IMTA
INSTITUTO MEXICANO
DE TECNOLOGÍA DEL AGUA

The future of water management and planning: The role of science and technology in the Mexican water sector

Álvaro A. Aldama

R & D as a decision support system for water management and planning

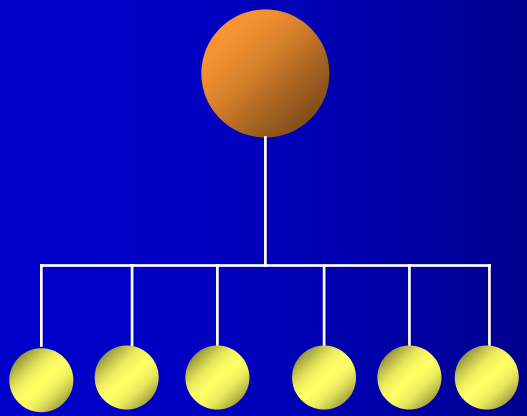
Background

- The Mexican Institute of Water Technology (IMTA) was created by a Presidential Decree published on August 8, 1986, as an institution belonging to the Department of Agriculture and Water Resources. Since December 29, 1994, the Institute was integrated to the Department of the Environment and Natural Resources.

IMTA: The scientific and technological arm of the water sector

- On the basis of scientific studies and technological developments, IMTA proposes to the executive and operational public institutions of the water sector as well as to the different users of water, solutions to problems related to the use, treatment, conservation, remediation, planning and management of water resources.

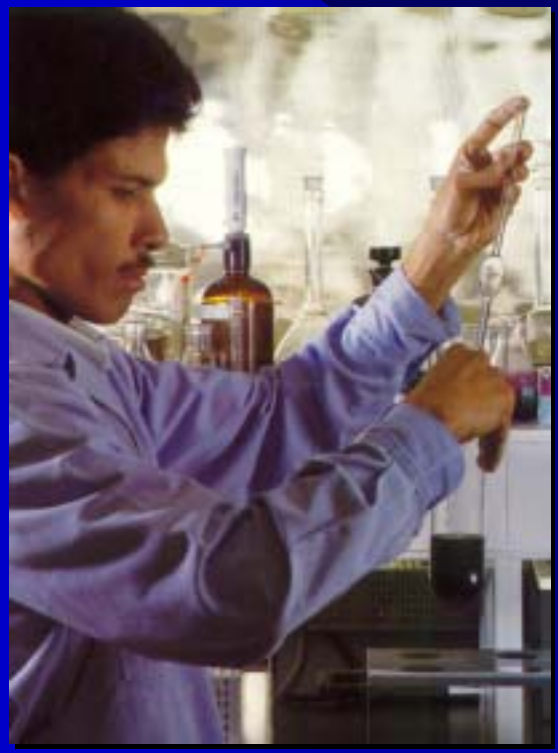
Organization



IMTA is organized in six divisions:

- Hydraulics
- Hydrology
- Water Treatment and Water Quality
- Irrigation and Drainage
- Social Studies and Communication
- Profesional Development and Economics

Staff



- A total of 436 people work at IMTA. Of these, 285 are research scientists and engineers, 32 occupy management positions, 33 belong to the administrative staff and 86 belong to the support staff. 50 of the Institute´s employees have Ph.D. degrees, 129 have M.S. degrees, and 162 have B.S. degrees.

Facilities

- Lot of 20 ha
- Constructed facilities of 22,959 m^2
- Fourteen laboratories: hydraulics, water quality, industrial wastewater, wastewater treatment plant, potabilization, hidrobiology, hydrometeorology, soil mechanics, material science, isotopic hydrology, geochemistry, irrigation and drainage, communications, and computer science.
- Quality assurance system: 231 lab tests with accreditation.

Mission

- To perform research, to develop, adapt and transfer technology, to provide technogical services, and to train qualified human resources for water resources management, conservation, treatment and remediation, in order to countribute to the sustainable developement of the country.

Vision

- To produce in Mexico the required technological transformation of the water sector to achieve a sustainable use and management of the resource.

Real-time irrigation forecasting system

Real-time irritation forecast application in Northwestern Mexico

Problem:

The supply of water for irrigation at the right times and in adequate amounts are the factors that have the greatest impact on agricultural yield and on-farm efficient use of water. It has been difficult to develop adequate water distribution programs in Mexican irrigation districts, due to the lack of information.

Agrometeorological station

Actions:

- A comptutational system for real-time irrigation forecasting was developed. The system has been applied at the following irrigation districts: Río Fuerte, Valle del Carrizo y Culiacán-Humaya-San Lorenzo, Sin., Lázaro Cárdenas, Mich., and Valle de Santo Domingo, B.C.S. Twenty five automatic agrometeorological stations were installed there, in order to monitor the meteorological variables that are associated with crop demand of water.

Impacts:

Successful experiences with the forecasting system

- **In farms managed with the irrigation forecasting system, 10 to 40% reductions in irrigation volumes and 15 to 60% increases in yield have been achieved, depending on the degree of technification.**
- **It has been estimated that the widespread application of this technology in Mexican irrigation districts, would increase agricultural yields in 5 million tons of grains and reduce agricultural consumption of water by 3 billion m^3 every year.**

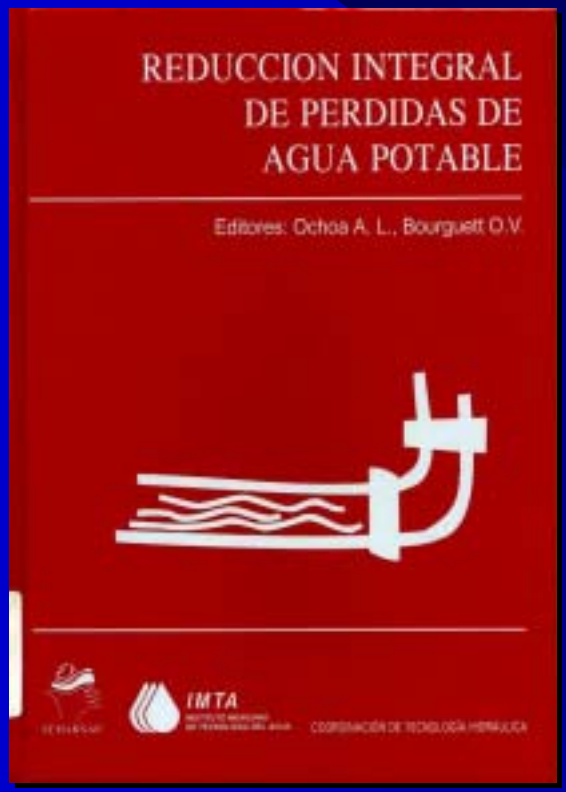
Leakage recovery in municipal water distribution systems

Water leakage at a domestic intake

Problem:

- It has been estimated that at least 35% of wated is lost to leakage in municipal distribution systems throughout Mexico, mostly due to aging and poorly installed infrastructure.

Actions:



Leakage reduction manual

- An integrated leakage management protocol was developed. The protocol includes the following phases: modeling-based diagnosis, pipe network sectorization, leakage elimination and control, and operational and management measures to improve the service provided by water utilities.The protocol has been applied in the following cities: México City, Guadalajara, León, Veracruz , Jalapa, Chetumal, Reynosa, Colima, Manzanillo, Cuernavaca, among others.
- The technology transfer process has been performed through training courses and manual publications.

Water leak at Reynosa

Impacts:

- At Reynosa, a diagnosis and a hierarchical leakage recovery process were performed. On the basis of a cost-benefit analysis, the first actions were done at the Granjas sector, where 5,184 m^3/day were recovered, implying an economic benefit of almost half a million dollars per year.
- It has been estimated that the widespread application of the technology througout Mexico would imply reducing the leakage levels to 18%, equivalent to the recovery of a volume of 1.3 billion m^3, enough to supply water to 12 million people.

Aquatic weed control

Problem:

Water hyacinth infestation at the Trigomil reservoir

- In 1993 it was estimated that the surface area infested with aquatic weeds in lakes and reservoirs was 69,000 ha, 80% of which were covered with water hyacinth. In irrigation districts 9,840 km of canals and 14,206 km of drains were infested with water hyacinth and other species, mostly of the *Hydrilla* genus. Aquatic weeds produce a number of problems, such as: intake obstruction, reduced conveyance of canals and drains, increased evaporation and proliferation of mosquitoes.

Neochetina Brucchi and Neochetina Eichornea

Fungi

Actions:

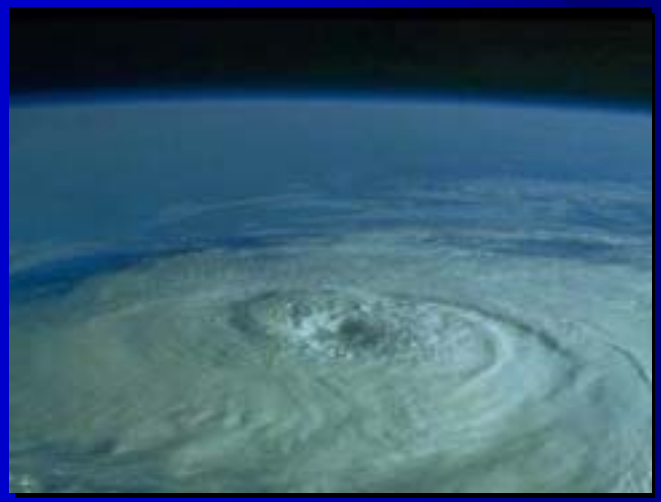
- A protocol for the control of aquatic weeds was developed, on the basis of the application of various techniques, such as: manual and mechanical removal, chemical treatment and biological control.
- Biological control methods based on the use of insects of the *Neochetina* genus, fungi and herbivorous carp, have been developed.
- Maintenance programs have been established, to prevent reinfestation of weed-free water bodies and applying basin-wide contol programs.

Impacts:

Trigomil reservoir. February 2001

- The aquatic weed control goal established in the 1995-2000 Water Plan was to eliminate weeds in 40,000 ha infested with them. This goal was achieved two years in advance.
- It is estimated that the net annual benefit associated with aquatic weed control is 25 million dollars.

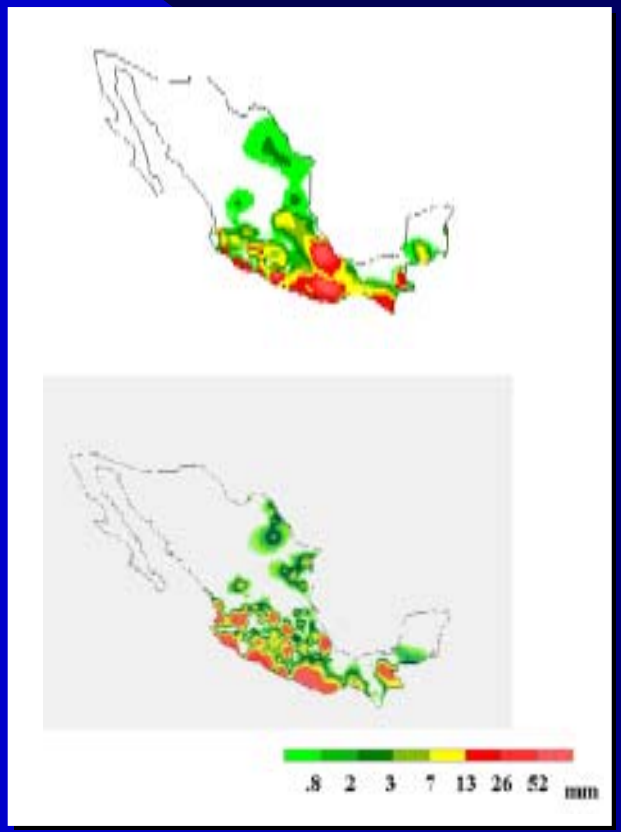
Numerical weather forecast



Hurricane satellite image

Problem:

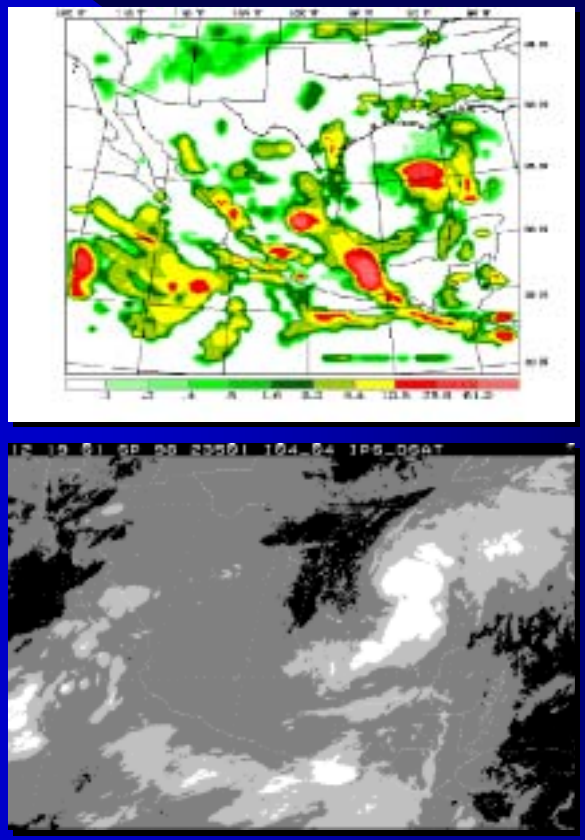
- Severe atmospheric phenomena, such as intense rains, droughts, high temperatures, frosting and hurricanes produce loss of human lives and significant economic damages in Mexico. In order to mitigate such effects it is essential to have an effective weather forecasting system. Subjective methods have been used in the country for a long time and the urgent need to modernize them has been identified.



Intense precipitation in Chiapas. 24 h numerical forecast (upper image) and observed precipitation (lower image). September 11, 1998.

Actions:

- A mesoscale model for weather forecasting has been adapted and developed.
- The model is operational and the forecasts that it produces are available through internet at the site http://galileo.imta.mx.



24 precipitation numerical forecast (upper image) and infrared satellite image corresponding to hurricane Earl. September 1, 1998

Impacts:

- Operational simulations have provided adequate forecasts for individual storms and large systems, such as hurricanes Earl and Charley in 1998.
- Intense precipitation that occurred in September, 1998 in Chiapas was adequately forecasted.
- The model results have been employed to monitor the dispersion of smoke produced by forest fires.
- The Mexican National Weather Service has incorporated the model as one of its operational tools.

Water education

Problem:

Public awareness raising session through the showing of a video.

- Overcoming the enormous water challenges faced by Mexico requires not only identifiying and applying the right technical solutions, but aiming at the appropriation of technological innovations by water users. In addition, it is essential to produce a change the ways in which the general population relates to water, to prevent waste and contamination of the resource.

Girl participating in a water education program

Water education source book

Actions:

- Video material has been produced in the following topics: irrigation district transfer, on-farm development program, agricultural lot leveling, real-time irrigation forecast, aquatic weed control, chemigation, on-time irrigation rate payment, infraestructure conservation, water and soil conservation, rural sanitation and water and children.
- A water education source book for K-12 teachers was adapted and published, including a large number of water-related activities. A children-oriented web site was produced, aimed at raising the awareness of kids regarding the proper use and protection of water resouces.

Impacts:

Children-oriented web page

www.imta.mx/otros/tedigo/home.html

- 162 video materials, employed to inform and train over 250 thousand water users in irrigations districts.
- 1,500 children participating in water and children programs.