Strengthening China Europe Water Innovation Cooperation: results from PIANO project

Relevance of PIANO results for future EU/China water innovation cooperation

P.I.A.N.O.
Policies, Innovation And Network for enhancing Opportunities for China-Europe water cooperation
中欧水源合作机会增进政策，创新和联网

www.project-piano.net

In collaboration with

CHINA EUROPE Water Platform
www.cewp.org

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P.I.A.N.O.

Policies, Innovation And Network for enhancing Opportunities for China-Europe water cooperation

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Webinar Of LNEC

Webinar Of LNEC

The presentation of the activities performed in mapping water innovation solutions to tackle the water challenges focused by the PIANO project was the main subject of the webinar held by J.P. Lobo Ferreira, unit director in LNEC, on 6 April 2018.

The webinar is available at this link:

https://youtu.be/2N5LmZva7ZE

European Commission

Workshop on
"Application of the R&I Tool for Better Regulation
in the European Commission's policy initiative on Water Reuse"

Brussels, 31.05.2017

DG RTD initiative on Innovation Principle

Case: Policy options for Water Reuse: impact to R&I

Define and delimit your domain, add possible sub-categories. **Send note (ca. ½ page) to DTU.**	LNEC	15May
Identify core data sources for TWIs in your domain: **- Provide 6-8 reports/analyses of TWI** **- Check EC water innovation project specific databases (e.g. ECOWEB, EUREKA).** **- Suggest possible other sources** **- Send a note to DTU (full references).**	LNEC with ISPRA	5 June
Make a gross list of at least 20 as far as possible TWIs in your domain, **-Describe each TWI according to List Template defined by DTU.**	LNEC	5 August
Score the TWI based on Scoring Template provided by DTU	LNEC	10 Sept.
Verify and comment on Inventory 1 sent by DTU	LNEC	5 Oct
Milestone 5 "Inventory of European technological water innovations" for this domain	DTU, EWA (CEWP)	30 Nov

RESEARCH AND DEVELOPMENT
Potential areas for future cooperation

On water quantity

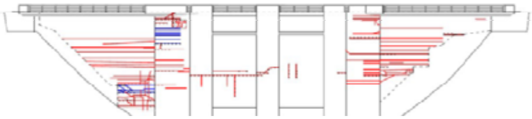
Models linking groundwater/surface water/transitional waters and coastal waters

a) Flood risk mapping

b) Drought prediction

c) Comprehensive reservoir operation

d) Rain harvesting methodologies

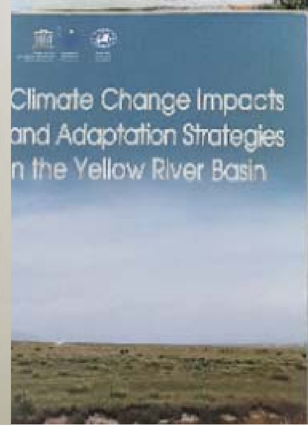


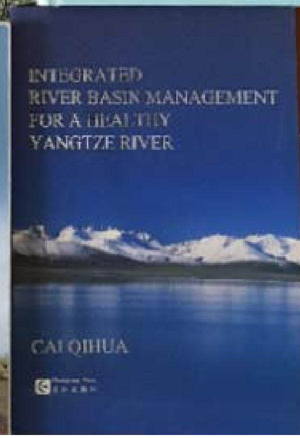
On integrated modelling/monitoring

a) information sharing technologies

b) conflict resolution mechanisms

c) decision support systems
   - o water quality models
   - o hydrological models
   - o monitoring
   - o modelling





WP 2: Technological Water Innovations

P.I.A.N.O.
Policies, Innovation And Network for enhancing Opportunities for China-Europe water cooperation

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TWIs Catalogue

Home / TWIs Catalogue

http://project-piano.net/twis-catalogue-2/

The identification and prioritization of European technological water innovations (TWI) that have potential for application in China and the identification of water challenges where neither Europe nor China has suitable technologies to offer and hence opportunities may exist for the joint development of technological solutions were carried by Work Package (WP) 2 within the Policies, Innovations and Networks for enhancing Opportunities for China Europe Water Cooperation (PIANO) project.

Download **TWIs Catalogue**

Technological innovations

Identified and analyzed by PIANO project WP 2

P.I.A.N.O.

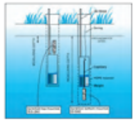
Domain:

- Agricultural Water Management,
- Municipal Water Management,
- River Basin Management,
- Industrial Water Management,
- Water For Energy

Agricultural Water Management

TWIEU A36 Groundwater sampling system

WATER DOMAIN	Agricultural Water Management
CATEGORY	*Groundwater Technologies*
Subcategory	*Monitoring Technologies*
Technology	**Groundwater sampling system**



source: www.sorbisense.dk

5. Stage of development of the technology:
a) TRL (1-10), possibly add comments: TRL 9
b) The product-system architectural match/mismatch 1-5 (5 highest match): 5
c) Time to market: already there, 1-5 y, 5-10 y, > 10 y, don't know: 5-10
d) Maturity of market: immature, medium, mature: mature
6. Contribution of TWI to meet Chinese Water Challenges: Integrated systems of precision irrigation aim at saving water and total costs of water abstraction and supply for irrigation, therefore, they represent the first step for loss and waste reduction in agriculture and the environment.

Groundwater sampling system with passive samplers measuring volatile organic compounds such as chlorinated solvents and constituents of petroleum fuels in groundwater, including sampler analysis

River Basin Management and Flood Control (RBMFC)

TWIEU, D2. Smart and sand engines (sensors that relay real-time status reports on the condition of the dike). Use of new natural materials (flexible concrete, durable grass) to bolster flood defenses

WATER DOMAIN	River Basin Management And Flood Control
CATEGORY	Integrated River Basin Management Tools (Flood Protection)
Subcategory	**Preventative Technologies**
Technology	River Basin Flooding Abatement / Urban Flooding Abatement

source: https://www.deltares.nl/en/projects/smart-dike-reinforcement-using-smooth-block-revetments

source: http://e360.yale.edu/feature/to_control_floods_the_dutch_turn_to_nature_for_inspiration/2621/)

To give nature a helping hand, Dutch researchers are working on new dike materials like flexible cement to attach energy-absorbing stones, geotextiles that prevent internal erosion — a major cause of breaches — and super-strong grass that dampens wave action. One intriguing process strengthens dikes with "bio grout" produced by bacteria fed a substance that makes them excrete calcium. So far, it only works on a small scale. The new designs provide a longer-term solution than barriers.
One new dike is protected by a widened beach and concealed beneath a pedestrian-friendly esplanade which combine ecological, recreational, and economic functions with flood control.
Devices like Smart Dikes are expensive, and haven't yet proven their worth.

Water for Energy

TWIEU, E15. Earthquake safety assessment for concrete dams foundation failure by application of integrated numerical tools

WATER DOMAIN	WATER FOR ENERGY
CATEGORY	ENERGY PRODUCTION TECHNOLOGIES
Subcategory	DECISION SUPPORT SYSTEMS (DSS)
Technology	RISK ASSESSMENT & PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS

Source: http://www.lnec.pt/barragens-betao/en/
https://drive.google.com/file/d/0Bzk4EuaNi2w5VlRQWnc2Q3l0VUE/view?usp=sharing

Earthquake safety assessment for concrete dams foundation failure involves application of the existing and the development of new integrated numerical tools to assess the safety of dam foundations in rock masses considering extreme actions, such as those imposed by high intensity seismic events.
Two major roles are anticipated for their use: assess the safety level of existing dams, in order to support decisions regarding the need for rehabilitation works; define and the major potential failure modes allowing a more effective design of new dams, and expediting the interpretation of data collected during or after the seismic events, and thus allowing an adequate support to the definition of emergency decisions.

6.4 River basin management and flood control

Flood protection has always been a high priority in China. Small and large dams, temporary flood retention areas, dykes and river spillways have the purpose to control rivers throughout China. At the same time, existing urban drainage systems in the major cities are relatively inefficient regarding capacity to cope with urban floods.

Serious challenges with urban waterlogging during intense precipitation events due especially to high urbanization rate have led to the design of a new drainage pipeline network for 1-3year rain events for general areas of the cities and 3-4 year events in key identified areas of the cities.

In an effort to avoid the huge economic, social and humanitarian damages caused by flooding, in 2013 the Chinese Central Government called for the widespread adoption of "the sponge city" approach, providing funds for pilot activities in 16 urban districts. Sponge cities are designed not only to funnel rainwater away but also to retain and reuse it to recharge depleted aquifers, irrigate parks and gardens, flush toilets and clean houses. Through enhanced infiltration, evapotranspiration and capturing methods, such as for instance replacing concrete drains with permeable green areas, water can again seep into the soil and replenish groundwater.

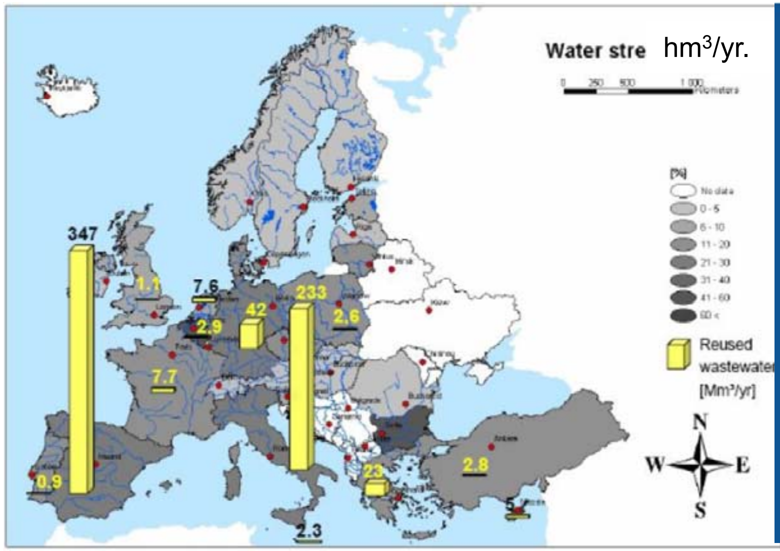
An untapped potential for water reuse in the EU

- Reused wastewater in Europe: **1 billion m³ / year** in 2006 =
  - 2.4% of the total volume of treated effluents (5-12% in Greece, Italy and Spain)
  - ~ 0.4% of annual EU freshwater withdrawals

- Achievable potential.
  → **6 billion m³ / year**
  by 2025

- A strategic option beneficial to both the environment and economy

→ Towards a more Circular Economy



Source: Hochstrat et al., 2006

Groundwater artificial recharge solutions for integrated management of watersheds and aquifer systems under extreme drought scenarios

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

João Paulo LOBO-FERREIRA, Luís OLIVEIRA and Catarina DIAMANTINO

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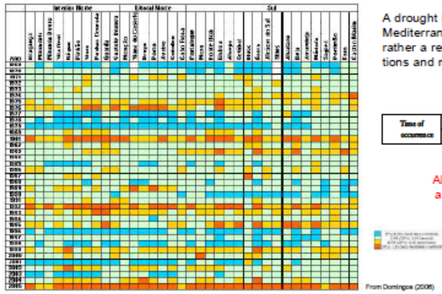
ASEM WaterNet — Multi-stakeholder Platform for ASEM Science and Technology Cooperation on Sustainable Water Use

1. INTRODUCTION The conceptual idea of Aquifer Storage and Recovery (ASR) is considered as one of the scientific based solutions towards scientific based mitigation measures to climate variability and change in many parts of the world.

In Portugal two European Union sponsored 6th Framework Programme for Research Projects have been addressing this topic: GABARDINE Project on "Groundwater Artificial Recharge Based on Alternative Sources of Water: Advanced Integrated Technologies and Management" and the Coordinated Action ASEMWATERNet, a "Multi-Stakeholder Platform for ASEM S&T Cooperation on Sustainable Water Use"

2. DROUGHTS AND WATER QUANTITY VARIABILITY



SPI- 12 index table for Portugal Mainland

A drought is a natural phenomenon in the Mediterranean region. It is not a fatality rather a recurrent situation requiring solutions and mitigation measures.

		Origin	
		Natural	Anthropogenic
Time of occurrence	Permanent	Aridity	Desertification
	Temporary	Drought	Lack of water available

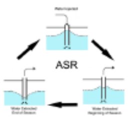
During the 2004/2005 drought in Algarve the electrical conductivity was a problem in Querença-Silves aquifer

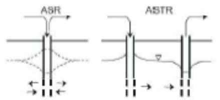
In Portugal the characterization of droughts is made since 1942 using precipitation data.

Using the SPI-12 index (*cf.* Palmer, 1965) it is possible to say that since the agricultural year (September to August) of 1943/1944 there have been five years considered as drought in most of the country, being two years extreme droughts (*cf.* Domingos, 2006).

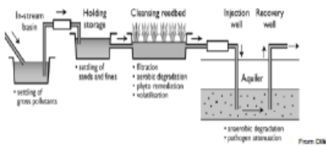
One may easily see in this SPI- 12 index table above, computed for all Portuguese mainland districts a sequence of blue lines (wet years) flowed by a sequence of red lines (dry years), that seams to become more common as time proceeds, and also more compact along the districts from North to South. Adaptation measures need to be adopted to cope with this reality.

3. AQUIFER STORAGE AND RECOVERY (ASR) AND AQUIFER STORAGE TRANSFER AND RECOVERY (ASTR)





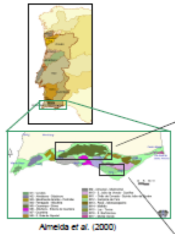
ASR is, by definition, the injection of water in a well when surplus of water is available and withdrawing it, from the same well, when the water is needed



From Dillon et al. (2006)

The advantage of using the same well is economic. The fact is that no extra wells, facilities or treatment plants (i.e. the same water treatment plant can be use to treat the water that is going to be injected and to treat the one that is pumped back) need to be constructed and therefore purchased (Dillon *et al.*, 2006).

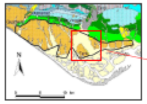
4. DESCRITION OF THE CASE-STUDIES: QUERENÇA-SILVES AQUIFER SYSTEM (ASEMWATERNET) AND CAMPINA DE FARO AQUIFER SYSTEM (GABÁRDINE)



Almeida et al. (2000)

Querença - Silves aquifer system

General Characteristics	Area	Average Productivity	Transmissivity	Annual Recharge	Storage Coefficient
Mainly Karstic; Confined to free aquifer system	318 km²	12.2 L/s	From 83 to 3000 m²/day	93 hm³	From 5*10⁻³ to 3*10⁻²



Campina de Faro aquifer system

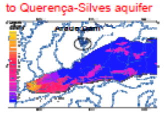
Campina de Faro study area

General Characteristics	Area	Average Productivity	Average Transmissivity	Annual Recharge	Storage Coefficient
Multilayer system - free aquifer and confined aquifer	86.4 km²	6 L/s	397 m²/day	10 hm³	1.3*10⁻⁴

5. SOLUTION FOR INTEGRATED MANAGEMENT OF WATERSHEDS AND AQUIFER SYSTEMS UNDER EXTREME DROUGHT SCENARIOS - APPLICATION TO THE QUERENÇA-SILVES AQUIFER SYSTEM

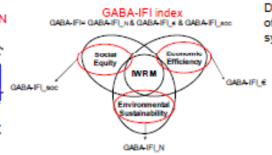
A new method called GABA-IFI was developed, aiming a preliminary identification of candidate areas for the installation of groundwater artificial recharge systems based on previous studies developed for five Portuguese Watershed Plans by Oliveira and Lobo-Ferreira (2002). This new method is described in http://www.asemwaternet.org.pt/pdf/events/GAB-IFI_eng.pdf. This index was created based on the three "pillars" of an Integrated Water Resources Management.

Application of the GABA-IFI_N to Querença-Silves aquifer



GABA-IFI index

GABA-IFI= GABA-IFI_N & GABA-IFI_ϵ & GABA-IFI_soc



During the 2004/2005 drought in Portugal the volume of withdrawal water from Querença-Silves aquifer system was of 50.29 hm³.

AND

In the hydrological year of 2000/2001 the total discharge of the Arade dam (the downstream dam of the Arade river) was of 56.75 hm³ of water (from http://snirh.inag.pt).

This "not used or lost" water could have been used for the artificial recharge of Querença-Silves aquifer.

REFERENCES

-Almeida, C.; Mendonça, J.L.; Jesus, M.R.; Gomes, A.J. (2000) - *"Sistemas Aquíferos de Portugal Continental"*. Relatório. INAG, Instituto da Água. Lisbon. Electr. Doc., CD-ROM

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-Lobo-ferreira, J.P. and Oliveira, L. G. S (2007)- *"Aquifer Storage and Recovery and applicability to Algarve (Portugal)"*, Paper presented at XXXV Congress of the International Association of Hidrogeologists, Lisbon.

-Mota, R.; Monteiro dos Santos, F.; Diamantino, C. e Lobo Ferreira, J.P. (2008) - *"Evolução temporal da resistividade eléctrica aplicada a estudos ambientais e hidrogeológicos"*. XI Congresso Nacional de Geotecnia. 7-11, April 2008, Coimbra, 10 pp.

-Oliveira, L. G. S. (2007) - *"Soluções para uma gestão adequada de bacias hidrográficas e de sistemas aquíferos, em cenários de escassez hídrica extrema"*, Thesis submitted for the Degree of Master, Instituto Superior Técnico, Lisbon.

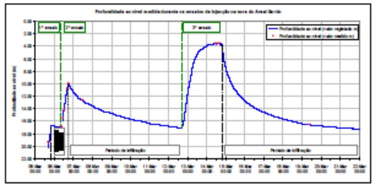
6. THE ARTIFICIAL RECHARGE EXPERIMENTS CARRIED OUT IN THE CAMPINA DE FARO AQUIFER SYSTEM

Multiple artificial recharge experiments were accomplished in the Portuguese case study area during the GABARDINE project. The purpose of the experiments was to assess and quantify the effectiveness and applicability of the different groundwater artificial recharge methodologies

6.1) Artificial recharge using a large diameter well

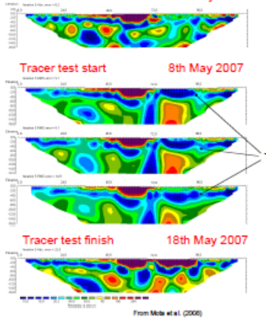
Large diameter well (5 meters) "Nora"

- 3 injections tests (4h, 7h and 50 h)
- constant discharge (20m³/h)

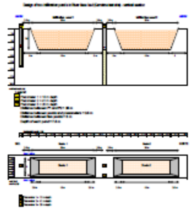


6.2) Artificial recharge tests in infiltration basins using NaCl tracer

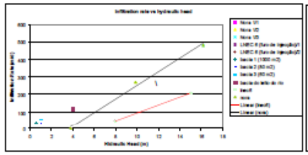
Electric resistivity models obtained before, during and after the tracer test at the infiltration basin in Rio Seco, Carreiros (Mota et al., 2008)



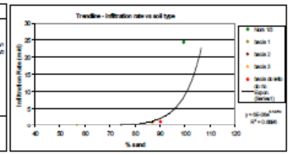
From Mota et al. (2008)



The experiments carried out allow extrapolating artificial recharge for other possible conditions

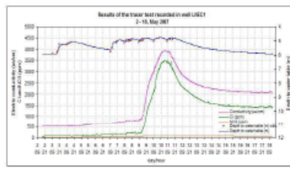


Correlation infiltration rates vs soil types

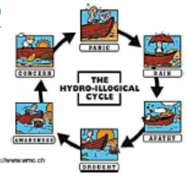


Correlation infiltration rates vs hydraulic head

These two graphics exibit the parametres to be considered for artificial recharge.



Results of the tracer test



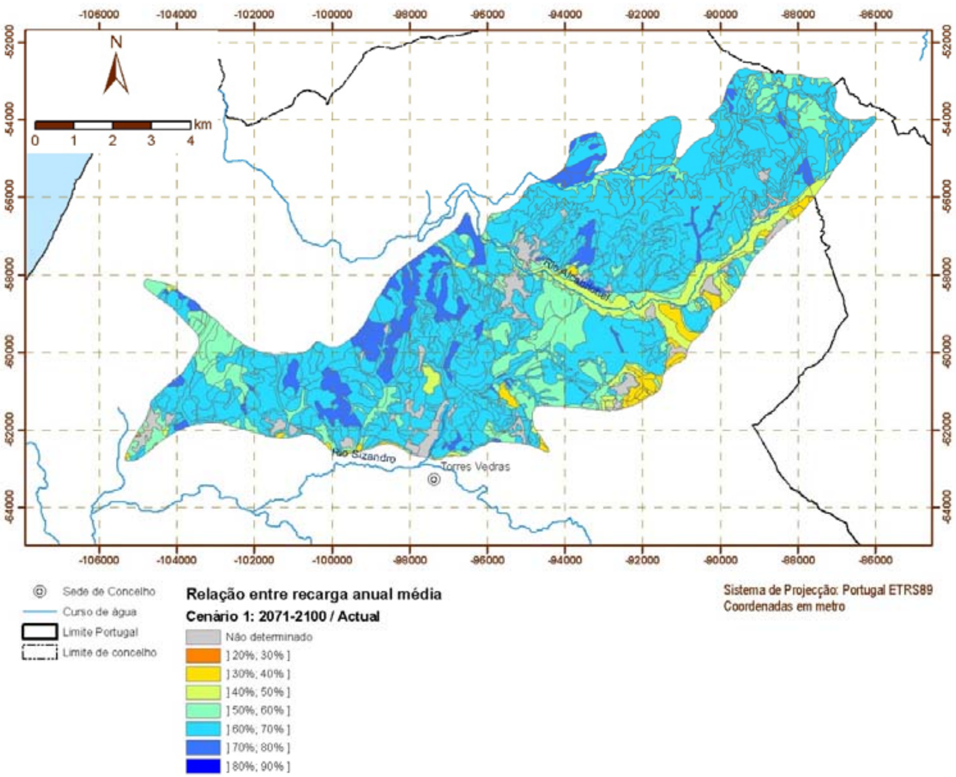
From http://www.wmo.ch

With this proposal the authors believe that the effects of the illogical cycle can be minimized

7. CONCLUSION As main conclusion, we may state that artificial recharge may be seen as one good solution aiming a scientific based adaptation to climate change or climate variability conditions in the near future. This technology allows the use of surplus water in wet years or so that extra supply water may be available later in dries years

The authors do acknowledge the support of the European Commission for ASEMWATERNET (http://www.dha.lnec.pt/nas/pdf/ASEMWATERNet_Project_Summary_en.pdf) and 6th European Union Framework Programme Project GABARDINE—"Groundwater artificial recharge based on alternative sources of water: advanced integrated technologies and management" (http://www.gabardine-fp6.org/).

5. DIAGNOSIS: IMPLICATIONS OF CLIMATE CHANGE FOR GROUNDWATER RECHARGE



Torres Vedras groundwater body

“River basin management and flood control”

4.1. Preliminary selection of sub-thematic areas

LNEC considered relevant for analysis the following ten sub-thematic areas:

1. research on flash flood forecasting and early warning based on enhanced precipitation flow models
2. landscape-scale sediment management and control / Loess plateau watershed rehabilitation project
3. prediction and management of drought and water scarcity situations and environmental impacts on wetlands / ecological restoration / rebuilding natural capital
4. climate change impact assessment on China water resources /water scarcity, drought indicators, forecasting and contingency planning
5. technologies for efficient distribution and higher water use efficiency
6. ecological minimum flow and migration of fish population
7. exchange of experiences on the implementation of measures preventing pollution
8. trans-boundary water management and related challenges in the field of pollution prevention, operation of early-warning systems, abstraction management and conflict management
9. management of groundwater, including groundwater monitoring and trends´ analysis in urban and agricultural areas / North China Plain aquifer at Risk Due to Groundwater Depletion
10. groundwater allocation arrangements to adequately regulate groundwater quantity and use / development of non-conventional water resources including managed aquifer recharge

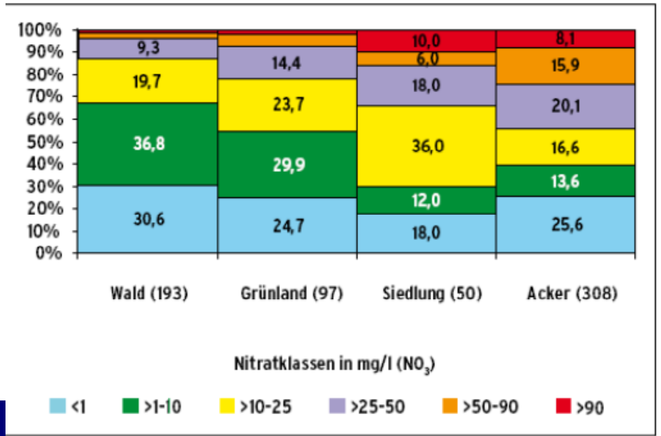
Preliminary selection of sub-thematic areas “Water for Energy”

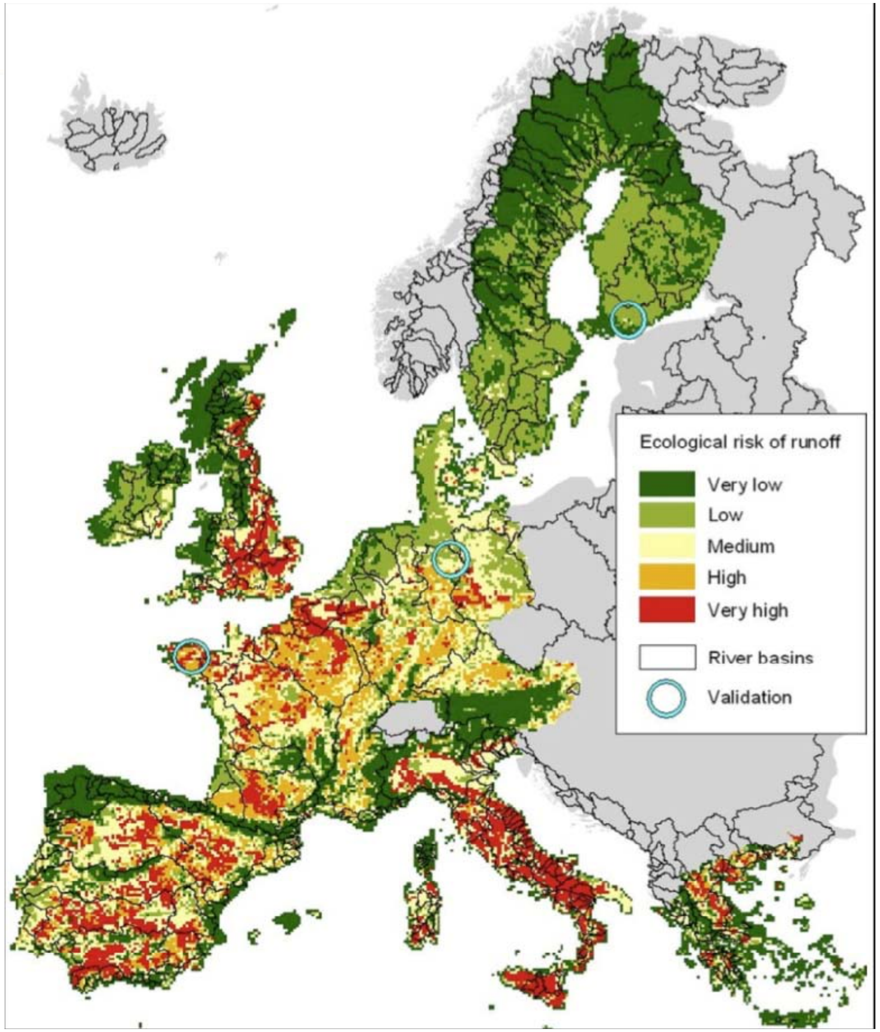
Primarily focus on the direct use of water in the energy production sector, where priority is on the promotion of renewable energy sources. This includes tools to predict and map resource flows and assessing trade-offs between resource uses, and small scale hydropower technologies including their development, electricity efficiency, optimisation of hydropower generation, including retrofitting of small-scale schemes, construction of fish bypass facilities, maintenance of ecological flows and other mitigation measures to reduce adverse impacts to the riverine environment.

Based on initial delimitation of domain for TWIs of Task 1e categories, on EDP/Labelec framework suggestions and also on other suggestions, e.g. http://www.small-hydro.com/Programs/innovative-technologies.aspx the six categories selected for Task 1e TWIs are the following:

1. Energy production technologies (Electrical & Mechanical Equipment)
2. Water management technologies (Operation & Maintenance)
3. Mitigation measures (Environment)
4. Safety and efficiency of the existing dams and reservoirs
5. Construction
6. New production technologies

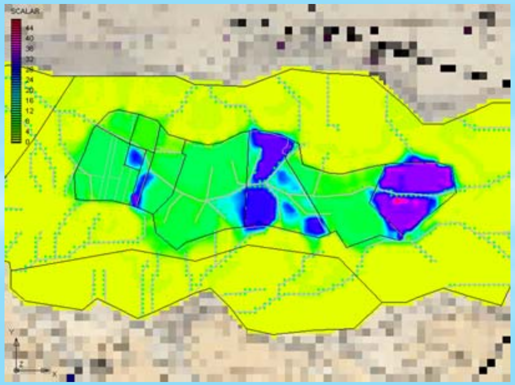
Beyond the water sector: Agriculture





Vadose zone monitoring and modelling

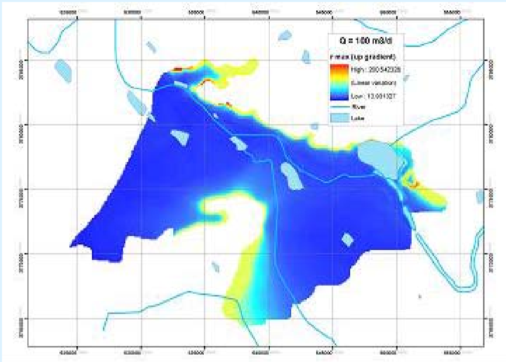
Groundwater quality modelling



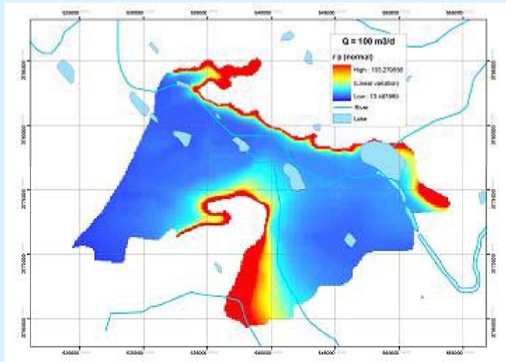
Runoff and groundwater return flow to rivers

Geographical groundwater protection zoning

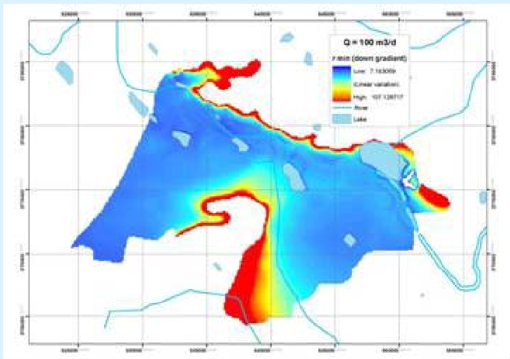
Results achieved with the application of Krijgsman and Lobo Ferreira methodology to calculate <u>intermediate protection zone</u> for the porous and unconfined aquifer of Zhangji case study area (Q = 100 m^3/day)



Upgradient protection distance (m)



Protection distance perpendicular to flow direction (m)



Downgradient protection distance (m)

NAS

WATER DOMAIN	WATER FOR ENERGY
WATER CHALLENGE	RETROFITTING OF EXISTING SMALL SCALE HYDROPOWER SCHEMES
TYPE OF TWI	TURBINES AND COMPONENTS
TECHNOLOGY	TWIEU, E6. Small turbines to be retrofitted e.g. intake towers, unused ship locks, canal weirs and navigation and irrigation dams
CATEGORY	ENERGY PRODUCTION TECHNOLOGIES: SMALLSCALE HYDROPOWER
DESCRIPTION	Use at existing structures HYDROMATRIX® technology enables customers to tap into the unused hydropower potential of intake towers, unused ship locks, canal weirs and navigation and irrigation dams by using these existing structures as a profitable and renewable energy resource. Flexibility in arranging the small TG-units and associated electromechanical equipment allows integration of HYDROMATRIX® plants in existing structures that fulfil the basic application criteria. High profitability HYDROMATRIX® turbines can operate with only minimal tailrace submergence. Deep excavation and other costly civil work can be avoided, thus leading to significant cost savings. State-of-the-art hydraulic runner design and generator technology guarantee highest possible energy generation through high levels of hydraulic and electrical efficiency. In 2010 ANDRITZ HYDRO received the Austrian State Prize for Environmental and Energy Technology for its HYDROMATRIX® concept .

source
http://www.small-hydro.com/Programs/innovative-technologies.aspx
http://www.andritz.com/hy-hydromatrix-en.pdf

Challenge 1 - Water scarcity	
Irrigation technologies and irrigation management: DSS and modelling for water resources assessment	RIA & IA
Water reuse: new technologies (e.g. cascading systems); Safe reuse of treated wastewater reuse	IA
Efficiency of water use; Groundwater efficiency in irrigated agriculture	IA
Water reuse in irrigated agriculture	RIA & IA
Solutions for sustainable use of water resources in bio-economy sector	RIA
Challenge 2 - Water pollution	
Nutrients and pesticide technologies management; Technologies for pollution remediation - manure separation; manure treatment technologies	RIA & IA
Water-related soil degradation technologies (salinity, erosion, degradation, clogging, oxidation)	RIA & IA
Technology for pollution monitoring;	RIA & IA
Precision farming technologies (incl. manure treatment technologies)	IA
DSS and related technologies	RIA & IA
Challenge 3 - Extreme events: floods and droughts	
On-line monitoring and forecasting of floods and droughts;	RIA
Early warning system, forecasting of extreme events; floods control; DSS	RIA
Remediation technologies	RIA & IA

*(*) **IA**: Innovation Action. **RIA**: Research and Innovation Action. (See definition Cap. 5)*

(**) The icons are referred to the "Sustainable Development Goals", also known as "Global Goals" identified by UNDP as universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The chosen icons are considered to be relevant to the actions listed in the domain.

Research and Innovation actions	Type of actions (*)	SDGs Goals (**)
Challenge 1 - Water scarcity		
Optimization of water uses and water saving; water balance modelling systems	IA	
Monitoring system to assess GW abstraction and recharge; Managed Aquifer Recharge Technologies	RIA & IA	
Freshwater bodies classification and matching alert system; Freshwater overexploitation	IA	
Research at catchment scale: assessment method of available water resources	RIA	
Challenge 2 - Water pollution		
Technologies for contaminated areas remediation	RIA & IA	
Survey the state of degraded water resources systems; Studying and modelling the transfer of contaminants	RIA	
Data integration technologies - hydrological parameters, pollution loads, water quality	RIA	

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Challenge 3 - Extreme events: floods and droughts	
Technologies for seasonal forecasting (Drought) and climate models for evaluation of uncertainty	RIA & IA
New remote sensing technologies (satellite, Doppler radar, wireless sensors etc.)	RIA & IA
Integrated modelling across SW and GW, coastal and fluvial systems, water and sediment transport	RIA & IA
Risk Based decision making and planning tools	RIA & IA
Develop tools and new technologies for adaptation to floods and droughts - Early Warning Systems	RIA
Water management methods and technologies: modelling technologies; Space-based technology (SBT);	RIA & IA
Challenge 4 -Ecosystem degradation	
DSS for system restoration, covering physical, ecological, social and economic benefits and costs	RIA
Research on pressure-impact-response relationships	RIA
Develop new Water Management schemes - policy, regulations, monetary model, governance	RIA & IA
Ecological engineering and Ecohydrology: research on restoration methodologies of aquatic systems	RIA & IA
Research on ecological flows	RIA
Nature Based Solutions: Use of new natural materials	RIA & IA
Integrated river basin management tools: Bio-inspired dams for ecosystem degradation	RIA & IA

Source: http://www.lnec.pt/barragens-betao/en/
https://drive.google.com/file/d/0Bzk4EuaNUsx5Vl9QWnc2Q3BSVUE/view?usp=sharing

WATER DOMAIN	WATER FOR ENERGY
WATER CHALLENGE	RISK ASSESSMENT & PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS
TYPE OF TWI	DECISION SUPPORT SYSTEMS (DSS)
TECHNOLOGY	TWIEU, E15. Earthquake safety assessment for concrete dams foundation failure by application of integrated numerical tools
CATEGORY	ENERGY PRODUCTION TECHNOLOGIES
DESCRIPTION	Earthquake safety assessment for concrete dams foundation failure involves application of the existing and the development of new integrated numerical tools to assess the safety of dam foundations in rock masses considering extreme actions, such as those imposed by high intensity seismic events. Two major roles are anticipated for their use: assess the safety level of existing dams, in order to support decisions regarding the need for rehabilitation works; define and the major potential failure modes allowing a more effective design of new dams, and expediting the interpretation of data collected during or after the seismic events, and thus allowing an adequate support to the definition of emergency decisions.

Simon Spooner

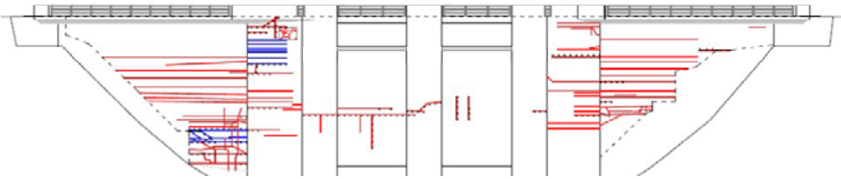
July 2014

Report prepared for CEWP Business opportunities Pillar with support from EU SME Centre.

Dams, dykes and flood safety

China has more than 87,000 large and small scale reservoirs. About 22,000 of these are above 15 m high and so defined as large dams. Many of China's dams were built of compacted earth by mass people's movements from the 1950's to the late 1970's with little skilled engineering supervision and are expected to have a maximum lifetime of about 50 years13. Thus it has been estimated that more than 50% of the dams built in this period pose significant risks and require remedial work14. More than RMB 60 billion was spent during the 11th Five Year Plan period on dam remediation and investment in this is expected to increase sharply in 12th FYP to 2015 as a target of making all dams safe by 2015 has been set.

This opens the opportunity for dam risk assessment and monitoring systems and novel technologies and methods for dam rehabilitation. The first contact for such projects could be the MWR International Cooperation Department or the Institute of Water Resources and Hydropower Research (IWHR). Actual engineering or construction work would be difficult for European firms to secure, but services and technologies could be supplied in partnership with Chinese contractors.



Challenge 1 - Water scarcity		
Improve industrial water reuse through water reuse technologies	RIA & IA	
Water-energy nexus: energy is needed for water supply and water is crucial in power production.	RIA & IA	7 AFFORDABLE AND CLEAN ENERGY; 8 DECENT WORK AND ECONOMIC GROWTH; 11 SUSTAINABLE CITIES AND COMMUNITIES

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6. Contribution of TWI to meet Chinese Water Challenges:
   With the development of the Chinese economy happening so fast, the demand for energy and renewable sources keeps increasing as well, resulting in the construction of hydropower dams at an astounding rate. In China there are over 900 species of freshwater fish and, despite fish passages being placed on these dams, their designs is not always the best, nor do the infrastructures allow for the high efficiency of those passages.
   This product can prove to be an important tool to increase the efficiency of those passages, either by guiding fish to them or avoiding that fish swim to unwanted areas.

In collaboration with PIANO partners

P.I.A.N.O. Policies, Innovation And Network for enhancing Opportunities for China-Europe water cooperation

Technical University of Denmark

ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale

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EUROPEAN WATER ASSOCIATION

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ATKINS

and

CHINA EUROPE Water Platform

Proposal of a shared Strategic Research and Innovation Agendas | SRIA

WP4 Task 4b - 4c

Thank you, Obrigado, Grazie!

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