

In order to know and manage the water to protect it as a key development element, that in excess or deficit or with a poor quality can be a risk for the population generating disasters and losses, is necessary applied the Knowledge Management proceeds.

BACKGROUND

In El Salvador the water monitoring and investigation, starts in the 70's in the Hydrological Area of the Ministry of Agriculture and Cattle. In this decade was built the national hydrometeorological network under the Central American Hydrometeorological Project (PHCA). With the collected information there were conducted several investigations on water quality, groundwater, water quantity and floods risk areas covering the whole country. During the 80's was elaborated the Master Plan on Water Management that constitute the most important study on the water resources of the country during a long period.

But after the Civil war starts (1980-1992) the data collecting and water investigation became more difficult to do, because of the destruction of the gage stations, the difficulties to take field information and also because of the decrease of the budget for this matter. That means that the water resources information that was generated during a long period of time, was reduce to the data collection of the nearest city sites and there are important gaps on the data in time and space.

After the Peace Agreements in 1992, starts a process of rebuilt the country at social, economical and environmental level. This process took time and resources and it was until 1994 that some international projects start to invest in the rebuilt of the hydrometeorological network and the national capabilities to manage water information.²

After the earthquake of 2001, the National Service of Territorial Studies (SNET) was created, and the Hydrological and the Meteorological Service were transfer from the Ministry of Agriculture to the Ministry of Environment, which was the entity under the SNET was created. That implies an improvement of the process of water data collection, water related investigation and for the first time, after 20 years, the investigation in water quality and groundwater was initiated as a systematic process.

In the last 5 years, the Hydrological Service of SNET has developed systematic water monitoring (surface and groundwater, water quality and quantity) in a more integrated way. This collected information and its processing, analysis and manage in order to transform the data in knowledge, has permitted to have a better understanding of the water status in the country.

THE STEPS OF THE PROCESS

Continuous Monitoring in space and time of the quantity and quality of surface water and groundwater.

With the objective of manage the water in an integrated way, is necessary to collect the water information with its full characteristics: How much water we have? Where is located? Which is the quality of the water? What is its behavior in space and time? And for this it is important to use the basin as the integration unit and its interaction with the groundwater location (aquifer

² FINNIDA, "Hydrometeorological Stations Reconstruction"

DANIDA-CEPREDENAC, "Mathematical Modelling for Flood Forecasting in Central America" (1992-1996)

MAG-IADB "Environmental Program of El Salvador - PAES", Ministry of Agriculture with a loan of IADB.

USAID Post-Mitch, "Central American Mitigation Initiative" (NOAA, USGS, USAID)

USAID Post Earthquake, "Reconstruction Project Post Earthquake" (USGS, USAID)

limits, discharge and recharge zones). And additionally, in order that the information can be compared, it has to be collected with established procedures and protocols.

In El Salvador, SNET is the institution in charge to do the water monitoring at national level. The quantity of the surface water is measured in 30 hydrometrical stations and 70 meteorological stations. The water quantity monitoring is made by a team of four persons in a monthly frequency. The water quality monitoring is collected from 144 sites in the principal rivers and 11 sites in the main lakes of the country. In this sites are measured some field parameters and are take samples to laboratory analysis³. This water quality monitoring is developed once a year during the dry season.⁴ The groundwater monitoring is a recent activity due resources and capabilities limitations. But at this time there are 22 sites with continue monitoring (wells) and 150 excavated wells monitored annually where are measured 7 field parameters and 18 laboratory parameters⁵.

Information Storage and Processing – Databases, Water Information Systems, Statistics, Maps and Graphics

The information coming from the water resources monitoring can have different sources and due that, different formats. It is very important to keep the same measurement methods and protocols, in order to have a singular data base for the information.

In El Salvador, the water resources information comes from different sources. SNET collect and analyze the hydrometeorological information coming from telemetric and automatic stations, but also collect information coming from conventional gage stations where is required to transform the graphics of the rivers level in numbers. Additionally, the information gathering is completed with manually data recover by the people that make the measurements in the rivers, wells, and also the local observers of the rain; besides the water quality information is coming from the laboratory analysis.

At this moment, one of the challenges of the institution is to have a database that can integrate all this information. Because of the amount of the investment to make this system, this has been developed by modules. It has been built the Hydrogeological Module⁶ that allow us to storage and manage with statistics and spatial analysis the groundwater data. In construction process is the adaptation of the Water Quality Module, which will allow us to do the same but in surface water quality information⁷. In other hand the Water Balance System has been designed and constructed by the technicians of SNET in order to have software that permits to run the water balance in a semi-automatic way, it contains an Irrigation Data Module, a Groundwater Module, a Water Demand Module integrated with the Water Supply Module.

³ The bases (approach, protocols, procedures) to do the water quality monitoring and the capabilities strengthening were established with PAES Program.

⁴ Because of resources limitations. Is intended to do 4 times at the year: during the dry season (December – March), during the rainy season (May – October), and during the seasons transitions (April and November)

⁵ The strengthening of the groundwater monitoring and laboratory analysis were done by the European Community Project FORGAES “Strengthening of the Environmental Management in El Salvador” and the “Critical Areas Decontamination Program” (DAC) executed by the Ministry of Environment with an IADB loan

⁶ FORGAES

⁷ Canadian International Development Agency, Water Quality Information System Project, 2007-2008.

Transformation of the Information into knowledge.

Once the information has been analyzed statistically, in the space and time, this is used to develop specific studies, in hydrology, hydrogeology and water quality topics.

Water Balance: Integrated and Dynamic

The Water Balance developed by SNET (2003-2005) is a dynamic and integrated analysis. Is Integrated because involves aspects of quantity and quality of surface water and groundwater, as much as the water demand and water availability (due the restrictions of its quality). It is dynamic, because it is updated in an automatic way trough the development of several applications that allow us to calculate annually the water balance, with the new information generated in each one of the hydrological cycle components, which are permanently monitored by SNET. In this way, also is possible to determinate the influence of the meteorological phenomena related with the climate variability such as El Niño or La Niña, droughts, floods, climate change, land use changes and water demand changes. The information presented in maps, graphics and tables allow the users and decision makers to take decisions about the water management, planning and also the land use planning, based on data and real information.

Water Quality Diagnosis and proposed uses of the water

The Water Quality Diagnosis (2006-2007) elaborated by SNET, was made to know the quality of the main rivers of the country and to know the critical polluted areas, including an analysis of the water aptitude to some uses: irrigation, recreational purposes that involves human contact, drink water, and aquatic life. This study permit to know the real situation of the rivers in order to take decisions about the decontamination of the resources to mitigate the damage to the population health and to the biodiversity and the environment. Also, this information permits to the stakeholders to define if they can use the water for their needs. Besides that, using the Water Quality Index applied, it could be determined if the quality of the water is deteriorating trough the time or if that measures taked are improving it.

Early Warning Systems

The information generated by the hydrometeorological studies is an important tool to forecast and warning about floods in an early and appropriate way. With the knowledge about the behavior of the basin, and its response to the rain, we can predict the possibilities of floods downstream at the lower part of the basins. In El Salvador, SNET manage 5 Early Warning System in the major basins of the country: Río Lempa, Río Grande de San Miguel, Río Jiboa, Río Paz and Río Goascorán. Also, there are other systems under development as the rural flash floods systems and the urban flood system for San Salvador City.

For instance, the Rio Lempa is the major basin of the country. There are 4 hydropower dams in the river and in the lower part of the basin at the Bajo Lempa, there is also an important flood area. The information coming from the hydrometeorological stations in real time at the SNET River Forecast Center, plus the meteorological forecast and the information coming from the reservoirs, all together are the inputs for the Hydrometeorological Model NWSRFS⁸, which results are the forecast in 15 places of the Lempa river and the inflows to the 4 reservoirs. This information allow to the electrical company to plan their dams management and to make water releases if is necessary in order to avoid major floods that can affect the Bajo Lempa area.

The gathering of the information in real time and also the recovering of the historical information, allows to the decision makers, the civil protection office and the local and national

⁸ National Weather Service River Forecast System (Developed by National Oceanographic and Atmospheric Administration –NOAA –of the United States of America).

government, to take the needed measures to assure the population safety during a hydrometeorological event.

Aquifer Diagnosis, Vulnerability of Aquifers and Recharge Areas Protection

About the groundwater investigation, SNET in El Salvador is working to create a basic groundwater information database, because, since almost two decades, the groundwater information is collect only with the exploitation purposes.

The purpose of the SNET investigation is to study the aquifers in order to know its state, to conduct actions for the protection of this sources of water, also, to know their vulnerability to the pollution and the over exploitation; to know the effects of the land uses and climate change can have under the aquifers, among others. This is a very recent area of work, but is important to develop to try to give some sustainability to the groundwater, and also, guide the territorial plans in order to do not affect the areas of recharge of the water.

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