

**SECOND PROGRESS REPORT OF THE  
AIACC LA06 PROJECT**

**(July 2002 – June 2003)**

**Assessment of Impacts and Adaptation Measures for the  
Water Resources Sector Due to Extreme Events  
Under Climate Change Conditions in Central America**

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**1. Executive Summary**

The Second Scientific Report of the AIACC LA06 Project describes the activities conducted by the PI's and Associated Researchers during the period from July 2002 to June 2003.

The main objective of this project within the AIACC agenda is to assess the impacts of extreme events, under climate change conditions, on the water resources of Central America in the context of other changes in the region's environment, economy and life's quality and to design adaptations measurements to be implemented by decision-makers.

The most important actions were related with studies related to signals of climate change in Central America, as well as the techniques for the production of climate change scenarios, including the necessary steps to implement statistical downscaling procedures to be use in the study region: Central America.

Studies to determine the ability of General Circulation Models (GCM) to simulate regional climate features has been undertaken using CCM3 (Community Climate Model V3) and ECHAM3-4 (European Center-Hamburg V3-4) output data. Downscaling techniques of the type of the SDSM (Statistical Downscaling System Model), and the MAGIC-SCENGEN are being implemented.

Other studies carry out deal with water capital, water uses, and socio-economic data for projection on water uses in Central America, changes in runoff under climate change and

variability in El Salvador, strategic framework for adaptation of the water resources sector to climate change in Central America, and economic impact of hydrometeorological events in Costa Rica.

Students have participated in the work carry out and the plans are that they will conduct their thesis work based on the project objectives.

As part of the Local Organizing Committee, the project's researchers were very active in the organization of the 1<sup>st</sup> Latin American and Caribbean Regional Workshop: Assessment for Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC), which took place in San José, Costa Rica, from 27 to 30 of May, 2003.

Collaboration with other groups is expected to increase, particularly with the researchers of the AIACC LA26 project (Impact of Global Change on the Coastal Areas of Río de la Plata: Sea Level Rise and Meteorological Effects; PI: Vicente Barros) and the AIACC project entitled Integrated Assessment of Social Vulnerability and Adaptation to Climate Variability and Change Among Farmers in Mexico and Argentina (PI: Carlos Gay), in order to exchange data, discuss ideas and propose future joint activities. Possible collaboration with AIACC SIS-06 project (The Threat of Dengue Fever-Assessment of Impacts and Adaptation to Climate Change in Human Health in the Caribbean; PI: Anthony Chen) is also being considered.

## **2. Activities**

### **Signals of climate change in Central America**

From studies carried out by the project's researchers and collaborators, using historical sources and meteorological records, it is concluded that Central America has experimented a climate change, particularly in the last decades. These studies indicate that the signal of climate change is particularly clear in the tendency of increase of the minimum temperature. This is no so clear in the maximum temperature. However, a generalized pattern found is that the diurnal range of temperature (maximum temperature minus minimum temperature) has been decreasing during the last decades.

### **Water capital, water uses, and socio-economic data for projection on water uses in Central America**

Concerning this topic, from the project's studies it is concluded the following:

- The information on water capital and water users it is not systematized in all Central America countries. Comparisons between countries are very difficult, since they use different methodologies. Nevertheless, it could be deduced that all countries have enough water, but it uses is unsuitable because of legislation problems (administration and use).

- In the case of Costa Rica it has been detected that in spite of having a large amount of rainfall the contamination and illegal uses reduce the availability of water. Costa Rica has an offer of potential water of 112.4 km<sup>3</sup> of which 75 km<sup>3</sup> are available as superficial water and 37 km<sup>3</sup> as underground water.
- In El Salvador, and taking into account preliminary projections of climate change, it is observed a decrease in the availability of water. In addition, much of the water used depends of rivers originating in Honduras and Guatemala, which shows the importance that has the shared water among countries.
- It exists a relationship between the availability of water and climate variability.
- The tendency of the sectorial demand of water in Central America for the next decades indicates that the domestic demand will reach the agricultural demand, which has implications for economies of the countries.
- The economy of the countries is related to the use of water and this is related to climate change.
- The climate originated problems should be analyzed in the context of other variables such as technology and social, economic and political aspects, in order to establish adaptation measurements that have a real impact.

### **Assessment of some GCM features and applications of downscaling in the Central America region**

Concerning this topic it is important to point out the following:

- An evaluation of the capacity of the GCM's to represent the main characteristics of the local and regional climate has been made.
- It has been concluded that it is not good to use only a downscaling technique. It is better to explore several downscaling techniques.
- It is important to associate conceptual models, physical coherent, to the different utilized statistical techniques.
- The results of downscaling should be presented for several scenarios (e.g., A1, A2, B2, etc.).
- Not necessarily a region should show a specific tendency under the same scenario. For example, a variable could have a positive tendency at sotavent and a negative tendency at barlovent.

### **Changes in runoff under climate change and variability in El Salvador**

A case study has been carried out concerning changes in runoff under climate change and variability in El Salvador. The main conclusions are:

- The changes in runoff may be due to several causes, each of which may be related to a small change but the joint effect it is very important.
- The effect of climate change and variability is increased due to other aspects such as changes in land use, water management, and increase in population, among others.
- The changes in runoff due to climate change and variability should be taking into account by engineers and decision makers involved in the building of hydraulic structures.
- Floods are the events that produce major impact or damage.
- Forecasts are complemented with social, economic and environmental indexes in order to determine the vulnerability.

### **Strategic framework for adaptation of the water resources sector to climate change in Central America**

Preliminary work on adaptation to climate change has been made. The results indicate:

- All societies take adaptation measurements to climate variability. These should be analyzed in order to implement successful future measurements.
- The governments are aware of the need to plan and implement adaptation measurements when they have to deal with natural disasters.
- It is important that adaptation strategies be included in some university programs.
- The adaptation of water resources sector to climate change is a process where different factors should be taken into account.
- Several adaptation measurements are being implemented in the region. They should be ordered in an orientation framework that allow they design and appropriated implementation.
- Adaptation, reduction of vulnerability and conservation of key ecosystems to water as an environmental service are linked.

### **Economic impact of hydrometeorological events in Costa Rica**

The main objective of this study is to determine the economic impact of disasters originated by hydrometeorological events, on the economy of Costa Rica during the 1996-2001 period. The types of disasters covered under this study include: droughts, floods, river overflows, heat waves, rainy winds, rain related accidents and landslides. These include 84% of the total of natural disasters documented in the country during that same period of time.

For the events documented in each year of the period, the following aspects were valued:

- the cost of relief (food and supplies, aid, equipment and removal of debris, etc.)
- the value of homes damaged or destroyed
- the value of reconstruction and/or repair of public schools, hospitals and clinics
- the cost of repair of meters of length of damaged roads
- the value of damaged bridges and aqueducts
- the value of losses in agriculture hectares of damaged crops and other measures officially reported
- the cost of medical attention to victims and evacuees
- the cost of relocation of families
- the value of death and missing persons based on the working years potentially lost of those individuals under 65 years of age

The series show a decreasing trend after 1998, due in part to the reduction of deaths, and because of the reduction of the intensity of the events considered.

The study findings show that the average annual value of the damages caused by hydrometeorological disasters was 57.498.036.184 colones (US \$ 146 305435.5), and represent a 1.15% of the GDP of Costa Rica. Considering the estimate of losses in agricultural crops, in relation to the total national agricultural production (agricultural, silvicultural and fisheries GDP), the annual average represents 1.5% of the agricultural GDP.

The direct values (medical attention to victims, compensation of agricultural losses) reach an annual average of 18.778.124.609 colones (US\$ 47 781487.5), which represent a 3% of the central government annual revenues. This amount is what the considered hydrometeorological events should require for its relief and compensation for damages and infrastructure.

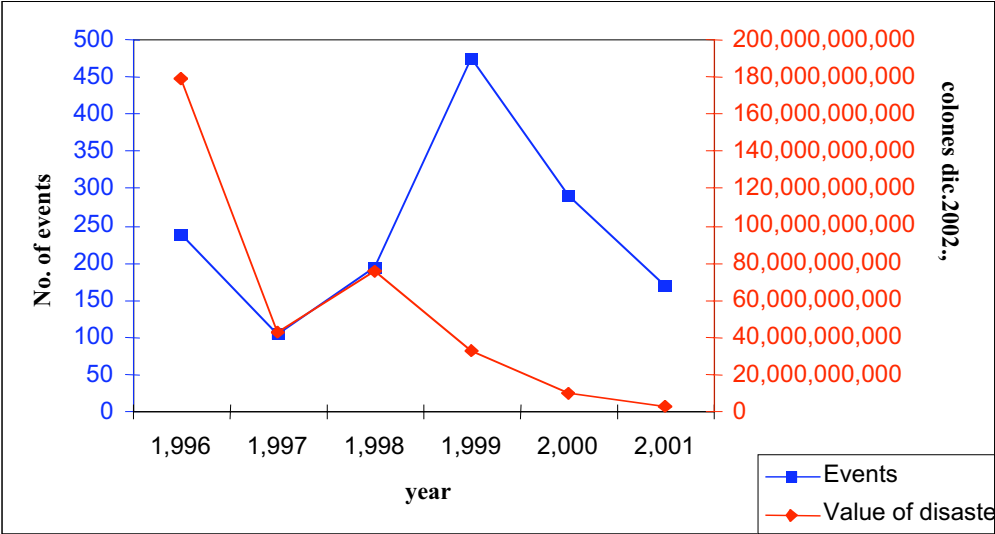
The estimated values for investment in roads, bridges, aqueducts and damaged or destroyed buildings and facilities, represent a high opportunity cost for the country's economic development options and social welfare. This amount is more or less, the equivalent to the investment in 30 new rural aqueduct systems, 157 bridges, near 425 Km of road systems, and more than 50 rural school buildings of three rooms each. Therefore, this values are appropriate indicators of the benefits foregone by the country in social and economic investments, in exchange of replacing the investments damages or destroyed by a recurrent hydrometeorological events in the five year period.

For those disasters whose magnitudes require an official declaration for state of emergency, a regulation plan is required. This entails appointing executing agencies (governmental

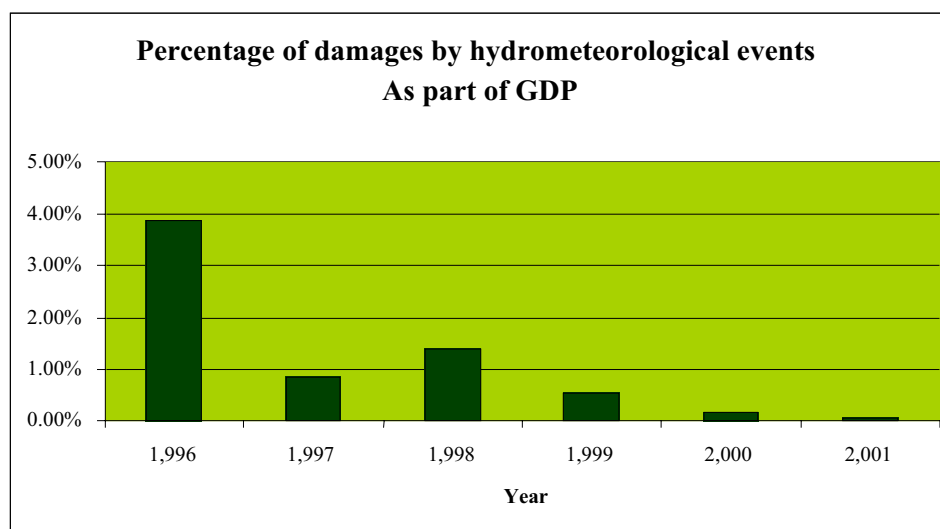
entities, local governments, and local organizations) and developing an investment plan. The National Commission for Emergencies (CNE) is responsible for the accounting of the executed funds in the items described in the investment plan for each event. Such accounting is systematized since 1998, and the average annual expenditures amount to 1 586 904587 colones (US\$ 4 037925.5), which represent only 17.3% of the total reported damages.

The estimates respond to the data base available in different sources. Its important to consider that such information is not generated in a systematic or continuous fashion. Due to this condition, the estimates are based in indirect criteria and logical assumptions. This suggests the need to develop a database that enables authorities and researchers to have an accurate information of what hydrometeorological events may imply in economic terms and to what it forgoes when disasters are recurrent.

**Fig. 1: No. of Events and Valuation of Total Damage**



**Fig. 2**



**Fig. 3: Coverage of expenditures in repair and reconstruction**

**As part of total direct cost  
-colones corrientes-**

<b>Year</b>	<b>Expenditures</b>	<b>Direct costs*</b>	<b>% coverage</b>
1,998	1,783,640,654	27,796,080,588	6.42%
1,999	1,303,013,364	9,655,023,425	13.50%
2,000	1,135,753,469	3,598,794,108	31.56%
2,001	458,245,383	2,583,279,245	17.74%
Average			<b>17.30%</b>

Note: \*Adjusted for inflation to colones corrientes of each year

**Source of information and database:**

La Red, 2002. Base de datos DesInventar, versión 5.4.1. 30 enero.

<http://www.desenredando.org>

Other sources: Office for Disaster Assistance (OFDA) USAID

### **3. Related activities**

***1<sup>st</sup> Latin American and Caribbean Regional Workshop: Assessment for Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC)***

As part of the Local Organizing Committee, the project's researchers were very active in the organization of the 1<sup>st</sup> Latin American and Caribbean Regional Workshop: Assessment for Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC), which took place in San José, Costa Rica, from 27 to 30 of May, 2003.

### ***Climate Outlooks***

During the last years, the Regional Committee on Hydraulic Resources (CRRH) has organized Climate Forums in different countries of the region. For the year 2003, two COFs has been organized, COF-IX in San Pedro Sula Honduras and COF- X in Santa Lucia, Guatemala. Several scientists who participate in this activity were from the LA06 project. Methodological aspects and technical decisions are made at these activities.

### ***Regional map of climate change information network***

With the support of the Organization of American States and the Government of Taiwan a 1:250.000, a digital map on water resources is being prepared. The work has already been finished for El Salvador, Costa Rica and Nicaragua and the rest of the countries will be ready next month. The map is going to be the platform for all climate and hydrological information for the Isthmus, including climate change related information.

### ***LA-06 and III World Water Forum (Japan 2003)***

The principal investigators of the project (Walter Fernández, Jorge Amador and Max Campos) participated in the Third World Water Forum, which took place in March 2003. LA06 was an active participant in almost all climate and water sessions. Presentations, poster sessions, discussion panels and Day of the Americas organization, were some of the specific actions where LA06 participated.

Activities financed by the International Secretariat for the Dialogue on Water and Climate for the WWF-3, and necessary for LA-06 were:

1. *Estimation of water capital per country.*
2. *Estimation of sectoral uses of water per country.*
3. *Estimation of potential growth of water uses.*
4. *Estimation of water capital under growing demand and climate change conditions.*
5. *Materials on climate change and water resources for the academic and education sectors.*

## **4. Student Participation**

Two students, Erick Rivera and Gabriela Mora, have been involved in the project.



## **5. Final Remarks**

The project is progressing very satisfactorily, without major difficulties.

Although we have not yet signed an agreement with AIACC and received any funds, we have proceeded with the project activities anyway, and we will charge this time against the AIACC grant, where correspond, once it comes through.

The last requests for signing the agreement for focal points GEF were very positive and responses from Nicaragua, Belize and El Salvador will be sent to UNEP Nairobi.