

PROJECT IDEA

1. Programme and calls

- WP 2014-2015 of the Social Challenge 5 Climate action, environment, resource efficiency and raw materials.
- Call – Water Innovation: Boosting its value for Europe:
- WATER-5-c-2014: Development of water supply and sanitation technology, systems and tools, and/or methodologies
- <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2584-water-5c-2015.html>

2. Timetable / Deadline

- WATER-5-c-2015: Development of water supply and sanitation technology, systems and tools, and/or methodologies
 - First stage: 16 October 2014
 - Second stage: 10 March 2015.

3. Title of the Project

Identification of Emerging Contaminants and Their Transformation Products on Integrated Water Cycle.

4. ACRONYM

IECs-TPs-IWC

5. Context

North-Africa

This area is the most water-scarce region of the world. Water management problems are already apparent in the region. Aquifers are over-pumped, water quality is very bad, and water supply and irrigation services are most of the times lacking. This has consequences for health, agricultural productivity, and the environment. Discussions about water lead to tension within communities, and people tend to migrate due to bad water services in the hope of better opportunities. Investing in water is expensive and public funds could often be used more efficiently elsewhere. The population keeps growing, which makes the per capita water availability drop even more. Furthermore, due to climate change there will be more frequent and severe droughts and floods in the future.

Regional water professionals agree that the focus should be more on integrated water resources management and regulation than on provision of services. The region has seen some important advances, but the progress has been slow. Countries have delayed tackling important water reforms, like reducing subsidies that encourage inefficient water use. Voices of population groups like women, children and environmentalists are not heard sufficiently by politicians. Some of the most important factors that affect water outcomes lie outside the responsibilities of traditional irrigation, water supply, and environmental agencies. Factors as trade, energy pricing, real estate, credit, and social protection, have a major impact on decisions of farmers and investors. So the incentive to use water well should increase by changing non-water policies as well.

The region made considerable progress in securing water supply the last decades. The public sector played a leading role in managing big investment programs in order to use water for household and industrial purposes as well as to secure food supply through domestic production. Nowadays most countries are capable to store a big amount of surface water in dams and reservoirs. However, further progress is needed to improve accountability in the water sector to help intermediate between citizens and governments or service providers, by providing information, voice, and access to justice.

Northern Africa has some large water basins, like the Nile, that are shared by several countries. Groundwater aquifers play a vital role in meeting basic water needs. Most people live along the Mediterranean coast and the Nile, where rainfall is highest as well, since the conditions in the Sahara desert are harsh. Across the Maghreb, awareness has been raised about the consequences of climate change. This has resulted in the development of a vulnerability and adaptation project. It aims to achieve a regionally integrated adaptation network, strengthened national capacities, development of national adaptation plans and deepened public awareness.

Sub-Saharan

About 75% of sub-Saharan Africa's water resources are concentrated in eight major river basins. Climatic and environmental changes have considerably reduced fresh water quantity over the past 20 years. Therefore, most countries in this region face severe water shortage. Another reason is 'land grabbing'. Property deals between sub-Saharan African countries and foreign companies often include selling rights to inland water resources. The property will be mostly used for extensive, water-demanding agricultural activities, which worsens the water scarcity even more.

The water in this region is of exceptionally poor quality. Due to pollution and unreliable supply and sanitation infrastructure, only a small percentage of the little water that is available can be used for human consumption. Almost half of the population in these countries suffers from water-borne diseases, such as cholera and infant diarrhea. Sub-Saharan Africa has the lowest level of sanitation. 45% of the population uses shared or dangerously inadequate facilities. Lack of funding is not the main cause for this, but lack of human capital, poor infrastructure, and inadequate legislation.

Water stress created by inadequate sanitation is worse in regions with higher population densities. Since there is a rapid urbanization process in sub-Saharan Africa, it will only get worse. Another reason contributing to water shortages is Africa's economic growth, which causes more pollution. Nearly 85% of its fresh water resources are used for agricultural purposes. Due to weather conditions and insufficient irrigation it is likely that agricultural productivity will fall up to 50% in the next decade, which affects prospects of greater social and economic development negatively.

Growing pressure on water resources can lead to domestic unrest, such as inter-state tensions or even armed conflict. 17 major river basins span 35 countries, which makes the cooperation to manage cross-border natural resources difficult.

6. General description of the project (Max. 2 pg.):

The current consumption habits of our society generate a series of waste substances and contaminants that are just being recently detected and may represent a new environmental problem. Such compounds, known as 'emerging contaminants', have not been yet taken into account in regulatory frameworks for control and prevention of environmental pollution. Emerging contaminants can be broadly defined as any synthetic or naturally occurring chemical or any microorganism that is not commonly monitored in the environment but has the potential to cause known or suspected adverse ecological and(or) human health effects. In some cases, release of emerging chemical or microbial contaminants to the environment has likely occurred for a long time, but may not have been recognized until new detection methods have been developed. In other cases, synthesis of new chemical compounds or changes in the use and disposal of existing chemicals can create new sources of emerging contaminants. Of all the emerging contaminants, probably of most concern and study in recent years are pharmaceutical drugs, or pharmaceuticals.

Chemical pollution of waste, superficial and drinking waters can pose a serious hazard to the aquatic environment, with negative effects such as accumulation of pollutants, acute and chronic toxicity in living organisms, habitat and biodiversity loss, and pollution of drinking water sources; effects that potentially constitute a threat to human health. Many pharmaceutical drugs are emitted to surface waters, by discharges from industries and wastewater treatment plants and depots from cattle, or additives in aquaculture foods. The concentrations of pharmaceuticals in waters depend on various factors:

- Amounts consumed by local population
- Unaltered fractions excreted by individuals (faeces, urine) that may end up in effluents absorbed to sludge of wastewater treatment plants (WWTP)
- The volume of the river basin
- Absorption and degradation processes in the environment.

In this line, this project proposal plans to study the particular case of different regions in Africa, studying the depuration process of emerging pollutants (EP) in their conventional WWTPs (Wastewater Treatment Plants) and WTPs (Water Treatment Plants), taking the system as a whole. The project will also devote efforts to the detection of new transformation products (TPs) formed in such water treatment plants, as well as to apply targeted analytical methods for this purpose using the QTOF high resolution instrument, development of innovative immunomagnetic – based capture methods for the concentration and detection of nucleic acids and pathogens and development of water tests. Finally, the project could also include an aspect of "sewage epidemiology", using concentrations in sewage to calculate usage of pharmaceutical compounds.

7. Main objectives (general and specifics):

The first objective of this proposal is to obtain reliable measurements of the concentrations and annual loads of pharmaceuticals and the transformation products, and to outline the trends of any seasonal variations on the IWC in the geographical areas (AFRICA) of this study.

Additionally, other objectives of this project are:

- Predicting the removal of EP in the WWTPs and WTPs by statistical models and artificial intelligence methods.
- To calculate the yields of the elimination processes of pharmaceuticals in WWTPs, in order to development of innovate methods for removal these contaminants.
- Screening and quantification of pathogens in field water samples using optimized immunomagnetic capture and molecular detection methods.
- To calculate usage of EP by studies of sewage epidemiology.

8. Main actions / activities:

WP1. Preliminary studies:

The first objective is to create a database of pharmacological compounds and their transformation products (TPs) potentially present in waste, superficial and drinking waters. The second objective is the development of innovative water tests based on immunomagnetic capture, real-time PCR and sequencing methodologies that will enable the accurate detection and quantification of emerging pathogens.

Expected outcomes:

- Analysis of the state of art.
- Development of a bibliographical research data base.
- Development of an integrated molecular-based assay, coupling innovative concentration and detection methods, for the evaluation of emerging pathogens in water samples

WP2. Study of WWTPs

The main objective of this WP is to identify and quantify emerging contaminants and their transformation products in WWTPs, in order to calculate the yields of the elimination processes of pharmaceuticals in WWTPs, and to investigate any existing correlation between experimental data with the volumes of prescribed and sold pharmaceuticals in the regions. The yields of the elimination processes of selected pathogens in WWTPs will also be assessed by comparing their loads in influents and effluents.

Additionally, we will study new and innovative ideas for removal of micro-pollutants during wastewater treatments. And the last objective is to perform the detailed genetic characterization of the pathogens detected in water and compare their profiles with the ones deposited in national reference human and animal databases.

WP3. Case Studies in surface waters

The main objective of this WP is to obtain reliable measurements of concentration and annual loads of selected emerging contaminants, and to outline the trends of any seasonal variations in the participating surface waters. In addition, screening, quantification and toxicity evaluation of emerging contaminants will be performed using bioassays and passive samplers.

WP4. Study of Drinking waters

The main objective of this WP is to identify and quantify emerging contaminants and their transformation products in WTP in different European regions (to be determined). Additionally, we will select and quantify pathogens in field samples using optimized immunomagnetic capture and molecular detection methods.

9. Profile of partners

We are building up an international Consortium for this project proposal:

1. Universities - Research groups and technological centers specialized in water treatment and management.
2. Drinking Water Companies
3. National Water Public Authorities
4. International Development Agencies

Geographical scope: African and European Institutions.

10. Foreseen duration and budget

- Duration: Between 2 and 4 years.
- Foreseen Budget: 2.000.000 €.

11. Contact details

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