Sustainable Water Management Initiatives in Latin America

A RALCEA Guide of Case Studies

European Commission

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PROLOGUE

The European Union Initiative for Water (EUWI, for short) was proposed by the European Union at the World Summit on Sustainable Development in Johannesburg in 2002 in order to respond to the need for balanced development in the water sector and to strengthen governance in country partners of the European Union. The main goal is to achieve the Millennium Development Goals (MDGs). The EUWI is emerging as an instrument of political dialogue promoted by Member States and the European Commission and its actions are articulated to promote an integrated and multidisciplinary management of water resources.

Within this framework, the European Commission, through the Directorate General for Development and Cooperation - EuropeAid (DG DEVCO) and the Directorate General Joint Research Centre, in close collaboration with the governments of Latin American countries, are implementing the RALCEA program (Latin American Network of Centers of Excellence in Water). The objectives of this program are: a) to strengthen South-South cooperation, b) promote the development of skills and scientific and technical cooperation of research institutions in the water sector in order to c) increasing the efficiency of support for decision makers at the national and regional levels. In this sense RALCEA program partners (Centers of Excellence and Government Representatives - Focal Points - Latin America and Cuba) identified three priority areas in which to focus activities in order to implement: 1) Analysis of Mapping actors involved in the management of Integrated Water Resources Management (IWRM) and their participation, 2) analysis of the variability of Regional water balance components, and 3) Water Quality and Sanitation.

The last subject area includes the proposed activities of RALCEA partners, along with the development of a strategy to strengthen and expand capabilities around water quality and sanitation in the region and includes a manual of best practices and technologies. The present document consists of 29 case studies proposed by the Centers of Excellence and Focal Points and is therefore one of the first tools designed by governmental, social, technical and research actors of RALCEA.

This first RALCEA document on the subject of Water Quality and Sanitation was coordinated by Fundación Chile and demonstrates the synergy that is developing between different Latin American institutions and their focal points, and also contributes to the effectiveness of the South-South cooperation that should exist in a strategic sector such as Water. This document can be found online on AQUAKNOW.NET which is a virtual collaboration tool that the European Commission has made available to the RALCEA partners for wider distribution and dissemination of program results.

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INTRODUCTION

Since water resources are getting scarcer in all the continents, availability and sustainable use of water are two issues that cause ever increasing interest worldwide.

97% of water in our planet can be found in oceans as salt water. From the 3% of fresh water in our planet only 1% can be found in lakes, the atmosphere, rivers, wetlands, and soil since the vast majority of it is stored in deep aquifers, glaciers, ice, and permanent snow.

According to the United Nations Department of Economic and Social Affairs, nearly 1,200 million people –almost one fifth of world population– live in areas where water is physically scarce while 500 million are close to live under the same conditions. Some other 1,600 million –about one fourth of world population– live in areas that suffer from economic water scarcity due to the lack of appropriate infrastructure to take water from rivers and aquifers.

Water scarcity is a phenomenon that occurs naturally but it can also be provoked by human activity. There is enough drinking water in the planet to supply 6,000 million people, but it is inequitably distributed, wasted, contaminated, and unsustainably managed.

To face the challenge that water scarcity represents and to achieve appropriate management involves very hard and cross-sectional work that considers key factors such as: 1) Cultural, Social, and Ecosystem Value of Water; 2) Efficient Use of Water Resources; 3) Aim for preservation of Hydrological resources ; 4) Water Governance.

RALCEA (Latin American Network of Knowledge Centers in the Water Sector), as a way to meet its aim to foster capacity development and research development initiatives on water quality and treatment and, decided to create a guideline that allows familiarization with case studies conducted by the Centers of Excellence in the Water Sector and Focal Points participating in the network. The purpose of this was to acquire new knowledge about water management and apply it to the development of more sustainable resource systems in the short- or long- term. Contact information of the corresponding entities has been included in case you need any further details.

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1

INNOVATIVE RESEARCH ON CULTURAL, SOCIAL, AND ECOSYTEMIC VALUE

ANTINOMOS (Network of Knowledge to Solve Real Water Problems in Developing Countries: Overcoming Differences and Knowledge Gaps)

DESCRIPTION

ANTINOMOS was an international program financed by the European Community. 13 entities[1] coming from Europe, Asia, Africa, and Latin America participated in this three-year project. Coordination was carried out by the Department of Architecture and Urban Planning at Polytechnic of Bary, Italy. This project is based on the results of an international report on the state of art of drinking water supply and sanitation generated by the research consortium that ANTINOMOS integrated. As part of the products, case studies were conducted in Mexico, South Africa, and India with the main objective to generate networks of knowledge to enforce local and global capacities regarding drinking water and sanitation. From the obtained results and learned lessons, the project actually generated a local and international network of knowledge that has not only allowed the generation of national capacities, but also the development of innovative tools to support practical solution of problems with drinking water supply and sanitation in countries which are deficient in this regard.

OBJECTIVES

To reduce the existing breach with respect to drinking water and sanitation through the development of learning opportunities that transcend individual disciplines and cognitive frameworks at global and local levels.

RESULTS AND MAJOR ACHIEVEMENTS

- A global and local network of knowledge that contributes to solution of real problems with drinking water supply and sanitation in communities that lack these services or that have deficient water systems.
- Development of learning tools and knowledge management regarding drinking water supply and sanitation in order to

1 Department of Architecture and Urban Planning, Polytechnic of Bari (Bari, Italia); Centre for Environmental Management (Vienna, Austria); Lettinga Association Foundation (Wageningen, Países Bajos); Water Sciences School (Cranfield University, Reino Unido); Swedish Institute for Infectious Disease Control (Estocolmo, Suecia); Ecole national du Genie rural, des Eaux et des Forets (Montepelier, France); University of Kwazulu- Natal (Sudáfrica); Instituto Mexicano de tecnología del Agua (México); Facultad Latinoamericana de Ciencias Sociales (México); Centre for Science and Environment (Nueva Delhi, India); India Institute of Management (Ahmadabad, India); Reform Support and Project Management Unit Department for Water Suply and Sanitation Government of Maharashtra (India) and UNESCO Institute for Water Education (International IHE).

effectively cross cognitive frameworks of the technological system with practices at local and global levels.

- 5 case studies in Mexico on the placing and application of technologies and on practices regarding drinking water and sanitation. Similar studies were also conducted in South Africa and India.

- An international report on the identification of problems with drinking water supply and sanitation- which considers social and institutional factors and corresponding technological application.

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Sustainability of Community Systems of Drinking Water and Sanitation in Rural Areas

DESCRIPTION

The reason why rural areas in Taricá have not had access to water supplies and quality sanitation is not related to the lack of appropriate infrastructure but mainly to deficient management and maintenance of the systems since they are carried out - without any government support or control- by the own community through community boards called JASS. Inappropriate maintenance led to system failure shortly after infrastructure was developed since the local government did not provide additional funds for sustainability and quality of the service.

The Agualimpia-FOMIN program intervened in order to improve communication and to foster cooperation between the local government of Taricá and the communities with deficient system management and maintenance. Due to this intervention, the authorities have created a Department for Technical Support to meet community demands; to provide training in management, operation, and maintenance; and to rule in a way that the management of water consumption in rural areas can be institutionalized.

OBJECTIVES

To enforce the local government of Taricá and the community boards (JASS) in order to institutionalize water and the sanitation systems in rural areas.

RESULTS AND MAJOR ACHIEVEMENTS

- Creation and enforcement of a local Department for Technical Support to meet the demands of the community

boards and to control the quality standards of water and sanitation services offered to the community.

- Optimization of 6 water and sanitation systems with funds provided by the local government and the community – by which 4091 inhabitants of rural areas were benefited.
- Acknowledgement and ratification of 20 community boards by the local government of Taricá.
- Complete evaluation of 20 drinking water and rural sanitation systems
- Training for 20 community boards in management, operations, and maintenance of water and sanitation systems.
- Decrease in the rate of debt due to non-payment of the 75-25% family contribution to 6 of the intervened community boards JASS.

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Payment Mechanisms Incubator for Ecosystem Services[1]

"The Incubator RSE is an opportunity in a country like Peru which requires giving a more comprehensive and systemic territory, ensuring the provision of the ecosystem services provided, ensuring their conservation and management and reward good practice that developed this objective. At the same time, the compensation for ecosystem services can be a tool for macro-regional integration and a new way to find solutions to disputes regarding access and use of resources. "(Manuel Pulgar Vidal, Minister of Environment of Peru, May 2012).

DESCRIPTION

The RSE Incubator facilitates the design and / or implementation of payment mechanisms in a consistent manner with the critical needs in each territory under established and public criteria. The design and implementation of RSE mechanisms requires complex specialized set of skills and capabilities, including expertise in the design and estimation of retribution, prioritizing actions to ensure the provision and quantification of ecosystem service, empowerment for negotiations, social and legal support, financial and social surveillance, among others. Many of these factors may not be developed and / or strengthened in the actors involved, with a weakness for making decision, implementation and evaluation of the results. To these needs, CONDESAN puts the service of the Ministry of Environment Peru, the knowledge generated based on research and lessons learned in different areas of Peru and the Andean region, primarily, through methodologies and tools to manage the ecosystem that positively impacts on human and environmental wellbeing.

OBJECTIVES

(i) To identify mechanisms of RSE in Peru, mainly hydrological

1 With the support of the Swiss Government, the Ministry of Environment of Peru (MINAM), Forest Trends and CONDESAN agreed to establish such institutional entity as part of the commitments made at the Sixth World Water Forum in Marseilles in 2011. The Incubator RSE is part of a global initiative of Forest Trends: Bolivia, Brazil, China, Ghana and Peru, and Peru formally launched in May 2012 to address mechanisms associated with water management, in its first phase.

(RSEH) in the first phase. (ii) To promote the implementation of RSE identified mechanisms, providing technical and financial support. (iii) To set resources from various sources for the implementation and sustainability of RSE mechanisms in Peru. (iv) To contribute to the development of public policies that provide sustainability to the implementation, development and strengthening of mechanisms of RSE in Peru. (v) To relate international experiences and local capabilities on RSE mechanisms under different strategies. (vi) To systematize learning, disseminating them at subnational, national, regional and global level, with the support of inter-agency partnerships and networks.

RESULTS AND MAJOR ACHIEVEMENTS

(i) Technical support for decision-making in the Rimac River Basin (Lima) and Cañete River Basin. (ii) Identification of support strategies in Jequetepeque River Basin (Cajamarca, La Libertad) and Microcuencas of Mishquiyacu, Rumiyacu y Almendra belonging to the Upper Mayo (San Martin). (iii) Identification of 16 RSEH national mechanisms in different phases of implementation. (iv) Support the development of national policies. (v) Exchange of knowledge and experiences, regional and global, through the Clinical Mechanisms for Sharing the Benefits of Nature.

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Regional Initiative on Hydrological Monitoring of Andean Ecosystems – By MHA Program

DESCRIPTION

The MHA Program articulates research centers, both local and national governments, and non-governmental entities in order to create an environment that fosters experience-sharing. Its aim is to connect theory and practice; to acquire and enforce knowledge of the Andean ecosystems hydrology to make appropriate decisions. In the view of the heavy investment being made in conservation at present, the MHA Program aims at improving the mechanisms to manage Andean ecosystems. In order to do so, it provides information about the hydrological lag-time (performance and hydrological control) when there are variations in the land- cover and use. MHA's methodology, accessible to non-specialists, allows the implementation and operation of participatory monitoring systems of water resources in micro basins of Andean ecosystems. These monitoring systems should not only provide results and conclusions in the short-term but they should also be included in long-term institutional agreements. MHA fills in the gaps left by the traditional large-scale monitoring of water resources, monitoring of glaciers under climate-change conditions, studies on hydrological modeling with no sufficient data for calibration in the Andes.

OBJECTIVES

The main objective is to acquire and enforce knowledge of the Andean ecosystems hydrology in order to make appropriate decisions regarding integrated water resources management in the Andes.

Secondary objectives are:

- Production and management of Information - according to common standards - about natural or intervened Andean ecosystems hydrology.
- Promotion of the interaction among (research-, public-, private-, community-) entities interested in the Andean ecosystems hydrology.
- Enforcement of technical capacities of local entities interested in their water sources hydrology.
- Diffusion – at all levels – of the knowledge produced through research on the Andean ecosystems hydrology.

RESULTS AND MAJOR ACHIEVEMENTS

(i) The MHA Program is an example of the south-south cooperation that has been built thanks to Andean capacities. There are 8 local partners (6 ONGs, 1 Fund for Water, 1 local government), 8 researchers (7 Andean centers and universities, 1 foreign university), 4 sponsors (two Andean regional projects, 2 foreign sponsors). (ii) Encouraging coordinated and cooperative action in the area has resulted in cooperative work to solve major hydrological problems at many levels. (iii) Despite network participation and complexity, both international and national universities providing consultantship from the very beginning should not ignore scientific rigor and guidance. (iv)17 micro basins have been implemented in 8 places throughout the Andes in order to draw conclusions at the regional level and to identify spatial variability in a given region. Advantages/Benefits are found at two levels: at the local level, it offers support in efficient decision-making about management and development of the basin; at the regional level, it offers a global perspective to avoid the risk of extrapolating data from one place to another. (v) Local partners –

who have been implementing their own hydrological monitoring systems - have been provided with continuous technical support; Access to information about Andean ecosystems hydrology has been improved by means of meetings and courses.

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Water Management: A Matter of Culture and Public Policy

DESCRIPTION

Apart from being highly symbolic, water is a vital resource for life, human health and environment – as well as a means of culturally-meaningful artistic expression not only in urban and rural areas but also in forests and biomes. According to Milton Santos, a landscape is a group of forms that, at some point, expresses the inheritance of successive interaction of men and nature. Space is the forms together with the life that motivates them. Landscape can be understood as a group of spaces in which production activities, rituals, celebrations, and social movements take place. It could perfectly be defined as "Cultural Landscape" or as a sign of human activity on Earth, or as the memo-book of an unknown worker.

Argollo Ferrão (2004) says that the Cultural Landscape - just as Rural Architecture – can show the spatial planning through understanding of the processes that occur in it. Co-evolution of cultural processes and production processes (based on science and technology) leads to acknowledgement of a third vector in co-evolution which accounts for production space (Argollo Ferrão, 2004). In fact, this concept makes perfect sense when promoting the means to qualify the region (Braga, 2011).

The director of the National Water Agency (ANA) declared that the cultural dimension of water should be taken into consideration at the moment of making political, financial, and scientific decisions regarding problems related to water resources use and management (Franca, 2009). This needs to be analyzed into detail in order to find equitative and sustainable solutions to water management.

United Nations (UN) promotes initiatives to introduce the cultural dimension of water in territory projects oriented to regional development. This is how it defined the 2005-2015 period as the International Decade for Action "Water for Life". By presidential decree, Brazil established the same period as "Water Decade" (Brazil, 2005).

In harmony with above, and to support Water Decade, ANA, and IPHAN (Instituto do Patrimonio Histórico y Artístico Nacional – entity tied to the Ministry of Culture), it organized the Seminar "Agua e Patrimonio Cultural" (Brasilia, 2012).

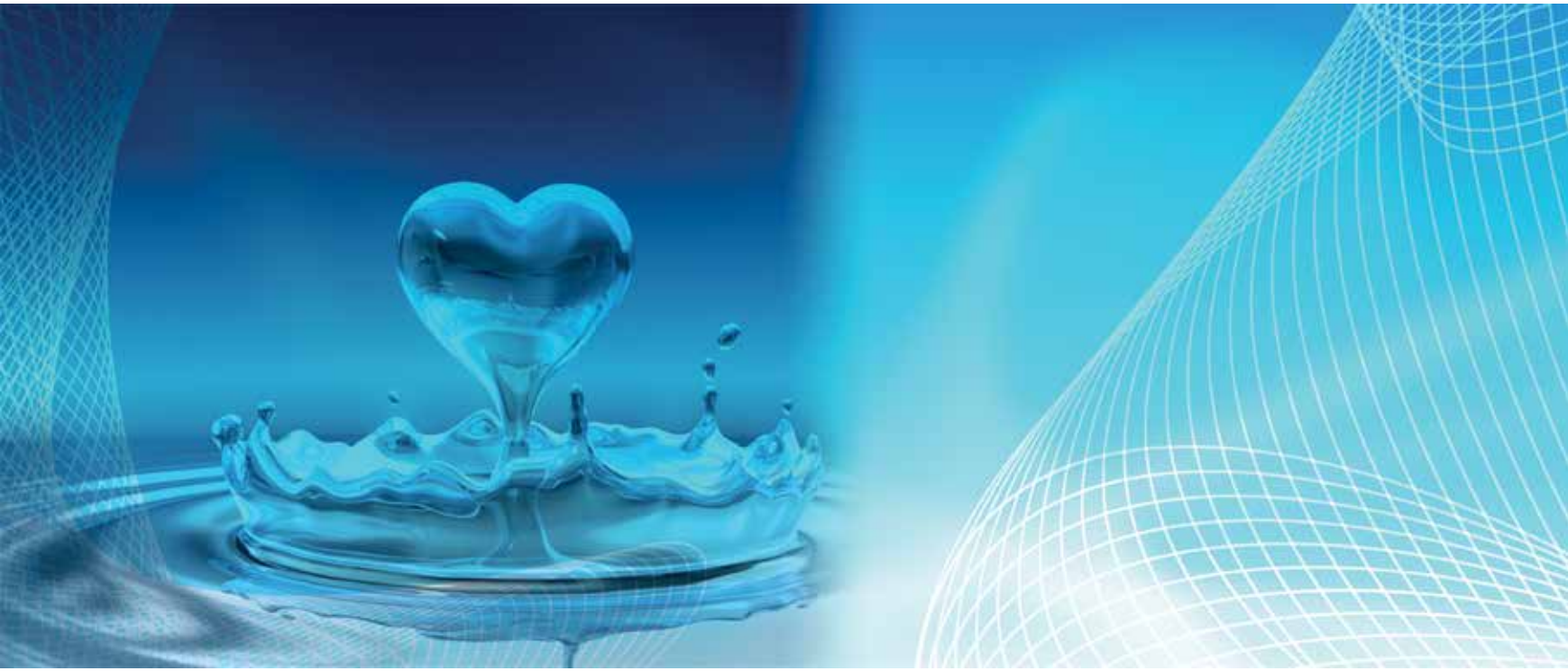
OBJECTIVES

The aim was to discuss the issue and to present the main legal instruments to protect this valuable resource in Brazil. These instruments can be found in environment regulations - especially in those on water resources - and also in regulations to promote tourism and protection of cultural heritage. Protection is an instrument that is included in cultural heritage policies and operated by IPHAN in the federal sphere; other culture-tied entity (with their respective state councils) in the different states and the Federal District; and by municipal councils for culture and cultural heritage protection.

RESULTS AND MAJOR ACHIEVEMENTS

In Brazil, there are several legal instruments for the protection of hybrid resources. These legal instruments consist of the regulations by the Brazilian National System of Conservation Units (SNUC), the environment legislation, the hybrid resources law, coastal management, the urban legislation, and the legislation on cultural heritage.

Sustainable development can be achieved by promoting perfect articulation of both hybrid resources management and heritage



management (environmental and cultural) in a given region. The instruments for heritage protection are also available for society and also for Public Management at the municipal and federal levels. These instruments can play a very important role in the recovery and conservation of hydrological resources since water is Heritage of Humanity – according to UNESCO.

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Micro Hydro-Plant for Energy Supply to Shops Used by Enterprising Members of the Community of Periquillo

DESCRIPTION

The community, represented by its Residents' Association La Cuesta-Periquillo, applying to this initiative is made of 30 families and it is geographically located at the foot of the Nonguén Reserve, from which thousands cubic meters of wood from native trees have been illegally extracted to be used as burning material. Therefore, it is necessary to raise awareness in the neighboring community about the value of this reserve by showing them other ways of utilizing the resources.

Many homes in this community use economic wood-burning stoves. However, the indiscriminate use of this resource has considerably affected the woods of the Nonguén Reserve. Using its hydrological potential to generate energy will make housewives understand the value, from a new perspective, the resources that the Nonguén Reserve offers.

OBJECTIVES

This project aims at installing, together with the community, a pilot Micro Hydro-Plant that in the future would be replicated by other communities near the Nonguén Reserve and other communities with similar characteristics in the neighboring areas of Hualqui-Chiguayante.

RESULTS AND MAJOR ACHIEVEMENTS

a) The project allowed building the necessary infrastructure to channel water into a hydraulic turbo-generator; installing the electric infrastructure and the imported equipment; and putting it into operation. Operation and efficiency were evaluated by measuring technical parameters.

b) Education and awareness-raising in the community as the result of the execution process of the Project, especially though the evaluations that were carried out, coordination meetings, and visits paid to water springs.

c) Community-generated energy supply to a shop and the place where the Community Union meets.

The generated energy will be used to illuminate the place where the Community Union meets and to operate an electric shop in this place, from which all members will benefit. The parameters to carry out this project are: a) Investment = $ 8,510 million (FPA : $4,000 million; remnant: obtained from other sources); b) Benefited People: 200 direct beneficiaries and 340 indirect beneficiaries; collaborators: the Municipality of Hualqui; DAEM , the University of Bío-Bío, environmental ONGs, and the Community Union.

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Remediation of Water Springs in the Hills of Talcahuano

DESCRIPTION

Water springs in the hills of Talcahuano play a major role in population establishment. They were the main fresh water source for the first communities that settled in the hills. Over the years, as population grew bigger and drinking water supply was made available, water springs were completely forgotten; they were left unseen in the gorges of the hills and were covered with garbage and bushes.

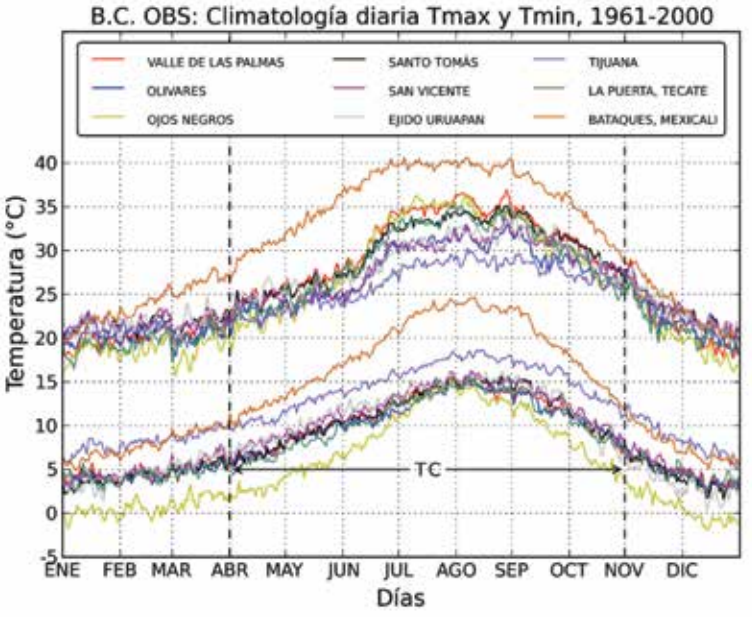
After the earthquake that struck our country in 2010, people from Talcahuano had no access to drinking water. Therefore, to meet the community need of this resource, water springs were turned into the main source of fresh water again. The major variation in the value of water springs led the communities from the hills of Talcahuano – represented by the Residents' Association of Península Tumbes - to think of an initiative on Water Springs Remediation and Maintenance. Funds provided by the Ministry of Environment and related entities as well as the cooperation of the local government, the University of Concepción, environmental NPOs, native communities, and religious communities made it possible to carry out an initiative from which 200 people benefited directly and 160 indirectly.

OBJECTIVES

a) to revalue the resource by hydrological mapping of the water springs to be intervened; b) to raise awareness about environmental and natural resources protection in the community; c) to identify the main factors and users to the considered in the remediation, maintenance, and future use of the resource; d) to do improvement works in the surroundings areas and access points of the water springs: sanitation of 12 out of the 22 water springs with the help of youth groups assisted by specialists in the field; implementation of access roads; aesthetic improvement in the access points; and installation of resource-protection signals.

RESULTS AND MAJOR ACHIEVEMENTS

a) Education and awareness-raising in the community as the result of the execution process of the Project, especially though the evaluations that were carried out, coordination meetings and visits paid to the water springs.



b) Relationship-building between the community, authorities, NPOs, and other organizations.

c) Commitment of the community to the protection of the water springs and to the development of new environmental projects.

d) Improvements to the infrastructure (access roads) and preservation of the water springs.

e) Acquisition of knowledge about how to evaluate the characteristics and quality of the water springs and to develop strategies for sustainable use of the resource through technologies made of waste material.

f) Reconstruction of the community historical memory with the help of seniors - who started at the point in history when water springs were the main (and sometimes the only) source of water that the early settlers had in the hills now inhabited by the Residents' Associations involved in the project.

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2

EFFICIENT USE OF WATER RESOURCES

Treatment Technologies Development and Water Resources Optimization in the Mining Industry

DESCRIPTION

One of the most important variables to be considered in any mining project – not only at present but also in the future – is availability of water resources. Any Project designed to extract minerals needs to be executed with the help of water; therefore, availability and appropriate water management is the key for the mining industry to be sustainable. The Chilean mining industry faces a greater challenge in this respect since most of the mining activity takes place in highly dry regions. Scarce water resources in northern Chile cause conflicts not only among competitive sectors of production (mining vs. agriculture) but also regarding availability of water for human use. The increasing 45% water demand projections for 2020 (source: COCHILCO 2011) make the current scenario even worse.

Wastewater treatment that allows water reuse; water recirculation during operations; desalination and direct use of sea water; and evaporation management can be mentioned among the best water management practices.

OBJECTIVES

To develop innovative and cost-effective technological solutions to remove contaminants from wastewater generated during the mining processes; to reuse water; and to reduce water losses during copper heap leaching.

RESULTS AND MAJOR ACHIEVEMENTS

With funds provided by INNOVA Chile from CORFO, CONICYT and private investors, Fundación Chile developed innovative technological solutions for the treatment and complete removal of contaminants such as sulfate, molybdate, arsenic, copper, lead, mercury, boron, and zinc from wastewater of different quality. The main solutions were developed on the basis of advanced catalytic oxidation; use of activated and modified natural zeolites, coordination and ion-exchange resins; fractional precipitation; processes of passive bio-treatment on sub-superficial damps and permeable reactive barriers. This technology was laboratory-developed by means of treatability studies in different water matrices where optimized operational conditions were to be found; then, they were pilot-escalated and -validated by means of in-situ modular systems. Among the types of wastewater treated we can mention: clear tailwater, water from filtration processes, acid water from smelting processes, acid mine drainage, and residual electrolytic solutions.

Furthermore, a project that allowed reduction in evaporation during copper heap leaching was also developed. The results of the tests conducted on the heaps in-situ showed that the developed solution allows to achieve the water loss reduction determined at the beginning of the project: over 8L/s when the settings of the sprinklers, drop size, and irrigation methods were modified

– without altering the irrigation rates to maintain the efficiency of mineral extraction. Currently, Fundación Chile has several options that have been mathematically modeled to reduce water use applicable to other mining activities involving irrigation for copper heap leaching.

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Rural Greenhouses Irrigated by Rainwater and Equipped with Controlled Sub-Irrigation Systems

DESCRIPTION

In Mexico, there are thousands of marginal rural communities, some of which live in highly dry areas where water is a vital resource to ensure food. They usually live in extreme poverty and they, without the help of technology, grow corn and beans for on-farm consumption.

In general, our project aimed at the implementation of an experimental study on growing food in small areas (a 1, 000m2 greenhouse) under controlled conditions and irrigated by rainwater, which is collected in the greenhouse roof and then stored in a 500,000-liter tank.

The greenhouse was equipped with a sub-irrigation system consisting of an underground piping system placed at a 1-meter deep stratum and impermeabilized by a geomembrane to avoid deep seepage losses.

The objective of this project was to develop and offer a technological alternative that fosters the efficient use of water and land for small-scale cultivation in order to contribute to coping with food shortage and sustainable development of water resources in the country.

Validation of advanced knowledge of an irrigation system allowed connection and enforcement of networks related to rainwater-harvesting for irrigation, sub-irrigation, and efficient use of land for agricultural development.

OBJECTIVES

to develop methods to design and operate controlled sub-irrigation systems for soils that have been isolated in rainfall-supplied greenhouses by geomembranes; to validate the methods through a study on a pilot greenhouse built for this specific purpose in State of Zacatecas.

RESULTS AND MAJOR OBJECTIVES

- Technical and financial information regarding implementation of rainwater harvesting systems for irrigation in greenhouses.
- Methods for the implementation of sub-irrigation systems to be used in small-scale production.
- Technical findings and recommendations for the validated production system.
- Development of technologies (manually- or software-operated). Training courses on the use of the developed models were offered with the purpose of making the negotiations for the new agreement more transparent.

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The Impact of Climate Change on Availability of Water Resources in the Semi-desert Northwestern Mexico and its Impact on Viticulture

DESCRIPTION

At the international level, a large number of articles have documented the importance of the climate on the viticulture aptitude of different regions of the world and the possible impact of climate change on such regions. Researchers at the Center for Scientific Research and Higher Education of Ensenada (CICESE) from Departments of Oceanography, Earth Sciences and Experimental and Applied Biology formed an interdisciplinary group to completely address the problem of climate change and its impact on the wine industry in Baja California – Mexico, and to be able to cope with different aspects related to temperature change, development of grapevines diseases, and changes in water availability in the region. This project analyses several climate variables relevant to viticulture regions in order to evaluate their aptitude in Northwestern Mexico, for example, the average temperature of the growing season (Apr-Oct), heat units (HU), and seasonal precipitation and its effects on the region under climate change scenarios.

OBJECTIVES

To analyze the current situation of viticulture and wine industry in Baja California and to assess possible effects of climate change on the wine sector under two emission scenarios, in other words, to determine whether those viticulture aptitude areas could change in the future. For that purpose, the following factors were studied: (1) the current problems of Baja California wine production, (2) the current and future climate to assess possible changes for viticulture aptitude producing regions, (3) the current behavior of diseases and vermin of the vines and the possible impact of climate change on them, and (4) the impact of climate change on water availability in the wine region.

RESULTS AND MAJOR ACHIEVEMENTS

Considering temperature and heat units, it was found that under climate change conditions, Baja California wine region will continue to be suitable during the 21st century, but at the end of the century those areas may decrease in size due to possible increases of temperature. The scenarios show that annual rainfall may decrease between 10 and 20 mm, and the summer rainfall may slightly increase. Water is a very relevant and limiting factor in Baja California. The availability of water in Guadalupe Valley has been aggravated by water consumption by the City of Ensenada, by the exploitation of sands in streams of the region, and by the increased urbanization in the valleys. Aquifers of Tijuana, Tecate and St. Thomas are over-exploited, and those of Guadalupe Valley and Ojos Negros are over-granted. Future scenarios of water recharge based annual rainfall reductions

indicate that the San Vicente Basin, south Ensenada, could be negatively affected with a nearly 20% reduction. For the other aquifers in the region are expected to fall between 5 and 15%. Furthermore, the new Ensenada-Tecate highway along the Wine Route has generated a touristic boom favorable to the region; However, it also represents a massive development pressure in the housing and additional pressure on water availability in the region so that future scenarios of water usage due to population growth, not including climate change, are even more worrying.

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Hydrological modeling of the basins that form the Cantareira System for assessing water availability in the metropolitan areas of São Paulo (RMSP), Campinas (RMC) and Baixada Santista (RMBS) - SP / Brazil

DESCRIPTION

The state of São Paulo is Brazil's most developed state and the Metropolitan Region of São Paulo is the most populated. In the decade of 1960 to 1970 there was a big problem to be solved: The largest city in Latin America, until that time, had been built on the banks of a small river, the headwaters of rivers and highly contaminated small streams to meet the needs of the region. Thus, the growth of RMSP was jeopardized due to the lack of water availability. The solution was to bring water from another river nearby; there were two alternatives: the Piracicaba River basin, located in the north of RMSP or the São Lourenço River basin, a tributary of the Ribeira de Iguape, located south-west. For economic reasons, it was decided to bring water from the Piracicaba River basin through the construction of its tributaries busbars with slopes in the Sierras de Mantiqueira and Cantareira, closest to the RMSP.

In the 1970s the construction of dams, canals, and tunnels began - which would connect the reservoirs to pump 200 m of elevation to the slope of the Serra da Cantareira in RMSP. This system is responsible for the mean reversion of 31 m3 / s used a total of 59 m3 / s. Since the 80s many industries left RMSP in order to look for better water quality and lower costs within the state of São Paulo. Many of these companies have settled right in the Piracicaba River basin. Currently, the basin of the Piracicaba, Capivari and Jundiaí is responsible for about 6% of the Brazilian GDP. To further complicate the scenario, RMBS, located on the coast of the state of São Paulo with a population of 1.6 million inhabitants, and in the summer months this number doubles, having the need for a reversal of waters of Billings reservoir for Baixada Santista, which has an elevation of about 720 m, native to RMSP. Three metropolitan areas depend on the same resources creating a scenario of imminent conflict.

It isn't clear whether such removals in the hydrological behavior are due to climate change, to the very influence of reservoirs constructed from the decades of 1970 to 1980. If they are coming from the increase in urbanized areas, since the Metropolitan Region Campinas has had the highest growth in Brazil in the last 70 years, exceeding the national average, or is this just a long-term cyclical behavior, as in the three decades prior to 1940 were also recorded rainfall higher than those recorded in the 1940/70.

OBJECTIVES

To reduce conflicts over water use, promote the recovery of the historical series of flows through rainfall-runoff models, without the influence of reservoirs and assess which the real flow regularization reservoirs Cantareira System are. To introduce the effect of reservoirs and correct the recovered series by modeling; to propose new rules of operation of existing reservoirs and to check if there are viable alternatives to increase water availability in basins forming the Piracicaba, Capivari and Jundiaí.

RESULTS AND MAJOR ACHIEVEMENTS

The results of this evaluation of alternatives help in further discussions on the renewal of the concession for the transposition of the waters of the Piracicaba River basin in the RMC for RMSP. It helps understand the complexity of the relations of production of water with natural cyclical changes or anthropogenic climatic changes affecting the three metropolitan areas in the state of São Paulo, Brazil

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3

AIM FOR PRESERVATION OF WATER RESOURCES

ABAR. Boron Removal from Water and Liquid Industrial Waste

DESCRIPTION

Boron occurs naturally in the environment since it is released from the Earth crust into the water bodies during erosion and infiltration processes.

High concentrations of boron can be toxic to vegetal species, which limits productivity and diversification of crops since it affects their output rate and quality. Even though there are not enough studies that prove whether Boron has an effect on health or not, boron concentration has been regulated in some countries to meet drinking water quality standards.

Despite the fact that Chilean irrigation standards (NCh 1333) determine that the maximum concentration of boron must be 0,75 mg/L, boron can be found in concentrations of up to 78 mg/L in northern Chile. Chilean regulations for drinking water quality standards do not include a criterion for boron concentration, but the World Health Organization suggests a maximum concentration of 0,5mg/L.

OBJECTIVES

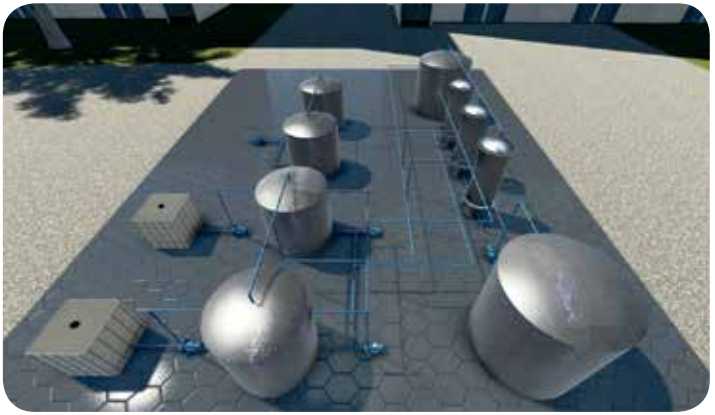
To develop cost-efficient technology to remove boron from rural, urban, and waste water in order to produce water suitable to be released into surface water bodies and to be re-used for irrigation according to the existing water quality standards.

RESULTS AND MAJOR ACHIEVEMENTS

After years of research and assessment of the efficacy of different technologies from all over the world for boron removal, Fundación Chile developed the ABAR technology – an improved ion exchange system to treat raw, urban, rural, and irrigation water. This technology was optimized after trying different resins and designing a columnar operation system with a specific configuration that allows the increase of the operating life and regeneration efficiency of the resins. This leads to lower operating costs and residue generation (eluted with boron concentrate).

The ABAR technology has not only technical advantages but also financial benefits. Among the most important technical advantages we can mention:

- 99,9% boron removal from the water to be treated.
- No pre-treatment needed.
- No generation of waste sludge; volume of boron concentrate recovered is 2-5% of the treated water (versus 40-80% of water treated by reverse osmosis).
- No use of chemical additives in the water treatment.
- It can be complemented by other technologies.
- Low energy consumption.
- Sub-products with value in the market such as boric acid can be obtained.



- Production of high quality water for discharge, reuse and human consumption.

In order to validate and diffuse the developed technology, treatability studies were carried out in over 15 water matrices from different sources and in which the boron concentration varied from 1 to 30 mg/L. A pilot study was also conducted in a grapevine crop in the Region of Atacama, which resulted in over 95% boron removal. Over 50 people from different sectors of production were trained.

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INBIOTREAT. Passive Biotechnology for Winery and Public Wastewater Management

DESCRIPTION

Globally there are different conventional treatments that allow the removal of contaminants from wastewater. However, there are some disadvantages because they require high consumption of reagents and / or energy and not always efficient for the removal of all contaminants. Fundación Chile in search of cost efficient technologies for wastewater treatment transferred and evaluated a passive treatment system that is a symbiosis between wetlands and microbiological treatment systems and is characterized by low operating and maintenance costs as artificially simulated in the degradation and removal of normal elements that occur in nature.

OBJECTIVES

To develop a passive type of treatment for industrial mining, winery and home wastewater treatment, it managed to reduce at least 80% of contaminants, stabilized physical and chemical parameters of treated water and also out of low maintenance and operation cost compared to conventional technologies. During the 3 years of research and development were tested for different types of effluents at laboratory scale, bench and pilot, which ended with the implementation of three industrial scale systems. Among the evaluated systems can be mentioned:

CODELCO Andina Division for the abatement of sulfate in the clear waters. The results allowed us to demonstrate that the treatment is effective in waters up to 1500 mg / L of sulfate can be used as a complement to other existing technologies.

Viña Montes and Vercellino for treating industrial wastewater with high organic matter content. The results of the deployed systems designed to treat between 4 to 100 [m3/day] showed that the developed InBioTreat system has a mean capacity of removal: 90% suspended solids, BOD5 80%, 66% and stabilization Total Nitrogen pH of the effluent outlet 7. Treated effluent also meets the values set by the Chilean Standard Irrigation (MOD NCh1.333/OF1978 1987) and with the ranges allowed by the Livestock Service (SAG) for irrigation water.

At present we designed a modular system that allows the transport technology and rapid implementation biotreatment units arranged in cells that can be coupled according to the amount of water to be treated.

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MILAF: Technology for Managment of Arsenic-Laden Sludge and Treatment of Acid Water from Copper Smelting Processes

DESCRIPTION

Any production activity, at some point during the process, generates residues that need to be managed in order to avoid impact on the environment. The mining industry is not an exception. Currently, copper smelting processes in Chile generate over 3,000,000m3 of low-purity sulfuric acid and high concentrations of arsenic and metals. In general, these acid waters are neutralized by the addition of lime to increase the pH from 1 up to 12 – a process that yearly generates over 18,000 tons of arsenic-laden sludge from smelting. This residue is considered to be one of the most hazardous pollutants due to the harmful effects it has on human health and the environment; therefore, it has to be disposed of in secure landfills. Then, the smelting industry has been forced to incur expenses of approximately USD 2.8 million per year for treatment and disposal of waste sludge.

OBJECTIVES

To develop a cost-efficient solution that can reduce the generation of waste sludge and hence lower waste sludge treatment and disposal costs.

RESULTS AND MAJOR ACHIEVEMENTS

Fundación Chile developed the MLAF technology in the research framework of acid wastewater treatment and reduction in waste sludge derived from a particular smelting. MLAF integrates treatment units based on fractional precipitation carried out with passive agents and arsenic selective removal through adsorption processes.

Results showed that this technology allows for 90% reduction in waste sludge generation; production of quality water that can be re-used in industrial processes; and also the recovery of 99% purity gypsum with market value. Estimates based on current costs indicate that, at industrial scale, the solution could reduce the cost of wastewater treatment and waste sludge disposal by USD 1.4 million per year.

On the other hand, the treatment has some other advantages such as: a) reduction in supplies since 20% less lime is used; b) reduction in the use of soil for toxic waste disposal, which minimizes the impact on the environment; and c) the opportunity to use the recovered sub-products with market value to do business with gypsum suppliers and save another USD 0.6million a year per smelting.

The MLAF technology was awarded in 2009 by the IC2 Institute at the University of Texas at Austin as one of the best technological innovation in Chile to be promoted worldwide. Currently, this technology is undergoing an intellectual property process, so that it can be reproduced in the future.

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Wastewater Sanitation through artificial damps in the basin of the Pátzcuaro Lake, Michoacan

DESCRIPTION

The Pátzcuaro Lake (Mexico) has euthrophication problems as a result of the wastewater discharge, which has greatly affected biodiversity (endemic species endangerment), production activities (fishing and tourism), and the health of the communities living by the bank. As part of the problem, there is insufficient infrastructure for wastewater treatment (mainly electro-mechanic systems) since most of it is out of order due to the lack of economic resources and training of the operators.

This study was conducted to offer an alternative solution. To do so, through a combination of treatment damps and maturation ponds, a low-cost system for municipal wastewater depuration was designed, built, and evaluated. Several aspects were combined: technical (a combination of natural treatment processes), social (community communication and participation), economic (treatment cost), environmental (monitoring of the water quality improvement in the lake through a study on macroinvertabrates).

The treatment system consisted of a system made of grilles, a desander, a septic tank, and two parallel modules joined by a supernadant damp, a maturation pool, and a polishing pool. The design considers fulfillment of Mexican regulations in two kinds of water re-use: discharge into a type-C receiving[1] body to protect aquatic life and discharge for agricultural irrigation in rural area with temperate climate where 2,700 people live.

OBJECTIVES

To design a low-cost and easy-to-operate wastewater treatment system that generates water with a quality according to Mexican regulations for aquatic life protection.

Secondary objectives involved building of the system, evaluation of the efficiency in contaminants removal, training of the operators, and evaluation of the water quality in the lake through a study of bio-indicators.

RESULTS AND MAJOR ACHIEVEMENTS

After two years of study of the wastewater treatment system, the results/advantages are: high efficiency in organic material and nutrients removal; protection of the aquatic life, biodiversity and production activities; high approval of this technological alternative by rural communities; reduction in health risks; aesthetic improvement of the region and reduction in stench; generation of extra economic resources as the result of the sale of vegetables, ornamental flowers, hand-craft material, and forage material that contributes to the sustainability of the system. Besides, four new systems have been built at bank of the lake for communities with 1,000-3,000 inhabitants.

1 According to the regulation NOM-001-SEMARNAT-1996, a receiving water body stands for a river, pondage or areas where wastewater is discharged. These receiving bodies are classified into three types, depending on the treated water use: type A, treated water for agricultural irrigation; type B, treated water for public and urban use; and type-C, aquatic life protection.

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Water Resources Management from the Source to the Effluent

DESCRIPTION

The Zamorano Panamerican School of Agriculture – funded in 1942 - is an international educational center located in Honduras. Its aim is to educate Latin-American young leaders who are capable of facing the challenge that sustainable agricultural production involves, as well as efficiently reacting to the effects of the changing climate through the development of knowledge, practices, and technologies for sustainable use of water resources. Zamorano School is aware of the need to educate students in the framework of the importance of water sources protection, sustainable water use for food production, human consumption, and implementation of treatment and re-use alternatives in order to generate sustainable water utilization cycles.

RESULTS AND MAJOR ACHIEVEMENTS

Zamorano School obtains the water for human consumption from water springs located at the foot of the Uyuca Biological Reserve. Zamorano School has been in charge of this reserve since 1985, when the Republic of Honduras government delegated responsibility via a statutory decree. Nevertheless, it is since 1948 that Zamorano School – in spite of the intense pressure from human activities that protected wildlife areas of Honduras face - has been working on the conservation of this reserve by means of continuous monitoring as well as prevention and fighting of wildfires. The Uyuca Biological Reserve is a sanctuary that shelters a large number of species and plays a major role in the regulation of water resources not only in the communities located at the foot of the Yeguare Valley but also in communities of San Antonio de Oriente and Tatumbla nearby Zamorano School. After the water obtained by the Zamorano-School system is purified, it is used in a series of production processes for educational purposes and agro-industrial plants that produce considerable organic discharges. For this reason, in the 80's, Zamorano School implemented feasible wastewater treatment alternatives through a five-pond purification synstem. The system is made of two primary parallel ponds and three maturation or secondary ponds in a series. Primary ponds remove the organic material through symbiosis of algae and bacteria; maturation ponds remove pathogens. The system efficiently removes 97% of BOD and 82% of COD. Some of the water from the purification pond is re-used to irrigate the crops of the Research Program on Bean (PIF) – a leading program in the region that produces genetically-improved seeds to be distributed in Central America. Furthermore, some water of the first pond and waste from livestock activities are used for experimental tests on biogas production. The produced boil is

used for tests on the production of energy forage for agricultural use. All the activities in this cycle - protection and management of water sources, purification, treatment, and re-use – offer educational in-practice scenarios that are included in the syllabus. This enforces and encourages students' responsibility for the environment and fosters integrated management of the resource.

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Ground Water Quality Indexes in the Eastern Region of Honduras

DESCRIPTION

Due to the growing problem with the supply of water from surface sources to human consumption, the extraction of ground water has become an alternative for different communities from Honduras to access this resource. However, there are not many initiatives to monitor water quality and consumers have little knowledge of the water source conditions and the risk that consuming contaminated water has. Isolated indexes of water quality may lead the community to over- or underestimate the conditions of a given water source; besides, enough information in this regard to make decisions is not usually provided. Therefore, the aim is to adapt water quality indexes used to evaluate ground water sources to the national context. The study was conducted with the support of "Texas Water Mission" at the University of Texas in San Antonio.

OBJECTIVES

The aims of the study were to describe water quality in perforated pits of the Department of El Paraíso - Honduras, according to physiochemical and bacteriological parameters in order to identify the main sources of contamination and to evaluate suitableness for human consumption. This study was also developed with the purpose of adjusting water quality indexes used internationally to the context of the eastern region of Honduras.

RESULTS AND MAJOR ACHIEVEMENTS

This study has led to 4 samplings in perforated pits located in rural and urban areas of the Department of El Paraíso – Honduras, during the period of 2011-2012. The water quality parameters analyzed were: electric conductivity, temperature, pH, total dissolved solids, dissolved oxygen, true color, nitrates, nitrites, alkalinity, hardness, fluorine, total and thermotolerant coliforms, turbidity, and total metal content (aluminum, nickel, copper, zinc, potassium, magnesium, arsenic, and cadmium). The following water quality indexes were modified in order to allow easier interpretation of the results: The CWQI (Canadian Water Quality Index) approved by the Canadian Ministry of Environment (UNEP, 2005) that considers fulfillment of parameters to meet human-consumption water quality standards; the GWQI (Groundwater Water Quality Index) – Ribeiro et al., (2002) that considers the health risks of some contaminants by assigning relative weights. Parameters with high levels in the studied pits were: hardness, turbidity, color, and coliform bacteria. 57% of the studied pits were labeled as excellent according to GWQI and 0% according to CWQI. Two pits showed poor water quality.

The study allowed the identification of contaminated pits in the region and the evaluation of the use of water quality indexes to describe the condition of the water sources for human consumption. In general, no differences between pits in urban and rural areas and small interannual in the analyzed parameters were found. The modified indexes allowed better interpretation of the results, a better system to inform communities benefiting from these water sources, and better comparison of the places. However, this interpretation has to be cautious and based on awareness of characteristics of the region and resource use.

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Dynamic Modeling of River Water Quality Bogota – Colombia

DESCRIPTION

Bogotá River has a drainage area of about 6,000 km2, a length of 380 km, an average flow of 40 m3 / s, and a wide range of activities and main uses of water resources, including tanneries in the basin high, water purification, irrigation and hydropower in its middle basin, besides provision without any treatment of wastewater from multiple districts located along its course, which total about 10 million inhabitants. Bogotá River is undoubtedly one of the most polluted rivers in the world, a bad example for other similar rivers in Latin America, on which are planning and executing various consolidation strategies. The enormous complexity and dynamics of the activities that impact the river and the huge costs associated with different strategies proposed sanitation, stress the importance of having a planning tool, permitting the modeling and analysis of dynamic quality Bogotá river water, sanitation under different scenarios. According to the above, and based on the results of previous studies performed in Bogota by the University of the Andes and the Pontificia Universidad Javeriana, Universidad Nacional de Colombia developed this tool which was funded by the Water and Sewerage Company of Bogotá.

OBJECTIVES

The primary objective was to develop a planning tool, which will minimize the costs of sampling and laboratory analysis, and that through the design and execution of three field campaigns allow rigorously implement the extended QUASAR model: model "AMQQ" (Lees et al., 1998). This, for the purpose of characterizing the dynamics of water quality to Bogotá River throughout its course, and analyze different scenarios implementing sustainable and cost effective river sanitation.

RESULTS AND MAJOR ACHIEVEMENTS

Through research, a tool to estimate travel times along the river was also developed through the implementation of integrated transport model ADZ-MDLC, which contributed to the establishment of a methodology sampling based on continuous in-situ recording of the electrical conductivity and other water quality parameters. It was successfully implemented in 84 monitoring points along the river and was replicated in three field campaigns. The results of laboratory tests on a total of approximately 300 samples, allowed calibrating and validating and performing sensitivity analysis and uncertainty model AMQQ for each of the 54 subsections into which the river was divided, by applying objective calibration methodologies GLUE (Beven et al., 1992) and SCE (Duan et al., 1993).

The adopted modeling strategy identified subsections of river processes, water quality conditions and model parameters calibrated similar to AMQQ, reducing river segmentation to five

different sections, each of which, we estimated the representative rates of the various processes. With the implemented model we investigated a total of twenty different consolidation scenarios. In general, the current condition of the river, the following problems were identified: deterioration of water quality with respect to the known conditions of previous years, need to implement a biological treatment of tannery effluents in the upper basin, low capacity pollutant load assimilation by the river in its upper and middle basins and the importance of tertiary treatment at the WWTP of Bogotá, among others.

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Drinking-Water Quality Safety in Community-Managed Systems in Peri-Urban and Rural Areas

DESCRIPTION

One of the causes that originated the water conflict in Bolivia corresponds to the potential privatization of water systems managed by the own community in the view of little action taken by authorities.

The city of Cochabamba has over 400 thousands community-managed water supply systems. Then, the aim of the present study is to help water system operators to improve community management of not only water quantity but also of water quality. Several studies have shown that drinking water quality deterioration is caused by deficient or null operation and maintenance of water systems, deficient training for water system operators, and the belief that water quality can only be measured by means of quality tests. It is usually forgotten that sanitary inspections, appropriate operation and maintenance of each part of the system are preventive actions to be taken into consideration. For this reason, a water quality control plan was developed. This plan includes frequent evaluation of the water systems, preventive maintenance actions, cleaning and disinfection of the water storage tanks, improvement of water quality with simple technologies and regional supplies, continuous training of operators, and water quality testing.

OBJECTIVES

To provide drinking-water system operators with simple tools that help them prevent water contamination, improve water quality.

RESULTS AND MAJOR ACHIEVEMENTS

- Score cards for sanitary inspection of the water, operation, and maintenance systems- simple preventive actions to treat water at the community and household level. A manual for water quality testing.
- Training of 55 water system operators in the use of sanitary inspection protocols to identify water contamination risks and hazard from infrastructure.
- Training of 55 water system operators in operation and maintenance of the water system, disinfection of water storage tanks, disinfection of water, minimal control of water quality standards.
- Employers for the sanitation area of 5 departments of Bolivia were trained in the use of tools for sanitary inspection, operation, and maintenance; disinfection of tanks and water; bacterial analysis for thermo-tolerant coliforms.

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Bacterial Inactivation Without Use of Chemicals

DESCRIPTION

The World Health Organization (WHO, 2011) stated that prevention of diseases caused by poor water quality poses great challenge for world health. Every year, there are 2 million deaths provoked by poor water quality, sanitation, and hygiene. 4% of the cases all over the world could be prevented by improving sanitation. A report on Human Development by the United Nations Development Programme (UNDP 2006) says that currently 1.2 million people are directly affected by water scarcity and 2.6 million people live in areas without basic sanitation. Nevertheless, the report also indicates that in 2005 2.7 million were affected by water scarcity. Drinking water quality is vital for human life; therefore, water scarcity and poor quality of available water have created an adverse scenario. In order to cope with this challenge, new water treatment technologies need to be developed. An alternative system to treat water by means of a device with a cavitating flow has proved to be efficient.

Cavitation describes the process of vaporization of a liquid (similar to the process of ebullition) that occurs when flow pressure declines up to vapor pressure. Cavitation can be generated by the use of a device with a high-velocity cavitating flow. Dalfré Filho (2002), Dalfré Filho (2005) y Dalfré Filho y Genovez (2009). With Venturi geometry modification and pressure that allows high-velocity cavitating flows, bacterial inactivation time and energy-consumption can be reduced.

OBJECTIVES

The aim was to develop a device with a cavitating flow that allowed inactivation of bacteria in water. Cavitation parameters are: pressure, velocity, and venturi configurations - which were studied and tested at the Hydraulics and Fluid Mechanics Laboratory at the Department of Civil Engineering, Architecture and Urban Planning at UNICAMP. Bacterial inactivation tests were conducted on non-pathogenic bacteria, Escherichia coli. Inactivation occurred with Venturis of different internal geometry – circular, conic 20° and conic 132°. With the optimal geometry of the venture, inactivation of E. coli occurred at different pressures (4,0 – 12,0 MPa).

RESULTS AND MAJOR ACHIEVEMENTS

Bacterial inactivation was satisfactory, about 4,0 log[1]. The device with the proposed pressure, velocity, and Venturi configurations proved to be effecient in the inactivation of these microorganisms. No chlorine was used (different from traditional processes). Its use could be applicable to raw water.

1 Temperature of the system is controlled so that inactivation is not affected.

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4

WATER GOVERNANCE

Integrated Water Resources Management in the Regions of Atacama, Arica and Parinacota

DESCRIPTION

Nowadays the development of the north of Chile is subject to improve the water resources management. The steady decline in reserves of surface water and groundwater as well as the continued growth in demand for the resource represents a severe constraint on productive activities, society and ecosystems.

This has been a constant concern of the national and regional authorities. While local capacity for water management have evolved in proportion to the growth in demand. This combination of factors has led to severe water conflicts with the environment and between users competing for a scarce resource. The sensitivity of the inhabitants and the reactions expressed in the area for the water issue implies that water management has a social, political and environmental component that should be considered.

Fundación Chile develops with co-financing from entities such as Innova Chile (CORFO); Regional Governments of Atacama, Arica and Parinacota, Water Directorate; National Irrigation Water Tables Guasco and Copiapo and others, the two projects which sought to contribute to the Integrated Water Resources Management (IWRM).

OBJECTIVES

To contribute to the Integrated Water Resources Management (IWRM) through the exploration and dissemination of tools, model management, and capacity building institutions that tend to maximize economic, environmental and social water use, and to improve management processes and conflict resolution at local level.

RESULTS AND MAJOR ACHIEVEMENTS

The execution of these projects brought about the generation of multiple results, among which are:

- Development of the first two basins Observatories in Latin America that integrate and systematize a publicly accessible web tool all available information relating to the issue of river water from each of the regions. www.observatoriocuencas.cl

- 4 Technology Missions to countries like Brazil, United States and Mexico, with the participation of 21 players in the Atacama region and 7 in Arica and Parinacota with the aim of prospecting tools that contribute to the responsible management of water resources.

- Documents Development and Transfer of Support processes of water resources management, such as: Action Plan Water Tables, Conflict Resolution Mechanisms, Governance Proposal by Water Banks and Water Governance.

- Permanent technical Advisory for water tables Copiapo and Guasco between 2009 and mid-2010.
- 10 training activities attended by over 350 people from public and private sectors.
- Development of a course on Integrated Water Resources Management and delivered to public officials and society actors in the Region of Arica and Parinacota.
- 12 international experts were brought to provide advice to the public and water tables in the region.
- 4 publications on water governance experiences, conflict resolution mechanisms, proposed plan of action for establishing water tables and establishment of water banks.

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Use of Mathematical Modeling to Reach Agreement on Integrated Water Resources Management of the Lerma- Chapala Basin

DESCRIPTION

The Agreement on Surface Water Distribution was signed with the purpose of controlling water management, protecting the water bodies in the Lerma- Champala basin, and providing equitable water distribution among users.

The Lerma-Chapala basin is formed by the States of Mexico, Querétaro, Michoacán, Guanajuato and Jalisco. In 2004, the River Basin Council (Consejo de Cuenca) – made up by different entities related to water management and the water users - signed an Agreement on Surface Water Distribution that determines operation regulations. This agreement is still in force, which allows better understanding of water distribution by being respectful to needs, concessions, and conservation of water bodies in the basin.

In order to test different scenarios and to select suitable regulations for water distribution, a model considering different variables and elements to make a simulation as close to reality as possible was used in the Lerma-Chamala basin. The main components are:

- Rainfall-rainoff Model
- Funcionamiento de vaso of the main dams of the basin, including Chapala
- Policies for allocation to the different kinds of irrigation systems.

OBJECTIVES

To reduce conflict caused by competition for water; improve water use efficiency; improve conservation of the Chapala Lake; and foster dialogue to reach agreements on water distribution.

RESULTS AND MAJOR ACHIEVEMENTS

The results obtained from the evaluation of modeled alternatives led to discussion on water distribution and subsequent signature of a new agreement to regulate availability, distribution, and surface water use in the national geographic area of Lema-Chamala.

Training courses on the use of the developed models were offered with the purpose of making the negotiations for the new agreement more transparent.

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Postgraduate Training in a Regional Water Issues

DESCRIPTION

The postgraduate training of academics in water issues is essential to ensure sustainable management. In this regard, the Centre for Water Trans disciplinary Studies (CETA) at the University of Buenos Aires (UBA) was a pioneer in the treatment of the topic of water with different disciplinary approaches, which were specified in the Master of Water Management (MGA[1]) and intense action at MERCOSUR regional level primarily through the Academic Committee of the Association of Water of Montevideo Universities Group (CAA-AUGM). In this case study raises the CETA experience in postgraduate training at the regional level through the MGA and the CAA-AUGM.

OBJECTIVES

The main objective is to train professionals to interpret the set of dimensions of knowledge, technologies and tools required to carry out an integrated water management.

RESULTS AND MAJOR ACHIEVEMENTS

The perception of students and graduates through surveys demonstrates that the construction of knowledge with an interdisciplinary approach is distinctive in this postgraduate and allowing them to have tools to apply the knowledge gained local issues with a view to the conservation and sustainable resource management. This is particularly important between 20-50% of the students come from different countries of the region, so that they return to their home countries to implement the knowledge and skills acquired by multiplying local capacities.

The MGA from the University of Buenos Aires has contributed a comprehensive view to training professionals who currently work as managers in different organisms. 90% of students in the first three classes have defended his master thesis. All graduates are inserted occupationally and 86% of those who developed tasks associated with water management have risen in rank within their institutions. Of those who were not occupationally related bodies linked to the issue (prior to the graduate study), 35% had obtained a position in any governmental or non-governmental institution in Latin America related to water management.

The Academic Committee Waters, whose coordination exercises the University of Buenos Aires, and is composed of 16 universities in Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay, has produced significant contributions in various aspects of water issues applying trans disciplinary, generating projects, publications and training and human resource development, and allowing the dissemination of this subject.

It should be pointed out that two of the projects developed by the CAA-AUGM were: “Continuing Education Program in Integrated Water Management in MERCOSUR (PECGIAM) and the project” Multidisciplinary approach in integrated water management in MERCOSUR (EMGIAM). In 2013 there is the realization of an International Course on Water Management in

1 The MGA emerges as one of the first higher education programs related to water resources management in Latin America

Rural Watersheds that has a regional footprint, considering that MERCOSUR is a region where most agrofood are exported all over the world.

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Contributions by the Program on Remediation and Management of Basins Zamorano University, Honduras. Eighteen years shared learning

DESCRIPTION

Basin management in Central America took greater importance on the public agenda because of the damage, loss of life, damage to infrastructure and the economy, caused by tropical storm and hurricane Mitch in 1998. As expected, the issues related to the management of natural resources and the environment take effect boom after a natural phenomenon. This is related to the impact such events have on the life and property of many people and economies of affected countries. In the case of Honduras, basin management programs were initiated after Hurricane Fifi along the north coast in 1974. It was there where most of basin management initiatives were concentrated led by government agencies such as the Honduran Forest Development Corporation (COHDEFOR), today Forest Conservation Institute (ICF) and the Ministry of Natural Resources, within which intervention in the mountains of the Sierra de Omoa was relatively successful. Despite the efforts, basin management has been forgotten after several years. This begs the question, will it be the same after Mitch and recent tropical storms and hurricanes that have hit Central America in the last decade? What should change for programs and basin management projects are part of the daily activity of the population and part of a national-territorial environmental management? What do we or should we do differently to ensure greater effectiveness, continuity and sustainability in basin management interventions?

OBJECTIVES

This article describes the basin management approach applied by Zamorano seeking greater effectiveness and sustainability in basin management producing drinking water, and tries to answer the questions above and summarizes the lessons learned.

RESULTS AND MAJOR ACHIEVEMENTS

The document is presented as a described and illustrated a summary of the results and achievements of the more than eighteen years of managing, designing and implementing basin management initiatives and water resources. It also describes the results of hydrological research developed in two reference sites "experimental basins": Capiro-Zapotillo Guinope Paradise and La Tigra Experimental Basin, located in La Tigra National Park, Honduras.

Keywords: Basin management, basin approach, environmental management, basin hydrology, water sources.

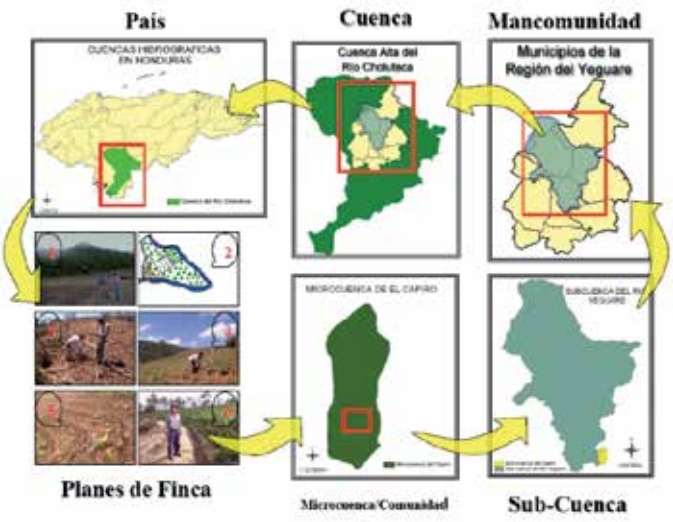

Figura 1: Model of development and territorial planning, and basin management to foster incremental and cumulative learning with locals.

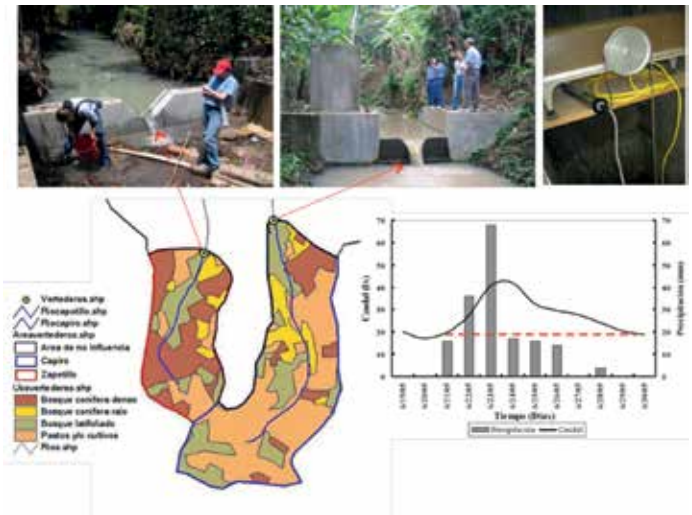

Figura 2. Hydrological paired basins research developed by Zamorano students in experimental micro basin Capiro-Zapotillo, Güinope Paradise, 2003-2004. Financial support consortium MIS / CIAT, Colombia.

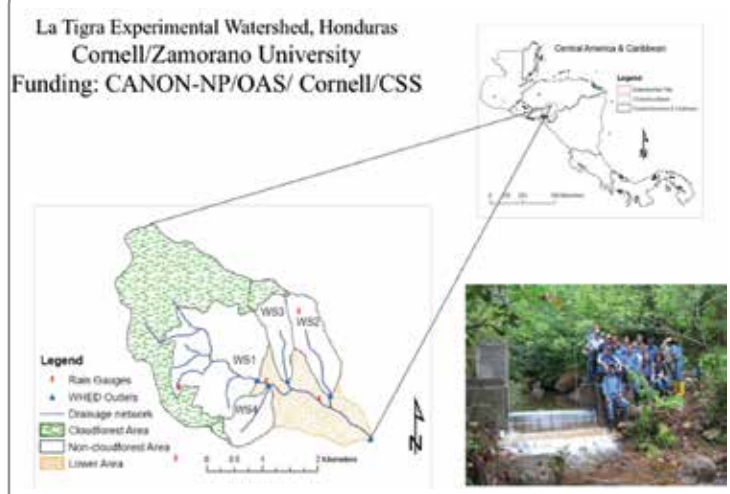

Figura 3. The experimental micro basin La Tigra. First experimental basin in Honduras and the second in Central America created for hydrological research in the fog forest (Caballero, et. Al, 2012).

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Meteorological-Environmental Implementation and Modeling of Urban Basins

DESCRIPTION

Urban development in Latin America estimates of 85% of the total population by 2030 will impact on hybrid resources, i.e., on the treatment and discharge of surface runoffs and wastewater into receiving bodies. In this regard, researchers at the National University of Colombia (UNC), tied to the Research Group GIREH (a research group on water resources engineering), have been developing a case study in the 1,2 m2 micro basin located at the university building since 2007. In order to collect hydrological data, they installed meteorological and hydrological equipment (14 pluviometers and a weather station installed in the campus roofs - ultrasonic water level sensors, samplers, and multi-parameter sounds installed in several pits of the combined sewer system of the campus, respectively). This has allowed a rigorous mathematical modeling of this kind of basins in respect of both water quantity and quality; in order to do so, it was not only necessary to have integrated consideration of meteorological and hydrological components but also a interdisciplinary and holistic approach to water management in urban areas since the analysis had to consider every component (sewer system, water treatment plants, receiving water bodies) and results provided by researchers on other disciplines such as climatology, architecture, geography, public, health, biology, among others.

OBJECTIVES

The main objectives are: i) to create a reliable hydrological data base that is compatible with the lag-time of urban basins ii) to analyze spatio-temporal variability of precipitation and its impact on the hydrological lag-time of urban micro basins iii) to rigorously use the mathematical modeling tools to analyze: the rainfall-rainoff process, the scour phenomena, contaminant accumulation and scouring processes, water balance components.

RESULTS AND MAJOR ACHIEVEMENTS

Some of the most important results: i) High spatio-temporal variability of precipitation in the studied area raises the question about the use of traditional methods, such as the Rational Formula, in the design of sewer systems since these take precipitation homogeneity for granted ii) The use of complex interpolation methods based on specific data does not always provide better results iii) The importance of having a reliable hydrological data base to do rigorous mathematical modeling, in which calibration, validation, analysis of sensitivity and uncertainty are considered iv) Methodological proposals for: hydro-meteorological implementation in urban basins, the analysis of the scour phenomena, the analysis of contaminant accumulation and

scouring processes, description of roof rainwater to be re-used v) The need of an holistic and interdisciplinary approach to conduct studies on water resources in urban areas.

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IWRM, a tool for Vulnerability Reduction and Adaption to Climate Change: Case Study- Ramsar Moyúa-Playitas-Tecomapa Wetlands, Nicaragua

DESCRIPTION

Moyúa-Playitas-Tecomapa is a lacustrian system placed in a hydrographic basin that the local government of Ciudad Darío, Matagalpa – Nicaragua, considers as at environmental risk. With the object of remediating the degradation of soils, forests, and water – as well as the social and economic impact on the population – an Integrated Management Plan (promoted as Municipal Ordinance by the Municipal Council) for this area has been created. This plan was designed in the framework of Integrated Water Resources Management (IWRM) and, at the same time, it is a strategy for adaptation to climate change and variability in the wetlands. The Ramsar Convention has referred to this place as "wetlands of worldwide importance" and listed it with number 1980.

The effects of climate change and variability are worse on those countries that have less historical responsibility in this issue. This proves the severe impact that climate variability and global changes have on economy, environment, agriculture, and food security. People, ecosystems, and economy notice the effects of climate change mainly through the water resources scenario. In simple words, the best way of adaptation to climate change is by means of efficient water management to create the conditions to endure the negative impact on population, terrestrial and aquatic ecosystems. The local hard work is illustrated in fig.1.

OBJECTIVES

To develop a management plan for the lacustrian system through the implementation of different management programs aimed not only at the conservation of water and forest resources but also at environmental awareness and education as well as sustainable economy. In order to do so, several initiatives have been promoted. The goal to be achieved is shown in fig.2

RESULTS AND MAJOR ACHIEVEMENTS

The design of a management plan with three main programs on economy, conservation and education, and environmental awareness. Each of them includes projects with the corresponding activities to be carried out.

- Plan on Economy: Development of sustainable tourism and production activities such as agro-forestry production (organic and systems for crop-farming and grazing), sale of environmental services, and development of nurseries and family-use-only gardens.

- Plan on Conservation: Remediation and protection of water

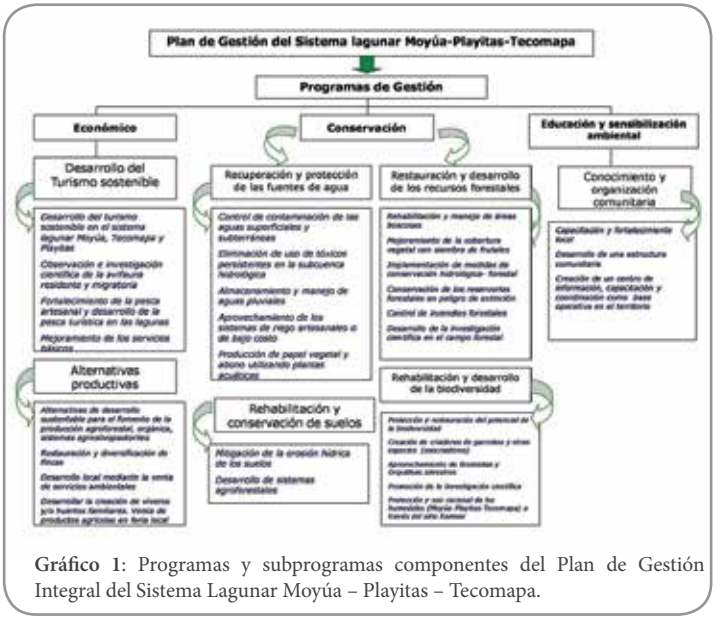

Gráfico 1: Programas y subprogramas componentes del Plan de Gestión Integral del Sistema Lagunar Moyúa – Playitas – Tecomapa.

resources; remediation and development of forest resources; remediation and conservation of soil: remediation and development of biodiversity. It includes activities for contamination control and impact mitigation; protection and remediation measures; promotion of research and responsible use of water resources.

- Plan on Environmental Awareness-raising: training and organization of the community. The proposed activities focus on training and enforcement of the local community.

The Integrated Management Plan for the lacustrian system of Moyúa-Playitas-Tecomapa is a tool to control contamination of surface and underground water through the removal of highly-toxic organic contaminants. Also, through sustainable productive and agronomic intervention, it is oriented towards the remediation of soil, water, forests, and biodiversity – which contributes to the improvement on the living conditions of the community – with the objective of providing environmental management and food security as well as being a tool for adaptation to climate change and variability.

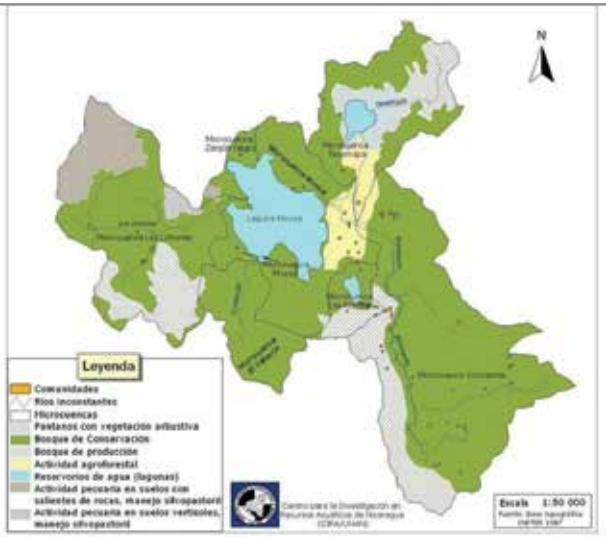

Gráfico 2: Imagen Objetivo del Plan de Gestión Integral del Sistema Lagunar Moyúa – Playitas- Tecomapa.

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Benefit-sharing Mechanisms: Agreements on the Welfare at Basins

DESCRIPTION

Appropriate management of ecosystem services allows understanding efficient ecosystem management as a synonym of human welfare. Welfare results in human beings with better capacity for good environmental management, generating a virtuous circle in the ecosystem.

However, in the case of water resources, people who benefit from them don't usually live in the area where the resources are, which makes it harder for this virtuous circle to occur. For this reason, CONDESAN raises the following question: How can we make people benefiting from Environmental Water Services (EWS) contribute to the welfare of those people in charge of their production and conservation?.

In order to answer this question, we started a long process of analysis when in 2003 we implemented the project "Cuencas Andinas" (Andean Basins) – which is based on the study of environmental externalities. The obtained results contributed to the incorporation of many Andean basins in first stage (2005-2008) of the Challenge Program on Water and Food (CPWR) – whose interest at that moment was in the Payment for Environmental Services (PES). Results showed that in practice other mechanisms were implemented, i.e., mechanisms based on dialogue and social agreement and not on PES. This was confirmed through the EWS Andean Scenario (Panorama Andino) in the Andean region by CONDESAN in 2010 - which led to the idea of building cooperative relationships through Benefit-sharing Mechanisms (BSM). These mechanisms consist in collective action processes to guarantee fulfillment of the individual and collective interests without affecting the base resources, life quality, and welfare of the community and people related to a given basin.

BSM was proposed as subject of study in the second stage (2010-2013) of the CPWR. During this stage, these mechanisms have been implemented in many basins and the acquired knowledge in this regard has allowed the development of a broader concept that is in harmony with highly variable reality in the Andes.

OBJECTIVES

To increase the overcoming capacity of social and environmental systems through better water management of the Andean basins. In order to do so, with the help of network of partners, we conduct research that has positive impact on poor communities and important policies.

RESULTS AND MAJOR ACHIEVEMENTS

(i)Projects were implemented in 17 basins with the help of local partners; in Colombia, Ecuador, Perú, Boliva, and Chile, 24 case

studies were systematized and over 24 cases were inventoried. (ii) Development of methodologies and tools for implementing, monitoring, and evaluating BSM. Furthermore, still in progress are: consolidation of the knowledge acquired and creation of a BSM conceptual framework that guides future interventions. (iii) Articulation of a partner network that involves researchers, both local and national governments, associations of consumers, among others – who intervene at the local, national, and/or regional levels. (iv) Knowledge and information was obtained not only to be used in the Andean region but also to be replicated all over the world.

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Evaluation of Water Governance in the Alto Tieté Basin

DESCRIPTION

In the framework of a River Basin Counsil (Comité de Cuenca), governance can be understood as a system involving regulations, institutions and democratic and participatory mechanisms for decision-making, which are usually based on personal motivations of the parties interested in the basin.

The study evaluated the governance of the Council of the Alto Telté basin by comparing: the investment criteria traditionally used by the Water Resources Management Fund of the State of São Paulo to finance projects, services and activities with the hypothetical criteria developed by a group of representatives of the basin. The latter criteria were developed by means of participatory methods used in the field of multi-criteria analysis in order to identify the different principles, goals, and beliefs that the representatives. Once governance was evaluated, it was possible to identify potential improvements in the public policies that the Council had developed, as well as to check governance capacity in the basin.

OBJECTIVES

The main objective of this study was to evaluate the governance by the Council of the Alto Telté basin.

The specific objectives of this study had the aim to:

- Identify methods that the Council currently uses to determine which projects are to receive the funds
- Identify decision-makers' preferences
- Evaluate the governance by the Council of the Alto Telté basin and – if needed -propose criteria for governance improvement.

RESULTS AND MAJOR ACHIEVEMENTS

It could be observed that most of the decision-makers want to modify or improve the current criteria or add new criteria; therefore, there is a low degree of compatibility between current criteria and the recently-developed criteria, which shows low governance capacity by the Council.

As a way of contributing to governance improvement by the Council of the Alto Telté, the potential addition of new criteria - based on the Interviewees' opinion, criteria used by former councils, and legal reports - was suggested.

Three reports containing a summary of the research methodology and results, as well as the new criteria proposal were prepared and then sent to the Council. The aim of the proposed model is not meant to be used step-by-step but revise and evaluate the currently-used criteria.

Based on these results, we want to encourage continuous revision of project selection processes so that they can be more efficient and meet the demands of hydrographic basins.

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Water Quality Monitoring of the Bíobio River: Private Research that Supports sustainable Water Management

DESCRIPTION

The Program on Water Quality Monitoring of the Biobío River System has been carried out uninterruptedly since 1994 in the scientific framework of the EULA (Europe-Latin America) Project "Water Resources Management of the Biobío River Basin and the neighboring Marine Coast" – which was developed by the University of Concepción with the help of funds provided by the European Cooperation and the Technology Management Council of Italian Universities from 1990 to1993. This project facilitated coordination between entities benefiting from the Biobío River water and the University so that they could manage the Monitoring Program jointly.

The Biobío River Basin (36º42' – 38º49' S; 71º00 - 73º20'W) is the country's third-largest (24,625km2) and second-longest basin with the greatest-flow (380km). This basin makes important contributions to society: water supply, hydro-electric energy, navigation, irrigation water, leisure, among others.

OBJECTIVES

The aims of this Monitoring Program are:

a) To measure the level of selected substances in the basin water under parameters specified in the national regulations for environmental quality and public health.

b) To evaluate spatio-temporal variations in the concentration of selected substances in the water of the Biobío River Basin.

c) To provide useful information in order to i) define the characteristics of the basin water at strategic places and ii) to objectively evaluate technological improvement implemented by the water resource users.

d) To inform, on a regular basis, about the conditions and evolution of the basin water.

RESULTS AND MAJOR ACHIEVEMENTS

a) Water Quality Mapping with data obtained through monitoring.

b) Information Diffusion.

c) Technological contribution to the development of quality regulations.

d) To be the only national program on water quality monitoring that has been carried out for 18 years systematically and uninterruptedly.

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Meeting RALCEA Ispra Italia 2011

Some Learned Lessons and Next Steps to Approach Water and Sanitation Issues

The 29 case studies presented in this compilation show the hydrological challenges that 10 Latin American countries face at present. The fact that each project is developed under specific geographic, social, economic, political, and climate characteristics offers the possibility to analyze the local context; to learn from the developed innovations and the challenges faced by each project; and to see the best practices carried out in the region.

On the one hand, these projects prove that it is possible to develop a wide range of initiatives on water management and; the other hand, they show that in order to get support from local authorities, relevant entities, and the communities, different approaches based on communication and cooperation should be used. Greater knowledge and social participation lead to a greater impact and sustainability of the project in the long-term. Many clear examples of the advantages derived from cooperative work among the involved entities are included here: (ANTINOMOS, MHEA Initiative, and the project on Postgraduate Training in Regional Water Issues, for instance).

Another learned lesson has to do with the community's commitment to water resources management. Community participation should be taken into consideration: first, from early stages of the initiative such as the conceptual development - as in the project on remediation of water springs - up to final stages when they become the beneficiaries of the developed technologies for the efficient resource use ; second, in the improvement to sanitation conditions (for example: the project developed by AguaLimpia, the Micro Hydro-plant in Perilillo, rainfall-supplied greenhouses, among others). Furthermore, the community plays a major role in the development of management instruments as in it can be noticed in the following projects: IWRM in the northern area of Chile, Payment Mechanisms for Ecosystem Services, and the Brazilian initiative on the use of legal instruments to protect heritage and water resources. This accounts for the socio-cultural dimension of water resources.

The technological dimension of water is equally important. Emerging and innovative technologies designed to efficient water use and/or remediation such as ABAR, Inbiotreat, MILAF and DROP do not only allow the final treatment of industrial wastewater but also the generation of alternatives for re-use and remediation of low-quality water at the community and industrial level – which contributes to the development of projects that aim at finding new water sources. All of this adds to the efforts on educating people by means of the implementation of networks of knowledge generated as the result of the interaction among different communities and water resources management (the project on modeling hydrographic basins in Brazil and the project on monitoring water quality of the Bogotá River in Columbia, for example).

Finally, this compilation was produced with the collaboration of 12 entities, among which Centers of Excellence in the Water Sector and Focal Points from all over Latin America can be found. This work has allowed us to share vital experiences in water quality and sanitation, but above all it has allowed us to enforce the incipient work by RALCEA. Our next step will be the development of strategies for future network sustainability by identifying existing capacities, developing research, generating new capacities and tools that allow solutions to be replicated in the region.

RALCEA is a program financed by the European Commission