United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

Ecohydrology Demonstration Sites - solution oriented living laboratories for the implementation of ecohydrology from molecular to basin scale

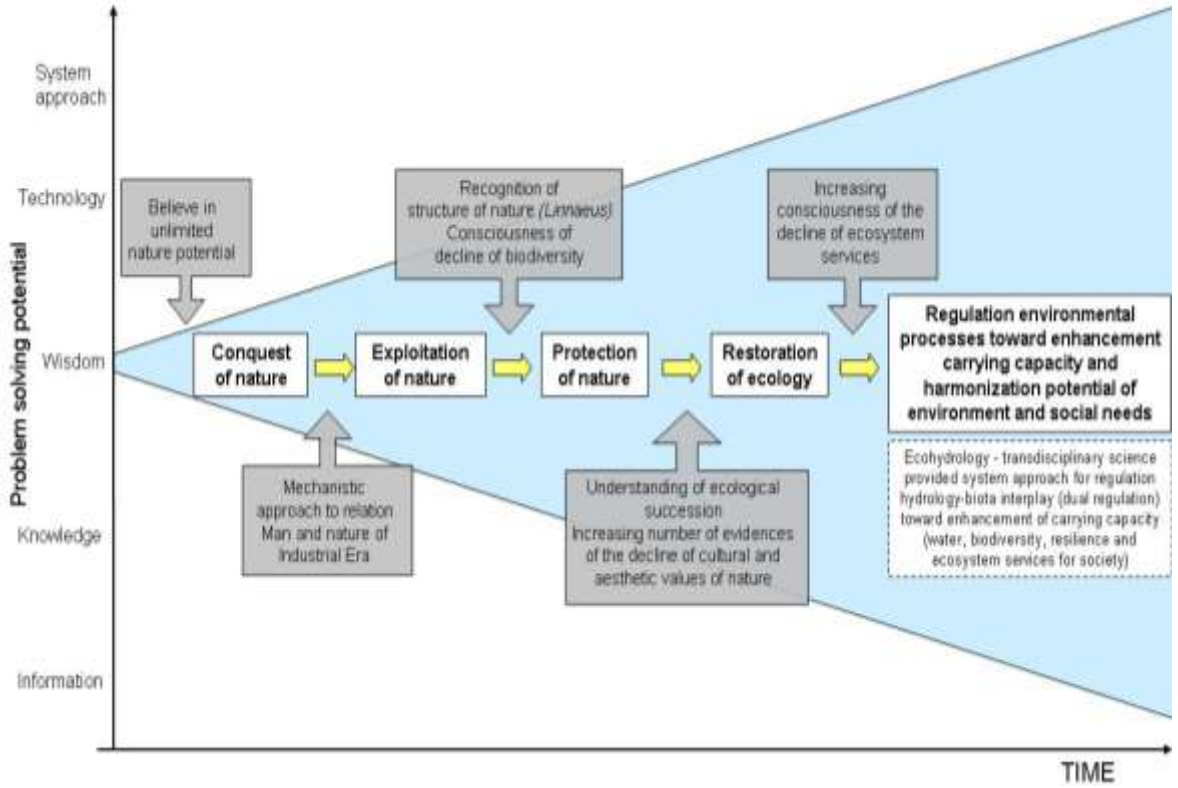
Blanca E. Jiménez-Cisneros
Director of the Division of Water Sciences and
Secretary of the International Hydrological Programme (IHP), UNESCO

IHP-VIII 2014-2021

IHP-VIII 2014-2021- Theme 5

Ecohydrology, engineering harmony for a sustainable world

Global challenge -> Urgent need to reverse degradation o water resources and stop further decline in biodiversity.



Ecohydrology concept in the perspective of evolution of relations between man and environment (Zalewski, 2011)

IHP-VIII 2014-2021- Theme 5

Ecohydrology, engineering harmony for a sustainable world

Focal Areas

5.1 - **Hydrological dimension of a catchment**– identification of potential threats and opportunities for a sustainable development.

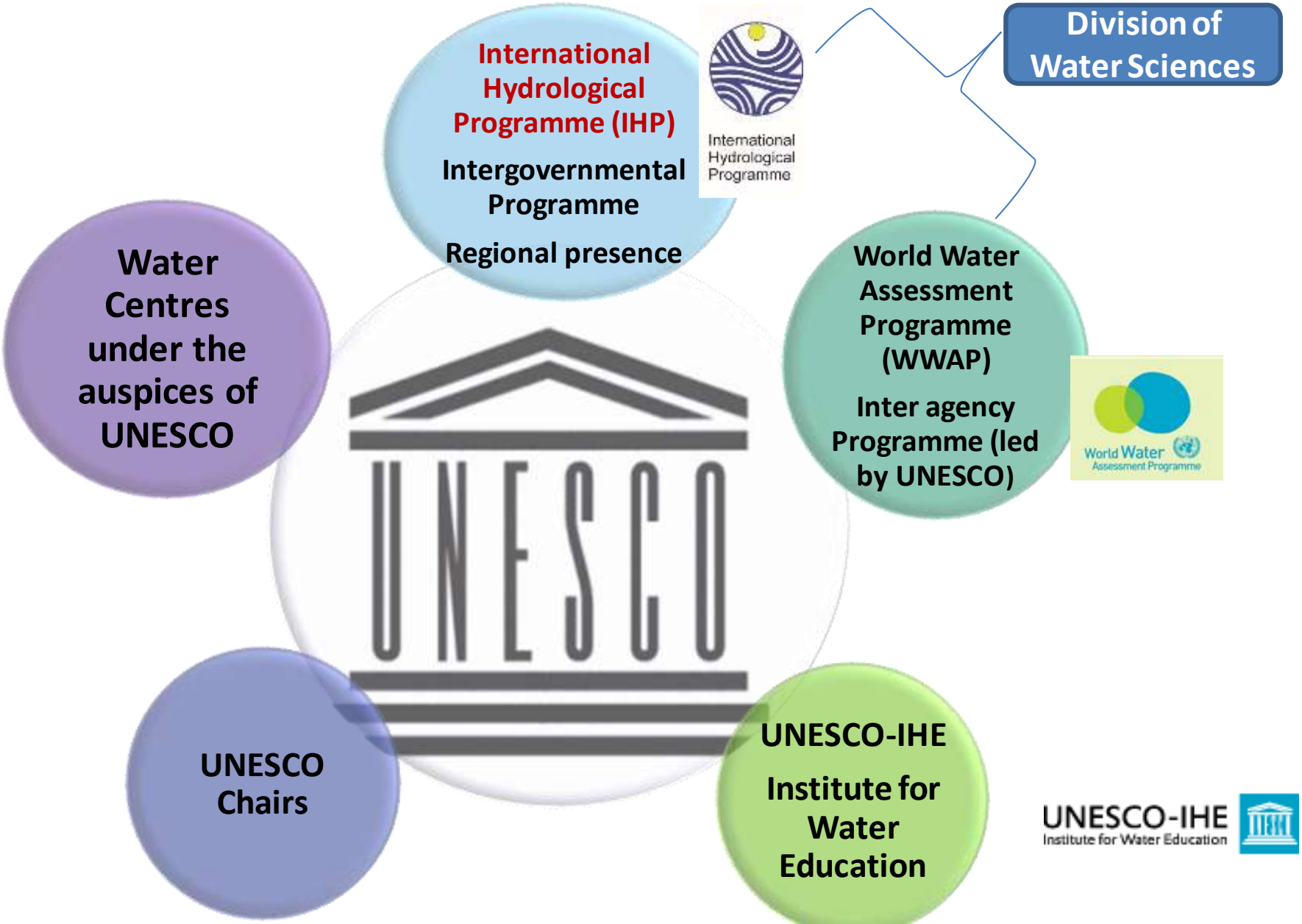
5.2 - Shaping of the catchment ecological structure for **ecosystem potential enhancement** – biological productivity and biodiversity.

5.3 - **Ecohydrology system solution and ecological engineering** for the enhancement of water and ecosystem resilience and ecosystem services.

5.4 - **Urban Ecohydrology** – storm water purification and retention in the city landscape, potential for improvement of health and quality of life.

5.5 - **Ecohydrological regulation** for sustaining and restoring **continental to coastal connectivity** and ecosystem functioning.

UNESCO and Water



United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

36 Established Water Centers

Arid- Areas	Urban Hydrology	Glaciology	Water Law & Policy/Cooperation	Eco-hydrology /Coastal Eco-hydrology	Groundwater	Water Hazards	Water Resources	Water Cultural Heritage	Humid Tropics

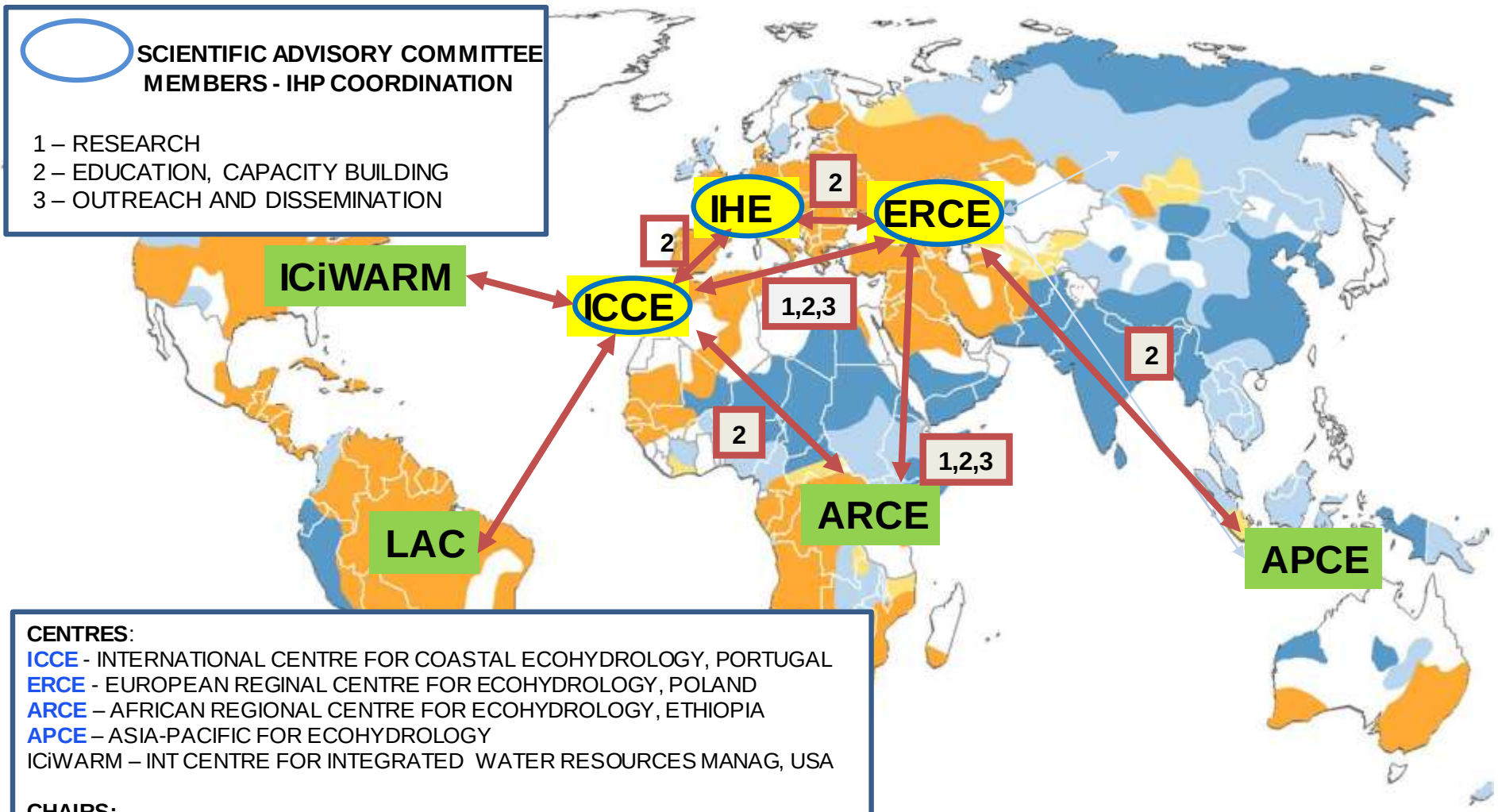
Ecohydrology Scientific Advisory Committee

- Strategic directions, new dimensions, activities to be undertaken
- **Develop criteria and guidelines** to apply for existing and new ecohydrological demonstration sites and demonstration cards
- Program execution, and communication of scientific advances and lessons learnt within theme 5 – "Ecohydrology, engineering harmony for a sustainable world"

- Chair: Maciej Zalewski ERCE
- Vice Chair: Luis Chicharo ICCE
- Vice Chair: Michael McClain, UNESCO-IHE

Bob Pietrowski ICIWaRM, USA
Pascal Breil, IRSTEA France
Stefano Fazi, IRSA (Istituto ricerca sulle acque) Italy
Marcelo Novillo, ARG focal point for LAC
Demin Zhou, chair in Ecohydroinformatics Beijin Normal UNIV
Ignasius Sutapa, Asia Pacific Centre for Ecohydrology, Indonesia

THE ECOHYDROLOGY "FAMILY"



CENTRES:
ICCE - INTERNATIONAL CENTRE FOR COASTAL ECOHYDROLOGY, PORTUGAL
ERCE - EUROPEAN REGINAL CENTRE FOR ECOHYDROLOGY, POLAND
ARCE – AFRICAN REGIONAL CENTRE FOR ECOHYDROLOGY, ETHIOPIA
APCE – ASIA-PACIFIC FOR ECOHYDROLOGY
ICiWARM – INT CENTRE FOR INTEGRATED WATER RESOURCES MANAG, USA

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FOCAL POINTS FOR ECOHYDROLOGY
LAC – LATIN AMERICA AND CARIBBEAN

ecohydrology programme

Centres for Ecohydrology

ERCE: European Regional Centre for Ecohydrology
In Lodz, Poland

- Further development of **ecohydrological science and its implementation for restoring freshwater resources** in the framework of the UNESCO International Hydrological Programme.

- Deliver tools for implementing the **European Water Framework Directive** as part of Poland's national cooperation.

- Promote **integrative multidisciplinary ecohydrological research** at a catchment scale for sustainable management, protection and restoration of aquatic resources.

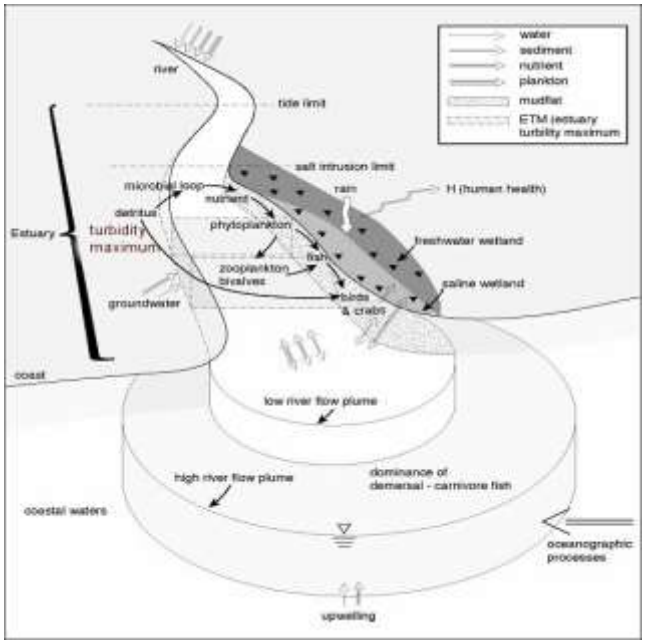
ecohydrology programme

http://www.erce.unesco.lodz.pl/

Centres for Ecohydrology

ICCE: International Centre for Coastal Ecohydrology, In Faro, Portugal

- Development of **solutions for coastal ecosystems** under climate change scenarios
- **Increase society awareness** and foster the participation of society including stakeholders and end-users to **adapt populations to climate-change impacts**, ensuring adequate water quality and quantity
- **Promote the scientific advance** on the integration of freshwater and coastal ecosystems and the **implementation of ecohydrology solutions** for controlling water quality and quantity



ecohydrology programme

http://www.ecohyd.org/

Centres for Ecohydrology

APCE: Asia Pacific Centre for Ecohydrology, In Cibinong, Indonesia

- Relation and uses **between biota and hydrology** in the Asia-Pacific region
- Identify a **hierarchy of environmental problems and sources of pollution** in selected areas associated with ecohydrological processes
- **Strenghten the network** of scientists in ecohydrology in Asia and the Pacific

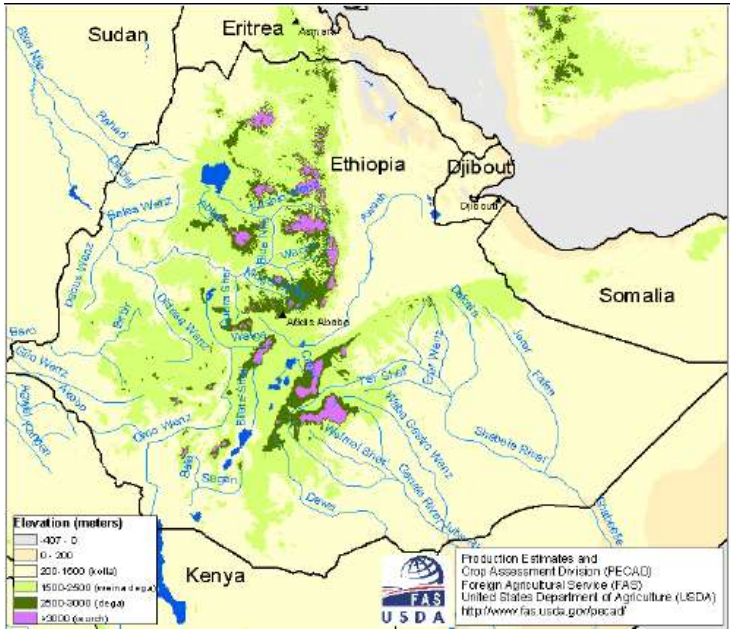
https://apce2012.wordpress.com/about/

Centres for Ecohydrology

ARCE: Africa Regional Centre for Ecohydrology, In Addis Ababa, Ethiopia (**newly approved**)

- **Promote** advanced scientific research on ecohydrology, monitoring and modeling systems

- Transfer of knowledge and its implementation in order for waterbodies to be ecologically sound to **implement the Water Related Framework Directive of the African Countries**, and other environment-related legal regulations



3 Chairs for Ecohydrology

1. UNESCO Chair in Hydroinformatics for Ecohydrology, Prof. Zhou Demin, Capital Normal University, China

-> increase the skills, capacity, networks and potential leaders and prospective water managers and policy makers

2. UNESCO Chair in Ecohydrology Water for Ecosystems and Societies , Prof. Chicharo Luis, University of Algarve, Faro, Portugal

-> **Develop modules on Ecohydrology for graduate and post graduate courses and training programs in Ecohydrology for professionals and practitioners, focusing on regional and local needs and** Contribute to the successful implementation of Sustainable Development and the Millennium Development targets

3. UNESCO Chair on Water Resources Management and Ecohydrology, Dr Danilov-Danilyan Viktor, Water Problem Institute of the Russian Academy of Sciences, Russian Federation

-> Widen possibilities of collaborative scientific investigations by educator postgraduate students and course on the "ecohydrological consequences of climate changes in cold regions and water resources management"

What are the **demonstration sites?**

The demonstration sites integrate the concept of "**enhanced ecosystem potential**" with EH strategies closely related with water to improve IWRM on specific areas.

They:

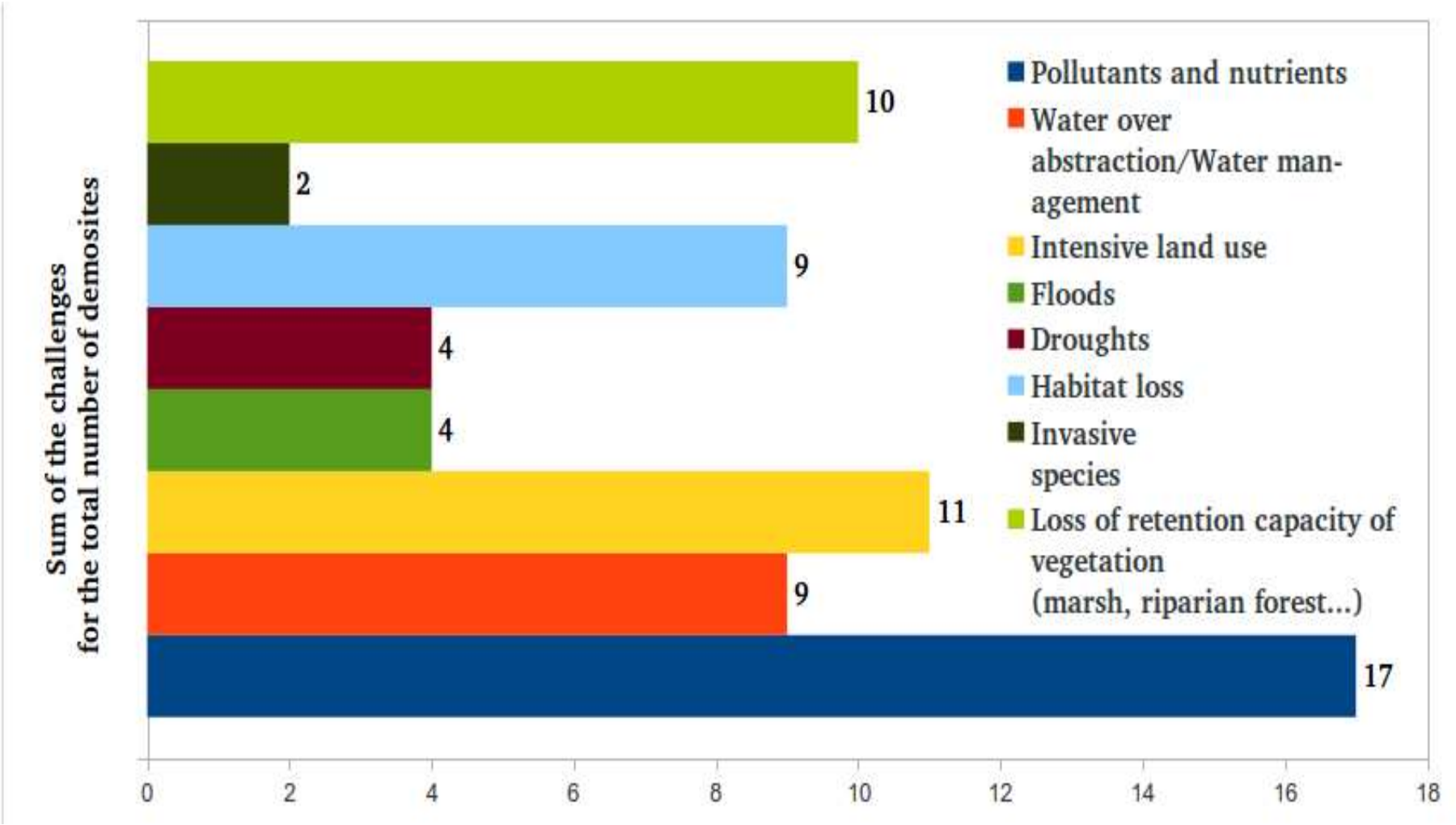
- Are **long-term monitoring** projects involving different local stakeholders in order to solve environmental, economic and social issues.

- Use the **most appropriate** and **cost-effective** ecohydrological engineering solutions for each ecosystem as management tools for Integrated Water Resources Management (IWRM).

- Provide contribution for both **human** sustainable development goals (e.g. Goal 2) and **environmental** ones (Goals **6**, 13, 14 and 15).

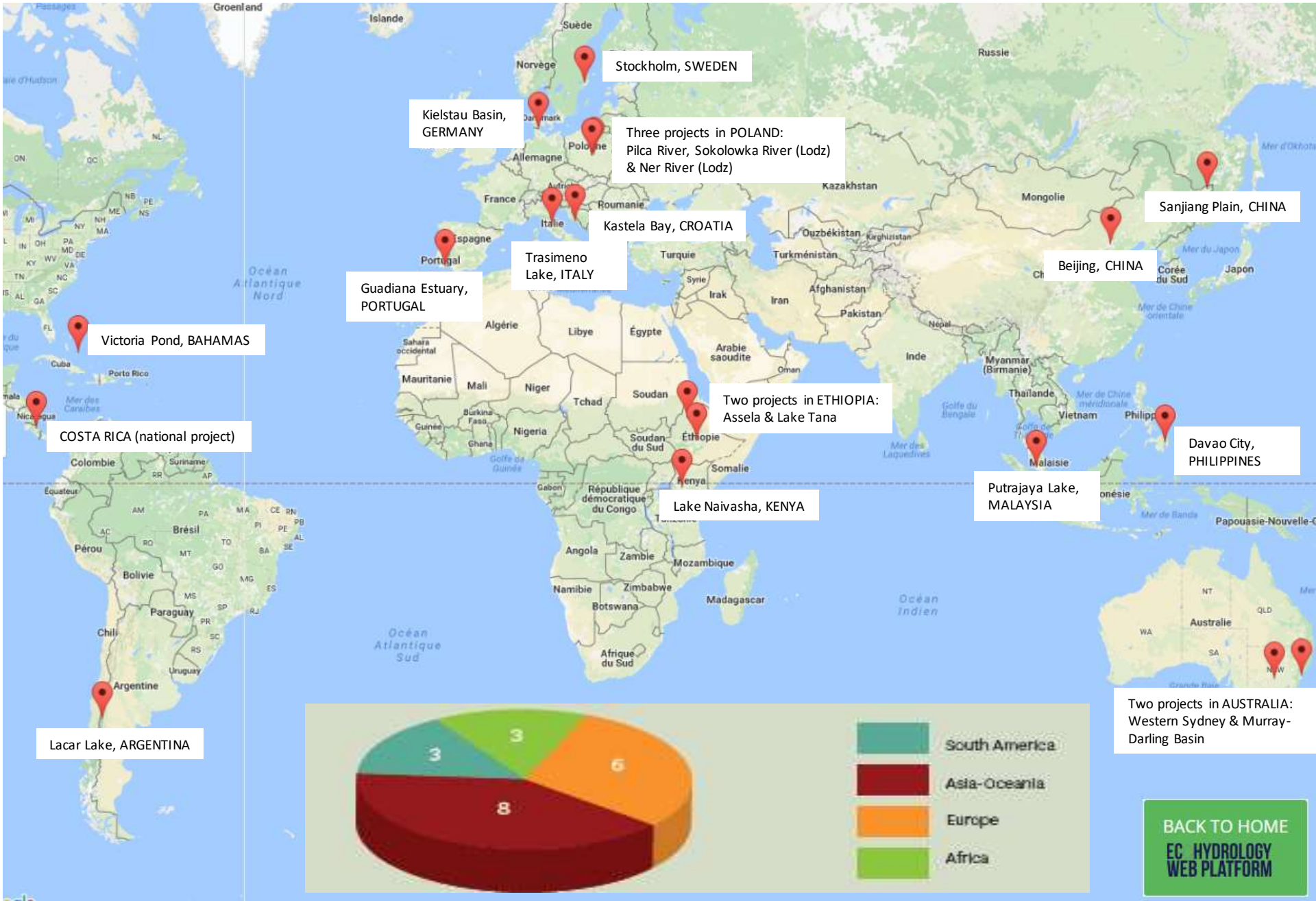
Those projects follow a solution-oriented approach for the enhancement of **W**ater resources, **B**iodiversity and ecosystem **S**ervices for society and of the **R**esilience to various forms of anthropogenic impacts (**WBSR**).

Major issues addressed by the demonstration sites



The three main threats are the excessive presence of pollutants and nutrients, intensive land use and loss of retention capacity of vegetation.

Network of the 20 demonstration sites



Main achievement of the Ecohydrology Programme

- **15 Member States adopted the criteria and guidelines in 20 demonstration sites**

2 Member States in Africa

4 Member States in Asia-Pacific

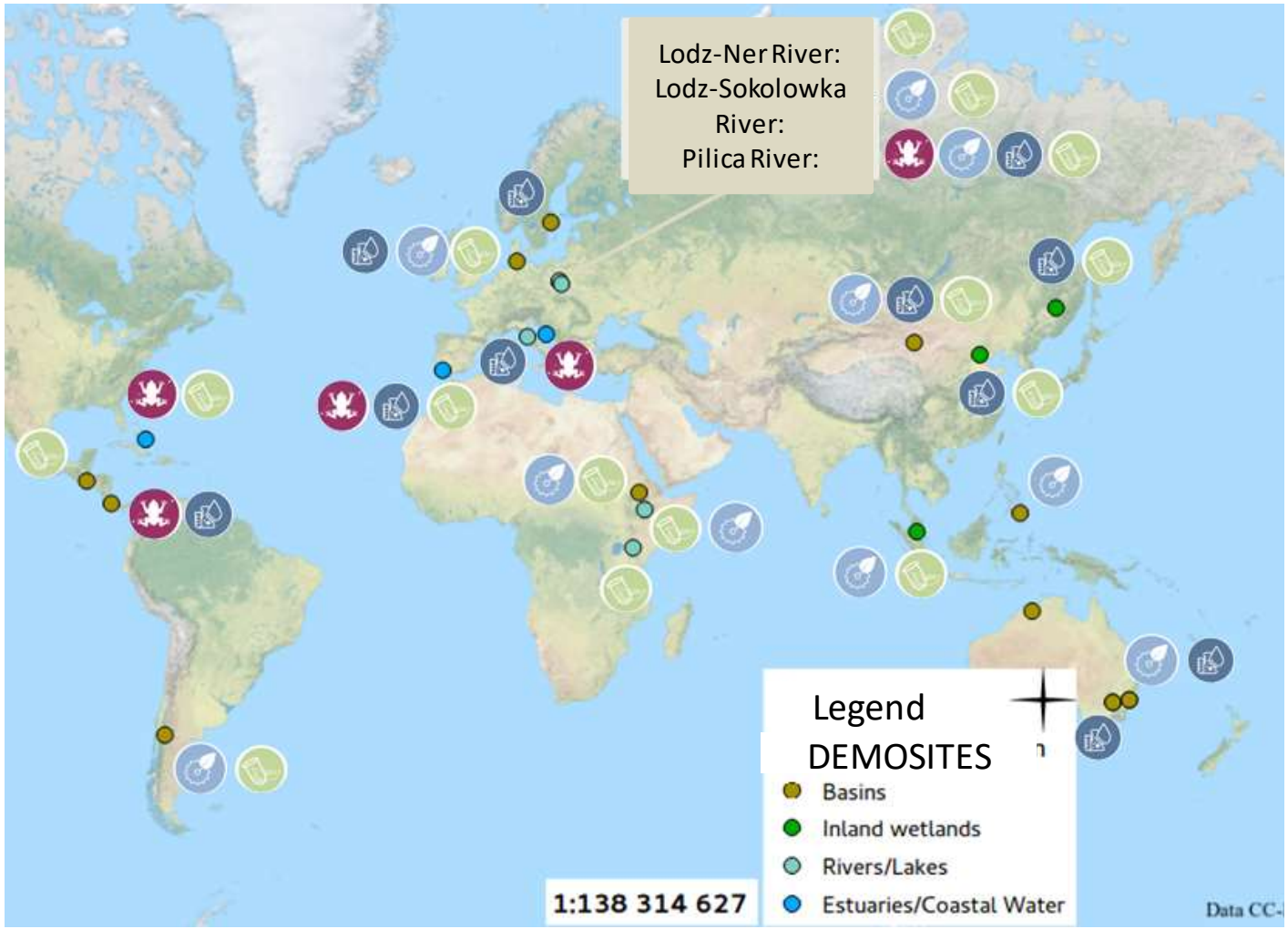
6 Member States in Europe

3 Member States in Latin America and the Caribbean

Putrajaya, Malaysia

Application of ecohydrology

Four ecohydrology engineering solutions:



65% of the demosites are using the **phytotechnologies** as EH solution.

48% -> hydrological flow

43% -> ecohydrological infrastructure

22% -> faunatechnology

1. Ethiopia, Ribb watershed & Lake Tana shore Capacity building in ecohydrology

Objectives:

- Reduce encroachment of agriculture to lake Tana shore
- Reduce **land degradation and flood in the watershed**

Ecohydrology engineering solutions applied:

- **Construction of a sedimentation-biofiltration system** (SBS) in the city of Debre Tabor to absorb micropollutants and nutrients and to convert them into less toxic forms
- **Restitution of eroded soils** by application of biodegradable geofibers and plantation of pioneering plants + creation of shelterbelts

2 Ethiopia, Asella City

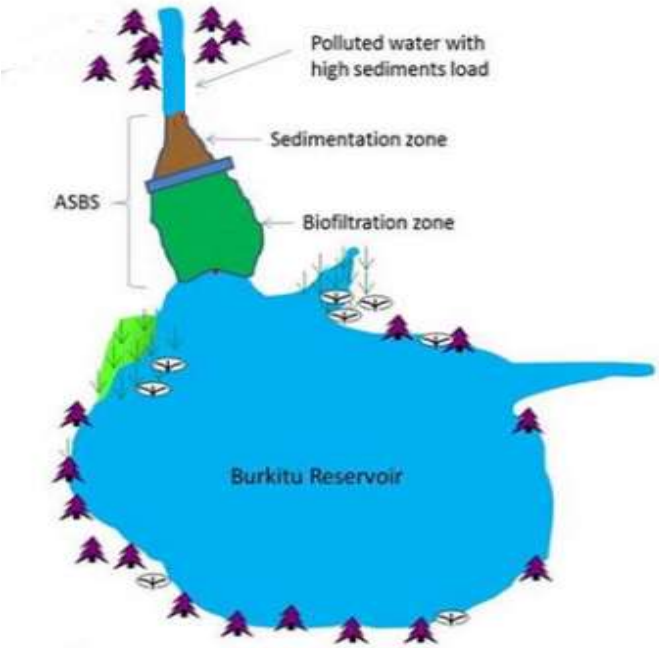
For restoration of the Burkitu reservoir as an alternative source for water supply

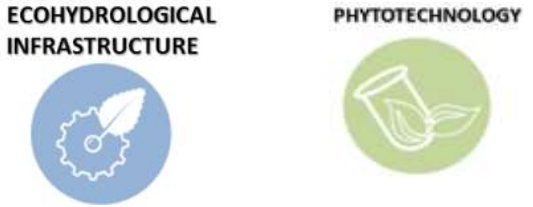
Objectives:

- Restore the **water quality**
- Upgrade the reservoir capacities to **provide recreational and aesthetic value** for cultural ecosystem services
- Promote and **implement aquaculture and capture fisheries**

Ecohydrology engineering solutions applied:

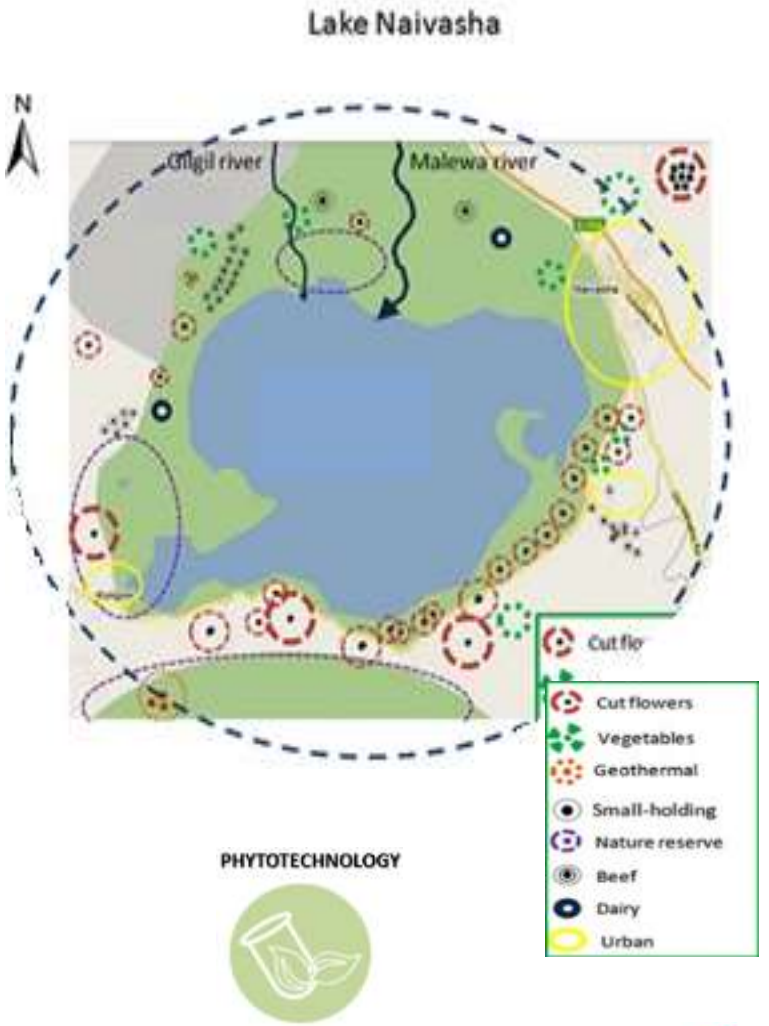
- **Construction of an infiltration dam** called the Asella Sequentional Biofiltering System (ASBS) in 2010 to absorb micropollutants and nutrients
- **Restitution of eroded soils** through the application of biodegradable geofibers on the stream banks and phytoremediation





3 Kenya- Naivasha basin

Sustainable utilisation of water



Objectives:

- Understanding of the **role of the water cycle in supporting human existence**

Ecohydrology engineering solutions applied:

- **Protection of *Cyperus papyrus* fringe** through replantation

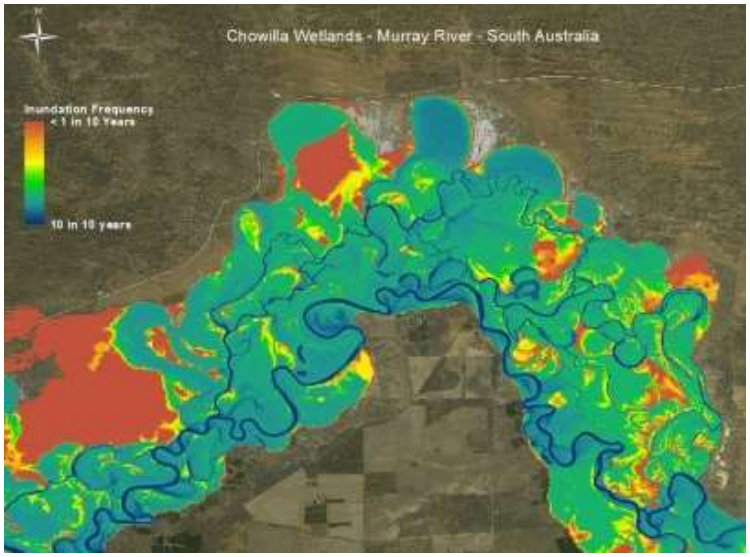
in the riparian area

- **Artificial islands** were planted onshore in ponds

with papyrus to be anchored offshore in selected locations

4. Australia, Murray Darling Bassin

Developing fit-for-purpose tools to address complex social, ecological and economic issues in water planning



Objectives:

- Identifying **social values in environmental assets** (wetlands) for purposes of prioritization in context of water scarcity
- Eliciting **Indigenous** cultural water values to be incorporated in water plans

Ecohydrology engineering solutions applied:

- **Modelisation** of salt accumulation, *floodplain inundation*, water requirements and vegetation health

5. Australia, Western Sydney

Developing solutions for environmental-friendly water management in peri-urban landscapes

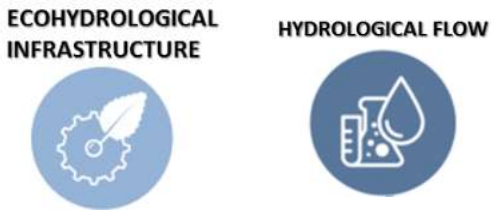
Objectives:

- Evaluate the effects of **land use changes and urbanization on water quality, microclimate and ecohydrology**
- **Develop and apply tools** and new technologies to improve liveability of **local urban areas**

Land use changes due to urbanisation of the South Creek catchment

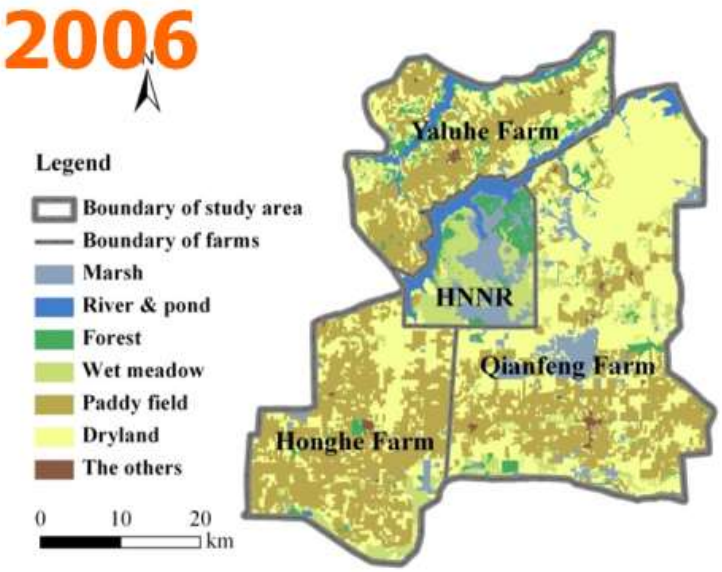
Ecohydrology engineering solutions applied:

- **Water reuse** and conservation using **rainwater harvesting system** in urban and peri-urban areas
- Building of the pollution removal performance of **stormwater bioretention units**
- **Estimation of water allocation**, stream flows, stormwater runoff through the hydrological model



6. China, Sanjian Plain

To assess the degraded inland freshwater wetland habitat



Objectives:

- **Defining scientific policy for balancing sustainable development and healthy ecosystem on the water issue**
- Predicting quantitatively the wetland plant ecosystem responding to the change of hydrologic regime

Ecohydrology engineering solutions applied:

- **Marsh classification mapping** using high-resolution imagery
- Quantifying the different dynamic patterns of soil water linking with different plants
- Use of the dam to control water levels on marsh

7. China, Metropolitan Beijing

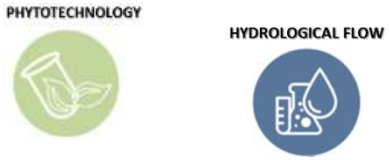
Management of regional water resources linked with maintaining of wetland biodiversity in the suburban area

Objectives:

- **Quantifying Land Use Cover Change** (LUCC) in the past 50 years for fixing of driving forces on wetlands using the Geoinformatic technology
- Presenting the **water policies linking with wetland biodiversity protection**

Ecohydrology engineering solutions applied:

- Assessment of mechanism of the interaction between the integrated water cycle and wetland vegetation
- Quantifying spatial and temporal transformation of the regional water cycle and assessing the anthropogenic influence on the regional hydrologic wetland processes



ecohydrology

8. Malaysia, Putrajaya Lake and wetland

Integrated catchment management

<u>Objectives</u>:

- Increase **stakeholder engagement and community** participation in Putrajaya
- Create awareness among communities
- **Educate people** to be more responsible in taking care of the environment

<u>Ecohydrology engineering solutions applied</u>:

- Implementation of the Putrajaya **constructed wetland system** since 1998
- Plantation of a variety of aquatic plants in this wetland (more than 70 species totaling 12 million number of plants)

9. Philippines, Davao City

Understanding ecohydrological connectivity in multiple catchments to conserve groundwater, protect surface water and contain risks

Objectives:

- **Transform the current high-level of awareness into cohesive and high impact policies and programs (both in the government and civil society)**

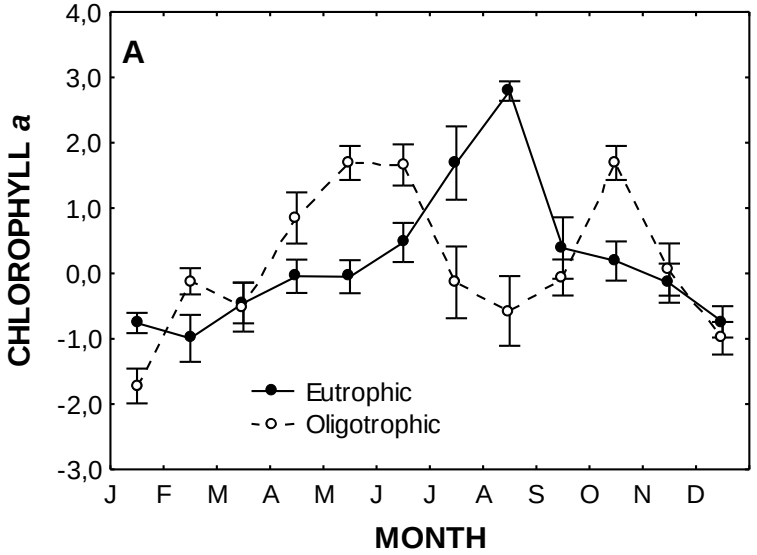
ECOHYDROLOGICAL INFRASTRUCTURE

Ecohydrology engineering solutions applied:

- Rehabilitation of critical areas
- Construction of a **water treatment plant** to tap the Tamugan-Panigan River for drinking water
- Centrally-automated rainwater gauges in strategic locations

10. Croatia, Kastela Bay

Sustainable estuarine zone management for control of eutrophication, toxic blooms and conservation biodiversity



Objectives:

- **Creation of conditions for safe development of economy**
- Maintenance of achieved level of water quality

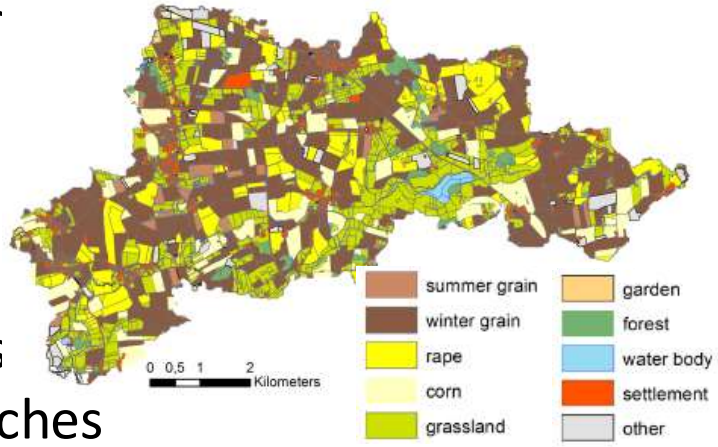
Ecohydrology engineering solutions applied:

- Follow-up of the **microbial food web structure**

(development of an index based on phytoplankton-related parameters)

11. Germany, Klelstau

Sustainable water resources management and education **in rural landscapes**



Objectives:

- **Cooperation** between research, administra and local stakeholders for solving problems
- Implementation of ecohydrological approaches
- **Education** of students

Ecohydrology engineering solutions applied:

- **Renaturalisation** of river sections and riparian wetlands
- Building and testing of **reactive ditches and retention ponds**
- River basin model, Hydraulic models, Species distribution model (SWAT; HEC-RAS; ADH; BIOMOD)

12. Italy, Trasimeno Lake

Sustainable water resources management plans for environment protection, minimum instream flows regulation and ecosystem preservation

Trasimeno Lake water crisis in 2003, lake level falls 1,85 m below gauge zero

Objectives:

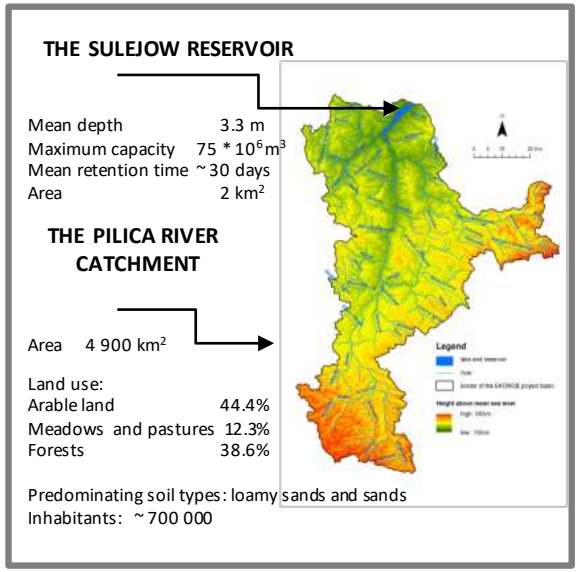
- **Harmonise biodiversity protection**, stakeholder expectations and administrative constraints to achieve an integrated management of the catchment

Ecohydrology engineering solutions applied:

- **Rehabilitation of natural flows** by monitoring the water withdrawals
- **Integrated Lake Basin Management**

13. Poland, Pilica River

Development and implementation of the ecohydrology concept for reduction of cyanobacterial blooms in a man-made reservoir



Objectives:

- Establishing a multi-stakeholder platform
- Raising ecological awareness and activation of the local community

Ecohydrology engineering solutions applied:

- Integration for **synergy denitrification and biogeochemical barriers** with highly efficient diverse plants
- Pressure mapping and quantification of emissions with the use of modelling
- **Hydrobiomanipulation** for enhancement of filtering large zooplankton by the water level regulation

ecohydrology programme

14. Poland, Lodz River

Urban water management and city planning for human health and sustainable development

<u>Objectives</u>:

- Establishing functional system between Waste Water Treatment Plant (WWTP) and willow plantation
- Elaboration and legalization of the **Blue-Green Network Concept**
- Involvement of counties through **production of biomass** which is **being used for heating schools and public buildings**

PHYTOTECHNOLOGY

<u>Ecohydrology engineering solutions applied</u>:

- Use of sewage sludge in biomass and **bioenergy production** on willow plantations
- **Phytoremediation** for inactivation and removal of heavy metals from the sludge

15. Poland, Lodz, Sokolowka River

Urban water management

Objectives:

- Rehabilitation of Sokolowka river and its valley
- Elaboration and legalization of the Blue-Green Network Concept
- Implementation of **best management practices** by developers in stormwater management

Constructed wetlands

Ecohydrology engineering solutions applied:

- Construction of reservoirs **to mitigate the extreme stormwater flow**
- **Stormwater purification** in sedimentary-biofiltration system
- Phytotechnology in reservoirs for the development of blue-green network in urban areas health and quality of life

ECOHYDROLOGICAL INFRASTRUCTURE

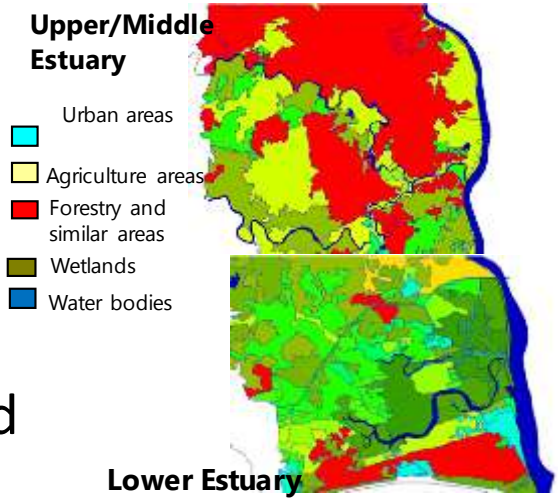
PHYTOTECHNOLOGY

16. Portugal

Sustainable estuarine zone management

Objectives:

- Quantification of river flows, residence time and productivity on **estuarine and coastal ecological functioning and services**
- Discuss **trade off between water allocation for agriculture and hydroelectric power production** against sustainability of estuarine ecosystems and coastal services
- Analysis of the role of salt marsh plants as buffer vegetation



Ecohydrology engineering solutions applied:

- Use of two species of bivalves and saltmarsh plants as **indication of water quality**
- **Release of freshwater pulses** from the reservoir to control the risks of harmful algal blooms

ecohydrology programme

17 Sweden, Norrstrom drainage Basin

Adaptive water management in response to hydro-climatic change effects on ecosystem services and biodiversity

Objectives:

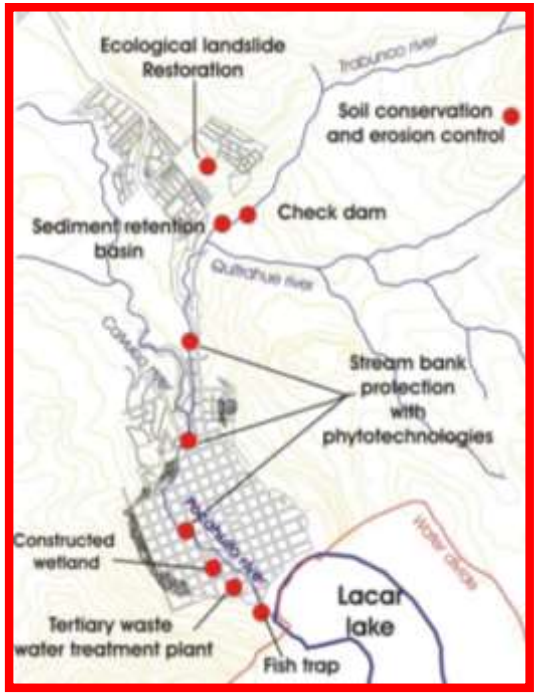
- Efficiently reduce **eutrophication impacts** of population, agricultural and industrial pressures
- Understand and efficiently mitigate and **adapt to impacts of hydro-climatic and land-use changes**

Ecohydrology engineering solutions applied:

- **Management analysis** regarding nutrient loading to inland and coastal water ecosystems, including focus on regulating ecosystem services of wetlands
- Assessment of drivers and ecohydrological effects of **hydro-climatic** and land-use changes through time

18. Argentina, Lácar Lake Basin/San Martin de los Andes Neuquen

Improving land use policies



Objectives:

- Involvement of local authorities/ stakeholders in implementing ecohydrology management strategies
- On-site training for **young scientists and decision-makers**
- Dissemination of information on ecohydrological approach for water management

Ecohydrology engineering solutions applied:

- Biofiltration and sediment trapping using **constructed wetlands and vegetation management**
- **Reducing natural and geohydrological risks through control of woody debris, and landslides and margin restoration**

19. Bahamas, George Twon , Great Exuma

Restoration of Victoria pond wetland habitat in historic George Town, Great Exuma for sustainable management to control pollution and enhance near shore fish habitat

A carpent anemon

Objectives:

- Create local mangrove preserve
- **Help maintaining and financing**
- Development of a long-term community outrea and coastal stewardship programme

Ecohydrology engineering solutions applied:

- Plantation of **mangroves** and coastal plants (restoration of plant communities)
- **Environmental Sensitivity Index (ESI) mapping**
- Model the frequency of occurrence of hypoxia events and the near-shore epifaunal community

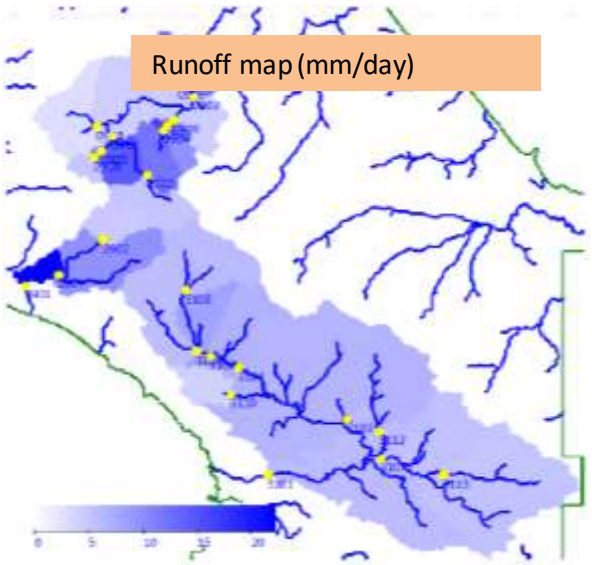
PHYTOTECHNOLOGY

FAUNATECHNOLOGY

ecohydrology

20 COSTA RICA

A methodology to estimate compensatory runoff



Objectives:

- **Adaptive flow management** which envisages a continuous monitoring of the outcomes of the chosen decision and learning from thus obtained new knowledge
- **Analysis of the likely impacts of different minimum flow scenarios**

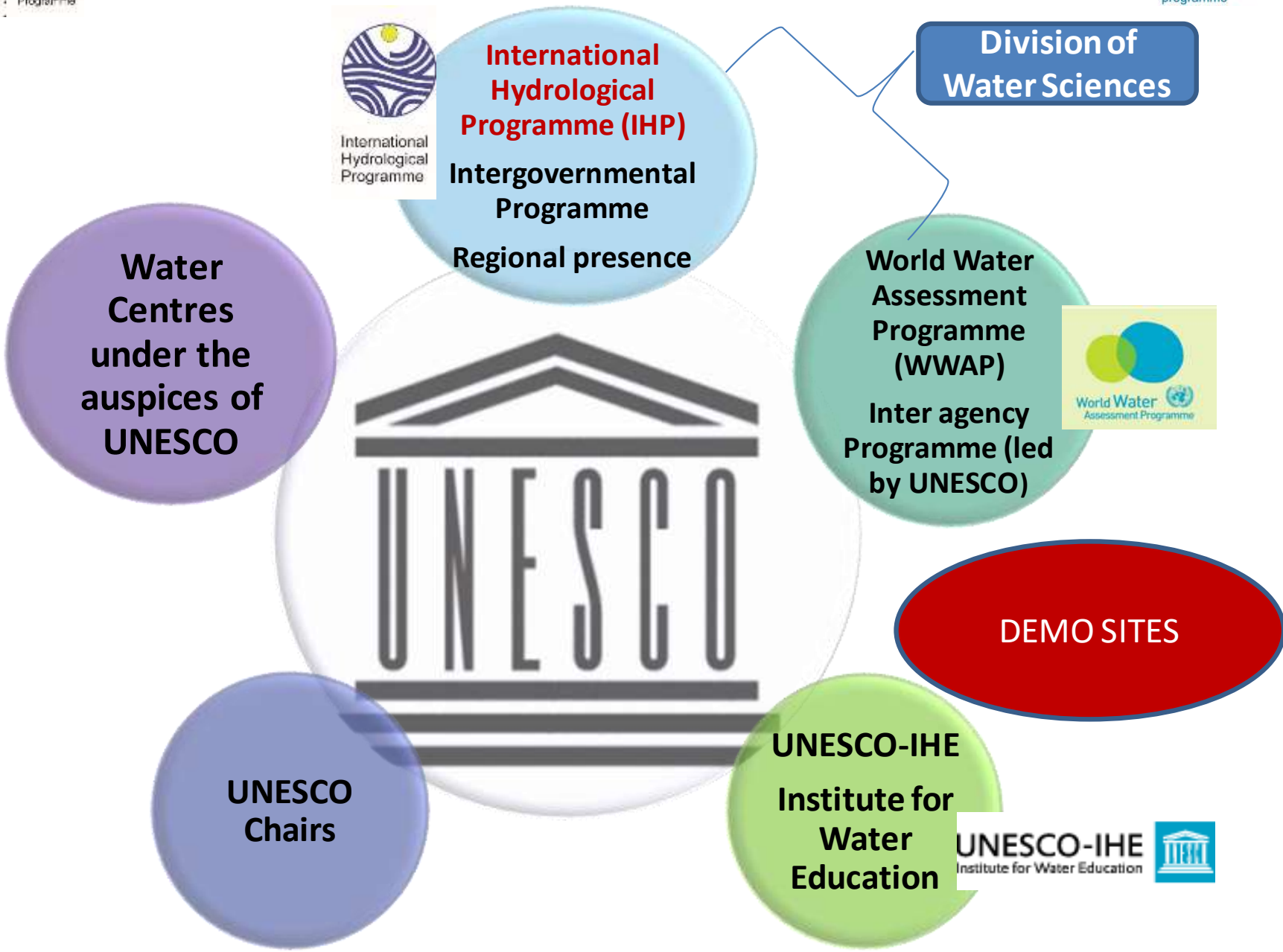
Ecohydrology engineering solutions applied:

- Interdisciplanary methodology for the determination of the **compensatory runoff at a site-specific level** (RANA-ICE study)
- Consider life cycles of the selected **indicator species** and their demand of habitats as an input for evaluative adaptive flow

HYDROLOGICAL FLOW

FAUNATECHNOLOGY

UNESCO and Water



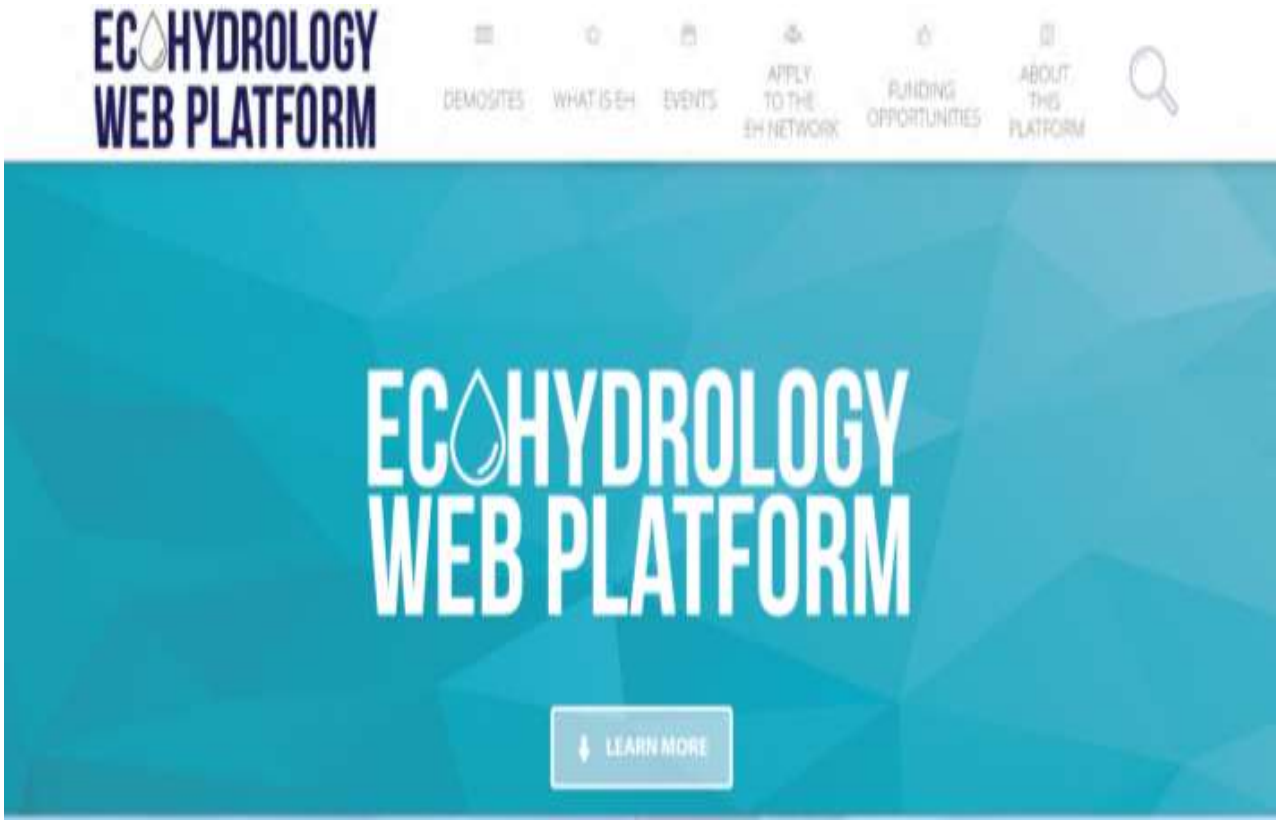
Criteria and guidelines of the demonstration sites

- Set by the advisory board (who approves, as well)

- *** You can find these criteria and guidelines more in details on the Ecohydrology web platform following this link: http://ecohydrology-ihp.org/demosites/candidate/form?approved=true**

Web-platform: an interactive network (collaboration with CIH, Itaipu)

- The web-platform is the interactive environment that will enhance the dissemination of the ecohydrological concept within different targets, from scientists to general public and to Member States
- www.ecohydrology-ihp.org



Ecohydrology symposium in Ethiopia, 7-11 November 2016

- Two days of symposium (Addis Ababa)
- One day of fieldtrip (Asella BioFarm Park)
- Two days of training course (development and application of ecohydrological biotechnologies)

http://ehsymposiumafrica.org

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Thank you for your attention

ecohydrology programme