Technologies for Water Recycling and Reuse in Latin American Context:
Assessment, Decision Tools and Implementable Strategies under an Uncertain Future

FP7 - ENV.2011.3.1.1-1

Final publishable summary report

December 2015

Executive summary

In order to be able to maximize the benefits from reuse and recycling technologies projects a larger systemic analysis of the environment is needed, an enlargement of the traditional narrow planning and management approaches, and a growing sensitivity to decision-making associated with multi-objective, multi-purpose actions and multi uses parameters. However, the problem is not centered on the lack of treatment techniques and technologies, but rather on how such schemes may become more efficient and implementable. COROADO will both develop new and adapt existing concepts and operational frameworks and produce a web-based decision support system (DSS) for reuse and recycling technologies in the context of integrated water resources management, taking into account long-lasting changes, and at the same time addressing environmental and ecosystem integrity. Climate change and water scarcity in relation with the pertinent technologies will also be addressed. The web based DSS, which will be used as a Communication, Capacity Building and Research Tool will present a richer menu of options from assessment and planning to implementation, monitoring and evaluation. The system will be designed to present critical information in an interesting and efficient manner, offering an engaging learning experience. Thus, COROADO would focus on:

a) Developing tools for analyzing reuse and recycling technologies and trade-offs

b) Addressing non-linearity and resilience

c) Promoting and organizing active participation of stakeholders and capacity building efforts.

The project will include deliberate efforts to ensure knowledge and capacity exchanges between the project sites, and among Latin American, European and other parts of the world facing similar conditions, by introducing exchanges based on research in the four study sites and generated outcomes with a strong emphasis in dissemination. The effort may develop an understanding of needed transitions of governance and policy systems in order to mainstream such water reuse and recycling technologies implementation, providing a continuous and appropriate set of guidelines, and manuals so that policy relevant standards may be applied by end users and policy makers and after the completion of COROADO, without any further support.

Summary description of the project context and the main objectives

The comprehensiveness of assessing and implementing water reuse and recycling technologies has been the subject of controversy and debate in the current literature. It has been recognized, however, that in order to be able to maximize the benefits from any water resource project, a larger systemic analysis of the surrounding environment is needed; a broadening of the traditional narrow planning and management approaches, and an increased sensitivity to decision-making problems associated with multi-objective, multi-purpose actions and multiuse/users considerations. The framework for implementing water reuse and recycling technologies would include a mix of such considerations as natural conditions (e.g. aridity, global change); variety of uses (irrigation, municipal uses, water quality, effluent control, etc.); sources of supply (surface, groundwater, mixed); and sociodemographic conditions (such as population growth, urbanization, industrialization, etc.).

Latin America's wealth of water (about 26% of the Earth's total) represents an important resource and should in theory provide a firm foundation for adaptation to support human well-being even under conditions of change. Latin America's water resources provide and support many human and natural benefits, or ecosystem services. These benefits include clean water, fresh air, fertile soils, hydropower, food, timber, grazing lands as well as a range of cultural services and values. Furthermore, water also provides the range of options through which ecosystems and species, as well as human users of ecosystems, can adapt to changing climatic and other environmental conditions. Careful management of this "adaptation base" is of central importance in all efforts to build Latin American resilience to climate change and meet the Millennium Development Goals (MDGs). The UN's Millennium Ecosystem Assessment, Convention to Combat Desertification and Framework Convention on Climate Change have all highlighted the importance of water and ecosystem services in supporting and enhancing human well-being.

Currently, the development of Latin America's water resources is in many watersheds/catchment areas far from sustainable, allowing vital assets to degrade and leaving the continent more vulnerable to future change. Key constraints to integrated management include inadequate knowledge of water systems and water technologies components, and the potential for non-linear ecological change, as well as an absence of appropriate tools and the capacity with which to interpret the data and manage complex social-ecological interactions. The current situation seems one in which policy, decision makers and stakeholders are often usually uninvolved and unaware of the rapidly growing field of water reuse and recycling research and knowledge. Furthermore, the expertise, data and methods developed are often not in a format useful to the decision-makers which need tools and information who they can apply in their day to day activities.

Thus, the overall Objective of COROADO project was to assess the potential of various water recycling and reuse technologies for Latin America, quantify the actual needs, benefits and costs of those technologies, evaluate their social acceptance, and provide affordable, efficient and effective solutions for water supply and sanitation in rural and agricultural areas in the context of climate change and water scarcity mitigation. Emphasis was given to address the complexity between technological options and societal needs, through applying an ecosystem approach in Integrated Water Resources Management (IWRM) frameworks and building a methodology embedding a knowledge base and a toolbox for enhancing the capacity for adaptive governance and management in the area. This approach has led in presenting technology developments that integrate engineering, physical, and ecological sciences, while at the same time integrating the water reuse and recycling infrastructure. In this context, such issues have been compiled into a web based decision support system (DSS) that can show-case best practice and models that may be applied in a variety of environmental and socio-economic conditions within the Latin American region.

The importance of water systems (from river basins up to individual stream level) for fresh water, food, energy and recreation is more than apparent, yet there is increasing evidence that degradation of water systems is proliferating in recent years. However, a distinction has to be made between degradation of water per se in regards to quality/quantity and degradation or inadequate infrastructure and technologies. Aging related infrastructure and failures and at the same time technological development and breakdowns pose immediate needs to assess reuse and recycling technologies and its ability to meet current and future demands. Policy instruments and guidelines for implementation are also needed in order to make any technological solutions applicable and efficient. Such policy development should coincide with ongoing efforts to incorporate reuse and recycling technologies. This significant intersection of infrastructure and environmental degradation may provide unprecedented and largely unappreciated opportunities for water reuse and recycling technologies. In this regard, COROADO focused on trying to solve the existing gridlock of three areas:

- Assessing the reuse and recycling technologies for Latin America (water and wastewater treatment plants, irrigation systems, etc.). Rapid growth of population, economy and infrastructure has been experienced in the last century in many parts of the continent. Furthermore, such traits are exacerbated by climate changes and water scarcity. Thus substantial funds would be required in order to reach again acceptable levels of safety and function for appropriate water supply. Such funding seems difficult to be appropriated, but it may seem that societies may have no choice, but to pay the price for the years to come. Reuse and recycling technologies could play a crucial role in a sustainable solution;
- Degradation in both quality and quantity of water systems and the loss of associated ecosystem services. Significant ecological degradation is associated, at least partially, on the water use patterns in relation to infrastructure expansion. Irrigation networks, water conveyance structures and roads increase sediment erosion, fragment habitat, and facilitate the spread of invasive species. Coastal areas and estuaries have been altered due to urban sprawl. Dams and levees restrict fish migration and have drastically altered river basins flow regimes. Implications of infrastructure degradation on ecosystems, (treatment plants effluents, silted up dams etc.) are compounding to the problems. Furthermore, offshore platforms discharge waste and release atmospheric pollution;
- Incorporating reuse and recycling technologies in an integrated management scheme. So far, such efforts have often been limited in scale, and their effectiveness is frequently unclear often because they do not usually address the system as a whole. However, it seems that there is growing need for, political will,

education and, further funding to include the integrated management of water resources and the capacity of ecosystems to maintain generation of a broad range of services in the face of uncertainty and change.

Special consideration has been paid to the social and economic aspects linked to the exploitation of potentially proposed new technological options. In addition to that COROADO facilitated the change from a culture dominated by "technological" solutions to more integrated approaches, supportive to local needs and supported by the public. More explicitly COROADO focused on the following key elements, which may form the enabling environment for the formulation of the objectives:

- A Case Study approach: The project worked in four different case studies, which constitute a variety of technological, social and economic types of water resources areas having at the same time a reuse and recycling potential across Latin America, and which ensured a substantial participation of industrial partners and end-users.
- An integration of multi-disciplinary expertise to address complex technical, water resources, social, economic and physical problems. An effort was made to include a high level of flexibility in the project.
- An identification and combination of risks, problems sources in relation to reuse / recycling technologies, and of the cumulative, synergistic and long-term impacts resulting from agricultural practices, existing or developed water infrastructures, urban development and/or industrial activities. A search for more robust technologies has been included together with the evaluation of the acceptability of such reuse and recycling options to end-users.
- An overview of the current state-of-the-art approaches to reuse and recycling technologies, vulnerability assessment on a system scale to changing social and economic conditions, with special attention to past successful and unsuccessful water reuse/recycling efforts and management attempts.
- An approach to determine the "perception" of water reuse and recycling technologies from different stakeholder groups, and their implication for decision-making processes and conflict management. The central role of vulnerability and resilience on the pertinent systems was also part of the process.
- A sensitivity analysis of the various indicators used to predict reuse and recycling technologies implementation risks, to obtain an appropriate set of simple, low cost and efficient key indices related to all the categories of indicators (drivers, pressures, state, impacts and responses, DPSIR) and possible nondeterministic interrelations beyond the more linear DPSIR approach.
- An emphasis on suitable IT support, with the development of a web based modular knowledge base which facilitated the integration of research activities, dissemination of research progress and communication; incorporating the prototype of an innovative, highly flexible and open web based toolbox to support anticipatory planning processes from policy making to implementation and providing operational guidelines.
- A widespread suitable dissemination, training and education programme within the case studies areas, in order to inform and extend the involvement of the stakeholders (and the public in general) in COROADO, and communicate research results widely across Latin America, Europe and beyond.

In this regard, the theoretical background of the project developed a methodology for the application and evaluation of the pertinent reuse and recycling technologies and policies. The assessment of such technologies and policies in real conditions in the case study areas, should improve decision-making capabilities through the analysis of quantitative and qualitative results and impacts, the evaluation of the entire gamut of potential outcomes and the suggestion of appropriate solutions. In this effort the key objectives may be underscored in the following:

- To develop capacity and methods for assessing, mapping and valuing multiple water reuse and recycling technologies, across space and time for informed integrated management.
- To develop understanding and tools for building resilience and incorporating trade-offs into water reuse and recycling technologies implementation though integrated management of water resources, in the face of uncertainty, unexpected events and climate change.
- To develop an understanding of needed transitions of governance and policy systems in order to mainstream such water reuse and recycling technologies implementation in decision-making processes
- To develop and disseminate a web toolbox and share lessons learned regionally to the international audience and to facilitate partnerships among local and regional and national institutions.
- The design of appropriate environmental planning and applicable investment strategies, based on the bottom-up case-study driven approach for each case study and by expansion to other similar areas, in order to select the most suitable technologies to be implemented.
- The overall approach which would reduce fragmentation in the efforts to implement reuse and recycling technologies, techniques and strategies, involving and empowering stakeholders at different levels and at different stages of an anticipatory planning process.
- Finally, providing a continuous and appropriate set of guidelines, manuals and educational material so that policy relevant standards can be applied by end users and policy makers upon the completion of COROADO, without any further support.

Such an approach may enable decision-makers to assess the immediate and long-term effectiveness of reuse and recycling technologies and to design appropriate environmental planning and optimal investment strategies at local and regional level, in line also with the requirements of various water related EU and other International policies.

Description of the main S & T results/foregrounds

The overall approach of the COROADO project is comprised as follows:

- **Developing tools for analyzing reuse and recycling technologies and trade-offs**

A major challenge for the research community is to develop good workable methods for how to analyze reuse and recycling technologies, i.e. to determine where they are generated and at what scales, how they change under different scenarios, what their rates of the expected lifetime are and what trade-offs are involved. Currently there are not so many tools available to enable decision-makers and water resource user groups to view, assess and value reuse and recycling technologies and the resultant trade-offs in their decision-making processes. This is a crucial gap. Furthermore, multiple types of trade-offs need to be considered: temporal (benefits now – costs later), spatial (benefit here - cost there), beneficiary (some win - others lose) or related to services (manage for one service – lose another). It has also been suggested that major water resources degradation tends to occur as "syndromes of simultaneous failure" related to anthropogenic and natural pressures. Such possibilities of moving towards "winning more and losing less" should be explored, by e.g. improving access to information on reuse and recycling technologies, integrating water resources management into national and local decision making and in ensuring equity and strengthening rights of local people over their resources.

- **B. Addressing non-linearity and resilience**

A lack of understanding and tools to address the potential for abrupt, non-linear change makes the management of ecosystems and their services particularly challenging. This is especially true in the context of the Latin America, where variability and surprise events associated with nonlinear dynamics are becoming increasingly common. COROADO intended advance scenario methodology for application to operational questions of reuse and recycling technologies and water resources management. In addition, to carry our resilience assessments in order to underline potential threshold vulnerability points that may trigger non-linear change and explore potential policy options for building resilience.

- **C. Active participation of stakeholders and building capacity**

The management of reuse and recycling technologies and their implementation not only requires information, but also well-informed stakeholders, decision makers and managers with adequate knowledge and resources to make decisions, and ensured enforcement of these decisions. There is currently an enormous gap in the region, especially at the local scale where water use decisions may have been devolved with limited human, technical and financial capacity.

The COROADO has been divided into a logical series of interrelated Working Packages (WP's) each with specific goals, tasks, deliverables and milestones to be achieved. The conceptual visualization of the overall project structure and the basic interrelations and interdependencies are presented in Figure 1. The work plan has been divided in three phases in order to facilitate the approach and show the interrelations on a more complete and coherent way:

- PHASE 1: The Diagnostic Phase
- PHASE 2: The Implementation Phase
- PHASE 3: The guidelines development Synthesis Phase

Each phase was made up of a number of WPs. All of those phases were interrelated with WP1 Project management and WP9 Dissemination as shown in Figure 2. The first WP was devoted to project Management. WP2 inventorized the target areas and defined them in terms of their context. WP3 related Hydro – Geo information and prepared the data-bases. A harmonized data information system was also started in WP3 to contain all relevant information. WP4 produced analysis and assessment of reuse and recycling technologies in cooperation with the stakeholders. WP5 assessed water supply in agricultural areas. WP6 produced a web based Information Technology (IT) system with specific tools that integrate data and methods, the socio-economic and environmental aspects to assist in the implementation of reuse and recycling technologies. WP7 assessed those strategies with the tools developed in WPs 2, 3, 4, 5 and 6 in an integrated plan for the case study areas that focused on extrapolating on a larger scale. The results were being monitored using selected indicators and relevant measurement techniques. WP8 finally translated the reuse and recycling technologies strategies to practical guidelines for local and regional scale. WP9 disseminated the project results to relevant stakeholder audiences, decisions makers and the public at large.

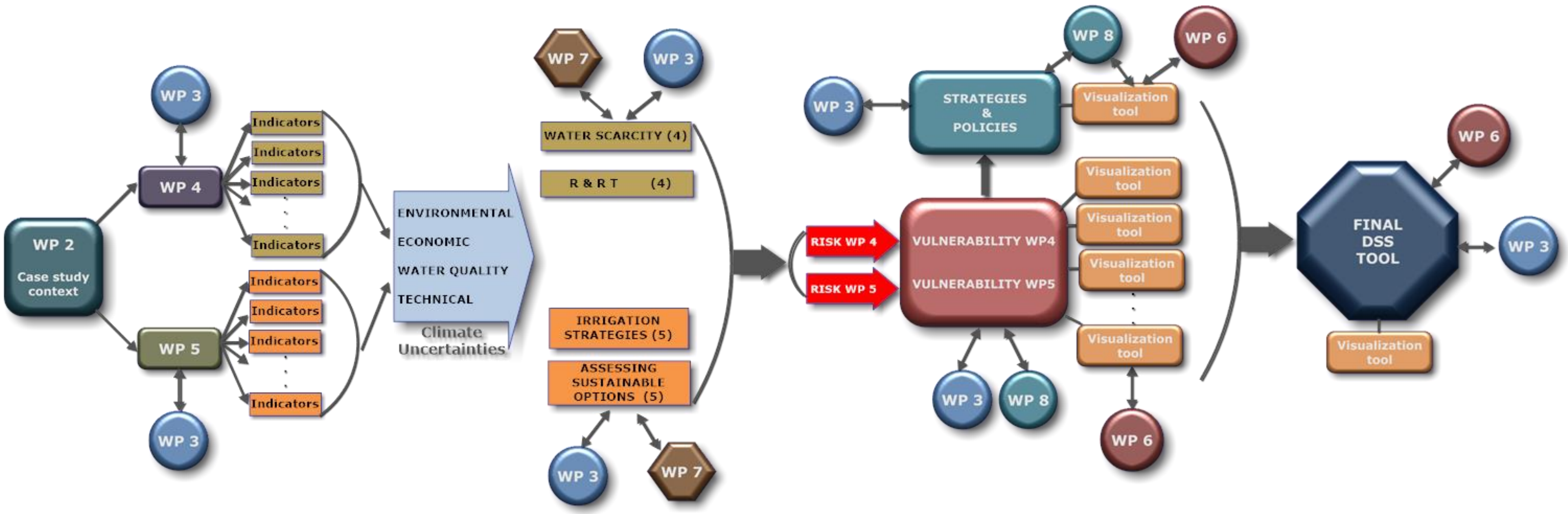


Figure 1. Interrelationship between the Project WPs leading to the Conceptual representation of the work plan.

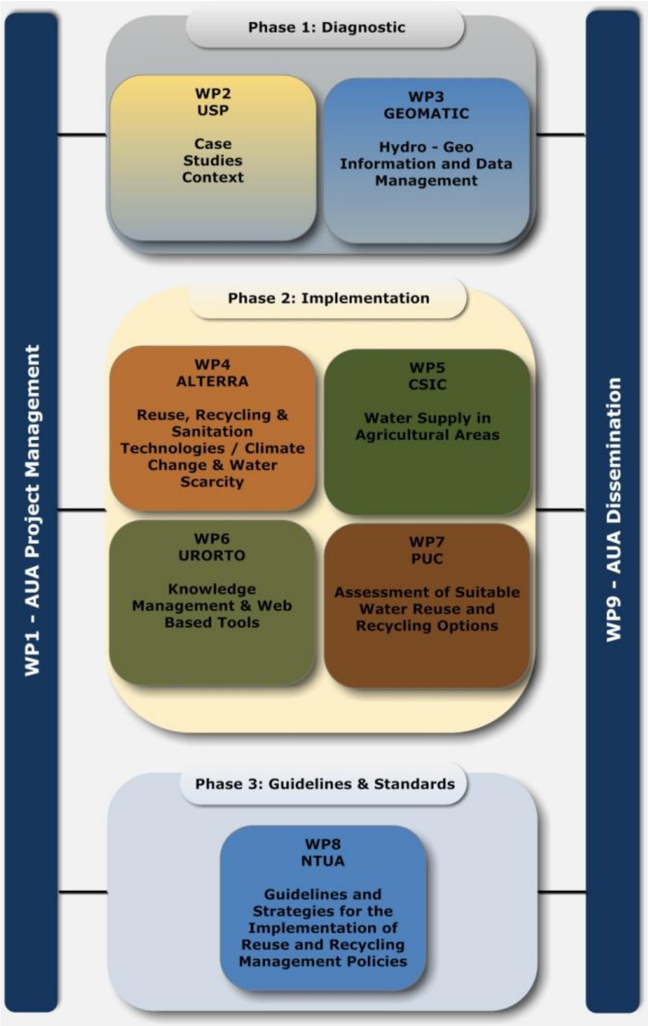


Figure 2. Interrelationship between the Project WPs including WP coordinators and participating partners.

The progress and results of the COROADO project are described in the 24 Deliverables and the 29 Milestones which are displayed in the Description of Work document (COROADO, 2011) as well as in a number of internal reports. According to the information which is provided in the produced material, the final results of the COROADO project as well as the components of those results are presented in Table 1. A brief description of the main results and their components is enlisted as follows:

Table 1. The main results of the COROADO project and their components

Main Results	
Web – Service Toolbox	D1.2 and D9.2
Scientific Workshops	D2.1, D2.3, D1.3 and D9.3
Design and development of the web-based DSS	D6.2

Components	
Geographical database design and Web GIS system development	D3.3
Development and application of a web-based geographical tool	D4.2
Report on a tool for assessing change of irrigation practices due to water scarcity and climate change	D5.3
Tools and instruments for supporting decision-making for water R&R scenarios and strategies	D7.2
Guidelines of Management Strategies and Policies on Reuse and Recycling Technologies	D8.3
Project Web portal	MS2
Manual of Indicators	Internal Report (WP4, WP5 and WP1)
Vulnerability Indices	Internal Report AUA and D8.1

A. MAIN RESULTS

1. Web – Service Toolbox

The web based Service Toolbox is the result of the contributions of several partners of the COROADO project, with different backgrounds and expertise, cooperating from within the main work packages. These contributions include the main results of the WP4 tool from 'Stage I assessment' (modules 1-5) and the 'Stage II assessment' tool POSEIDON (module 6). Included in the web based Service Toolbox are also the Guidelines on Management Strategies & policies for the implementation of water R&R technologies that are to be reported in deliverable D8.3 (Assimacopoulos et al., 2015b).

The web based Service Toolbox will help to introduce or enhance (Karavitis et al., 2015c,d):

- Identification, evaluation and improvement of the already applied water reuse and recycling technologies and techniques and incorporation of appropriate new ones in the case study areas in order to develop effective and applicable policy options in Latin America.
- Resilience and capacity building policies to facilitate integrated management of water resources in the face of uncertainty, unexpected events and climatic vagaries.
- Water supply and demand policies as well as policies related to the efficient use of water. Such policies that promote the sustainable use of water, enclose a number of sub-sectors including pricing and cost recovery policies, demand and conservation policies, etc.
- Environmental policies that will aim and promote the use of recycled water.

2. Scientific Workshops

The COROADO project conducted two series of Stakeholders Workshops in the case studies. The dates of the corresponding workshops per case study are presented in Table 2.

Table 2. Dates of the workshops

Case Studies (Beneficiary)	First Series of Workshops	Second Series of Workshops
Brazil (USP)	June 27, 2012	September 26, 2014
Chile (PUC)	August 8, 2012	October 27, 2014
Argentina (UC)	August 31, 2012	October 27, 2014
Mexico (TDC)	July 5, 2012	October 16, 2014

The two series of Stakeholders had distinct and yet consecutive objectives to fulfill. In other words, the two workshops served as the two parts of a single process which progressed gradually. More specifically, the objectives of the First Stakeholders Workshop were to (Porto et al., 2012; Karavitis et al., 2015a,b):

- Inform the stakeholders about the objectives of COROADO project.
- Inform and facilitate the involved stakeholders understand the constraints and opportunities in their (natural and anthropogenic) environment in terms of water reuse and recycling technologies.
- Collect the perceptions of the stakeholders and evaluate their acceptance towards the potential actions and solutions (regarding water reuse and recycling technologies) in a water scarcity scenario.

Continuing the course of actions set by the First Stakeholders Workshop, the second round of the COROADO workshops aimed at (Porto and Dalcanale, 2015; Karavitis et al., 2015a.b):

- Demonstrating the developed draft version of the COROADO Decision Support System (DSS) to the invited stakeholders.
- Receiving feedback on the demonstrated tool and feed it to the pertinent Work Packages for the refinement of the final Decision Support System to be performed.

In order to fulfill the stated objectives, two sets of Workshop Guidelines had been developed and distributed by AUA with contributions from all the other beneficiaries.

3. Design and Development of the Web-based Decision Support System (DSS)

The COROADO web-based DSS is a complex and integrated tool which aims to be used as a tool for transition to reuse and rehabilitation strategies. The COROADO DSS serves the purpose of assisting the user, which can be a stakeholder like a water authority officer,

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

an interested party, an individual farmer, etc, in evaluating a region under two modes: a Vulnerability Assessment of the region using the Water Changing Conditions Vulnerability Index (WCC VI) and an Operational Evaluation of the system using the simple water balance model (SWBM) developed by the UPORTO team for the COROADO DSS. The Operational Evaluation makes use of a simple water balance model to quantify the needs of water of defined areas of the region (e.g. a city, an industry, agriculture areas, etc.) and to allocate the available water at sources to each demand node, following a set of priority and allocation rules (Maia et al., 2015). The COROADO DSS was designed to be a user friendly tool, relying in a smooth and seamless web interface, which presents itself to the user as transparent and simple to use. The definition of the vulnerability level was based on the selected indictors. The indicators analysis of the area leads to the selection of the appropriate waste treatment technologies and then to the implementation of R& R options. The calculating modules of the DSS run on the server side, which requires only an updated browser from the user side, and little computational power, to run the application. Three distinct main modules compose the COROADO DSS, each being built upon a multi-layer architecture as presented in Figure 3.

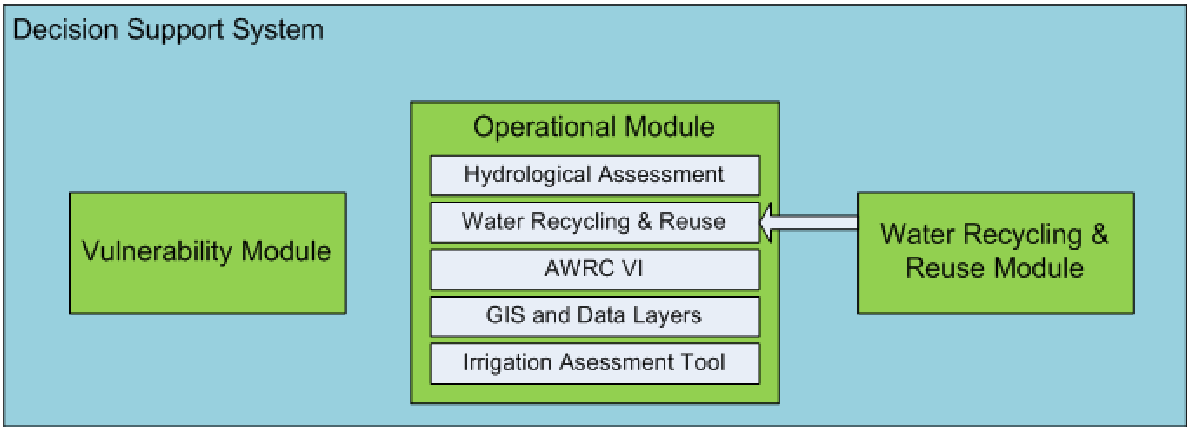
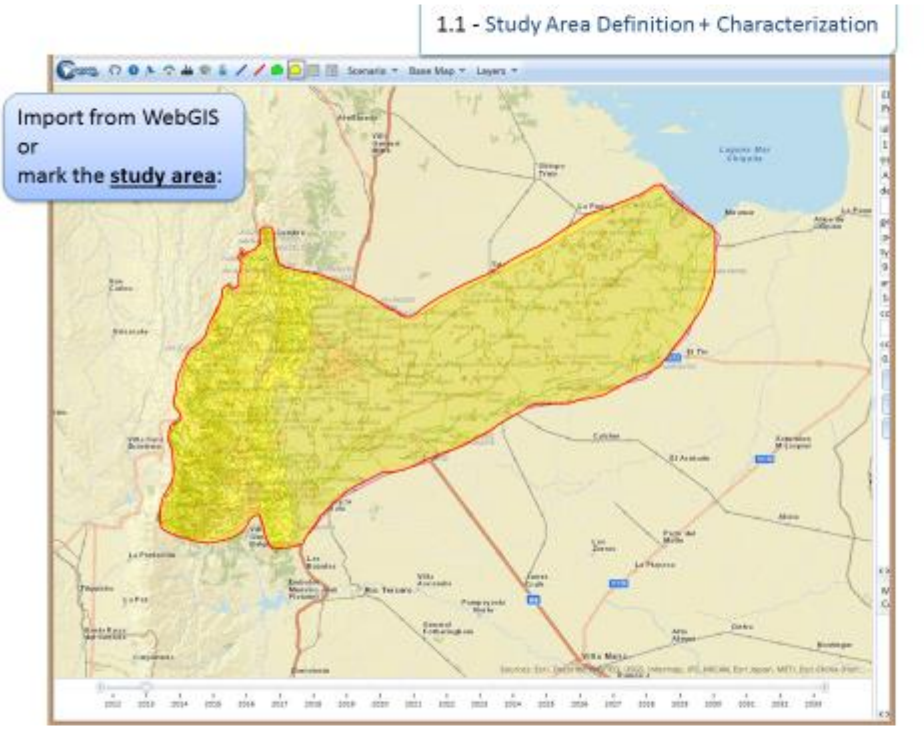
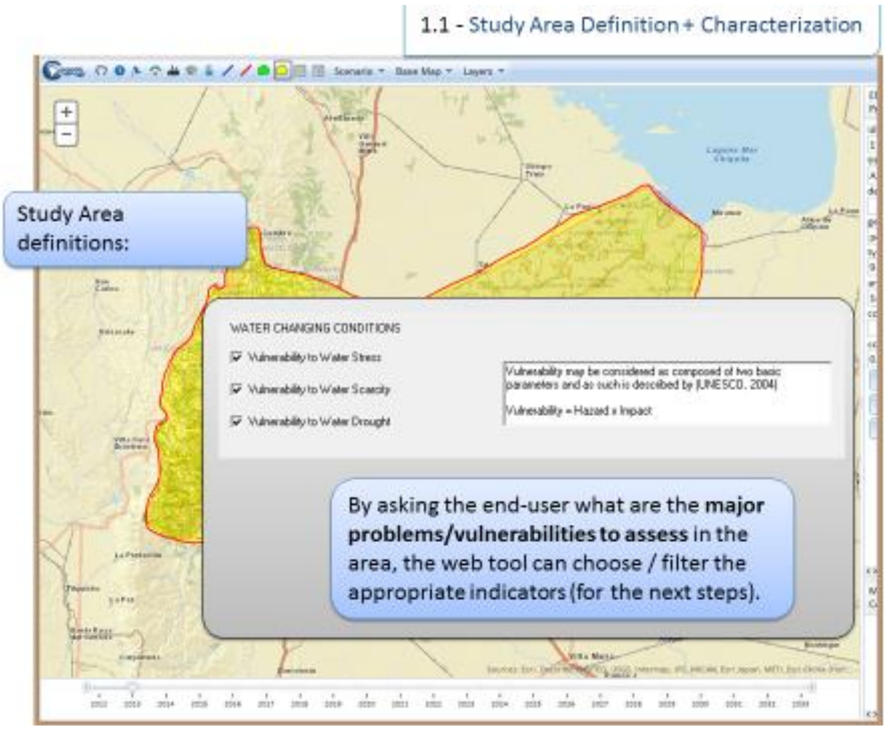


Figure 3. COROADO DSS structure

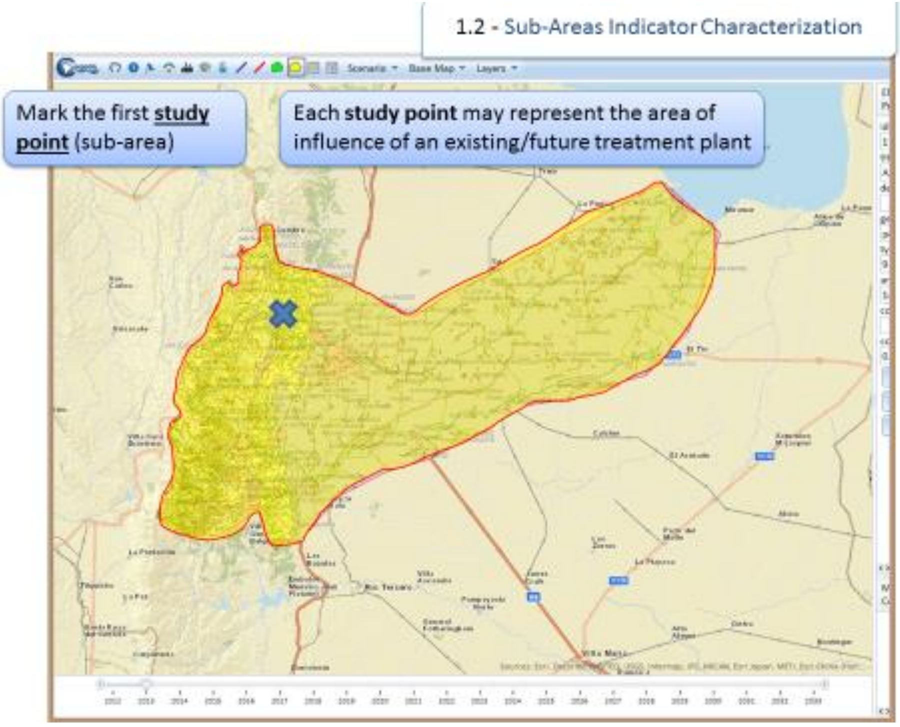
The CORAODO DSS includes contributions from partners of the all the remaining Work packages, of which the Water Changing Conditions Vulnerability Index (WP1), case studies data (WP2), ArcGis Server (WP3), PODEIDON (WP4), IATool (WP5), Multi-Criteria Decision Analysis (WP7) and the Adverse Water Related Conditions Vulnerability Index (WP8) are highlighted. The process of the vulnerability characterization and Wr section is visualized progressively in the screens presented in Figure 3.1. Two indicative screens of the DSS results for a typical and an optimum application are depicted in the following figures 3.2 and 3.3 respectively. The overall comparative results are presented in Figure 3.4. The results are then visualized in a GIS environment.

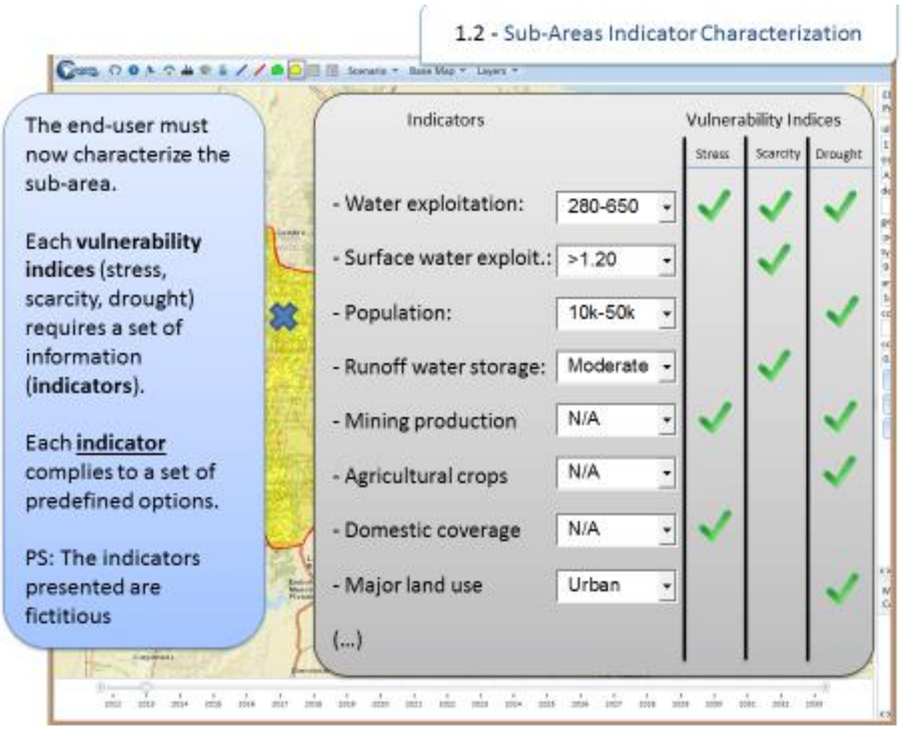
This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025



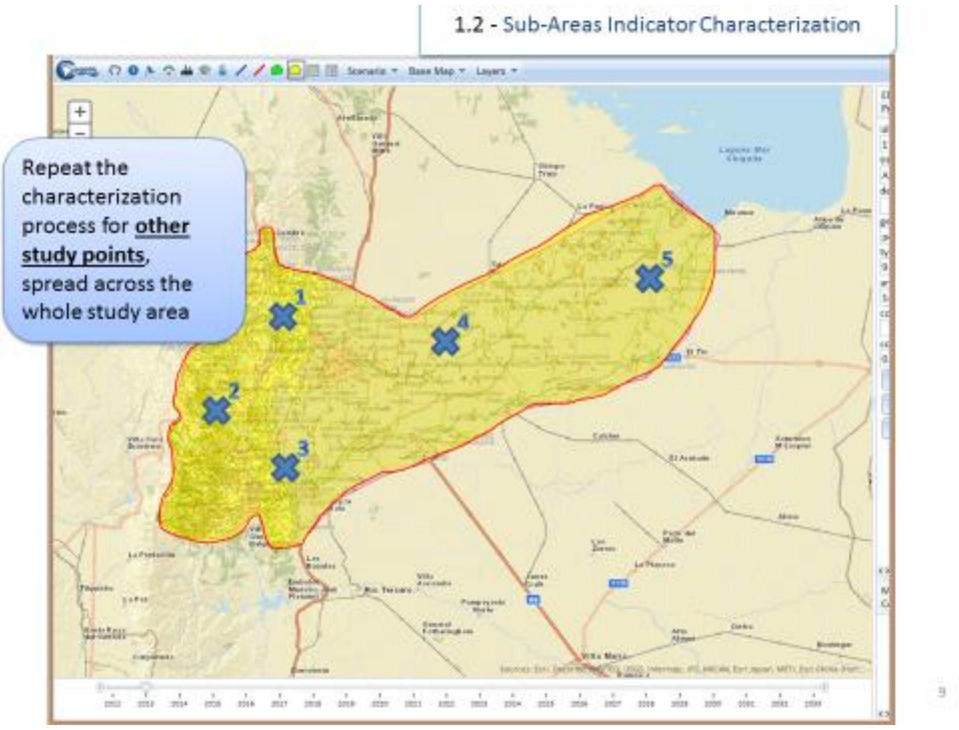


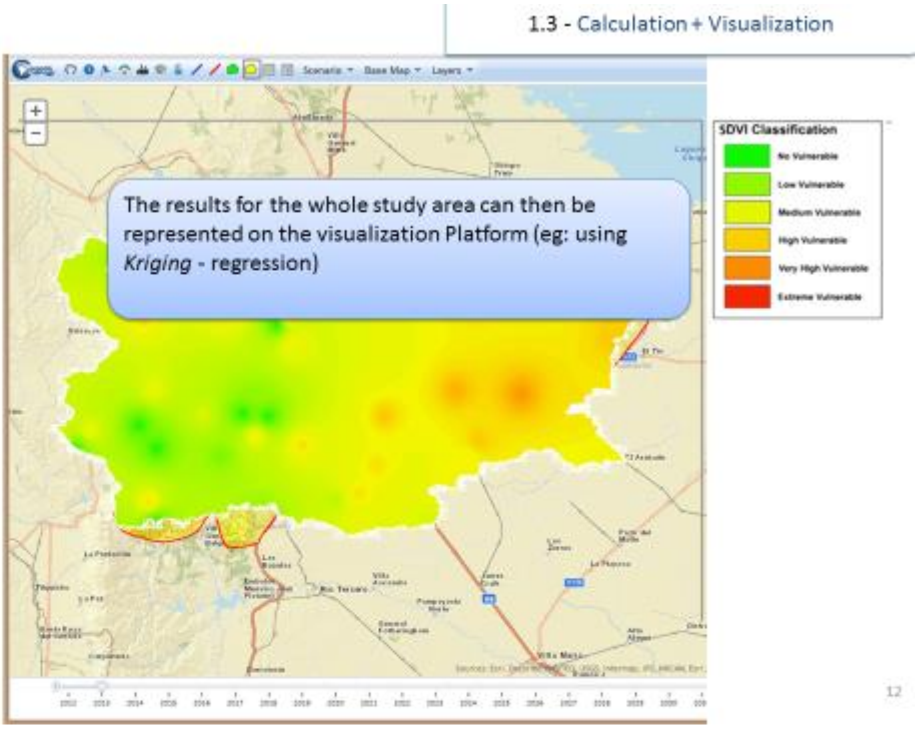
This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025



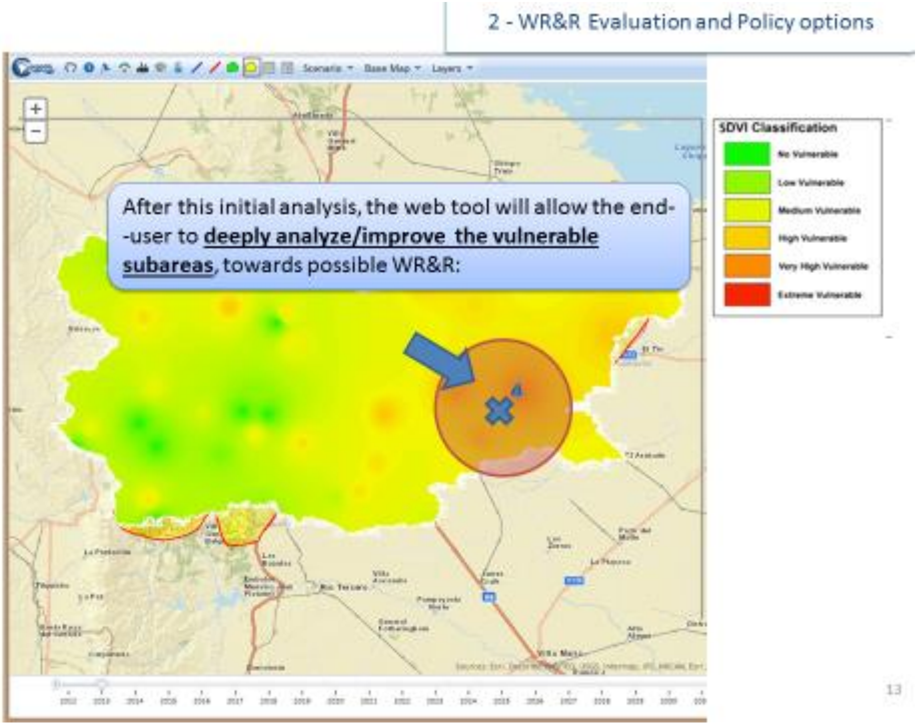


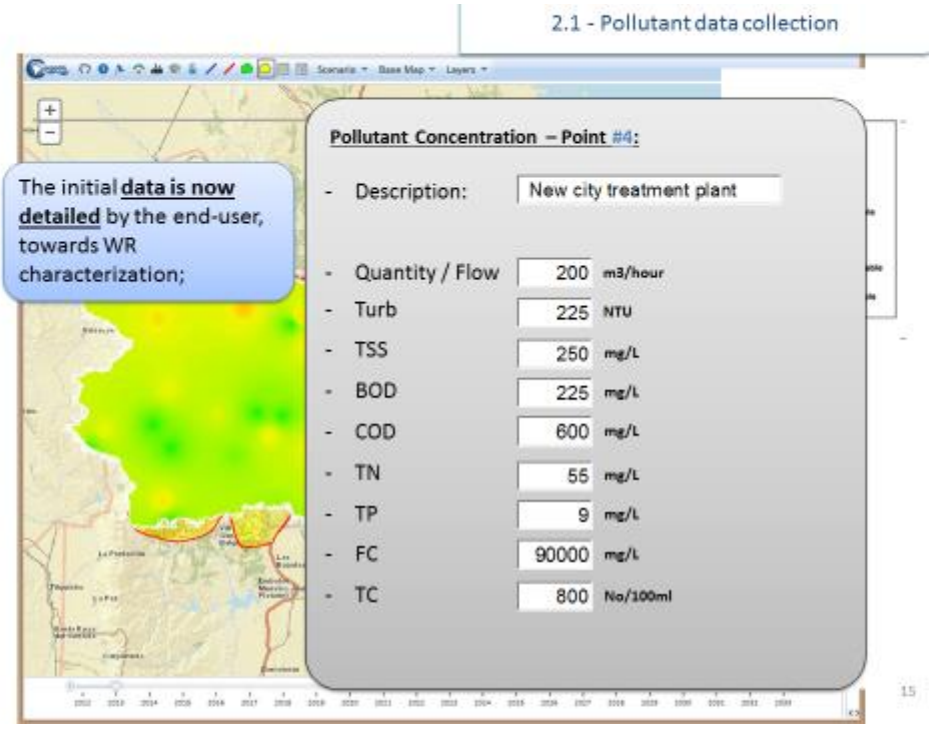
This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025



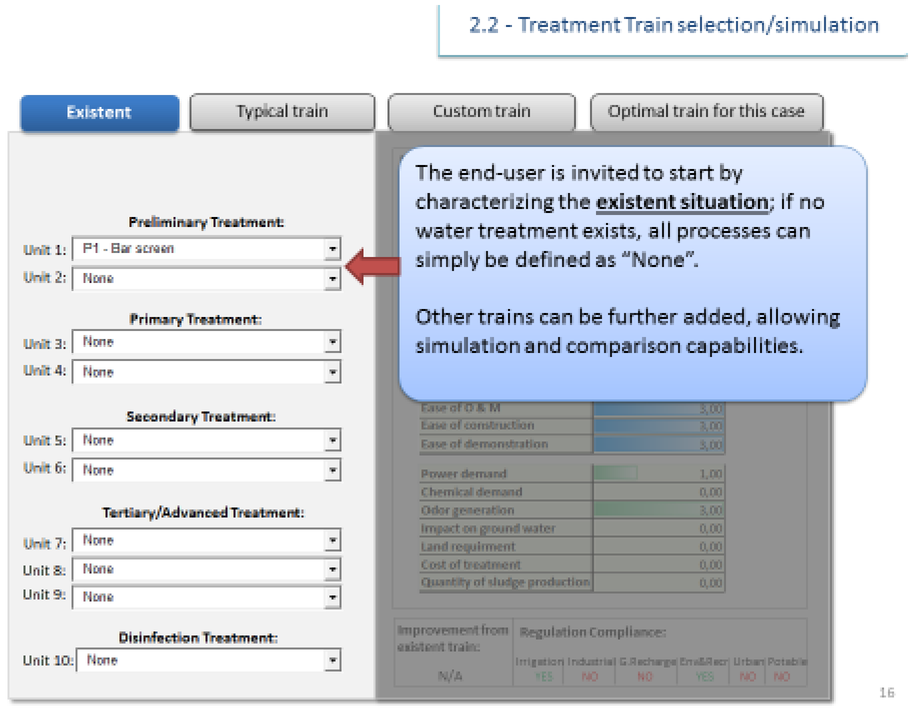


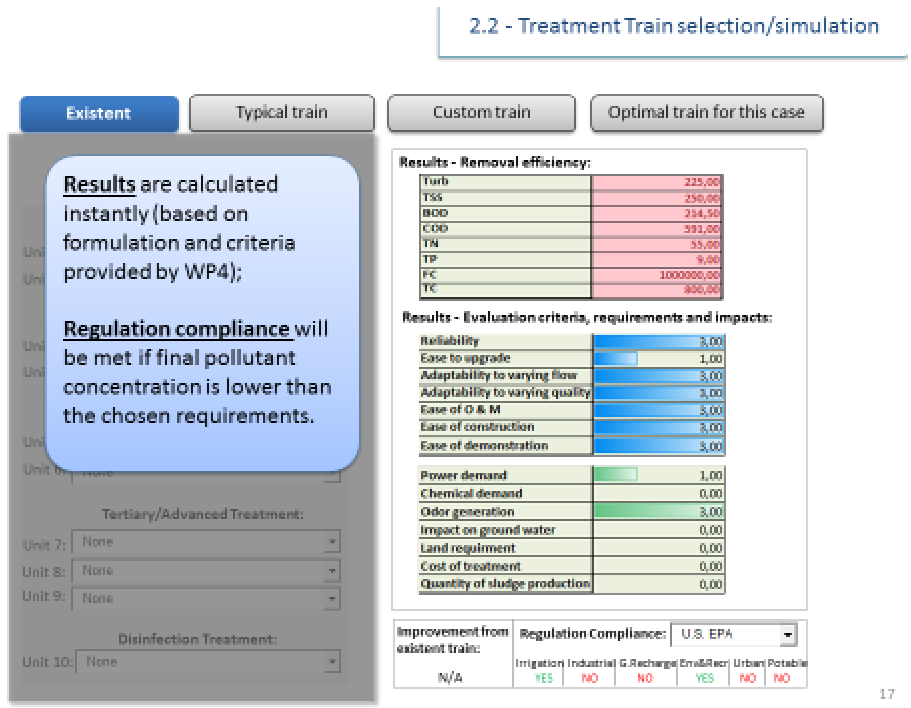
This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025



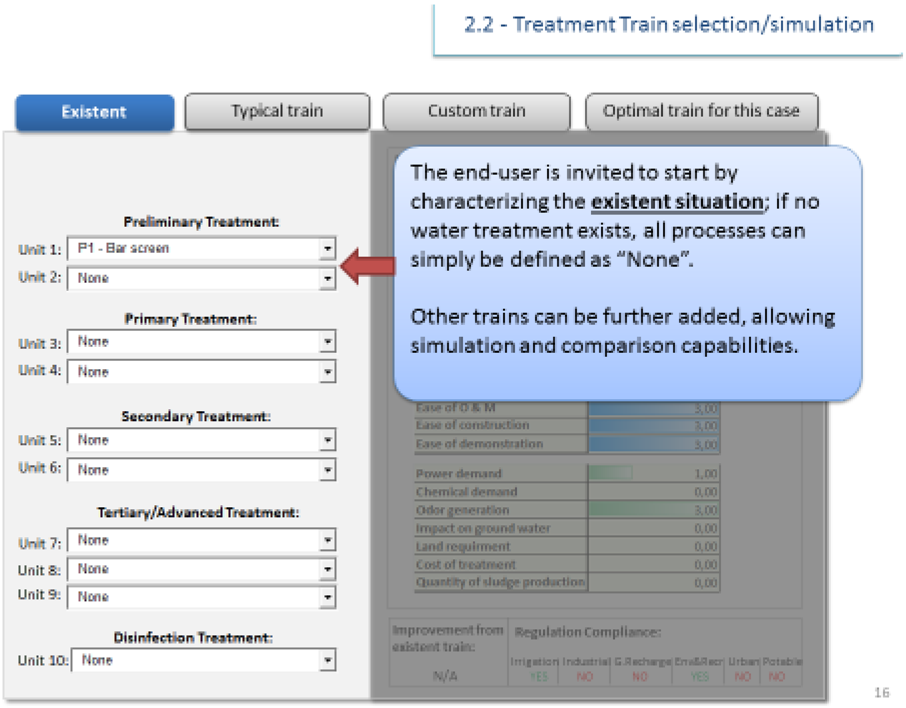


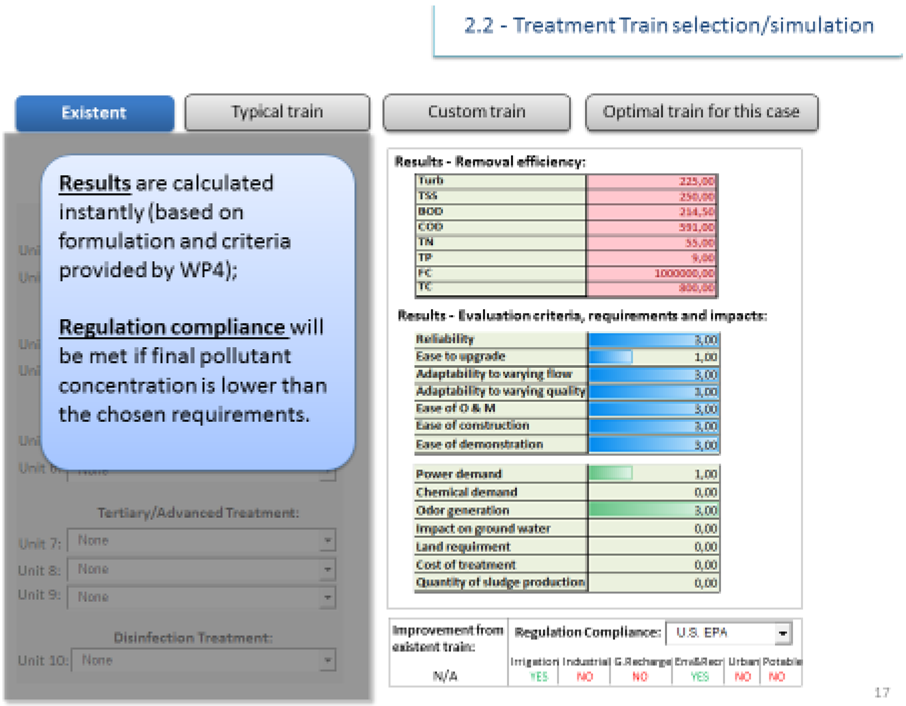
This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025





This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025





This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

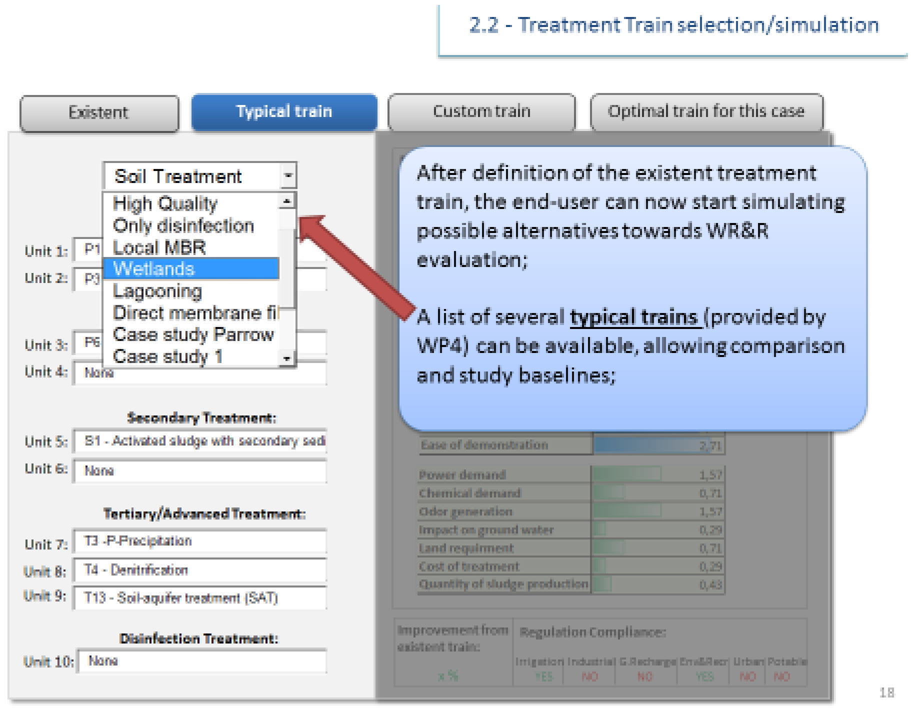


Figure 3.1.DSS screens progressively portraying the procedure of the application.

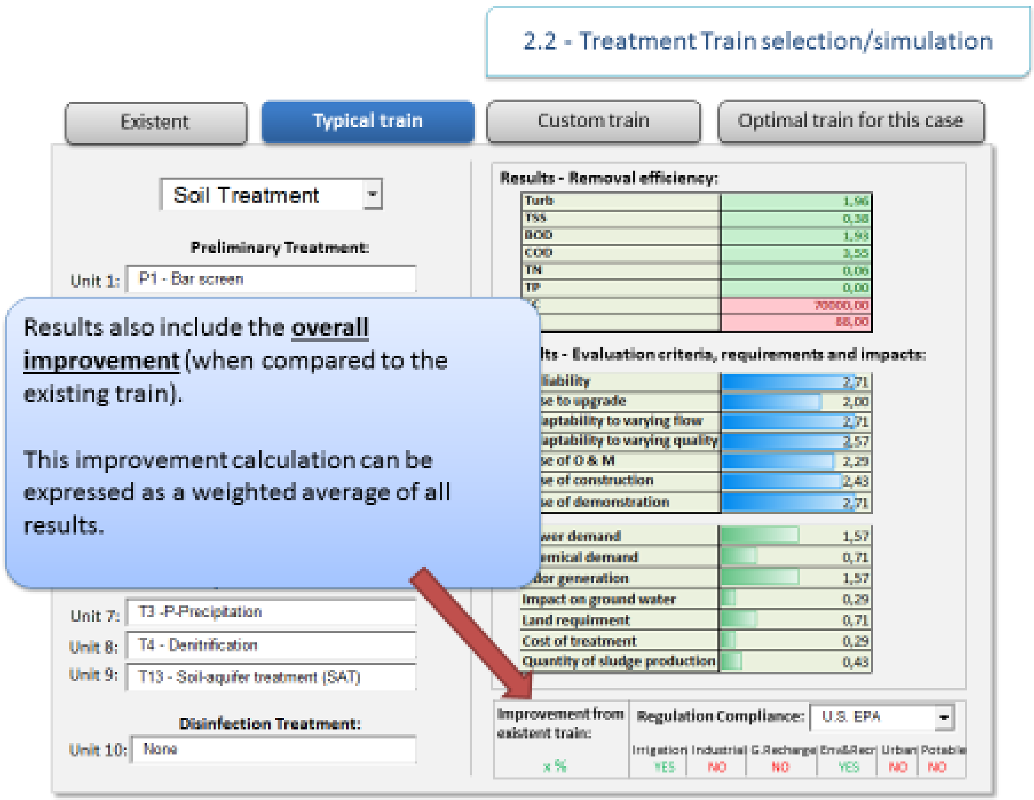


Figure 3.2.DSS screen portraying results for a typical (basic) application.

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

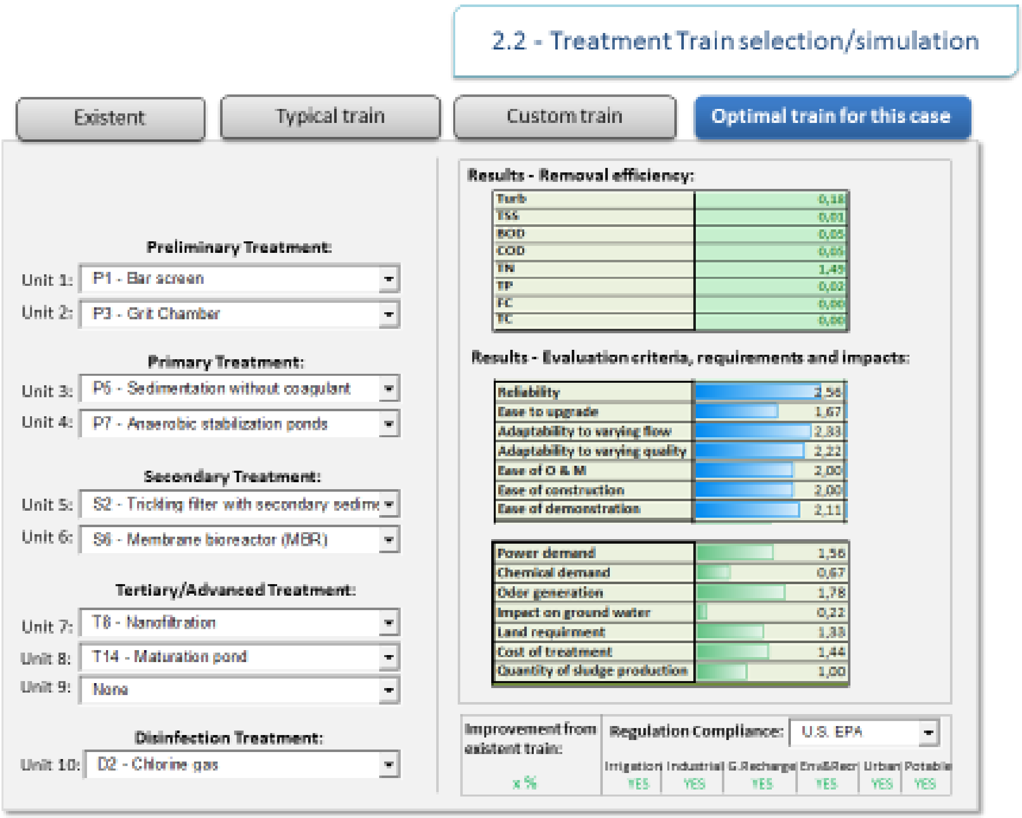


Figure 3.3.DSS screen portraying results for the optimum (most appropriate) application.

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

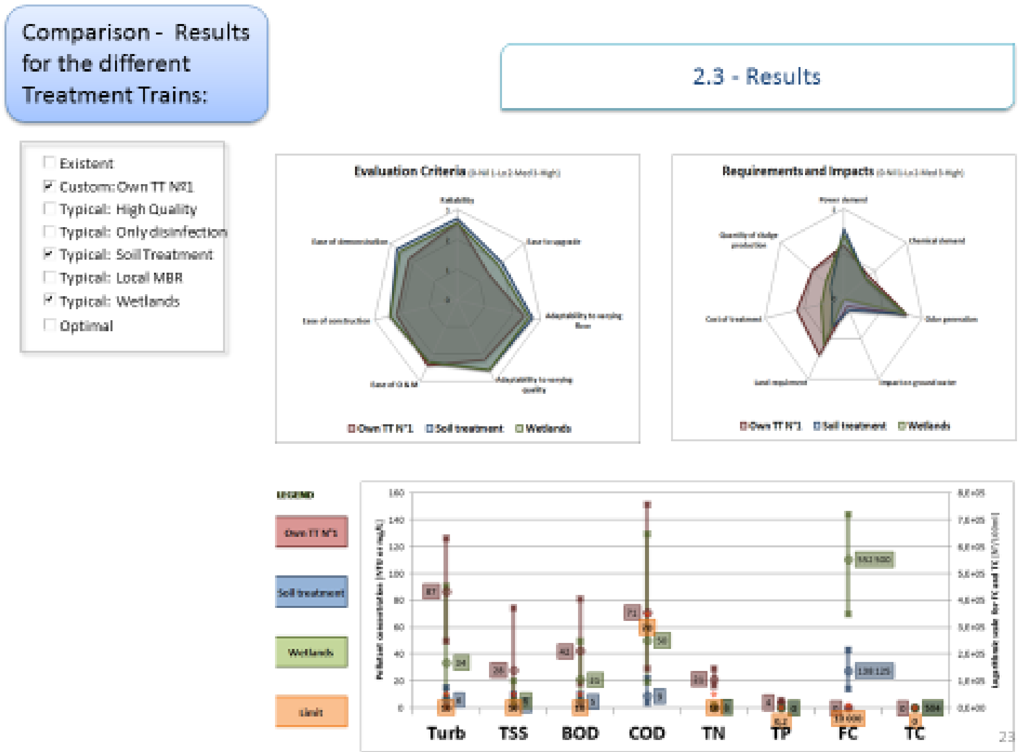


Figure 3.4. DSS screen portraying comparative results for the various treatments application.

B. COMPONENTS OF THE RESULTS

1. Geographical Database Design and Web GIS System Development

Within the context of this project, a Web GIS platform is developed to share the data and information produced by the project's partners easily, validly, promptly and to multiple end-users (Salahoris et al., 2014). The use of a Web-based platform eliminates the need to install special desktop software. This cuts down client deployment time and costs to zero, and enables any authorized user to immediately access the platform from anywhere in the world. Users have the ability, without the requirement of knowing the handling of commercial and complicated Geographic Information System (GIS) applications, to utilize the capabilities of GIS; to query on the databases and receive direct answers; to locate points of interest; and to download information provided by the administrator of the system. The Web GIS covers both the needs of broad public for viewing the COROADO collected geographical information and the requirements for specific access & editing of GIS data by project's partners.

The system was designed with critical contributions made by Work Package 2 (Case Studies Context – University of Sao Paulo - USP), 4 (Reuse, Recycling & Sanitation Technologies / Climate Change & Water Scarcity - ALTERRA) and 6 (Knowledge Management and Web based Tools – University of Porto - UPORTO).

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

2. Development and Application of a Web-based Geographical Tool

The tool developed in WP4 consists of six modules (Verzandvoort et al., 2015). Modules 1-3 help the user to identify which parts of the area under consideration (a river basin or region in Latin-America) have lower and higher availability of green and blue water flows based on the characteristics of the physical water system (i.e. climatic conditions, land cover and use, soils, hydrography, relief and substrate), which parts of the area suffer from water stress conditions, and which areas offer potential for water reuse and recycling systems. Modules 4 and 5 enable the user to identify sites where wastewater is currently produced, and the locations of potential users of recycled and treated wastewater in the area. This results in a selection of zones with potential for the implementation of water reuse systems, and identified quantity and quality of treated wastewater in the zone. In Module 6 (POSEIDON), the user can select wastewater treatment technologies to meet the required water quantity and quality of specific water users in the zone. Treatment technologies can be combined into a wastewater treatment train, which can be compared based on economic, ecological and technical criteria. This results in a basket of optional wastewater treatment systems.

3. Report on a Tool for Assessing Change of Irrigation Practices due to Water Scarcity and Climate Change

The software Irrigation Assessment Tool (IAT) is presented for assessing past and future change of irrigation practices due to water scarcity (Salvador et al., 2014). The software has been produced at this time as a stand-alone development, but it can be presented as a linkable library to be used in combination with other software pieces for a comprehensive modeling of water reuse and recycling among different sectors in the Latin American context. The software has been presented in a multilingual environment (English, Spanish and Portuguese). Basic irrigation engineering procedures have been merged in this software with indicators related to the reused / recycled water. The software combines data on irrigation systems and techniques, crop agronomy, soils, water quality, weather and irrigation scheduling to run a simulation for an irrigation season which results the estimation of the indicators which can be computed from the available data.

The geographical unit of the software is the module, an element which is considered uniform in the variables above. A set of modules results in a scenario, representing a large, heterogeneous irrigated area. This model integrates a number of COROADO building blocks to deliver a tool which can provide answers to the many unsolved questions about the application of reused / recycled water in agricultural irrigation.

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

4. Tools and Instruments for Supporting Decision – Making for Water R&R Scenarios and Strategies

Given the range of uncertainty involved in multidimensional decision making, COROADO proposed and assessed a robust aggregation methodology for the evaluation of water reuse and recycling technological ranking (Hunter and Gironás, 2015). In doing so, stakeholder decision making in multi-user/multi-criteria systems is simplified by allowing for opinion fluidity in the selection of sustainable solutions. Traditional weighted sum methods, while perhaps providing more optimal results in a deterministic situation, are less capable of capturing the uncertainty both in future environmental parameters and in stakeholder opinions present in environmental decision making. The proposed application of Fuzzy TOPSIS, however, offers a robust ranking methodology able to withstand variability in the number of surveyed stakeholders and the number of evaluation criteria considered. Comparing results similarities between water use sectors and between vastly different study sites, we found that stakeholder opinions have more in common with their colleagues than with their countrymen, requiring an increase in intra-watershed dialogue to coordinate water resource amelioration efforts.

5. Guidelines of Management Strategies and Policies on Reuse and Recycling Technologies

The aim of the guidelines is to provide the necessary tools for the development of an enabling environment for WR&R implementation (Assimacopoulos et al., 2015b). The specific conditions that need to be in place in order to achieve the successful implementation of WR&R strategies are analyzed, i.e.:

- Favorable policy frameworks
- Adequate funding & provision of financial incentives
- Public support & acceptance of reclaimed water
- Technical competence & expertise
- Coherent legal & institutional frameworks

A checklist with the factors that influence WR&R implementation either positively (drivers) or negatively (barriers), and need to be considered for strengthening the aspects of the enabling environment, is also provided. Supportive measures, management tools and instruments are recommended to enhance the positive influence of these factors and to promote the sustainability and scaling up of reclaimed water use. Recommendations have been derived from the regional experience gained at the four COROADO Study Sites and from the guidelines proposed by certified national and international organizations and experts.

The target audience of these guidelines comprises all actors interested in implementing WR&R strategies, ranging from decision and policy makers (e.g. government, authorities, regulators and managers) to interested practitioners and investors (public

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

and private sectors), experts and potential reclaimed water users (e.g. industries, farmers, communities).

6. Project Web Portal

The cornerstone of the dissemination actions and the most vital tool for the communication among the partnership was the project's web-site that has been developed and will be updated in the future.

The website contains two main sections:

- The project section (PS) - www.coroado-project.eu – Figure 4.
- The technologies for water recycling and reuse information and knowledge section TRIKS – developed in www.coroado-project.eu/dissemination (Karavitis et al., 2015c,d) – Figure 5.

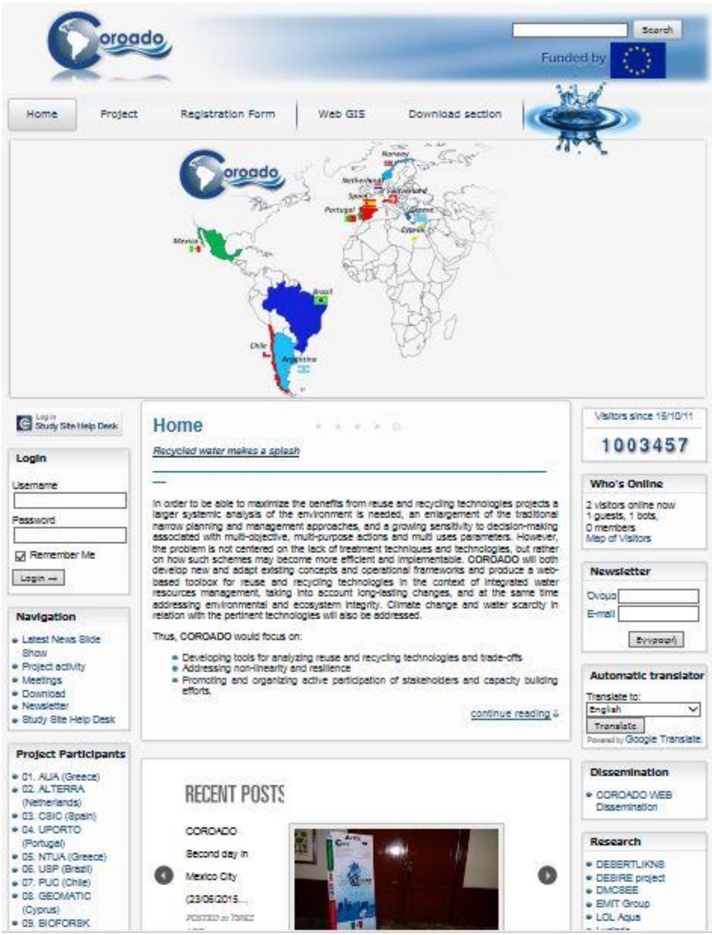


Figure 4. The COROADO Website

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

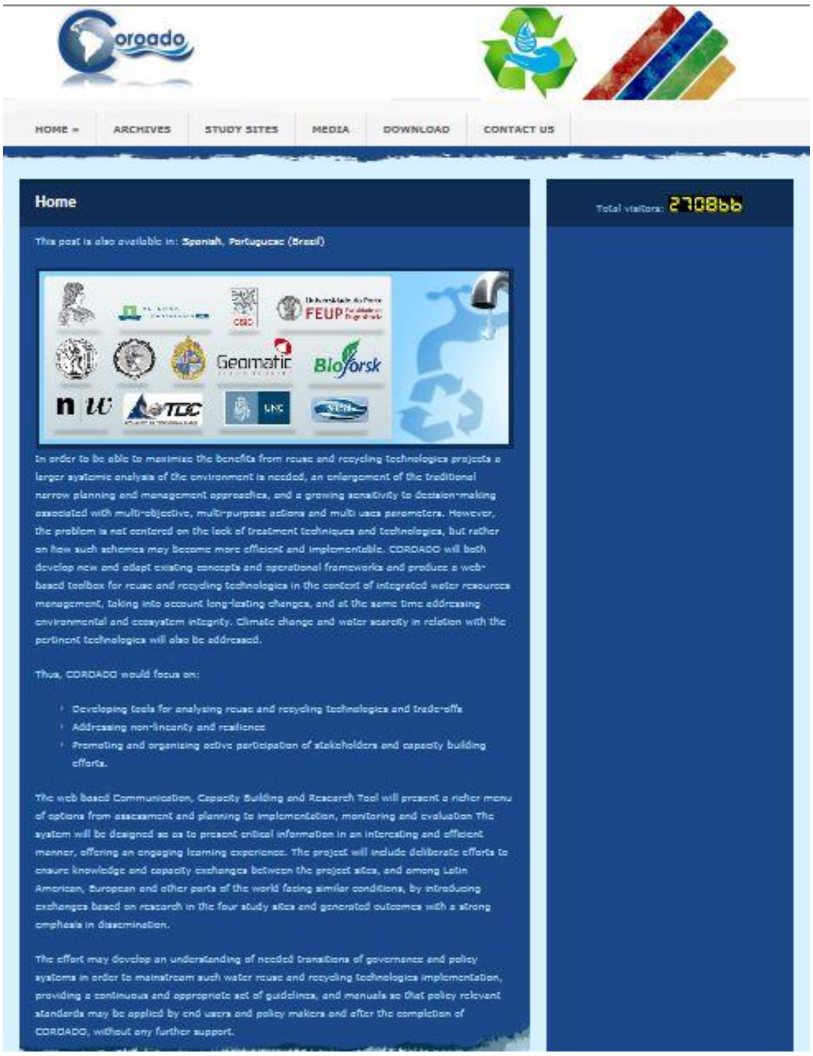


Figure 5. The COROADO Dissemination Site

The PS was built for the dissemination of the project and describes the project's overall objectives, activities, results, events and partnership. The TRIKS is the "demand" driven section of the website, through which the various thematic aspects of water recycling and reuse are disseminated. This part of the website resembles a virtual campus with several facilities available to the visitors.

7. Manual of Indicators

The COROADO manual of indicators is conceived as the Core of the Project since it contained the suggested water/wastewater related indicators and variables that have been used for the development of the Project's final product, namely The Web-Based DSS (Karavitis et al., 2013). Those indicators/variables provided the base for a more comprehensive and user-friendly set of indicators and indices that have been developed on a more advanced stage of the project. The manual has been developed by the combined efforts of WP4, WP5 and WP1. It is composed of three distinct sectors:

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- Sector I: General water-related conditions – developed by WP4 (ALTERRA, FHNW and BIOFORSK)
- Sector II: Irrigation related indicators – developed by WP5 (CSIC)
- Sector III: Vulnerability related indicators – Developed by AUA

The document that contained the manual provided the processes that need to be followed for the filling up procedure.

8. Vulnerability Indices

Within the COROADO project, two sets of Vulnerability related indices have been developed. Namely:

- The Vulnerability to Water Changing Conditions Index - WCCVI (Karavitis et al., 2014 – Fig. 6) which is composed of three vulnerability sub-indices and expressed by Equation 1:
  - Vulnerability to Drought (DVI)
  - Vulnerability to Water Stress (WSTVI)
  - Vulnerability to Water Scarcity (WSCVI)

$$WCCVI = DVI + WSTVI + WSCVI \qquad \text{(Equation 1)}$$

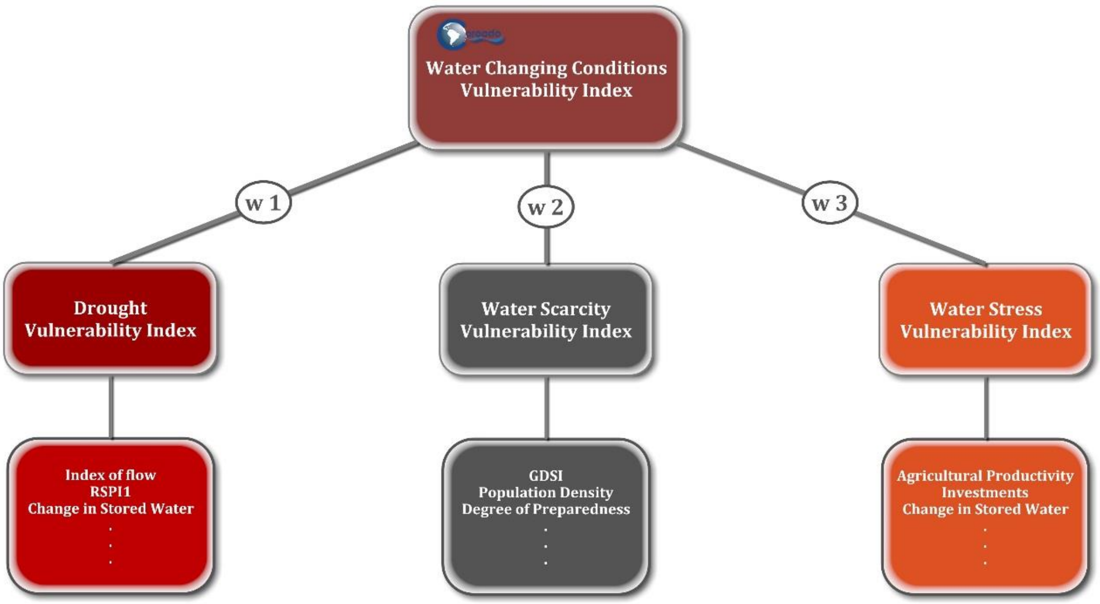


Figure 6. Schematic Procedure of the development of the Indices

- The Adverse Water Related Conditions Vulnerability Index - VI (Assimacopoulos et al., 2014) which is composed of two sub-indices and expressed by Equation 2:
  - The Exposure and Sensitivity Index (ESI)

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- The Adaptive Capacity Index (ACI)

$$VI = ESI - ACI \qquad \text{(Equation 2)}$$

Both the indices are included in the Web-based DSS for the evaluation of the areas of interest. Additionally, VI was used to assess the potential WR&R strategies in each case study (Assimacopoulos et al., 2015a).

References

Assimacopoulos D., Stathatou P., Katsiardi I. (2014). D.8.1: Comparative analysis of water systems' vulnerability and of water reuse & recycling technologies. COROADO Project

Assimacopoulos D., Stathatou P., Katsiardi I. (2015a). D.8.2: Strategies for the integration of reuse and recycling options.

Assimacopoulos D., Stathatou P., Katsiardi I. (2015b). D.8.3: Guidelines of Management Strategies and Policies on Reuse and Recycling Technologies. COROADO Project

COROADO (2011). Description of Work (DOW) Document.

Hunter C., Gironás J. (2015). D.7.2: Tools and instruments for supporting individual and group decision-making processes for R&R scenarios and strategies. COROADO Project

Karavitis, C., Skondras, N., Fassouli, V., Tsesmelis, D., Stamatakos, D., Alexandris, S., Verzandvoort, S., Heesmans, H., van den Elsen, E. Oertlé, E., Gross, T., Wintgens, T., Stolte, J., Eggen G., Salvador, R., Isidoro, D., Dechmi, F., Lecina, S., Aragues, R., Quilez, D., Zapata, N. and Playan, E. (2013). Internal Report: Manual of Indicators: Data Request

Karavitis, C., Skondras, N., Stamatakos, D., (2015a). D1.3: Report from the COROADO Scientific Workshop. COROADO Project

Karavitis C.A., Skondras N., Tsesmelis D.E., Stamatakos D., Vasilakou C. G., Fassouli, V., Alexandris, S. (2015b). D9.3: Workshop and Seminar Proceedings and Series of Scientific Publications. COROADO Project

Karavitis, C., Skondras, N., Stamatakos, D., Maia R., Pêgo J.P., Alves R., Pinho F., Verzandvoort S., Heesmans, H., Heidema, N., Oertlé, E., Engbretsen, A. (2015c). D.1.2: An internal project web site COROADO-web launched. COROADO Project

Karavitis, C., Skondras, N., Stamatakos, D., Maia R., Pêgo J.P., Alves R., Pinho F., Verzandvoort S., Heesmans, H., Heidema, N., Oertlé, E., Engbretsen, A. (2015d). D. 9.2. Web based Service Toolbox. COROADO Project

Karavitis C.A., Vasilakou C. G., Tsesmelis D.E., Stamatakos D., Skondras N., Alexandris S., Fassouli V., Gironás J., Hunter C., Porto M., Dalcanale F., Reyna S., Labaque M., Vanegas

M., Ramirez E. (2014). Internal Report: Statistical Analysis and Development of Vulnerability Indicators

Maia R., Pêgo J.P., Pinho F., Alves R. (2015). D.6.2: Design and development of the web-based DSS. COROADO Project

Porto M., Dalcanale F., Mierzwa J.C., Rodrigues L.D.B., Pio A., Gironás J., Dorsaz J.-M., Suárez F., Vanegas M., Hinojosa G., Campos A., Salinas R., Reyna S. (2012). D.2.1: Report on the Context of the Areas, Workshop Structure and Development. COROADO Project

Porto M., Dalcanale F. (2015), D.2.3: Case Studies Workshops Report. COROADO Project

Salahoris M., Tofas L., Todorovic B., Kalabokidis K. (2014). D. 3.3: Report on Geographical database design and Web GIS system development. COROADO Project

Salvador R., López C., Alexandris S., Playán E. (2014). D.5.3. - Report on a tool for assessing past and future change of irrigation practices due to water scarcity

Stathatou, P – M., Kampragou, E., Grigoropoulou, H., Assimacopoulos, D., Karavitis, C., Porto, M.F.A., Gironas, J., Vanegas, M., Reyna, S. 2015. Vulnerability of Water Systems: A Comprehensive Framework for its Assessment and Identification of Adaptation Strategies. Desalination and Water Treatment, (2015): 1 – 13.

Verzandvoort S., Oertlé E., Gross T., Breitenmoser L., Engbretsen A., Stolte J., Martin G.G., Heesmans H., Heidema N., Assinck F., Elsen E., Walvoort D. and Beek R. (2015). D.4.2. - Development and application of a web-based geographical tool for WR&R technologies. COROADO Project

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

Description of the potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results

1. Strategic impact

The COROADO project was designed to assess the potential of water recycling and reuse technologies in Latin America on the basis of the latest scientific achievements in engineering, ecology, agronomy, hydrology, social science, economics, and eco-technology, cross-linked with local available knowledge. The project provides a fully integrated approach to deal with water reuse and recycling technologies problems at local and regional scales, with cooperation, consultation and interaction of a variety of end-users and stakeholders using advanced participatory, monitoring, and modelling techniques. The research outputs will serve audiences at various levels ranging from the scientific community to practitioners, governmental authorities, policy makers, NGOs, water users and local communities.

There is almost universal agreement that first major challenge in respect to water scarcity mitigation is the need to make better use the technologies, which already exist. COROADO will make a major contribution towards this objective and, even more important, the integration of new technologies as they emerge. To do this it will explore new interfaces between disciplines, sectors, and citizens to develop an innovative approach to the degradation of freshwater resources. Partners are well placed to deliver innovation of this scale. Advocating the integration of water scarcity mitigation strategies, expertise, methods and tools will improve the cooperation between EU and Latin America, increasing in the same time the efficiency of European industry and the competitiveness of European companies exporting goods and services on global markets. Strategically distributed partners from Latin America will ensure the broad and economically beneficial impact to the water sector in the region. Through planned dissemination strategies, as well as through direct contacts, partners from Latin America will engage a number of different SMEs and public sector institutions dealing with water recycling and reuse and other related activities. The involvement of the key partners from many EU countries in COROADO will help consolidate and embed this expertise within European water management processes. The Project includes both SME partners and public sector stakeholders to directly exploit innovations.

The overall approach being offered by the COROADO aims to deliver a very high level in interdisciplinary, cross sectoral integration within the context and stakeholder driven process grounded in Case Studies across Latin America. A number of recent EC projects have strongly emphasized the importance of participatory decision making and other bottom-up approaches involving stakeholder groups and the public in combating water scarcity. However, it is rare for local knowledge generated from such bottom-up approaches to be combined with knowledge gained through more top-down, science-led approaches. By integrating and harnessing knowledge from within and between scientific and local knowledge bases, this project will enable water managers and policy-makers to fully realize their capacity to monitor and respond to the challenges of water supply in agriculture, water recycling and reuse technologies and restoration of depleted aquifers. The resulting 'hybrid knowledge' should allow scientists, local actors and their different understandings to interact in order to produce useful policy and more effective practice. However, while a growing number of studies are advocating this approach, there are very few actually doing it, and there are few tools available to achieve the necessary integration of these different knowledge bases. This project provides a widely transferable methodological approach that can combine bottom-up and top-down approaches to scarcity mitigation, using a range of qualitative and quantitative tools. The approach will provide scientifically robust research outputs that are relevant to the needs and priorities of the people who have to face the challenges of water degraded systems on a daily basis. By combining knowledge from water managers, policymakers and researchers, COROADO is be able to deliver water recycling strategies that are more effective than any of these groups could have developed in isolation. By combining regional economic models with agent-based and biophysical models, the regional economic effects of proposed strategies can be evaluated, in addition to their effect on people's livelihoods. By engaging with a wide range of SMEs and NGOs during this project, we can ensure rapid access to a wide range of relevant stakeholders, and ensure effective dissemination of results both during and after the life of this project. All in all, this approach may drive the development of a whole new understanding of data collection and regional aggregation, perceptions, analytical methods, representation of issues, communication, decision making, review and change. At this level the COROADO will make a significant contribution to a "culture change" in respect to approach to water scarcity mitigation. Innovation will also take place at the level of the three core aspects of the project:

- COROADO is grounded in a Case Study approach. A whole range of innovative solutions will be required for the Case Studies to adapt analysis and response options for use in these different sites and to produce not only a Latin America scale synthesis of methods and tools, but one to be expanded on a larger scale internationally.
- COROADO is truly stakeholder driven. Innovation at this level is in the adoption of participatory processes enabling meaningful interaction between stakeholders and the very wide range of sectoral and disciplinary experts, and facilitating the feedback between the two groups.
- COROADO emphasizes the integration of multi-disciplinary expertise. Innovation at this level is in responding to the need to assess the relative contribution or impact of different combinations of options. Experts need to integrate their respective specialist methods and tools to the appropriate degree to improve the capacity of stakeholders to make the best possible informed decisions.

Some concrete steps that the COROADO project foresaw to ensure that the expected impacts are:

- **1.1. Reinforcing competitiveness**

The cooperation between research organizations and SMEs/NGOs working in the field of the WFD objectives enforces the competitiveness of Europe's environmental industry in view of the world-wide competition. COROADO will integrate research, application experience, and practice needs to protect water supply, in particular in agriculture, restoration of depleted aquifers and better application of water recycling and reuse technologies. This is an important factor in strengthening both Latin America's and Europe's industrial and agricultural competitiveness.

- **1.2. Solving societal and economic problems**

COROADO will have a direct impact on a wide range of societal and economic issues, including i) the Quality of life, health and safety through an early integration of effective guidelines for protection and rehabilitation policies that reduce or avoid water degradation of fragile ecosystems and the impact of Global Change and related risks, including enhancement of livelihood conditions, ii) the Environment in ensuring a sustainable water and land management and the maintenance of biodiversity, and iii) Employment by enforcing competitiveness of service providers, consultants, water–soil ecology related industries and generally of the Latino American and European knowledge-based economy, and by expansion to the rest of the world.

- **1.3. Innovation related activities**

COROADO's innovation is expected to result from integration of scientific and traditional knowledge at different levels, namely i) the integrated analysis of the drivers and pressures for the water scarcity mitigation in general, ii) the integration of environmental media (soil, water, plant, and atmosphere), and iii) the integration of different stakeholder groups including problem causers, problem owners, and problem solvers. COROADO is anticipated to provide guidelines, recommendations and tools that will directly link research findings into feasible management actions.

- **1.4. Exploitation and dissemination related activities**

The exploitation and dissemination strategy will follow a four-level approach: i) direct dissemination of R&D results into the international scientific community, ii) exploitation of new potential applications through interested parties, iii) training of highly skilled stakeholder staff, and iv) integration of results to provide sustainable environmental solutions and the design of generic restoration guidelines and rehabilitation standards that may meet compliance needs towards regulations. The dissemination means include a dedicated website and web-portal, manual-style decision support system for water managers, farmers and extension workers, publications, handbooks, conferences, workshops, and training courses. Special attention will be given in the links and co-operation with other Latin American oriented similar research projects.

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- **1.5. European added value**

One impact of COROADO will be to increase the capacity of the European Research Area (ERA) in the field of sustainable development and management of natural resources. By involving a wide range of experts, including SMEs, in the exploitation of research findings and the design of land use and management tools and options, COROADO will enhance awareness at the European scale. The management design also addresses research needs among Latin American and European member states and will be based at the local or regional scale and as a result will cross national borders. The complexity, interdisciplinarity and critical mass of a project like COROADO, in terms of financial and human resources, exceeds the means of a single country and calls for the combination of complementary national skills. Moreover, most of the issues concern environment, agriculture and ecosystem management, which are of trans-border nature and linked with the Union's priorities and implementation policies on these matters.

- **1.6 Coordination with other activities at national, European and international level**

Members of the COROADO consortium have been / are involved in a wide range of related projects. Of particular relevance are international oriented projects like DESIRE, DMCSEE, AquaSTRESS, LOLaqua, IMAGE, MELIA, NOSTRUM, RAMFLOOD, ARID CLUSTER, MEDEFLU, DESERT-LINKS, AUTOHAZARD – PRO, WATERSTRATEGYMAN, PESERA, MEDALUS, DESIRE, NeWATER ISBP, AQUAREC and TiGrESS FLOODSITE, AQUATERRA, DESURVEY, LADAMER, WOCAT, DEMON I and II, NEWATER, HYDRATE, ASEMWATERNET, CABRI-VOLGA, SWITCH, INECO, RECONDES, SCAPE, DIS-4ME, REDMED, DESERTLINKS, REACTION, CLEMDES, VULCAN, ECO-SLOPES, CORINE, COST 634, SENSOR, SEAMLESS, ROSELT, LUCC, ARID-Net, SOWAP, MEDCOASTLAND, ILTER, and WWAP, ARCHIOMEDES. Where relevant and possible, cross-linkages will be made between on-going projects and existing local, regional, national or international networks will be embedded in our overall project approach.

2. Plan for the use and dissemination of foreground

One of the COROADO objectives is the public dissemination, dialogue and communication (reaching and ample range of stakeholders and societal interest groups) on water scarcity mitigation thematic areas and project overall activities and results, with the establishment of an Internet WEB and the use of more traditional tools. Such activities address internet based dissemination and dialogue on water supply in agriculture, water recycling and reuse technologies and restoration of depleted aquifers, ensuring differentiated online transfer and dialogue, responding to the societal demand (WEB demand driven) at different levels of priority and geographical contexts (driving forces) that influence societal group of interests and stakeholders. The work foreseen in this project is aimed at developing a comprehensive Internet based dissemination and dialogue among project partners and, more important, between the project and external stakeholders and visitors through the implementation and maintenance of a "demand" driven Web forum. All effort will be done to implement a demand driven on rehabilitation of water degraded systems.

- **2.1. Demonstration and training activities**

Throughout the COROADO project a number of demonstration activities are realized. In fact the whole of the project demonstrates a close cooperation between various groups of stakeholders, SMEs, NGOs and the institutes in the consortium. The strategy and philosophy in COROADO is that scarcity mitigation strategies that are not supported by the local stakeholder communities have limited values as they most probably will never be implemented to their full potential.

Specific demonstration and training activities are:

- Focus groups meetings will be organized and demonstrations will be conducted on how indicators can be used to define vulnerability under various strategies for the reduction of water withdrawals for both surface and ground water systems.
- Exchange visits will be organized to demonstrate successful water recycling and reuse technologies application from one test site to stakeholders from other test sites.
- Regional training workshops will be organized for process-oriented “learning for sustainability”- in each case study including all stakeholders (water users, water user associations, policy makers, researchers).
- Use models to simulate scenarios showing trends and predictions. These are shown to the stakeholders in a series of feedback meetings the effect of their efforts in very practical and direct terms (e.g. reuse and recycling technologies implementation, water quality measures, etc.). This is a two-way street as information provided by the stakeholders is essential in improving the predictive quality of the models.
- Regional training workshops will be run to train case study country staff in relevant participatory research techniques, and to help develop relevant participatory processes in each country to deliver participatory outputs for all WPs. Model outputs will be combined with results from field trials and interviews with water managers, and presented to extensionists and policy-makers in focus groups for evaluation. These meetings will function as a dissemination mechanism at the same time as providing valuable data for the project.
- In-country staff who have gained experience working with stakeholders through previous WPs will be trained to present model outputs alongside other project results to stakeholders in focus groups. They will be provided with a range of tools to accomplish this, including training in facilitation skills where necessary and training in the use of storyboards illustrated by GIS and/or digitally manipulated photographs (provided from this WP) to communicate results effectively to a range of stakeholders.

This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- COROADO dissemination and training products will be demonstrated, tested and evaluated in the study sites and at training and dissemination workshops. A conference will be organized at the end of the project to present the methods used in COROADO and all the COROADO products to scientists and senior policy makers at national and regional level in both Latin America and Europe. Products will also be demonstrated at meetings run by other projects and organizations. Finally, we will disseminate the results as well as the research processes we have followed to international organizations on a European level, such as EEA, DMCSEE and global networks such as UNEP and UNCCD as a method for assessing water scarcity mitigation with a potentially global application. An email circulation list will be used to alert potential users in the internet networks whenever new information or products become available.

Some of the COROADO products will require accompanying training plans and training material, in the shape of e.g. PowerPoint presentations, manuals, storyboard exercises or workshops. Many of these will be required to support WP7 and WP8 in the assessment and integration phase. Throughout the COROADO project products will be tested and evaluated by users and stakeholders so that improvements can be made where necessary. Dissemination to new users will be through training workshops in the study sites. For example, in-country staff who has gained experience working with stakeholders through other WPs will be trained to present model outputs alongside other project results to stakeholders in focus groups. They will be provided with a range of tools to accomplish this, including training in facilitation skills where necessary to communicate results effectively to a range of stakeholders. The final training products will be made available in the study sites, and globally.

- **2.2. Specific dissemination tasks**

The objective of WP9 is the public dissemination, dialogue and communication (reaching and ample range of stakeholders and societal interest groups) on rehabilitation of water degraded systems thematic areas and project overall activities and results, with the establishment of an Internet WEB and the use of more traditional tools. The WP9 activities address internet based dissemination and dialogue on water stress management, ensuring differentiated online transfer and dialogue, responding to the societal demand (WEB demand driven) at different levels of priority and geographical contexts (driving forces) that influence societal group of interests and stakeholders. The work foreseen in this Work Package is aimed at developing a comprehensive Internet based dissemination and dialogue among project partners and, more important, between the project and external stakeholders and visitors through the implementation and maintenance of a “demand” driven Web forum. All effort will be done to implement a demand driven on water stress.

The WEB will contain two main sections:

- The project section (PS) and

This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- The technologies for water recycling and reuse information and knowledge section (TRIKS).

The PS is built for the dissemination of the project and will describe project overall objectives, activities, results, events and partnership. The TWRIKS is the “demand” driven section of the WEB, through which the various thematic aspects of water recycling and reuse are disseminated. This part of the WEB will resemble a virtual campus with several facilities available to the visitors: i) relevant catalogued references; ii) aggregated country base information on water reuse and recycling technologies; iii) organized glossaries of water reuse and recycling technologies; iv) country reports on reuse and recycling technologies efforts; v) special aggregated information and knowledge derived from WPs’.

A public room dedicated to establish continuous dialogue with external participants, especially end users and citizens, will be established. Stakeholders, end-users and citizens will be stimulated and facilitated by the project partners, acting as country focal point, to upload their own views, ideas, questions in regard to the activities of COROADO and water scarcity mitigation in general. The knowledge provided in WPs’ 2 to 8 will be imported with the involvement of each WP Coordinator to WP9 and subjected to further organization and extraction in function of the different level of dissemination targets: scientific, technological, political, citizen.

The annual assessment of WEB performance-impact will be carried out by using performance indicators: i) n. of accesses/year, ii) number of external inputs/year; iii) quantity of information (glossary, country information base, etc), iv) n. of genders accessing the WEB, v) n. of exchanges with other WEBS, vi) n. of catalogued relevant references. Other indicators will be developed in the inception phase. Other dissemination means are foreseen like electronic newsletter and leaflets on selected topics. Material will be also prepared for distribution through different type of media: newspapers, local TV and radio.

The PS is built for the dissemination of the project, and will describe project in its whole. The TWRIKS is the real “demand” driven part of the Web. This part of the Web forum will be a sort of virtual campus for dissemination of organized knowledge derived from WPs 2 to 8. Traditional means like periodical electronic videos, newsletter, leaflets and brochures will be prepared for dissemination.

WP9 is the project tool to develop dissemination and transfer of knowledge within and outside the project. All the means described in WP9 are dedicated to manage the dissemination and share of knowledge. The management of knowledge transfer and share is basically built on demand driven. In addition, the dissemination activities will be handled within an overall project Knowledge Management Plan (KMP). The KMP will document the process knowledge generation, internal transfer and communication throughout the project life, and after the project. The KMP will be updated as part of

This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 283025

each successive project updated implementation plan. WP9 also supports Workshops and seminars . More specifically:

Develop a series of tailor-made workshops that will build capacity for the sustainable development of water resources. The workshops will build expertise in evaluating multiple re-use and recycling technologies incorporating trade-offs in management decisions. This will include tools for building resilience into the management of water resources in the face of uncertainty, unexpected events and climate change. The workshops will be collaboratively run with the hosting Latin American institutions who will jointly design the curriculum to meet their training needs. The follow-up program will form an integral part of the capacity building activities since they will ensure that workshop participants are able to apply their new skills afterwards through applied projects and through training others in their institutions. In WP 2 and 9 COROADO web will serve as a Capacity Building Tool, it will develop a capacity building Open Source tool for managers and policy-makers, providing guidelines in how Integrated Water Resources Management (IWRM) can be applied to local and regional governance. It will produce both digital and printed versions of outcome materials.

International Workshop tasks are: Identification of sponsor and negotiation of their financial support, including support to second and third type events; Creation of a rational and comprehensive mailing list of stakeholders; Promotion of IWs and identification of relevant stakeholders for participation; Receiving, reviewing and organizing input from all Work-blocks; Formulation of Workshops platform discussion frame (conceptual frame of the Workshop to help rational discussion in Plenary and Session Working Groups); Identification of invited key-note speakers; Organisation of International Workshops (logistics, invitation, public announcements, pricing, prints); Preparation of pre-IW proceedings (extended abstracts); Implementation of the Workshops (4 full days, including one day for plenary working group and session working groups); Rational organization of outcomes from Working Groups for publication (also for use in Second Type event); Prepare IWs final proceedings and CD-ROM (output for WP9 for public domain).

Post International-Workshop Seminar tasks are: Promotion of the Seminars; Identification of facilitators; Formulation of the conceptual frame of post IW transfershare; Preparation of the Seminar handbooks; Organisation (logistic, public announcements, pricing, prints); Implementation of each Seminar (duration: 3 days for a maximum of 10 facilitators); Preparation of CDrom and platform for distance share-transfer (available in the Internet WEB of WP9).

The COROADO-web: WP1 will establish and manage COROADO-web, a tool for sharing and visualizing spatial data and outcomes. Data used or generated by these tools will be included in a searchable database and will be displayed as tables, graphically, in a

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

downloadable format for use in spreadsheet programs or as a printable document. The integrated interdisciplinary structure of the tool will allow the holistic operationality of data. COROADO web portal is a component of the toolbox, and will be developed to have a threefold function throughout the project, as an Internal Communication Tool (WP1) will be used within the consortium for displaying data and monitoring project deliverables for consortium partners and will provide dynamic information and feedback loops on partner initiatives and an opportunity to exchange and evaluate ideas and information, as a Capacity Building Tool (WP2, WP9) and as a Research Tool (WP 4,5,7,8). Its development is coordinated by WP1. The Internal Communication Tool will be launched by WP 1 early on to enable easy access and display of existing data for all work packages.

A key factor that affects the effectiveness of natural resource management institutions and its affiliated organizations implementing the COROADO approach is their ability to share knowledge, amongst each other and with external partners. With the aim of ultimately developing a new generation of knowledge-sharing, education and training system, the COROADO-web Capacity Building Tool seeks to convert existing training toolkits from text-based tools to an interactive and dynamic learning system, with particular focus on the respective learning requirements of the specified user groups.

In order to accomplish this, the toolbox needs to be adjustable to meet the learning abilities of users with different educational, cultural and language proficiencies. Technically, the system will be designed to operate also on low end computer systems and bandwidths, with potentially alternative delivery modalities (internet upload, CD, printed versions). Offline usability is possible, but all collaborative online features need the user to be online to participate. However, even with only sporadic internet connections, the user can access shared forums and messages.

A multi-layered knowledge model should provide the basis for the overall system. As the system grows it will need to remain simple, relevant and transparent, with an emphasis on action and participation. Ultimately, the goal is to have a virtual learning environment that can be populated with an ever-growing portfolio of learning products, toolkits, manuals, methods etc., which can simply add-on to and become extensions to the environment.

In this way, COROADO-web can be used as part of a strategy towards enhancing synergy between scientists, planners, policy-makers, and common citizens, encouraging the active participation of society at large in research development, education and collaborative planning. Individual countries have structural and functional differences in the ways they implement their national research information. To improve the sharing of the burdens that are related to the production of science communication materials,

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

European and Latino American research and funding organizations can jointly produce educational material on a creative collaboration platform, setting guidelines for long-term activities, capacity building courses and workshops.

3. Contribution to standards, policy developments and regulations

Amongst others, COROADO will provide outputs that will inform the following standards, policies and regulations:

- FP7 Cooperation Work Programme 2010: Environment (including climate change)
- The Millennium Declaration and Millennium Development Goals (MDGs)
- The European Water Framework Directive (WFD [2000/60/c])
- Common Agricultural Policy CAP and Environmental Policies with the element of agri-environment (Reg. 2078: Agri-environmental measures; Reg.746/96: Implementation of agri-environmental measures).
- Sustainable Development Strategy (SDS) [COM(2001) 265 final]
- Environmental Impact Assessment Directive (EIA) [85/337/EC]
- Strategic Environmental Assessment Directive (SEA) [2001/42/EC]
- Through its wide-ranging researcher composition, the project embraces the concept of a European Research Area.
- European Climate Change Programme (ECCP)
- EU Council Nitrate Directive (91/676/EEC)
- EU Council Urban Wastewater Directive (91/271/EEC)
- Water Framework Directive and embedded directives (2000/60/EC)
- EU Council Directive on surface freshwater requirements (75/440/EEC)
- EU Council Directive on quality of drinking water (80/778/EEC)
- EU Council Directive concerning the quality of bathing water (76/160/EEC)
- EC, JRS, DGXII, Freshwater. A Challenge for Research and Innovation, 1998. EUR 18098 EN
- Protection of Groundwater, EC Directive 80/68
- Resolution of the Council and the Representatives of the Governments of the Member States, meeting within the Council of 1 Feb. 1993 on a Community programme of policy and action in relation to the environment and sustainable development.
- A European Community Programme of policy and action in relation to the environment and sustainable development.
- Official Journal nº C 138, 17/05/1993, pp. 0001-0004
- EU Preparatory act 15.10.30,10-Management and efficiency use of space, environment and natural resources.
- Pricing policies for enhancing the sustainability of water resources, COM (2000) 417 final
- Communication from the Commission on impact assessment, COM (2002) 276 final

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 283025

- Communication from the Commission Stimulating technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union, COM (2004) 38 final

Furthermore, COROADO responds to the CDD and CBD and subsequent meetings of the parties, particularly CoP V/6 (2000), those on Dry and Sub-humid Land Biodiversity (CoP V/23) and the joint message from UNEP and the EEA with attention on the status of European waters (2000). In these protocols, the close interrelations of socioeconomy and biodiversity is highlighted. In addition to this, many water degradation remediation activities on agricultural land can be used to meet targets under the United Nations Framework Convention on Climate Change (UNFCCC). Finally, the high integration level of geoinformation and earth observation techniques in the COROADO project closely corresponds to the objectives of the GEO initiative to use such information in sustainable development around the world.