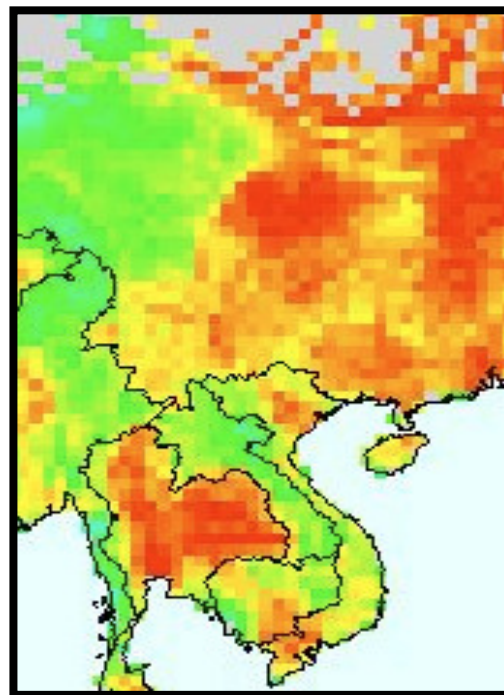
Examples of What GWSP Achieved

- Extending the dialogue about water and global change beyond climate alone

Water-Poverty-Food Security Mapping (GWSP-CGIAR-CEH-CIESIN)

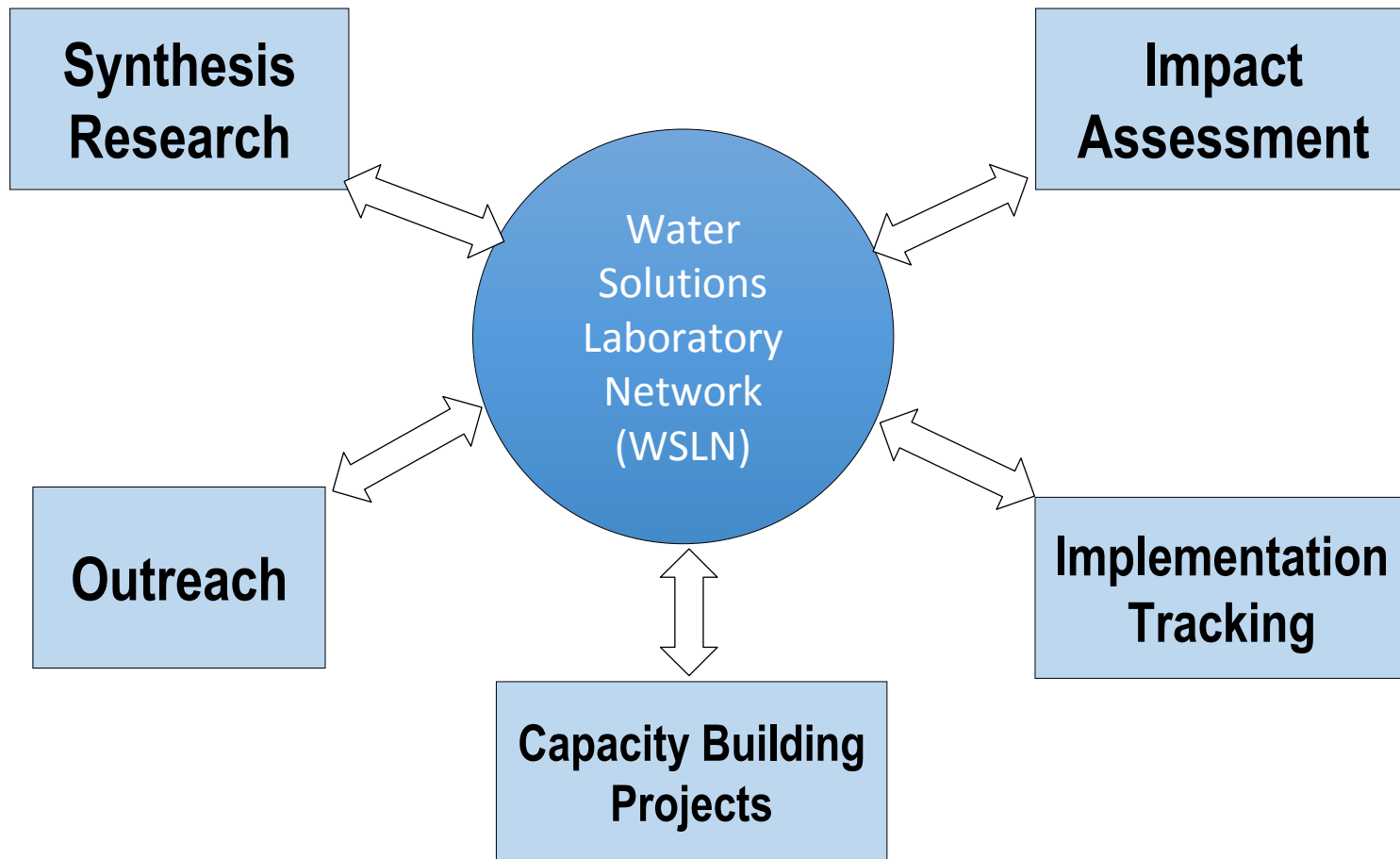


Biodiversity-Human Water Security Analysis (GWSP-DIVERSITAS)



king forward...

The Sustainable Water Futures Programme: *A solutions-oriented legacy of the GWSP*

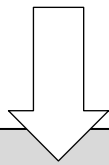


Looking forward...

The Sustainable Water Futures Programme: *A solutions-oriented legacy of the GWSP*

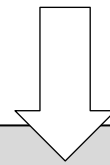
Flexible Programme Structure enables several strategically important water-relevant issues to be addressed:

FULLY
GLOBAL



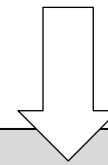
- SDGs*
- Global Trade Policies
- Support to UN Conventions
- NEXUS Trade-offs
- Climate adaptation

REGIONALLY
SIGNIFICANT



- Combating water-borne disease
- Optimizing irrigation
- Urban water
- Assessment of regional energy mix (e.g., fracking)

FOCUSED
TOPICS



- Ad hoc collaborations
- Support to NGOs, gvts, private sector
- Technology development

* Full suite, not just drinking water & sanitation

GEO Water is seen as a relevant contributor to GWSP programme. GEO water is also seen as a potential contribution to SWF programme. However we may need to reorient our services to that group with the new solutions focus.