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# Collection of international expertise projects at INRAE

July 2021

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July 2021

**In September 2018 and July 2019, some 30 INRAE experts shared their fieldwork during seminars dedicated to international expertise projects. All of these projects are presented in this brochure.**

Brochure prepared by Almerinda Pinto and José Martinez from the Directorate of Support for Public Policies (DAPP).

Cover photo: © voran - stock.adobe.com

# Collection of international expertise projects at INRAE

This document presents over 30 international expertise projects carried out by INRAE expert scientists.

The information allowing this publication was collected by the Directorate of Support for Public Policies, one of the two directorates of the Deputy-Directorate-General of Expertise and Support for Public Policies (DGD EAPP). It is the result of: (i) a survey on the different types of expertise (survey carried out in 2019), (ii) feedback from groups of expert scientists in response to this survey, and (iii) a presentation of these projects during two consecutive seminars (September 2018 and July 2019).

All the presentations contained in this collection of projects have been reviewed and validated by their expert authors. They are mainly short presentations displaying what this type of activity is about and how it is linked to scientific research activity.

The interested reader will find references and full reports on the subject that can be consulted for further information.

Through this collection, one discovers a large number of areas of action and involvement in more than 25 countries in Europe, Africa, Latin America, North America and Asia, as well as a large number of sponsors and partners of these activities, including the World Bank, the FAO, the UN (UNDAC-OCHA), the UNDP, the AFD (French Development Agency), the FFEM (French Facility for Global Environment), the European Commission, as well as numerous national and international private engineering consultants. It reveals a high level of expertise that is perfectly in line with the scientific excellence and academic recognition of the institution's teams that have responded to these requests for expertise. The topics covered by these projects are also very diverse: risks (design and safety of structures), sustainable food systems, value chains, ecological engineering and management of riverbanks, the quality of aquatic environments, the evolution of fish populations, irrigation policies and water governance, agricultural equipment, satellite imagery and space hydrology as well as sanitation (processes and participatory planning).

This compilation constitutes a first volume in testimony of this activity, it will be updated in the course of time as the projects in progress unfold.

We hope you enjoy reading it.

**José Martinez**
Research Director
Responsible for international expertise development at the Directorate of Support for Public Policies (DAPP)

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# Improving the estimates of agricultural land wealth

**BONTEMS Philippe**
TSE-R, Toulouse

**Europe and International**
2015

**Réf:**
Bontems Philippe & Ay Jean-Sauveur & Chakir Raja & Latruffe Laure, 2015. "Improving the estimates of agricultural land valuation: report to the World Bank," Working Papers hal-01462707, HAL.

The World Bank provides an assessment of a country's economic performance based on gross domestic product (GDP) and wealth, the latter including manufactured capital, natural capital, human capital and social capital. For the valuation of agricultural land, the basic approach is to use information from land sales. This has been widely used in the US in particular. This approach will be left aside, as land markets and reliable data on land prices are lacking in many countries of the world.

The approach we propose could be compared to an approach based on land prices in some case studies where such data is available.

The purpose of land valuation is ambiguous because of the necessary distinction between private and social values. It is acknowledged that land resources produce certain social values that are covered neither by national accounting nor by the methodology described in the mandate. It is not clear whether they should be included in estimates of land wealth. Since estimating social values is difficult, we focus on private values while offering occasional perspectives on the integration of social values.

In particular, we investigate how to better estimate land returns growth rates and how to include uncertainty. We also examine how to review the rental rates parameters used in the net present value of land. Finally, we suggest ways to include climate change and land degradation impacts.

Recommendations by Philippe Bontems: "In the short term, modify the World Bank methodology by including our suggestions on rental rates as well as conducting a sensitivity analysis on prices. In the medium term, the specifications concerning the growth rates of future land returns could be modified after some econometric analysis. Similarly, one can imagine the inclusion of uncertainty and an infinite time horizon in all wealth components in the general World Bank methodology.

In the longer term, further research and reflection are needed on the inclusion of the impacts of land degradation and climate change."

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World Bank

# ANTAM Project:
## Asian and Pacific Network for testing of agricultural machinery

**DOUZALS Jean-Paul**
ITAP, Montpellier

**Thailand**
2015-2018

**Réf:**
ANTAM Standard Code for Testing of Powered Knapsack Misters-Cum-Dusters, 2018

The diffusion of agricultural mechanization, especially in less developed countries, involves various sub-sectors (farmers' access to capital, infrastructure development, manufacturing capacity and import regulations).

To address this complex set of interrelated issues, governments play a crucial role in the timely and cost-effective implementation of regulations that help stakeholders overcome barriers to the diffusion of mechanized agriculture. For the Asia-Pacific region, this project is under the responsibility of CSAM-ESCAP, the Beijing-based regional center for sustainable agricultural mechanization of the UN ESCAP platform.

France is one of the 62 members for the Asia-Pacific region and is one of the 26 signatory countries of the ANTAM project.

The certification of agricultural machinery is undoubtedly one of the most effective public interventions contributing to the CSAM-ESCAP project, under the responsibility of the ANTAM network of national testing stations.

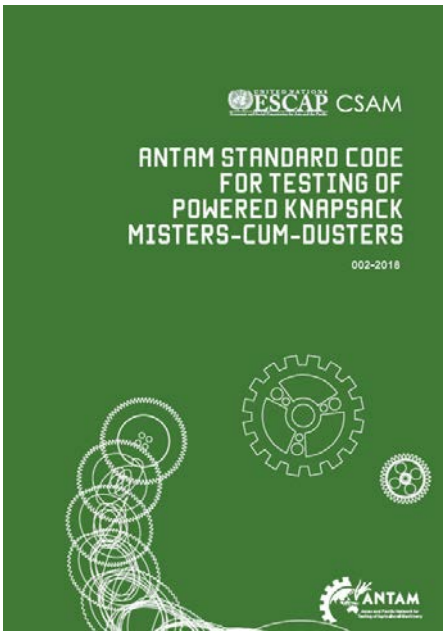
Within this context and further to the request of the French Embassy in Bangkok that was transmitted to the French Ministry of Agriculture, Jean-Paul Douzals was proposed as an expert to:

- represent France on the committee (national contact point) - and participate in the annual meeting;
- contribute to the drafting of a test protocol for machines with a backpack power unit - with periodic updates (standardization, norms);
- contribute to training activities on the implementation of the test protocol in 2016 (1 week), in Malaysia and in 2017 (2 weeks), Nanjing station - China.

With the aim of harmonizing test standards for the safe, efficient and environmentally sound use of agricultural machinery in support of the SDGs, "ANTAM Standard Codes" have been drafted.

The first draft editions have already been reviewed since 2015.

UN - CSAM - ESCAP

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# ISO and EN standards

**DOUZALS Jean-Paul**
ITAP, Montpellier

**Europe and International**
2015-2020

**Réf:**
ISO/TC 23/SC 6 Standard - Equipment for crop protection

Jean-Paul Douzals contributes to the development of various ISO (international) and EN (European) standards, with over the last 5 years, 20 standards published within the ISO TC 23SC6 group with regard to spraying.

He also participates in 6 pre-normative working groups for the development and validation of methods.

International Organization for Standardization, CENELEC / ETSI


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IN THIS SECTION



# Exploring Sustainable Food Systems:

## Reflections on participatory research and expertise at the United Nations

**LOCONTO Allison**
LISIS, Champs-sur-Marne

**Africa, Latin America and India**
2013-2019

**Réf:**
FAO/INRA. 2015. Innovative Approaches to Linking Sustainable and Agroecological Production with Markets in Developping Countries
FAO. *2017. Comment les marchés encouragent l'adoption de l'agriculture durable.*
FAO/INRA. 2016. Innovative Markets sor Sustainable Agriculture
FAO/INRA. 2018. Constructing markets for agroecology FAO/INRAE. 2020. *Systèmes alimentaires durables : un manuel pour s'y retrouver.*
Video: Interview "*Innover pour une alimentation durable*"

This study aimed to understand institutional innovations, like how institutions and stakeholders adapt and change their rules in local food systems. The main findings were:

i. incentives to adopt sustainable practices stem from the autonomy generated by the innovative rules set up by local actors to interact in the market based on reciprocity and knowledge exchange;
ii. in order to adapt their practices and create new markets, local actors rely on social values: reliability, health, food sovereignty, youth mobilisation, employment;
iii. farmers, consumers, cooperatives, companies, civil servants and NGOs, among others, innovate through their combined efforts to review their rules. Sustainability standards require the cooperation of producers in improving their practices in terms of; securing access to an expanded market, methods for maintaining contact and monitoring rule changes.

Since 2016, the research activity has shifted to a research-action approach involving researcher-stakeholder workshops and the co-production of a handbook to catalyse innovations in sustainable food systems. The direct experiences of the researchers and stakeholders has led to a systematic analysis of more than 80 innovations operating in over 25 countries. The barriers and levers to innovation were documented and organised in a text covering 12 areas fundamental to food systems (e.g., inputs, consumers, financing, guarantees and formalisation of initiatives). This handbook was tested in Senegal and India by grassroots movements and a prospective scenario was developed to facilitate the reading and use of the handbook.

Since its inception in 2013, this project has generated 4 FAO/INRAE co-publications.

In addition, the "One Planet" network was officially launched in October 2015 and comprises over 190 partners worldwide. Created in 2012, based on the work of the FAO-UNEP "Sustainable Food Systems" programme, to develop the SDG 12, headed by the Ministry of Agriculture and Livestock of Costa Rica, the Swiss Federal Office for Agriculture and the WWF. This network is supported by a multi-stakeholder advisory group of 19 partners with 4 themes: (1) awareness raising, (2) enabling environment, (3) knowledge/information and tools, and (4) synergies. Three members of INRAE were responsible for theme (3), to understand and measure the sustainability of food systems through the creation of a database to provide a global view of these issues thus allowing members to be aware of existing tools.

Two international conferences have already been held on this topic.

Handbooks were also drafted based on the topics that participants wanted to work on and/or for which they were looking for advice from different experts (e.g. the "Collaborative Framework for Food Systems Transformation" produced by UN Environment and the


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initiative on reducing the use of plastics in food chains carried out for the WWF).

Among other outputs, several booklets (Participatory Guarantee System) and Bhoomi Ka videos "India for Eco Food" based on 4 challenges, have been published, generating a wealth of ideas and various tools.

The next "Global Conference sustainable food systems" planned for November 2020 and organised by the Thai government, will result in a glossary leading to reflections on the balance between research and expertise: for example, difficulties, dissemination and co-construction of knowledge.

Working with international organizations such as the FAO is a unique experience that allows researchers to develop programmes and policies, but also to build a network and communicate with citizens. Some aspects to keep in mind are the administrative tasks, the difficulties in meeting managers' expectations or working independently. Low wages could also hinder progress.

FAO : #AGP / ESN / SLM

## Methodological support for the analysis and development of inclusive and sustainable value chains

**MACOMBE Catherine**
ITAP, Montpellier

**Various**
2016

**Réf:**
Project: ISS-FANSSA Request BX-11

The European Commission has local delegations in most developing countries. One of the roles of these delegations is to assess the merits of development projects submitted to them by both public and private actors. If the project is judged favourably, the delegation will support it. A large proportion of these projects concern the creation, restructuring or expansion of the agricultural (food and non-food) and agri-food sectors. Until now, the delegations have followed an agreed protocol for assessing projects, but this has few criteria and does not provide sufficient insight into the projects submitted.

As a result, the Brussels Delegation managers within the European Commission's DG DEVCO (Directorate-General for International Cooperation and Development) decided in 2015 to set up and test new evaluation methods for the economic, environmental and social aspects of the projects submitted.

In this context, 3 researchers from CIRAD (the French agricultural research and international cooperation organization), a researcher from INRAE (Irstea at the time) and a professor from a Belgian university, were called upon and mandated.

C. Macombe worked in partnership with D. Lœillet from CIRAD, to carry out two tasks: an inventory and a diagnosis of existing methods for evaluating the social impacts generated by projects in the agricultural and agri-food sectors, and the proposal of new social evaluation methods applicable in the delegations.

Following the completion of the diagnoses and proposals, DG DEVCO set up a consortium of experts (almost 50 from CIRAD, the others belonging to several European universities) in 2016 to carry out case studies in the Global South, applying new economic, environmental and social evaluation methods. Since 2016, more than 30 case studies have already been carried out. The programme has been renewed in 2019 and will continue in the coming years.

EU DG DEVCO, Landell Mills


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# BTSF training: equipment for plant protection products
## (Better Training for Safer Food)

**DOUZALS Jean-Paul**
ITAP, Montpellier

**Europe**
2015 & 2019-2020

**Réf:**
European Union Sanitary and phytosanitary requirements BTSF Academy, trainings

Participation in training courses financed by the European Commission BTSF (Better Training for Safer Food) on the control and calibration of plant protection equipment: 3 courses per year since 2015.

The aim is to introduce participants to the control and adjustment of spraying equipment, but also to address issues of operator protection and new technologies.

The target audience is staff from EU (and some non-EU) Ministries of Agriculture and staff from environmental agencies.

The operation was repeated in 2019-2020 with 250 people trained to date.

European Commission


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# Biodiversity & Bioengineering

IN THIS SECTION



## Tarpaulin techniques for knotweed control


**ÉVETTE André**
LESSEM, Grenoble


**Luxembourg**
2017-2021

André Évette and Vincent Breton conducted a study in order to test Dupont™ geosynthetic tarpaulins to control knotweed as part of the multi-year agreement with SNCF *Réseau* and DuPont™.

Various experiments are being conducted on a site in Chalon-sur-Saône.

The mission, partly carried out in Luxembourg with a visit to the factory, has allowed them to learn more about DuPont™ products and to advance the experimentation programme. A technical railway day on Japanese knotweed was organised on 18 June 2019 jointly by the 3 partners.

SNCF *Réseau* is fully financing the studies conducted at its request.

SNCF Réseau – DuPont™

**Réf:**
SET n°27. 2019. *Les techniques de bâchage pour le contrôle de la renouée. pages 62-67*
Video: Interview André Évette, river bank restoration

©A. Petit (SNCF Réseau)

## Riverbank restoration, civil and bioengineering, invasive species


**ÉVETTE André**
LESSEM, Grenoble


**Canada**
2017-2021

This survey for Kerr Wood Leidal (KWL) took place in Calgary, Alberta.

It began in 2017 and is expected to be completed in 2021. The City of Calgary is committed to the conservation, protection and restoration of its natural areas. At the confluence of two major rivers, the riverbank ecosystems are heavily impacted by the complex interactions between natural environments and urbanisation. The Riparian Action Program (RAP) has been established and one of the key actions is to integrate bioengineering techniques into riverbank restoration.

In this context, André Évette was involved in the "Bank Bioengineering Assessment Effectiveness Monitoring" valuation project, and after analysing the results, the experts made recommendations, including:

- improving project documentation and data recording, to be shared with the RAP team. Indeed, projects cannot be supervised within the framework of the RMP (Riparian Monitoring Program) without a shared understanding of the objectives, implementation and maintenance;
- applying a soil amendment to the cuttings. This action was shown to statistically improve growth (more cuttings survived).

**Réf:**
The Riparian Action Program: A blueprint for resilience, 2014
Video: Interview André Évette, river bank restoration

Kerr Wood Leidal

© City of Calgary

The benefits of this expertise will be:
• a large international dataset on bioengineering for riverbank protection that can be highlighted in scientific articles;
• a vast professional network in Quebec and Alberta involving public administrations, researchers and engineering firms;
• numerous cross-disciplinary exchanges with various scientists.

## France ✦ Quebec: development and optimization of riverbank protection techniques

**ÉVETTE André**
LESSEM, Grenoble

**Canada**
2017-2019

**Réf:**
Video: Collaboration France-Québec : pour un partage des connaissances sur le génie végétal 2017/2019
SET hors-série n° 57. 2019. *Le génie végétal pour la protection des berges de cours d'eau au Québec : état des lieux et perspectives pour les Basses-terres du Saint- Laurent.*
Video: Interview André Évette, river bank restoration

Laval University / Ministry of Transportation of Quebec

This expertise was conducted for the University of Laval and the Ministry of Transportation of Quebec (MTQ).

Since 2015, the INRAE unit LESSEM in Grenoble and the University of Laval have been working on the development and transfer of knowledge on bioengineering and riverbank restoration between France and Quebec, with the aim of improving know-how in ecological engineering.

The programme supported by the *Commission permanente de coopération franco-québécoise* includes an assessment of the biodiversity of landscaped riverbanks and the implementation of pilot projects, experiments and technical workshops in both countries.

Quebec faces severe constraints such as landslides related to sensitive clays which are a major issue requiring monitoring.

The experts worked with both institutions to develop techniques for managing these risks. André Évette contributed to the drafting and monitoring of the research project in addition to the scientific and technical expertise.

© André Evette

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# Sturgeon: restoration and farming in the context of global warming

**CHÈVRE Patrick**
EABX, Bordeaux

Various

**Réf:**
Video of the unit: *Pour la conservation et la restauration de l'esturgeon européen* IDEE/Irstea. 2019. *Restructuration de la pisciculture d'esturgeons de Yenikend (Azerbaïdjan) : Étude de faisabilité*

IDEE, SRL Consulting and Total CSR

INRAE has been an institutional member of the World Sturgeon Conservation Society (WSCS) involved in the conservation of the European sturgeon for more than 30 years.

Given the declining stocks, a few specimens of *A. Sturio* were captured in an attempt to reproduce their life cycle. The first experimental phase was the adaptation of the fish to captivity at the Saint-Seurin-sur-l'Isle station. Artificial reproduction and juvenile rearing were subsequently developed. The team also devised *in vitro* ovulation of sturgeon oocytes. This technique provides an indication of the quality of the oocyte and allows the *in vitro* production of larvæ.

Result: Although in the 1980s *A. Sturio* was no longer observed in its natural habitat, today its population is being restored in the Gironde estuary. Fish, originally from restocking, have been caught along the Atlantic coast from Spain to the North Sea. From a commercial point of view, Aquitaine's caviar producers are now ranked 4th worldwide.

As INRAE has demonstrated its experience in the artificial reproduction, restocking and conservation of sturgeon, the institute is often called upon by breeders and academic bodies, including internationally. Patrick Chèvre has participated in various expert projects, including:

- conservation and training projects; Azerbaijan; Total E&P Absheron in Baku;
- alternative breeding project (control of maturation and reproduction) in France: Biofry (Huso farm).

These projects have shown that the effects of global warming on stocks and breeding (like poor maturation quality and new pathologies) can be reduced by using species that are more resistant to high temperatures and adapted methods (use of closed circuits), or even through the relocation of key activities.

The primary goals have been achieved, including:

- a substantial increase in both wild and commercial stocks;
- a variety of efficient farming practices and methods;
- data sets;
- public and private partnerships;
- education and training actions;
- scientific actions.

In terms of education, two major training campaigns on sturgeon farming have been conducted in Azerbaijan and Georgia.

In April 2018, Patrick Chèvre, an expert in sturgeon conservation biology/zootechnics carried out an expertise assignment in coordination with Total and the French consultancy IDEE retained for the study financed through Total's CSR policy. The project,

© Christophe Maître, INRAE

located in the Yenikend region, aims to create a sturgeon breeding training center with a component for the preservation of endangered species in the Caspian Sea.

In March 2019, Éric Rochard also carried out an environmental assessment mission on the Rioni River in Georgia at the request of the international consultancy SLR. It should be noted that he was contacted following the work carried out in September 2017 by Hervé Capra (INRAE Lyon) for SLR on the hydropeaking of a large hydroelectric dam upstream.

## PACTE: Programme d'adaptation au changement climatique des TErritoires ruraux de Tunisie (Programme of adaptation to climate change in vulnerable territories in Tunisia)

**MORARDET Sylvie**
G-EAU, Montpellier

**Tunisia**
2018-2021

Cirad (AFD)

The Directorate General of Agricultural Land Development & Conservation (DG ACTA) of the Tunisian Ministry of Agriculture, Water Resources and Fisheries (MARHP), and the French agricultural research and international cooperation organization (CIRAD), signed on 29 May 2018 a special partnership agreement for the implementation of the Programme of adaptation to climate change in vulnerable territories (PACTE).

INRAE and CIRAD act together under the UMR convention governing the operation of the UMR G-EAU, of which they have joint supervision.

As part of the technical assistance to the PACTE programme ("PACTE-Platforms Proposal"), CIRAD and INRAE agreed that INRAE would be involved in the coordination and implementation of the concerted planning and monitoring-evaluation activities and the associated training modules, as well as in the support of the implementation of all the activities in two of the PACTE intervention areas.

INRAE is involved in the coordination and steering of the project through Sylvie Morardet, who is in charge of component n° 3 "Concerted planning and impact monitoring and evaluation". As part of this project, Sylvie Morardet carried out a two-year mission in Tunisia. The COOPLAGE[1] team is also involved in the co-design activities of the concerted planning sequence, the associated training and implementation, the procedural monitoring and evaluation activities, and in the overall evaluation of PACTE.

The PACTE programme, centring on 5 Tunisian governorates (Bizerte, Kairouan, Le Kef, Sidi Bouzid and Siliana), aims to strengthen adaptation to climate change in rural areas.

It is funded by the AFD with € 51.5 million and by the French Facility for Global Environment (FFEM) with € 2 million.

1 COOPLAGE is an integrated suite of tools and stands for « Coupler des Outils Ouverts et Participatifs pour Laisser les Acteurs s'adapter pour la Gestion de l'Environnement » (coupling open and participatory tools to let actors adapt for environment management).

© Rached CHERIF/AFD

# High-resolution hydroclimatic modelling in three watersheds in Israel, Jordan and Palestine

## Climate change impacts on streamflow of the upper Jordan River

**THIREL Guillaume**
HYCAR, Antony

**Israel, Jordan, Palestine**
2016-2018

**Réf:**
Givati A., Thirel G., Rosenfeld D., Paz D. 2019. Climate change impacts on streamflow at the upper Jordan River based on an ensemble of regional climate models. Journal of Hydrology: Regional Studies (21): 92-109

In 2016, Guillaume Thirel was asked to participate in two projects[1] funded by the United Nations Development Programme (UNDP) to carry out hydroclimatic modelling in three watersheds in Israel, Jordan and Palestine in the context of climate change.

The three partner consultancies, ACTERRA, TEC Conseil and ARIA Technologies were responsible for coordinating this project, which involved Israeli, Jordanian and Palestinian climatologists and hydrogeologists. This project led to the production of high-resolution climate projections (25 km and 5 km) for 11 hydroclimatic indices using dynamic downscaling methods (CORDEX and WRF mesoscale model).

Several visits were organised. The first visit to the Israeli Hydrological Service / Israeli Water Authority, in the presence of the representative of the design office in charge of this project, made it possible to meet with a modeller and the person in charge of hydrological forecasting. As this project is aimed at studying the impact of climate change, it was possible to discuss the proper use of our hydrological models, since the INRAE airGR software package is already in use. Subsequently, a visit to the Zarqa watershed in Jordan allowed us to observe a wastewater treatment plant (WWTP) and to discuss with the staff their vision of the impact of climate change on the WWTP.

The next visit was to a landslide that had occurred a month earlier and then to the flow measurement station used for the project.

Finally, a meeting was organised under the aegis of the UNDP with the Jordanian (hydrogeologists and Ministry of Water) and Palestinian representatives as well as those of the 3 French consultancy firms. The results of airGR modelling on the watersheds of Israel and especially Jordan were presented and very well received. The aspect of being free of charge + performance + little data needed having resonated with the different partners, airGR was distributed and even installed at the end of the meeting.

This work has led to the creation of an online data visualisation portal (Climate Service) and has fuelled the elaboration of adaptation plans for the water resources of the 3 countries.

In 2016, Guillaume Thirel participated in a one-week training course organised by ACTERRA in partnership with *Météo France*. The training on hydrological modelling and the use of airGR in the context of climate change and its impacts on hydrology was addressed to a delegation of 15 experts from the 3 countries concerned.

In this context, the main work of our team on R²D², Climaware, Explore 2070 and the 2013 IAHS workshop on the robustness of hydrological models was presented.

In 2017, the expertise of the HYDRO team was sought in order to participate in the implementation of robust hydrological modelling on target watersheds, including the successful use of the airGR software package on two of these watersheds.

The mission resulted in a publication with three Israeli co-authors in the "Journal of Hydrology: Regional Studies", referenced below.

UN: UNDP

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1 https://webgr.irstea.fr/projets/projets-acheves/pnud/

IN THIS SECTION



# COSTEA (Scientific and Technical Committee on Agricultural Water)

**BOUARFA Sami**
G-EAU, Montpellier

**Various**
2013-2023

**Réf:**
COSTEA produces, among others, concept notes, support material for seminars, study reports, scientific publications and videos. INRAE publication: "*Quelles agricultures irriguées demain. Répondre aux enjeux de la sécurité alimentaire et du développement durable*" (5 March 2020)
Video: Interview with Sami Bouarfa, *gestion et usages de l'eau*

AFD

Funded by the AFD and led by Afeid[1], COSTEA brings together, on a voluntary basis, a community of international experts from the irrigation sector, with the objective of contributing to improving the efficacy of irrigation policies and projects.

COSTEA aims to produce awareness, analyse feedback, compare points of view and question the renewal of public policies on irrigation and hydro-agricultural development. Its aim is therefore to participate in the elaboration of a position regarding the modalities of irrigated agriculture and thus to provide support in the elaboration and implementation of irrigation policies and projects.

This community experts associates as much as possible the project managers in the countries where the AFD operates and all the actors with whom they interact at various levels of the administration, universities and research institutes, NGOs, professional organisations and associations of irrigators and sector stakeholders..

The programme was created in 2013 as part of a project financed by the AFD to support the growing demand of Global South countries for reinvestment in irrigation; ever since, its ambition has been confirmed both through its renewal for 4 years in 2017, but also through links established with the "Sahel Irrigation Initiative Support" (SIIS), a project supported by the World Bank.

Thus, after a successful first phase of setting up this committee (2013-2016) supported by the AFD to the extent of €1.2 million, a second, more ambitious phase of €5 million has been launched and is ongoing (2017-2023).

© Florence Deram malerbe

1 Sami Bouarfa - President of the Technical Committee of Afeid (an association that leads a dialogue between irrigation stakeholders in France and intervenes internationally in support of French cooperation and as a member of the International Commission on Irrigation and Drainage)

# Implementation of the Water Framework Directive: mission in Quebec

## Sharing INRAE's French know-how and expertise

**CHAUVIN Christian**
EABX, Bordeaux

**Canada**
2018

MELCC

The Canadian province of Quebec: twice the size of France, with a population of 7.5 million, has average anthropic pressure on its natural environments and well-preserved surface waters overall, with many wild rivers that are little frequented or used.

However, the pressure, which is concentrated on an urbanised strip, to the south along the banks of the St Lawrence, is not negligible, with known points of disturbance (like mines, paper mills and hydroelectric plants).

The expertise requested by the Quebec Ministry of the Environment (MELCC) concerned questions of methodology: how has France implemented the requirements of the European Water Framework Directive in its policies and regulations? How does one move from solely chemical and physico-chemical monitoring to hydrobiological assessment? How can impact reduction requirements be made binding? How can restoration operations be integrated into the policy for improving the state of aquatic environments?

The Government of Quebec has embarked on an ambitious policy of monitoring and improving the quality of rivers and lakes affected by discharges, use or development. The American example is taken into account, but the European experience is considered very interesting. Within the framework of its Environmental Science Forum, the Ministry wanted a French-speaking European expert to present the methodology and strategy for implementing the WFD in France.

This type of expert mission on a specific topic can be very profitable because INRAE is in a leading position on this subject.

Christian Chauvin, coordinator in France for the Aquaref consortium, gave a lecture on these subjects and then led 4 workshops the following day for the ministry's departments. The question of bioindicators came up regularly, as did the introduction of regulations and permanent monitoring networks.

Many other ideas were discussed, including the prescription of compulsory restoration or mitigation, as well as the establishment of a quality approach or the training of operators. Many questions remain to be explored further in the event of a future mission.


© MELCC

# China-Europe Water Platform (CEWP): Nanxi watershed, China

**CHAUVIN Christian**
EABX, Bordeaux

**China (PRC)**
Oct.-Nov. 2017

**Réf:**
Chauvin C. 2017. *Compte-rendu de mission en Chine : 25 octobre-1er novembre 2017.*

Several European cooperation projects are underway as part of the China-Europe Water Platform (CEWP). One of these projects, led by the University of Évora (Portugal), required the mobilisation of European experts in order to carry out an initial survey of the Nanxi watershed.

Christian Chauvin (INRAE Bordeaux) was invited by the Chinese authorities to take part in this expertise assignment, which was followed by several other study and exchange missions, and by the visit of Prof. Jianhua LI from the University of Shanghai to Bordeaux-Gazinet.

The Nanxi is a river that drains a relatively unspoilt area with a high landscape, tourist and cultural value, which has been classified as a National Park since 1988 and is a UNESCO-listed World Heritage Site. It is the last major tributary of the Ou River, on the left bank of its estuary at Wenzhou. It is subject to tidal movements in its downstream section. A major dam was built at Gaopucun to supply drinking water to one region of the watershed.

This dam now forms the limit of the tidal zone (3 to 4 m tidal range).

A reservoir is located in the upstream part of the watershed, retaining a large part of the flow at low water.


© Christian Chauvin

A second reservoir project is under study. The conclusions of the expert group are awaited to guide the decision on the second reservoir project and on a programme for the Nanxi river.

The main issues encountered on the Nanxi concern:

- the general aspects of ecological degradation linked to the creation of the dam downstream and the reservoir upstream. The problems noted on site and discussed concern eutrophication (development of algae) and morphodynamic characteristics (reduction in discharge and velocity, deepening of the bed, modification of substrates);
- the virtual disappearance of the Ayu (*Plecoglossus altivelis*) populations. This migratory fish is emblematic of several Chinese rivers, including the Nanxi. Populations have collapsed, and there is a lack of data on numbers and viability. This problem is the main challenge of the restoration programme.

In general, China has high expectations from scientific and technical collaborations in the environmental domain and more specifically the water related one. Numerous initiatives are being pursued to preserve or restore aquatic environments, but there is a lack of basic knowledge, experience and methodology.

Of course, there is still a strong antagonism between development (use of water for hydroelectricity production, drinking water supply or irrigation) and preservation as aquatic environments, but the will of the authorities seems to be effective in considering these environmental issues as important.

IWHR (China Institute of Water resources & Hydropower Research),
Wetland Restoration & Ecological Services (OIEau) with SYKE and the University of Évora

## WaSaf (Water Sources in Africa): monitoring and sustainable management of surface water resources in Africa

**HUMBERT Jean-François**
iEES, Paris/Versailles-Grignon

**Ivory Coast, Senegal, Uganda**
2016-2021

WaSaf (Monitoring and protection of surface water sources in Africa) is an international project coordinated by INRAE on the monitoring and protection of continental surface water systems used for drinking water production in three African countries, namely the Ivory Coast, Senegal and Uganda. Bringing together a consortium of African and French research teams working in the humanities and environmental sciences, it is based on the close involvement of all stakeholders in the water sector, from the natural resources to the distributed water, and is financed by the French Facility for Global Environment (FFEM) over a period of 5 years.

The objectives of this programme, launched on 8 February 2016 in Abidjan (Ivory Coast), are as follows:

- to set up permanent monitoring of surface aquatic ecosystems, which requires the choice of tools and approaches adapted to local contexts, the training of personnel in the use of these tools and the definition of decision trees to guide the monitoring operators in the actions to be taken in crisis situations (e.g. during cyanobacterial blooms). In addition, a pilot study on participatory monitoring of cyanobacterial blooms was conducted in the Aghien lagoon (Ivory Coast);
- assessment of: (i) the current quality of the ecosystems targeted in this study through the analysis of existing and the acquisition of additional data, and (ii) their possible evolution

**Réf:**
Broadcast on RFI "*C'est pas du vent*" about the WaSAf programme
Website: humbert19.wixsite.com/WaSaf
Facebook: facebook.com/WaSaf
First publications:
-Olokotum et al. 2020. A review of socioecological causes and consequences of cyanobacterial blooms in Lake Victoria. Harmful Algae. *In press.*
-Mitroi et al. 2020. Can participatory approaches strengthen the monitoring of cyanobacterial blooms in developing countries?
Results from a pilot study conducted in the Lagoon Aghien (Ivory Coast).PLoS ONE. *In press*


© WAaSaf

through the analysis of the pressures exerted on them and their watersheds as well as through experiments carried out in mesocosms in these ecosystems;
• preparation and/or support for the institutions concerned in setting up observatories for aquatic environments, particularly in defining the missions and operation of these observatories and in creating databases to centralise all the data collected;
• analysis of the perception of the ecological and sanitary state of ecosystems in the riverside populations and identification of the uses made of these ecosystems and their watersheds; the conflicts generated by the multiplicity of these uses and their consequences on water quality;
• carrying out a comparative analysis of the organisation of water governance in the three countries targeted by this programme in order to compare the strengths and weaknesses of each governance system and the consequences on ecosystem management;
• raising awareness and mobilising all those whose activities exert pressure on these ecosystems and creating dialogue platforms bringing together users, managers, institutional representatives and scientists to prepare measures to protect and/or restore ecosystems.

This five-year project (2016-2021) is financed by the French Facility for Global Environment (FFEM) and includes co-financing from the AFD and several French research and higher education institutes (CNRS, INRAE, IRD, MNHN, Paris VI and Paris VII Universities) through the involvement of their staff.

(FFEM)

## SWOT working group on spatial hydrology in the Congo

**MALATERRE Pierre-Olivier**
G-EAU, Montpellier

**Congo**
2014-2022

**Réf:**
Cote DDD: OIE/34230
Oubanas H., Gejadze I., Malaterre P.-O., Mercier F. 2018. River discharge estimation from synthetic SWOT- type observations using variational data assimilation and the full Saint-Venant hydraulic model. Journal of Hydrology, vol. 559, p. 638-647

The SWOT (Surface Water and Ocean Topography) satellite will be launched in 2022 as part of a Franco-American CNES-NASA mission, supported also by the UK and Canadian space agencies.

The overall budget is around 1 billion dollars, an Investments for the Future programme (PIA) has also been granted to prepare the downstream products that will make use of the satellite data collected. Well before the launch, CNES and NASA are very active in defining and preparing future uses.

Since 2014 INRAE (Montpellier) has been a member of the international scientific team of this project, working mainly on river flow reconstruction from data provided by the satellite.

This work is recognised by the international community, with numerous publications.

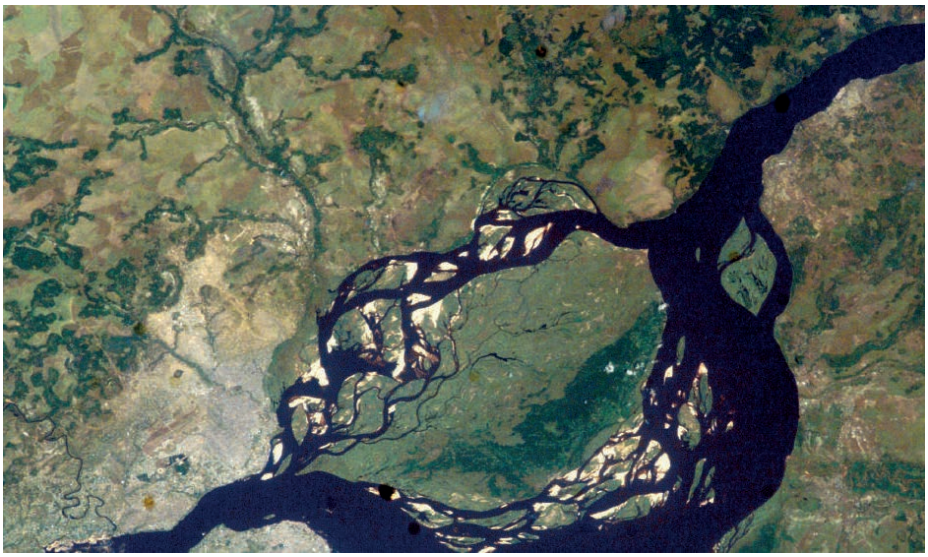
INRAE is currently testing its algorithm on some 50 rivers around the world.

Presented as revolutionary with a brand-new technology, SWOT will offer almost complete coverage of the globe outside the poles: using a "mesoscale" for the oceans, but particularly for continental hydrology (rivers and lakes).

Some rivers have been selected for specific studies.

A working group on spatial hydrology was created in 2014. Led by the International Office for Water (OIEau), it brings together several partners, French research, institutional, technical and operational actors: the CNES, IRD, AFD, INRAE, BRLI, CNR and CLS. Activities have been carried out with this consortium in relation with the International Commission of the Congo-Ubangui-Sangha Basin (CICOS, created in 1999).

By 2022, the working group should be able to provide the spatio-temporal variations in the water levels of major rivers, lakes and streams, the flow rate of major rivers as well as sea levels. These spatial altimetry data open up many prospects, both for scientific research



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and for the operational management of water resources, particularly for large transboundary rivers.

The Congo River was chosen as an experimental river because it is particularly interesting for its flow rate (the second largest in the world after the Amazon), its size (4,700 km), its challenges (river transport, irrigation, drinking water, hydroelectricity), and its international and transboundary nature (its watershed spans seven countries).

CNES, CICOS, OIEau

## GEMI Project: water governance in MBAM-et-INOUBOU

### Emergence of an intercommunal structure

**WITTNER Christophe**
Geste-Engees, Strasbourg

**Cameroon**
May 2019

**Réf:**
Collective publication: «*Gouvernance intercommunale dans le domaine de l'eau et de l'assainissement au Cameroun*» Link: Cameroun - *Partenariats avec les syndicats de communes du Mbam et Inoubou, et de la Lékié*
Video: *Gouvernance de l'eau dans le Mbam et Inoubou*
Alsatian partners: SDEA, ENGEES, ISF, GESCOD et IRCOD Alsace
Cameroonian partner: ERA Cameroun

With a multitude of equipment no longer functioning, the rural populations of the 9 municipalities in the Mbam-et-Inoubou department were experiencing serious difficulties in obtaining a supply of drinking water. In a national context of emerging decentralisation, the 9 mayors of the department decided to create an association of mayors to promote and support the creation of a joint authority. The aim was to benefit from an efficient partnership approach and to have a pertinent scale for the exercise of competences.

The actors chose a real legal innovation in Cameroon: the constitution of an inter-communal association whose objective is to provide the population with permanent access to drinking water and basic sanitation.

The first mission consisted in providing elements of reflection for the establishment of an intercommunal organising authority and the operational structuring of the latter: informing the selected representatives on the principles and implications of an exercise of supra-municipal competence, defining the role and place of the various actors, particularly the links between the future association and the existing village management structures by drawing up a relational diagram between the actors, tackling the problem of the transfer of personnel and existing works, laying down the groundwork for organising and steering the future service.

A second mission aimed to estimate the operating costs of the service and determine the conditions for the financial perpetuation of the future association in connection with the study of the population's willingness to pay for water.

It emerged that the timetable for the decentralisation of the competence would be accelerated in 2010 when the National Decentralisation Council met with the aim of transferring competences to the municipalities, including the competence for drinking water.

The funding accompanying the decentralization process and the modalities of payment to the public entities exercising water competences remained to be defined. There are several possibilities to reach the budget for the intercommunality, for example direct payment of funds by the State, payment via the EIF-COM, payment via the municipalities.

It was also brought to our attention that the salaries of the secretary-general and the municipal tax collector would be covered by the public entity managing the competences concerned. As part of the implementation of the Geographical Information System (GIS), it seems essential to capitalise on the information gathered during this study

in terms of the invoicing base and to enrich the database in the course of the promotion action. The ideal situation would be to have an exhaustive knowledge of the base with a view to determining unit prices more precisely, but also to define and implement the regulation methods of the village management committees.

The partnership between SDEA, ENGEES, ISF, Ircod Alsace and various Cameroonian organisations including ERA Cameroon, accompanied the progressive structuring of a water service which led to the creation of the first inter-communal association in Cameroon in November 2010; the association of the municipalities of Mbam-et-Inoubou (SYCOMI).

The municipalities of Lékié were inspired to create their own association (SYNCOLEK), with the support and expertise of SYCOMI and the SDEA (the water and sanitation association of Alsace and Moselle), in order to develop a public water and sanitation service in their turn.

© GESCOD : R-CMEA au Cameroun

SDEA, ENGEES, ISF, IRCOD and GESCOD Alsace

IN THIS SECTION



# Mapping the Mekong River flow regime: scientific benefit of a capacity building action

**LEBLOIS Étienne**
RIVERLY, Lyon

**Mekong River, lower basin: Cambodia, Laos, Thailand and Vietnam**
2018

**Réf:**
Project N°: HYCOS123: BKF-CSF, CF:202, GL AC 40609, Act: 1.4.4, Outcome 14; EMF-CSF, CF:202, GL AC 40609,
Act: 1.4.4, Outcome 14; EMF-AFD, CF: 201, GL AC 40603,
Act: 6.1.7, Outcome 61.

The Mekong River Commission (MRC) Secretariat, the cooperation body for the 4 lower basin countries - Cambodia, Laos, Thailand, Vietnam - has initiated and been supervising the Mekong-HYCOS and Mekong-HYCOS Follow-up projects since 2007. These projects have enabled the installation of more than 30 hydrological stations along the Mekong River and its tributaries, enabling the establishment of a data collection system shared between the MRC and its member states.

In 2017, the MRC wished to continue this support to the Mekong hydrometric network and requested financial support from the AFD for this purpose. The AFD wanted the strengthening of local skills in water resources analysis to go hand in hand with the deployment of the network; this led the MRC to request calls for tender to this effect, to which the OIEau, INRAE, IWMI and the CNR jointly responded.

They proposed, among other things, to deal with the regional analysis of the river regime.

The objectives were to obtain:

- a practical analysis showing how water data can be used at national and regional level;
- training in the use of the tools necessary for this analysis;
- and thereby encourage an overall improvement in the management and use of these data within the MRC.

Benjamin Graff, from CNR, coordinated a training team of 3 hydrology experts: Éric Sauquet (Riverly) for the analysis of the data at each measuring station, for example the delimitation of the hydrological regimes (magnitude and seasonal distribution of flows), Étienne Leblois (Riverly) for the mapping of this hydrological regime at all points of the hydrographic network and himself for the metrology.

This mapping work is *a priori* a classic scientific problem: the INRAE experts usually map the average discharge by breaking down the seasonal variability into statistically uncorrelated factors and by associating known physical characteristics such as the abundance of snowmelt or the amount of rainfall with these factors. However, this standard approach assumes a strong knowledge of local physical factors.

In this case, it was proposed to adapt the approach by using a machine

learning technique called 'non-negative matrix factorisation' which avoids the need for an explicit link to the dominant physical features. The experts thus chose to adapt their approach to provide tools suitable for later autonomous local use.

It has to be said that the level of capitalisation of these tools by the participants is unknown - the feeling is that alongside the organised sessions, long-term joint activities (joint work, exchange of personnel) would help to achieve lasting results; late 2020, some thought is given to this matter.

For the time being, one can retain from this initiative that expertise or training projects also make it possible to inform and stimulate research, since the expert himself is often led to introduce, according to the needs of local demand, innovative solutions which it will of course be up to him to rework at a later date in the context of his research.

MRC - AFD - CNR

## Expertise of the Hydraulics and Standardization Laboratory

**MOLLE Bruno**
G-EAU, Montpellier

**Morocco**
2016-2017

**Réf:**
Programme/Project n°: UTF/MOR/038/MOR

The implementation of the Green Morocco Plan, comprising various hydro-agricultural development programmes, including the Irrigation Extension Programme (*Programme d'Extension de l'Irrigation*), and the National Irrigation Water Saving Programme (*Programme National d'Économie de l'Eau en Irrigation*), has entered its cruising phase, relying mainly on the local branches of the Regional Agricultural Development Offices (e.g. ORMVA). This plan implies increased support needs to ensure the quality and efficiency of the implementation and operation of irrigation systems.

These aspects fall within the competence of the Directorate of Irrigation and Rural Infrastructure (DIAEA), more precisely within the missions of its department of experimentation, testing and standardisation (SEEN).

This department was recently assessed as part of an FAO mission, with a view to upgrading it to better carry out its missions in support of the modernisation policy.

In order to remove various constraints limiting the capacity of the SEEN to ensure the numerous missions necessary for an efficient support to the PEI and PNEEI programmes, the Directorate of Irrigation and Rural Infrastructure plans to modernise the laboratory facilities in order to evolve towards a certification of the tests it carries out.

Thus, under the overall responsibility of the FAO Representation in Morocco, the supervision of the LTU/NRLW technical services and in close collaboration with the National Directorate of the Convention and the officials concerned at the DIAEA, the international consultation focused on the following tasks:

1. to carry out a diagnosis of the current state of operation and calibration of the existing test benches, equipment and measuring tools at the Hydraulic laboratory of SEEN;
2. to examine the test protocols currently used by the hydraulics laboratory;
3. to inventory and propose all the types of hydraulic tests to be carried out by the laboratory for the evaluation of the technological and hydraulic performances and the quality control of the various irrigation appliances;
4. to identify the needs for upgrading the laboratory in terms of:
   - additional equipment for modernising and automating the tests;
   - processing methods and tools;
   - training of staff and teams in charge of carrying out and supervising tests;
   - development of technical and technological specifications for the equipment to be procured.

FAO

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# Expertise: the Hai He watershed

## Phase 3 Project: Recommendations for design, management and monitoring of constructed wetlands in the Hai He watershed - AFD - FEXTE – International Office for Water

**TOURNEBIZE Julien**
HYCAR, Antony

**China (PRC)**
2016-2019

**Réf:**
Related articles: *Chine - Poursuite du projet de bassin pilote de la rivière Hai et du sous bassin de la rivière Zhou Juillet 2011 - Signature d'un accord de coopération entre la France et la Chine sur la gestion des ressources en eau de la rivière Hai*
French-Chinese cooperation in the Hai Pilot River Basin and Zhou Sub-Basin

Access to water is a major concern for China, which has only 7% of the world's water resources for one fifth of the world's population. The distribution of these resources is somewhat uneven: water is plentiful in the South, but scarce in the West and North. Ultimately, the quality is threatened by pollution from industrial, urban and agricultural waste.

In the north-east of China, the Hai or Hai He watershed covers an area of 318,000 km² with 130 million inhabitants and is one of the country's most developed economic areas, including Beijing and Tianjin.

Along with two other rivers (Zhou and Luan) this watershed was selected as a pilot sector for strengthening IWRM (Integrated Water Resources Management & Protection) competencies as part of the cooperation agreement signed on 29 December 2009.

INRAE's participation in the expertise on ecological engineering is in response to Julien Tournebize's intervention during a training session with the delegation of Hai He in 2014 on behalf of OIEau. This Chinese delegation was received by INRAE in October 2018.

The continuity reflects the quality of the established relations and shows a real willingness to go further in the French-Chinese cooperation on IWRM. The project was selected to receive the "Chinese Government Friendship Award", presented by the Vice Prime Minister, Mr. Ma Kai, on the occasion of China's national celebration day.

This phase concerns: adaptation-resilience to climate change, the fight against point and nonpoint pollution, management of aquatic ecosystems, restoration of environments, monitoring networks, information systems, management of reservoir lakes and master plans for sanitation. An economic component financed by the FEXTE[1] and implemented by the AFD provides for complementary expertise and the testing of French water management technologies.

This proposed "economic" component is the "preparatory study for the review of biodiversity monitoring and purification efficiency (capacity to remove pollutants) in the project for the development of constructed wetlands in the Hai River watershed". This document presents the technical aspects of the latter project.

The activities financed under the FEXTE project provide additional assistance and expertise to the French parties to identify future investment needs related to watershed management as well as to developing technical specifications for the actions included in the proposed measures. It also helps to identify relevant technologies or skills in France.

This could be of interest to the Chinese partners.

Following the expert mission in April 2014, the September 2017 mission was made jointly with Biotope and commissioned by OIEau.

With this organisation, an expert report had been produced on the regulation of nonpoint pollution and biodiversity, particularly of the constructed wetland in the Juqiao reservoir. The report was submitted to OIEau, which commissioned the study.

OIEau, Biotope

1 The Fund for Technical Expertise and Experience Transfers finances technical cooperation programmes and project preparation studies in developing countries. In 2017, the AFD pledged 14.7 million euros. The FEXTE is designed to meet the demands and needs for French expertise and experience in countries receiving official development assistance (as defined by the OECD Development Assistance Committee) in which the AFD is authorized to operate, while contributing to their sustainable development.

IN THIS SECTION



## Lom Pangar Dam (Cameroon)

**BONELLI Stéphane**
RECOVER, Aix-en-Provence

**Cameroon**
2014-2016

**Réf:**
Bonelli S., Nicaise S., Byron F. 2015. *Projet de réalisation du barrage de Lom Pangar (Cameroun) - Étude de la sensibilité à l'érosion interne de la fondation du barrage et de ses matériaux. Rapport pour Coyne et Bellier / ISL Ingénierie, 193 p.*

The research and development work carried out on internal erosion led to an innovative assessment of Cameroon's largest dam, the Lom Pangar Dam, which was impounded in 2016, is 57 m high and stores 6 billion $m^3$ of water for hydroelectricity. The Coyne & Bellier[1]/ ISL Engineering partnership commissioned INRAE in 2014 to carry out laboratory tests on the dam's foundation soil in order to provide elements for qualifying the risk of internal erosion. More than 30 HETs (Hole Erosion Tests) were carried out in Aix-en-Provence on samples taken in Cameroon during the April 2014 geotechnical reconnaissance campaign.

Specific procedures were deployed to carry out tests on intact samples and to integrate the effects of the construction of the dam (increase in density) and the filling of the reservoir (saturation). The results obtained then allowed the quantification of the influence of important parameters on erodibility: dry soil density, water content and especially the fraction of fine clay particles, allowing a distinction to be made between silt (weathered gneiss) and lateritic clays. These results were then used for the internal erosion risk assessment of the foundation. This was reportedly the first analysis of this level deployed on the foundation soil of a large dam before its construction.

ISL Engineering, Coyne & Bellier

© SL ingéniérie, projets

1 In 1986, Coyne & Bellier was integrated into Tractebel Engie when Tractionel and Electrobel Engineering merged; see presentation and history. "*Coyne & Bellier: une expérience au cœur des grands ouvrages*" as well as a short presentation of Tractebel-engineering by the CFBR.

## Soil erodibility by HET and JET

### HET = Hole Erosion Test vs. JET = Jet Erosion Test

**BONELLI Stéphane**
RECOVER, Aix-en-Provence

**Belgium**
2014

**Réf:**
Video HET - Hole Erosion Test (laboratory internal erosion test), Irstea TV, 2015
Bonelli S. (ed.), Erosion in Geomechanics Applied to Dams and Levees, Wiley/ISTE, 388 p., 2013

Since most hydraulic structure failures are attributed to internal erosion, the Flanders Hydraulics Research Centre (FHR) in Flanders, Belgium, needed tools to assess the safety of the Scheldt's maritime and river dykes, as well as the project to reinforce and raise these dykes.

Stéphane Bonelli and Sylvie Nicaise from the RECOVER unit were asked to coordinate the erosion tests. The experimental tests took place in the geomechanics laboratory of the RECOVER unit in Belgium. They were carried out on different test devices

according to their typology, like, JET for overflow, HET for piping erosion and CET for contact erosion.

The conclusions confirmed which choice of tools were best adapted to the different constraints.

These tools which improve internal erosion risk assessment meet expectations and are likely to lead to international development.

This expertise has been integrated into the FHR projects on the Scheldt dykes following the report on the vulnerability of a dyke soil to internal and surface erosion.

HET: Hole Erosion Test, developed by Irstea.

JET: Jet Erosion Test falls under standard ASTM[1] D5852 (withdrawn in 2016).

1 ASTM: American Society for Testing and Materials

© Sylvie NICAISE - Irstea

Flanders Hydraulics Research

# Georgia: impact of a hydroelectric dam on fish populations

## The Namakhvani cascade dam on the Rioni River

**CAPRA Hervé**
RIVERLY, Lyon

**Georgia**
2017

In 2017, the local branch of the Norwegian Clean Energy Group, Georgia[1], planned to invest in Georgia and develop a hydroelectric cascade project at the Namakhvani Dam on the Rioni River, in the municipalities of Tskhaltubo and Tsageri. The project anticipated maintaining a minimum discharge of 10% of the average annual discharge, but without a previously established scientific basis.

1 Now Enka: page https://www.enka.com/portfo-lio-item/namakhvani-hydro-power-plant-cascade-project/

Clean Energy Group therefore entered into an agreement with SRL Consulting (Grenoble) in order to fill this gap with additional studies on the environmental and social aspects of the project. The latter chose in turn to delegate the impact studies of the project on fish habitat and fish populations, commissioning Hervé Capra of the Dynam laboratory (then MALY unit) in Lyon.

The fish species had been identified during a previous study in 2015: of the eight species listed - a few endemic - some are on the Georgian red list.

However, the study had not taken into account the probable impact of the existing downstream dam on fish populations, particularly migratory fish, owing to the lack of a crossing device.

The objective of Hervé Capra's expertise was therefore to:

- describe the habitat of the river fish affected by the presence and operation of the two dams/reservoirs;
- to assess the effects of the two hydroelectric systems on the distribution of fish species in the Rioni River;
- justify the environmental flow defined downstream of the Namakhvani Dam;
- propose mitigation, compensation or improvement measures for the management of hydropeaking flows.

Enka, the new contractor, plans to commission the Namakhvani Dam in 2018.

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Clean Energy Group / SRL Consultin

# Colombia – Ituango Dam at risk:
## UN emergency mission (21 May to 3 June 2018)

**CARVAJAL Claudio**
RECOVER, Aix-en-Provence

**Colombia**
May-June 2018

On 18 May 2018, the French Committee for large dams (CFBR) had called upon its members for an emergency international expertise mission on a large dam (>200m high) at risk, in Colombia where more than 25,000 people had been displaced to safer areas and where 130,000 inhabitants were under threat.

The Colombian authorities had launched an appeal for international assistance at the level of the UN and the European Union.

The Emergency Response Coordination Centre (ERCC) of the EU, then relayed the request to the COGIC in France (the interdepartmental crisis management operational center, Ministry of the Interior) and to the CMVOA (the ministerial monitoring and alert center, Ministry of the Environment).

After instruction and express coordination by INRAE, and support from the European Union, Claudio Carvajal was welcomed on 21 May in Medellín by the local United Nations team in charge of logistics and security.

Thus, a team of 4 experts was set up by the United Nations (UN) Environment Office. These experts proposed an analysis and a series of recommendations that will be taken into account in the project stabilisation processes (specialists in dams, hydroelectric design, geotechnics and geology).

Claudio Carvajal's work was highly appreciated. It should be noted that in terms of modelling, he was supported by his fellow researchers in France.

UN - UNDAC - ERCC

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# Design of protective structures against torrential hazards on the Cheekye
## Trapping large magnitude debris flows, induced by massive rock avalanche collapses: Cheekye debris barrier, Squamish (British Columbia, Canada)

**PITON Guillaume**
ETNA, Grenoble

**Canada**
2017-2021

Situated on the west coast of Canada, near Vancouver, the Cheekye River episodically experiences very large debris flows induced by high-altitude landslides. Such collapses, involving volumes of several million m³, have occurred in the region (Mount Meager, 2010; Joffre Peak, 2019). There is considerable scientific evidence that a similar major event can occur at any time in the Cheekye River. Modelling has shown that the phenomenon threatens the Brackendale area of the town of Squamish as well as Highway 99, which connects Vancouver to tourist resorts such as Whistler. The risk is considered too high by British Columbia State standards and mitigation measures are required.

About 15 different strategies were studied in order to mitigate the risks associated with such an event. A multi-criteria analysis showed that the most pertinent solution would be a debris barrier aimed at trapping almost all of the 10,000-year return period debris flow. The structure in question would be the largest debris flow trap in North America.

Our support was requested because of the unusual dimensions: 2,400,000 m³ of debris flow to be trapped in a structure approximately 30 m high. Sedimentation structures of the same type in France are generally 100 to 1,000 times smaller, the largest French structures being still 10 times smaller than the Cheekye barrier.

Debris barriers dedicated to the trapping of debris flows are rare in America, so North American specialists therefore have insufficient hindsight on the design of such structures. On the other hand, these structures are regularly used in Europe and Japan.

**Réf:**
Jakob M, Friele P. 2010. Frequency and magnitude of debris flows on Cheekye River, British Columbia. Geomorphology 114: 382–395. DOI: 10.1016/j.geomorph.2009.08.013
Piton G., Laigle D., Faug T., Tacnet J.-M., 2019. Functional Design of the Cheekye Debris Flow Barrier Technical Review of the Preliminary Design, BGC Engineering Inc., 58p, confidential report.

BGC Engineering, the engineering firm in charge of designing the structure, therefore sought the support of researchers from INRAE's ETNA research unit, who had published some noteworthy research work on the issue in recent years and who lead international working groups on these questions.

ETNA scientists helped refine the functional design of the barrier: its type, shape and main dimensions. A specific modelling tool was developed for the occasion in order to characterise the functioning of the structure in terms of storage and release as a function of the incoming flows and the obstruction rates of the various hydraulic components. In addition to their knowledge of the functioning of these structures, this development was an opportunity to apply possibilistic approaches to propagation methods, particularly adapted to the small amount of data available and the many doubts that persisted.

The mission to support BGC Engineering, a major North American consultancy firm, focused on the design of this torrential hazard protection structure on the Cheekye River. The results of this expertise, mainly carried out with BGC Engineering and various local organisations, remain confidential and cannot be disseminated.

BGC Engineering

© Shawn Connelly

## The Melah Dam, Tunisia: risk assessment

**ROYET Paul**
RECOVER, Aix-en-Provence

**Tunisia**
2014

**Réf:**
*Article Cahiers ingénierie / transition énergétique / n° 88 / Septembre 2013 : « Stockage de l'électricité : La station de pompage-turbinage de Melah amont » Plaquette Vincent LINO. Études d'exécution et assistance supervision phase travaux du Groupement SOGREAH/ ISL/SERAH/ SIAA* on the website of Cfbr

This expertise mission was requested by the Artelia-ISL consortium as part of its project management assistance offer on behalf of the Tunisian Ministry of Agriculture, Water Resources and Fisheries (MARHP). The General Directorate of Dams and Large Hydraulic Works (DGBGTH) mandated a committee of independent experts to ensure that the design and construction of the dam meet international safety standards.

INRAE participated in this expert committee with the presence of Paul Royet.

This expert committee carried out a one-week mission.

After a general presentation of the works, their progress and the main technical problems encountered, the committee visited the works under construction.

The experts' observations and recommendations focused in particular on hydrology, the implementation of embankments and monitoring. They were recorded in the mission report drawn up before departure.

Artelia - ISL Engineering

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IN THIS SECTION



# Lausanne: micropollutant treatment facility

## WWTP Wastewater treatment plant

**CHOUBERT Jean-Marc**
REVERSAAL, Lyon

**Switzerland**
2014

**Réf:**
STEPACT – 2014 – *MEP traitement des micropolluants La STEP Épura sur le site de la ville de Lausanne*
Report: *Traitement des micropolluants dans les eaux usées : rapport final sur les essais pilotes à la STEP de Vidy (Lausanne)*

In 2015, Lausanne launched a project to renovate its wastewater treatment plant (WWTP) in Vidy, which covers about 70,000m$^2$. Dating from 1964, the WWTP receives the wastewater of the agglomeration: more than 220,000 PE (person equivalent).

Moreover, the 2014 federal law (currently being amended) on the protection and quality of water requires, in particular, the abatement of micropollutants at the Vidy WWTP. Lausanne therefore had to take into account the increase in the connected population and the evolution of the discharge quality objectives, which include certain micropollutants.

In the "micropollutant treatment installation" package, the project owner relied on the recommendation of a panel of experts, which included Jean-Marc Choubert, in order to conclude the contract with the selected participant. The work consisted of studying the technical solutions proposed by various constructors. Jean-Marc Choubert relied heavily on the study of processes and procedures carried out in the course of 3 supervised theses, between 2010 and 2015, and research projects carried out since 2005.

A complex multi-barrier system involving several micropollutant removal processes (ozonation + sand filter and powdered activated carbon (PAC) + ultrafiltration) was selected by the panel of experts to meet the micropollutant treatment requirements.

Municipality of Lausanne

© STEP, Ville de Lausanne

# PLANISSIM project, Senegal

**LOMBARD-LATUNE Rémi**
REVERSAAL, Lyon

**Senegal**
2016-2017

**Réf:**
Lombard Latune R. 2019. *Innover pour les services d'assainissement en zone tropicale. Génie des procédés. Université de Lyon.*
Moretti P., Lombard-Latune R. 2018. *Les facteurs déterminants l'efficience et la pérennité du secteur de l'assainissement au Sénégal. Rapport des résultats 1.* [Research report IRSTEA. P. 139.
YouTube: *Paroles de chercheurs :* Wat-A-Game (2014)

The PLANISSIM project (sanitation planning through simulation and participatory modelling), is a project from the State of Senegal funded by EuropeAid (now International Partnerships).

The INRAE teams of Lyon and Montpellier (REVERSAAL et G-EAU) have been collaborating since 2015 on the development of a concerted sanitation planning approach. WasteWAG (WasteWAter Game) enables all stakeholders involved in a sanitation service to discuss technical choices and their consequences together, taking into account socio-economic, political, social and environmental factors.

Carried out in the framework of the PAISC (support programme for Senegalese civil society initiatives) and financed by the European Commission's Directorate-General for International Cooperation and Development (DG DEVCO, 10th European Development Fund), Planissim has enabled the finalisation and testing of WasteWAG for the first time on site.

The project was led by the NGO ACTED, with INRAE in charge of the scientific coordination of the project (methodological development, training of partners, workshop design and interpretation of results - Paul Moretti, Mélaine Aucante, Nils Ferrand).

Over a one-year, on site phase, Planissim brought together more than 1,000 participants, simple users with no technical knowledge in the field, in some 30 workshops led by Senegalese civil society organisations in two areas, one rural (Ranérou Ferlo department) and the other peri-urban (Rufisques). Eighty-eight percent of the sanitation systems proposed by the participants were technically coherent, from the collection of materials to their recovery; this illustrates the potential of the approach to gather the contributions of all stakeholders when making the technical choices that will condition the future services.

European Commission (EuropeAid)


© Rémi LOMBARD-LATUNE

## Sanitation in the Global South: international expertise missions to Lebanon and Morocco

**MOLLE Pascal**
REVERSAAL, Lyon

**Lebanon, Morocco**
2015-2019

**Réf:**
Video: *Interview Pascal Molle, traitement et valorisation des eaux usées* (1 :42')

The countries of the Global South are experiencing a significant problem in terms of wastewater management and treatment, a problem targeted as a priority with regard to the Millennium Development Goals and the Sustainable Development Goals (UN, 2015). In this context, INRAE's expertise being nationally active and recognized, is in great demand to assist state organisations in their wastewater management policy (treatment, reuse), as well as in their skills development in the various treatment technologies.

INRAE's experience in conducting projects on these topics in the Overseas Departments and Regions of France makes the transposition of the approach to Global South countries attractive to donors.

In this context, numerous actions have been carried out, either through collaboration as part of international cooperation (with the pS-Eau for example) or as part of an agreement with donors (such as the AFD). The expertise covers issues related to the transfer of skills on innovative technologies, support for improving the sizing or use of technologies present in the territories, as well as decision support on the choice of sanitation systems and technologies. While Global South countries are areas of growing demand for expertise (for example, Morocco, Lebanon, Tunisia and Costa Rica), this expertise is also sometimes requested by developed countries (like Switzerland or the USA).

AFD

© Pascal MOLLE

IN THIS SECTION



# Flooding emergency mission to Peru from 23 March to 14 April 2017

**RAMOS Maria-Helena**
HYCAR, Antony

Peru
**2017**

**Réf:**
MIRA Report (Multi-cluster Initial rapid assessment report) Peru 2017 and UNDAC report - Environmental Expert Support Mission UNO - PERU 2017
Collaboration ECMWF supports flood disaster response in Peru
Report "Flash Appeal – *inundaciones Costa Norte del Perú*, abril 2017"
Video: Interview Maria-Helena RAMOS, *les risques liés à l'eau*

In early 2017, northern Peru was hit by heavy rains, landslides and deadly floods. A state of emergency was declared on 29 March. In the meantime, on 20 March 2017, INRAE was called upon by the COGIC (interdepartmental crisis management operational centre) of the Ministry of the Interior following a request from the ERCC (the Emergency Response Coordination Centre of the European Union). The aim was to put forward an expert to join the Disaster Assessment and Coordination (UNDAC), team in Lima, which was commissioned by the United Nations Environment Programme (UNEP) and the Office for the Coordination of Humanitarian Affairs (UNOCHA) in Geneva, to provide expertise in the identification and assessment of secondary environmental risks and the environmental impacts of floods. UNDAC teams intervene, at the request of an affected country, for the assessment and coordination of disaster and humanitarian emergencies.

At INRAE, Maria-Helena Ramos, research director in hydrology within the HYCAR, research unit, joined the UNDAC team in Peru as an environmental expert. While in Peru, she helped collect and analyse data from the affected population to assess their needs for clean water, sanitation, food, health, resettlement and protection. This data allowed understanding the extent of the crisis and to define strategic humanitarian priorities.

Maria-Helena Ramos completed her mission dedicated to the identification and assessment of environmental risks. The field report was enriched by several contacts with local actors, including the national hydrometeorological forecasting service, which also made it possible to initiate an important collaboration[1] with the European Centre for Medium-Range Weather Forecasts (ECMWF).

The priority actions recommended in the final report particularly concerned wastewater treatment and solid waste management, with the deployment of efficient collection and adapted infrastructures, as well as – in the longer term – the mapping of risk zones to strengthen the planning and resilience strategies of territories in the face of natural risks.

Her account is very positive: "This experience has been enriching from many points of view. The fact that we were able to organise a mission in just a few hours and experience a humanitarian application of our work on flood forecasting and impact is very encouraging".

UN - UNDAC - ERCC

© Maria Helena RAMOS

1 collaboration with the ECMWF: https://www.ecmwf.int/en/newsletter/152/news/ecmwf-supports-flood-disaster-response-peru

# Partnership agreement "Methodology for characterizing adaptation to climate change"

**RICHARD Didier**
DIVaC, Antony

**Various**
2018

**Réf.**
Report May 2019 / seminars

Since 2015, climate change has been a priority for the French Development Agency (AFD), because climate change and development are two related emergencies and because energy and ecological transitions offer opportunities throughout the world. It is therefore very important for the AFD to be able to assess as rationally as possible the projects it examines regarding their capacity to reduce climate vulnerability.

This notion of climate vulnerability, which is particularly complex, led the AFD to turn to INRAE for a partnership aimed at furthering its reflections on the characterization of the concept of adaptation to climate change, with a particular focus on the characterization of the impacts of climate change on hydrological variables:

- comparative analysis of existing studies on the increased risks caused by climate change;
- recommendation of a methodology for carrying out studies on the increase in risks caused by climate change;
- reflection on risk management issues and in particular on vulnerability assessment, especially to climate change.

The partnership relies on a panel of experts including:

- specialists in hydrology/ climatology/ infrastructure: V. Andréassian, C. Perrin, G. Thirel, (in Antony), P. Arnaud, E. Martin, L. Peyras, R. Tourment (in Aix-en- Provence), M. Lang, E. Sauquet, J.-P. Vidal (in Lyon);
- specialists in vulnerability/adaptation/economics: P. Brémond, F. Grelot (in Montpellier) with general coordination by Didier Richard (delegate for expertise at the DIVaC) and José Martinez (DAI).

AFD

# Odra-Vistula flood management project for Poland

**TOURMENT Rémy**
RECOVER, Aix-en-Provence

**Poland**
2018

**Réf:**
Project n°: PL-Odra-Vistula Flood Management Project -- P147460

The generally peaceful Oder River (Odra in Polish), flows through the center of Wroclaw (formerly Breslau when the region was German). Here it divides into several branches joining four tributaries and several canals (also known as the "Polish Venice"). However, both the city and the river have experienced painful episodes. During heavy rainfall and snowmelt upstream, the Oder can hurtle through the city, as it did in 1997 and 2010.

With a flood control system designed for just 2,200 $m^3$ of water/second, until the 1997 flood when the flow approached 3,640 $m^3$ of water/second, Wroclaw was not prepared: this flood caused 56 deaths and destroyed more than 700,000 homes with damage estimated at more than 1 billion US dollars. Hence the "Odra-Vistula Flood Management" project covering 107,169 $km^2$ in Poland.

The aims are to increase access to flood protection for people living in selected areas of the Oder River and the upper Vistula River basins and to strengthen the institutional capacity to mitigate the impact of floods more effectively.

The project, worth around 500 million euros, has 5 main points.

1. Flood protection in the middle and lower reaches of the Oder. The aim is to enhance flood protection in summer and winter for the cities of Szczecin, Słubice, Gryfino and several other small towns along the Oder. Activities will include reconstruction of dykes and other bank protection works (like revetments and parapets), dredging of the Oder as well as canals and the Szczecin harbour, and river training works, that is recalibration and (re)-construction of groins and lateral submerged dams in the river, restoration of bends and bank protection.

© CEB

2. Flood protection for the Eastern Neisse (Nysa Klodzka) Valley to protect the town of Klodzka and other small valley towns as well as the city of Bardo at the outlet of the valley.
3. Flood protection for the upper Vistula to protect the Krakow agglomeration and Nowa Huta industrial area, the Sandomierz-Tarnobrzeg industrial and agricultural area and selected towns on tributaries in the sub-basins of the San and Raba rivers.
4. Institutional strengthening and enhanced forecasting to selectively support the strengthening of institutional capacity in priority areas by improving the emergency preparedness along the main rivers and their tributaries in south and west of Poland by enhancing the forecasting and operational water management capacity.
5. And finally, project management and studies.

World Bank

## Risks posed by transitions in flood protection structures

**TOURMENT Rémy**
RECOVER, Aix-en-Provence

**United Kingdom**
2017

**Réf:**
INRAE guide: Tourment R., Beullac B. *Inondations - Analyse du risque appliqué aux études de danger (EdD)*,
ISBN: 978-2-7430-2365-2

The UK Environment Agency (EA) launched a research study covering the assessment and management of risks associated with transitions in flood protection infrastructure. The aim of this research and development project was to better understand the effects of transition zones on the performance of flood protection works.

Transition zones are areas of weakness in an overall flood defence system where structures change geometry or composition (internal or external).

The interface between two different surfaces is the point where erosion processes (internal and external) are promoted.

If erosion processes are not detected or controlled, they can ultimately lead to failure and breach of the structure, most often resulting in flooding of the supposedly protected area.

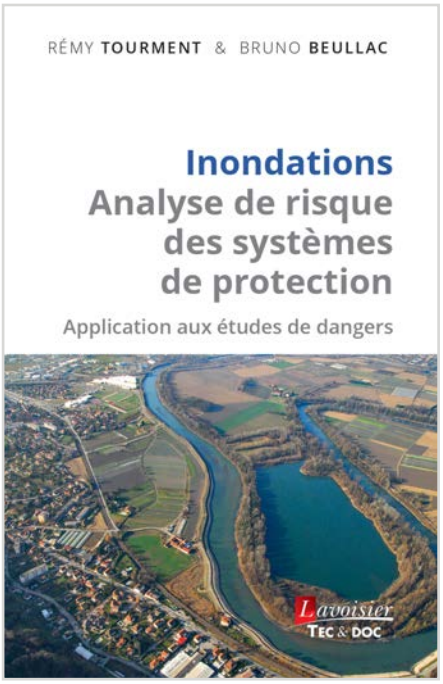
The study aimed to address these issues by helping authorities involved in risk management to:

- take into account the presence of transitions when assessing the safety of flood protection structures;
- quantify the effects of transitions on the performance of structures and flood risk;
- managing the risk associated with transitions with improved design and solutions for existing structures.

The contract holder was HR Wallingford and INRAE contributed its expertise (Rémy Tourment) at various key stages of the project. This contribution was managed through a subcontract.

This work followed an initial study on this issue that was carried out as part of the Flood- ProBE project and for which Rémy Tourment was the coordinator of the associated task.

HR Wallingford - EA



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# Geographical index and experts/units index

## Countries, regions



## Experts



## Index of INRAe units

## Institutional partners, research organisations



## United Nations



## European and UN bodies



## Non-governmental organisations



## Socio-professional partners

# Index of abbreviations and acronyms

| | |
|---|---|
| APP or [E]APP | [Expertise &] Support for Public Policies |
| AFD | French Development Agency |
| AFEID | French Association for Water, Irrigation and Drainage |
| AGP | Plant Production and Protection Division (now NSP), FAO |
| ANTAM | Asian & Pacific Network for Testing of Agricultural Machinery |
| WB | World Bank |
| BRLI | Bas-Rhône & Languedoc Engineering, BRL group |
| BTSF | Better Training for Safer Food |
| CENELEC | European Committee for Electrotechnical Standardization, EU |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| CEWP | China-Europe Water Platform |
| CFBR | French Committee on Large Dams |
| CICOS | International Commission of the Congo-Ubangui-Sangha Basin |
| CIRAD | French agricultural research and international cooperation organization |
| CLS | Collection Localisation Satellites |
| CMVOA | Ministerial monitoring and alert centre, French Ministry of the Environment |
| CNES | National Centre for Space Studies |
| CNR | Company of the Rhône |
| COGIC | Interdepartmental crisis management operational centre, Ministry of the Interior |
| COOPLAGE | Combining Open and Participatory Tools to Let Actors Adapt for environment management |
| COSTEA | Scientific and Technical Committee on Agricultural Water |
| CSAM | Centre for Sustainable Agricultural Mechanization, UN |
| DGBGTH | The General Directorate of Dams and Large Hydraulic Works (Agridata Tunisia) |
| DGD | Deputy Directorate (or Director) General |
| DG–DEVCO | Directorate-General for International Cooperation and Development (now DG INTPA) |
| DG/ACTA | Directorate General of Agricultural Land Development and Conservation |
| DIAEA | Directorate of Irrigation and Rural Infrastructure, Moroccan Ministry of Agriculture |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| Engees | National School for Water and Environmental Engineering |
| ERCC | Emergency Response Coordination Centre, EU |
| EA | Environment Agency, UK |
| ESCAP | Economic & Social Commission for Asia and the Pacific, UN |
| ESN | Food and Nutrition Division, FAO |
| ETSI | European Telecommunications Standards Institute, EU |
| FAO | Food & Agriculture Organization, UN |
| FEICOM | Special Council Support Fund for Mutual Assistance, Cameroon |
| FEXTE | Fund for Technical Expertise and Experience Transfers, AFD |
| FFEM | French Facility for Global Environment |
| FRH | Flanders Hydraulics Research |
| GEMI | Water Governance in Mbam-et-Inoubou |
| HET | Hole Erosion Test |
| Gescod/Ircod | Great Eastern France region solidarity and cooperation for Development (Regional Institute for cooperation and development) |
| IRD | French National Research Institute for Sustainable Development |
| ISF | Engineers without borders |
| IWHR | Institute of Water resources & Hydropower Research, China |
| IWMI | International Water Management Institute |
| KWL | Kerr Wood Leidal |
| MARHP | Tunisian Ministry of Agriculture, Water Resources and Fisheries |
| MELCC | Ministry of Sustainable Development, Environment, and Fight Against Climate Change, Canada |
| MIRA | Multi-cluster/sector Initial Rapid Assessment |
| MRC | Mekong River Commission |
| NASA | National Aeronautics & Space Administration |
| OIEau | International Office for Water |
| ORMVA | Regional Agricultural Development Office, Morocco |
| PACTE | Programme of adaptation to climate change in vulnerable territories in Tunisia |

| | |
|---|---|
| PIA | Investments for the Future Programme |
| PLANISSIM | Sanitation planning through simulation and participatory modelling |
| PNEEI | National Irrigation Water Saving Programme |
| pS-Eau | Water Solidarity Programme |
| RAP and RMP | Riparian Action Programme and Riparian Monitoring Programme, city of Calgary, Canada |
| PRC | People's Republic of China |
| SDEA | Water and sanitation association of Alsace and Moselle |
| SEEN | Department of experimentation, testing and standardisation (DIAEA), Moroccan Ministry of Agriculture |
| SET | Science, Water & Territories, INRAE's journal |
| SLM | Subregional Office for Mesoamerica, FAO |
| WWTP | Wastewater treatment plant |
| SWOT | Surface Water and Ocean Topography |
| SYCOMI | Association of the municipalities of Mbam-et-Inoubou |
| SYKE | Suomen ympäristökeskus \| Finnish Environment Institute |
| UNDAC | United Nations Disaster Assessment & Coordination |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UN | United Nations |
| UNOCHA | United Nations Office for the Coordination of Humanitarian Affairs |
| WaSaf | Water Sources in Africa |
| WasteWAG | WasteWAter Game |
| WWF | World Wide Fund for Nature |
| WSCS | World Sturgeon Conservation Society |

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