

U.S. DEPARTMENT OF COMMERCE

HURRICANE RECONSTRUCTION PROGRAM

CENTRAL AMERICA
AND THE
DOMINICAN REPUBLIC



FINAL REPORT
MAY 2002

Table of Contents

Executive Summary	1
Country Activities.....	18
Honduras.....	19
Nicaragua	34
Guatemala	50
El Salvador.....	62
Dominican Republic.....	75
Regional Programs.....	82
Gulf of Fonseca	83
Río Lempa Watershed.....	96
Regional Programs.....	100

LIST OF IMPORTANT ACRONYMS AND ABBREVIATIONS

ADIOS – Automated Data Inquiry of Oil Spills	INSIVUMEH - Instituto Nacional de Sismologia, Vulcanologia, Meteorologia e Hidrologia (Guatemala)
ANDA – National Water Authority (Nicaragua)	ITA – International Trade Administration
CAMEO – Computer Aided Management of Emergency Operations	LABCODAT - CRRH Data Quality Control Laboratory
CEL – Comisión Ejecutiva Hidroeléctrica del Río Lempa	LAN – Local Area Network
CENDEPESCA – Centro Nacional de Desarrollo de la Pesca (El Salvador)	MAGFOR – Ministry of Agriculture (Nicaragua)
COEN – Emergency Management (El Salvador)	MARENA – Ministry of the Environment (Nicaragua)
COF – Climate Outlook Forum	MARN - Ministry of the Environment (El Salvador)
CONRED – Emergency Management (Guatemala)	MSL - Mean Sea Level
CO-OPS - Center for Operational Oceanographic Products and Services (DOC/NOAA)	NESDIS – National Environmental Satellite, Data and Information Service
COPECO – Comision Permanente de Contingencias (Emergency Management, Honduras)	NIST – National Institute of Standards and Technology
CORS - Continuously Operating Reference Station	NGO – Non-Government Organization
CPH – Centro de Pronosticos Hidrologia	NGS - National Geodetic Survey
CPM – Centro de Pronosticos Meteorologia	NMHS – National Meteorological and Hydrologic Service
CRRH - Comite Regional de Recursos Hidraulicos (Regional Committee for Water Resources)	NOS - National Ocean Service
DCP - Data Collection Platform	NWS - National Weather Service
DOC – Department of Commerce	NWSRFS – National Weather Service River Forecast System
DOC/NOAA - Department of Commerce, National Oceanic and Atmospheric Administration	OAS - Organization of American States
DPAS - Data Processing and Analysis Subsystem	OGP – Office of Global Programs
DRGS - Digital Readout Ground Station	ONAMET – National Meteorological Agency (Dominican Republic)
ENP - Empresa Nacional Portuaria	PASA - Participating Agency Service Agreement
ESI – Environmental Sensitivity Index	PROARCA/COSTAS - Programa Ambiental Regional para Centro América, Coastal Resources
ESPINSA – Especialidades Industriales, S.A. (Private Specialists in Water Treatment, El Salvador)	PC - Personal Computer
FUSADES – Fundacion Salvadorena Para Desarrollo E Economico Social (El Salvador)	QA/QC - Quality Assurance/Quality Control
GOES - Geostationary Operational Environmental Satellite	RONMAC - Red de Observacion del Nivel del Mar para America Central (Water Level Observation Network for Central America)
GPS - Global Positioning System	SERNA – Secretaria de Recursos Naturales y Ambiente (Honduras)
HARN - High Accuracy Reference Network	SMN – Servicio Meteorologia Nacional (Honduras)
HUD – Housing and Urban Development	SNAT – Sistema Nacional Alerta Temprana (Dominican Republic)
IGN - Instituto Geografico Nacional (all countries)	SNET – Servicio Nacional Estudios Territoriales (El Salvador)
IMN – Instituto Meteorologia Nacional (Costa Rica)	UCA – University of Central America (Nicaragua)
INDRHI – Insituto Nacional de Recursos Hidráulicos (Dominican Republic)	USAID - U.S. Agency for International Development
INETER - Instituto Nicaraguense de Estudios Territoriales (Nicaragua)	USGS – U.S. Geological Survey
	VHF - Very High Frequency
	WAN – Wide Area Network
	WLON - Water Level Observation Network
	WX - Marine VHF Weather Channel

HURRICANE RECONSTRUCTION PROGRAM

CENTRAL AMERICA AND THE DOMINICAN REPUBLIC

EXECUTIVE SUMMARY

BACKGROUND

Hurricane Mitch was the most deadly and economically devastating hurricane to impact the Western Hemisphere in the last two centuries. Mitch struck Central America with such intensity that the damage left in its wake was not known for nearly a week. Its effects were felt by nearly three million people who were left homeless, lost their lives or were otherwise impacted by the storm. The damage estimate in Central America was \$US5 billion. The number of deaths was estimated at over 11,000. The hardest hit countries were Honduras, Nicaragua, Guatemala, and El Salvador. As it moved through the mountainous regions of Honduras, Mitch dropped rainfall at the rate of 12 to 24 inches per day in parts of Honduras and Nicaragua. The total rainfall for this storm is estimated at 75 inches in some locations. Triggered by cataclysmic rainfall, mudslides and floods were widespread. Entire villages in Honduras, Nicaragua, Guatemala, and El Salvador were devastated.

Hurricane Georges caused widespread damage throughout the Caribbean. The Dominican Republic was one of the harder hit islands. The hurricane struck the island with brutal rage for 16 long hours on September 22, 1998. Heavy rains and furious winds, which reached up to 130 mph, covered nearly 70 percent of the country. The heavy rains, particularly in the western part of the country, produced mudslides and prolonged flooding. Hurricane Georges killed over 200 persons and left a path of destruction critically affecting the lives of over half the population and setting back the country's human and natural resources as well as the physical infrastructure base.

Following the devastation caused by Hurricanes Mitch and Georges, the U.S. Department of Commerce was one of 13 U.S. Government Agencies funded by the U.S. Agency for International Development (USAID) to help the countries of Honduras, Nicaragua, Guatemala, El Salvador, and the Dominican Republic rebuild their economies and improve their abilities to respond to hurricanes and other natural disasters. The Department's Hurricane Reconstruction Program was comprised of activities developed by three of its bureaus: the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology (NIST), and the International Trade Administration (ITA). USAID allocated \$US17.1M to the Department for the program.

Consistent with its environmental and economic mandates, the Department's goal in assisting with the reconstruction of these impacted countries was to support their ability to make decisions that minimize their exposure to future disasters and promote sustainable uses of natural resources.

The Department's objectives during project implementation were to provide key infrastructure elements; develop much needed hydrometeorological forecasting and early warning systems; help promote more sustainable, resilient uses of coastal resources; help build local and regional capacity for coastal hazards and mitigation; develop guidance for improving the construction of houses and assessing construction of critical facilities; and encourage disaster-resilient economic revitalization.

Department activities emphasized training and capacity building to promote maintainability and sustainability of the systems and programs that were implemented.

The Department's Program included various activities in six prime Problem Areas: (1) Base Infrastructure Reconstruction; (2) Forecast and Early Warning Systems; (3) Disaster Preparedness and Response; (4) Sustainable, Resilient Coastal Communities; (5) Economic Revitalization; and (6) Transnational Watershed Management. Within each area, different objectives were identified that provided the basis for identifying the activities to be implemented. These objectives are outlined below:

Base Infrastructure Reconstruction

Provide a foundation for ongoing reconstruction efforts

Reconstruct and improve weather and hydrologic forecasting and early warning networks

Promote safe and efficient air and marine transportation

Provide for a geo-spatial data and water level reference network

Ensure that capacity exists to maintain and expand new base infrastructure

Forecast and Early Warning Systems

Strengthen and develop basic national tropical storm and flood early warning capabilities

Improve national and regional disaster preparedness and response infrastructures for forecasting, managing, and mitigating weather-related extreme events

Build from basic capabilities to develop more sophisticated national and regional water resources management and early warning tools

Provide climate forecast information that can be provided to national, regional, and international users

Disaster Preparedness and Response

Improve national and regional disaster preparedness and response infrastructures for forecasting, managing, and mitigating weather-related extreme events

Build local capacity for preventing and responding to hazardous materials spills

Develop and transfer a framework for developing contingency plans for releases of hazardous materials during severe storms

Sustainable, Resilient Coastal Communities

Develop an improved understanding of the Gulf of Fonseca natural processes in support of more sustainable uses of the Gulf by industry and artisans and for subsistence

Work within existing programs (e.g., PROARCA/Costa) to transfer information and tools for sustainable aquaculture, building practices, and other coastal management approaches that promote resilience and sustainability

Strengthen technical guidance for the construction of housing more resistant to natural hazards and assess the disaster resistance of critical facilities

Economic Revitalization

Promote the development of trade and trade infrastructure that is disaster resilient

Increase the transparency of government contracting in Central America and facilitate the continued adoption of open market economic rules

Increase the availability of information in the United States about business opportunities in Central America that would accelerate reconstruction

Expand the presence and use of the Department's U.S. and Foreign Commercial Service officers to help companies interested in working in the region

Transnational Watershed Management

Provide tools for the sound management of water resources in the Río Lempa watershed

All activities were coordinated with USAID, other U.S. Government Agencies, counterpart agencies within each affected country, international non-governmental agencies, the private sector and other donors.

The Department's program is summarized in the following section.

PROGRAM ACTIVITIES OVERVIEW

The Department performed many and varied activities under the Hurricane Reconstruction Program. Activities were accomplished either for a specific country or regionally, covering all countries. The bulk of the activities were accomplished in the four Central America countries impacted by Hurricane Mitch but some activities had both a country and a regional component. Any regional activities were conducted in one or more of the Mitch-affected countries. In order to optimize the Department's implementation of some regional activities and to take advantage of existing resources in the entire Central America region, some regional activities were based in Costa Rica. The following table summarizes the Department's key activities for each of the areas and shows where each activity was based.

Department of Commerce Key Activities Summary							
Area/Activity	Honduras	Nicaragua	Guatemala	El Salvador	Dominican Republic	Central America Regional	Comments
Base Infrastructure Reconstruction							
Improve Geodetic Networks	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Improve Hydrometeorological Networks	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
Improve Tide Stations	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Data downlink in Costa Rica
Develop Satellite Capabilities						<input checked="" type="checkbox"/>	Receive site in Costa Rica
Implement Training Programs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Forecast and Early Warning Systems							
Improve Flood Warning Network	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
Establish Flood Forecast Systems	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			See also Transnational Watershed Management
Develop Strategic Plans	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Implement Training Programs.						<input checked="" type="checkbox"/>	
Develop a Regional Climate							

Department of Commerce Key Activities Summary							
Area/Activity	Honduras	Nicaragua	Guatemala	El Salvador	Dominican Republic	Central America Regional	Comments
Prediction System							
Disaster Preparedness and Response							Emphasis on training and capacity building
Strengthen Forecast, Warning, Preparedness & Response Institutions	<input checked="" type="checkbox"/>						
Improve Hazard Materials Spill Prevention and Response	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Develop Reservoir Management Strategies					<input checked="" type="checkbox"/>		
Develop an Approach for a Regional Hydrometeorological Center						<input checked="" type="checkbox"/>	
Sustainable, Resilient Coastal Communities							
Support for Sustainable Uses of Gulf of Fonseca Resources	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Local Capacity Building and Support Network	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	

Department of Commerce Key Activities Summary							
Area/Activity	Honduras	Nicaragua	Guatemala	El Salvador	Dominican Republic	Central America Regional	Comments
Strengthen Guidance for Construction of Disaster-Resistant Housing					<input checked="" type="checkbox"/>		
Assess the Disaster-Resistance of Critical Facilities					<input checked="" type="checkbox"/>		
Economic Revitalization							
Support Trade Development and Commerce and Trade and Investment Forums						<input checked="" type="checkbox"/>	
Transnational Watershed Management							
Implement a Hydrologic Forecast Capability for the Río Lempa Watershed						<input checked="" type="checkbox"/>	Watershed located in portions of El Salvador, Honduras, and Guatemala – Forecast Capability Installed in El Salvador

ACTIVITIES

More detail on the Department's activities is provided in the body of the report. Provided below are examples of some of the activities performed by the Department's bureaus.

National Oceanic and Atmospheric Administration (NOAA)

NOAA's National Weather Service (NWS) focused on strengthening the hydrologic and meteorological agencies in Central America and the Dominican Republic by helping improve their capabilities in the areas of hydrologic forecasting (floods and droughts) and early warning systems. To accomplish this, the NWS installed monitoring equipment, improved communications systems, implemented hydrologic forecasting centers, and provided training in areas such as operational hydrology and meteorology, hydrologic modeling, monitoring system installation and maintenance, and maintenance program development.

As shown in the following maps, a total of 16 automatic weather stations, 31 automatic rain gage stations, and 3 automatic stream gage stations were installed throughout the region. These stations provide data for weather and hydrologic forecasting as well as climatological assessments.



Automatic Weather Stations



Automatic Rain and Stream Gages

In addition, the NWS also installed flood forecasting and warning systems throughout the region. Different types of systems were installed to provide the capability to forecast flows in the major rivers for flooding or drought conditions or quickly warn communities of flash floods. The river basins with systems installed are shaded on the following map.



Hydrologic Forecasting and Flood Warning Applications

One of the hydrologic forecasting applications was installation of the National Weather Service River Forecast System for the Río Lempa River Basin. This transnational basin includes the countries of El Salvador, Guatemala, and Honduras. The NWS installed rain gages, implemented a river forecast center and installed data communications systems. The forecast system is an integral part of the management of the water resources in the basin. The forecast center issues daily river forecasts that are used by the hydroelectric utility to manage their four reservoirs along the Río Lempa.

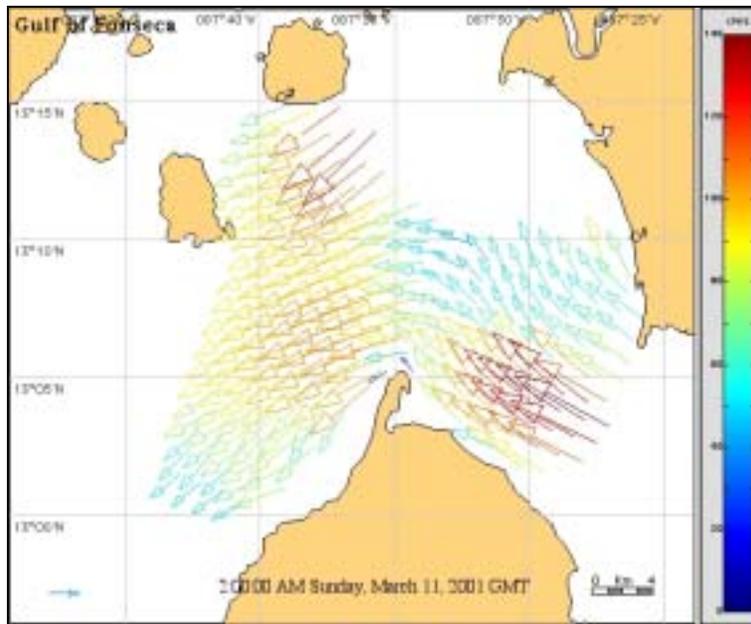
NOAA's National Ocean Service (NOS) accomplished a variety of activities under the Program. NOS activities focused on promoting sustainable, resilient coastal communities, including addressing sustainable uses of coastal ecosystems and appropriate land use decision making; improving the water level observation and geodetic networks; and hazardous materials spill prevention and response - including development of Environmental Sensitivity Index maps.

Tide gages were installed as part of the reconstruction of the water level observation network throughout the region. This network (Red de Observación del Nivel del Mar para America Central – RONMAC) supports the development of the geodetic control network for the region as well as provides crucial water level and meteorological data for port operations. Gages were installed in the locations shown in the following map.



Tide Gage (RONMAC) Network

Many NOS activities were centered on supporting sustainable uses of the Gulf of Fonseca resources. The Gulf is a very important estuary in the region and is bordered by Nicaragua, El Salvador and Honduras. NOS' work involved developing a better understanding of the natural processes in the Gulf to support more sustainable uses by industry and for subsistence. To accomplish this, an initial monitoring program for contaminants in water, sediment, fish and crabs was developed. Upon completion, the initial program was then transferred to local representatives in industry and/or NGOs. In addition a survey was accomplished to identify major circulation patterns in the Gulf. A sample output from the circulation survey and a map showing representative crab and sediment sampling locations are shown in the following.



Gulf of Fonseca Circulation Survey Analysis



Crab and Sediment Sampling Locations

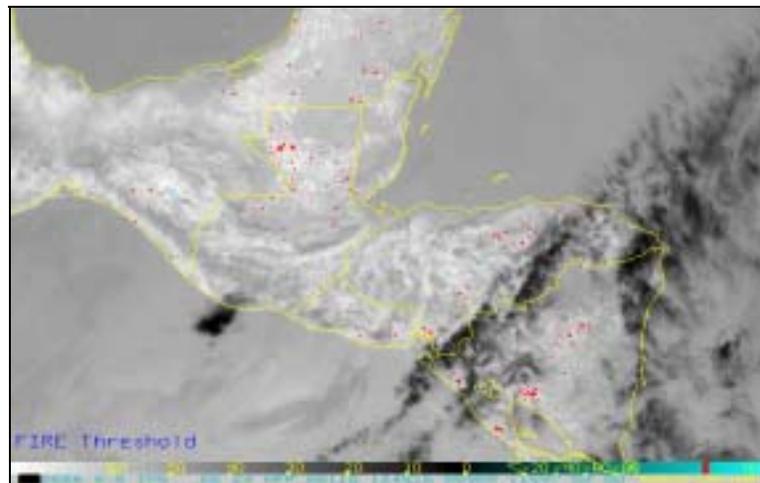
NOS also developed and implemented a project to reconstruct and improve geodetic networks in Nicaragua, Honduras, Guatemala, and El Salvador. Components of the program included installation of continuously operating reference systems with dual frequency global positioning system (GPS) receivers installed in each country - 24-hour continuous tracking capability and 1-2 cm accuracy, analysis and processing of a high accuracy GPS-reference network, and training on these systems.

As part of the hazardous materials spill prevention and response activities, NOS accomplished a series of workshops on responding to hazardous materials spills and on contingency planning to improve the local capacity in these areas. Environmental Sensitivity Index maps for critical coastlines such as the Gulf of Fonseca and the north coast of Honduras were also prepared. The ESIs provide key information to those responsible for hazardous material spill prevention and response by delineating critical environmental areas.

The National Environmental Satellite, Data and Information Service (NESDIS) of NOAA installed a regionally based satellite data receive system in Costa Rica. The data received from the NOAA GOES satellite is transmitted via the Internet to workstations installed in each country (NOAA also separately funded installation of workstations in Panama and Belize – no Hurricane Reconstruction Program funds were used). Through these workstations, meteorologists can view satellite cloud imagery at 1-kilometer resolution, see regional rainfall estimates, track volcanic ash plumes, and view potential forest fire hotspots –using special algorithms developed for Central America. The workstations allow the user a great deal of flexibility in viewing the satellite data.

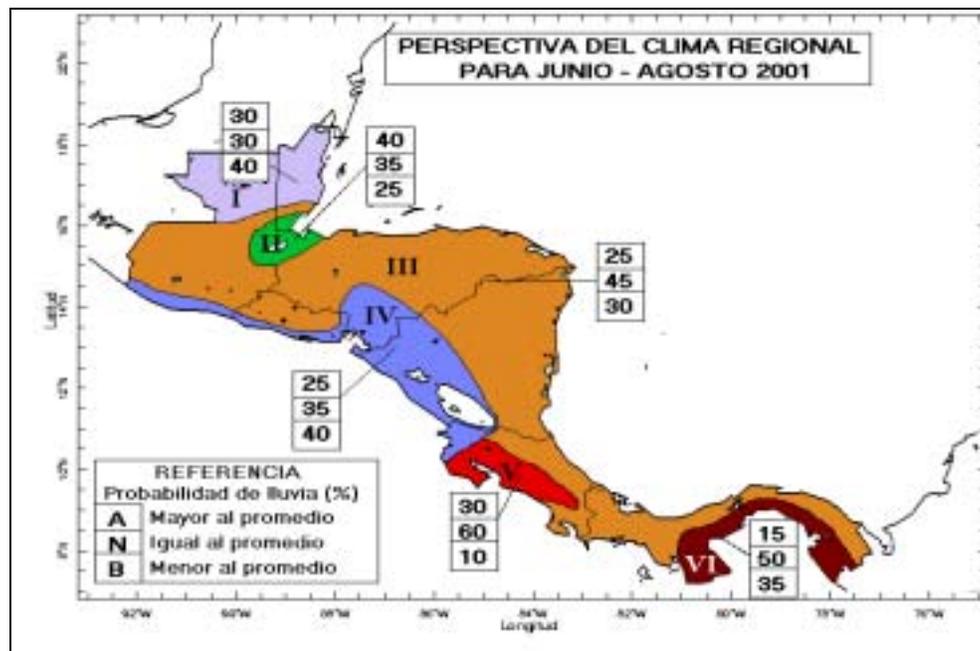


Satellite-Based Rainfall Estimates



Satellite-Based Fire Detection

NOAA's Office of Global Programs (OGP) developed a regional program to reduce the negative disruption often associated with climate variability and extreme events through the implementation of a climate information and applications system. One activity involved the organization of 'climate fora' to enable all countries to come together (physically or virtually) to develop a composite seasonal climate outlook for the region. Another activity was to provide capabilities within the region to perform model simulations and forecasts of regional climate. Climate forecast output from this modeling could then be used in local decision-making for different societal sectors throughout the region. These modeling results are then integrated into the climate forum process and seasonal outlooks are prepared – the June through August 2001 outlook is shown below.



Seasonal Outlook - Output From Climate Forum

National Institute of Standards and Technology

The Department's National Institute of Standards and Technology (NIST) worked exclusively in the Dominican Republic. NIST's focus was in the areas of building codes and construction practices that address buildings that are at-risk to severe winds and other natural hazards. To accomplish this, NIST performed two activities – assessing and strengthening the technical basis for guidance to assist the informal sector and small contractors in constructing housing that will be more resistant to natural hazards; and assist with the assessment of the disaster resistance of selected facilities that serve a critical function in the event of a natural disaster (e.g., hospitals and fire stations). These activities were accomplished through onsite assessments and workshops. A great deal of training was provided to the Dominican counterparts. NIST also worked closely with the Department of Housing and Urban Development on these activities.



Fire Station Assessed for Disaster Resistance - Dominican Republic

International Trade Administration

To help U.S. companies participate in internationally-funded reconstruction projects and other trade and investment opportunities in Central America, the International Trade Administration focused its efforts on four areas: (1) providing information on reconstruction efforts and possible projects, (2) facilitating U.S. company contacts with host countries' executing agencies, multilateral development banks, and potential business partners, (3) raising awareness in Central America of U.S. companies' skills and expertise, and (4) facilitating bilateral industry cooperation to make the region more resilient to natural disasters. They also hosted a delegation of 10 Honduran nursery managers as part of the Honduran Reforestation Initiative. This was aimed at helping Honduras on a variety of reforestation issues.



Hondurans Viewing a Reforestation Site in Alabama

FUNDING

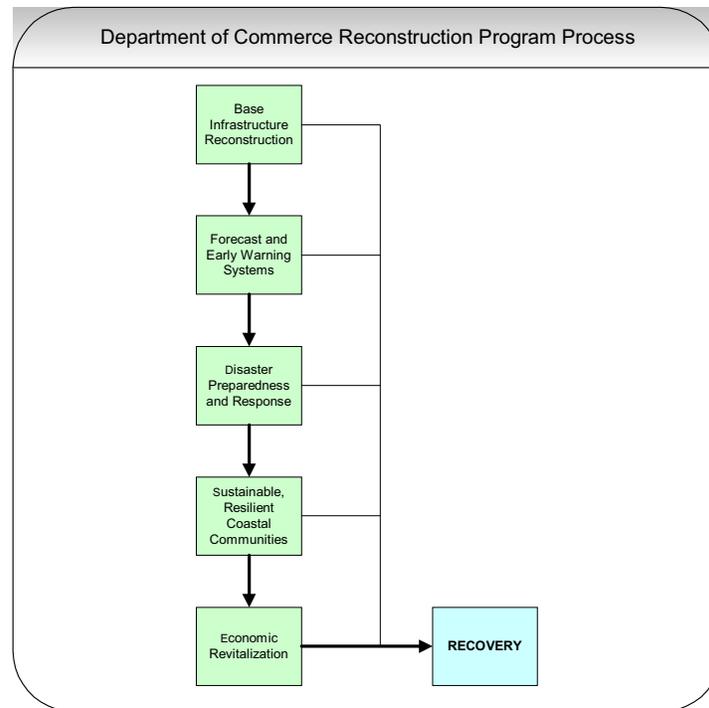
The Department's budgets for each Problem Area were as follows.

U.S. Department of Commerce Problem Area Budgets						
Problem Area	Honduras	Nicaragua	Guatemala	El Salvador	Dominican Republic	Regional
Base Infrastructure Reconstruction	\$1,808,000	\$1,789,000	\$938,000	\$974,000	\$0	\$1,293,000
Forecast and Early Warning Systems	\$1,615,000	\$1,580,000	\$665,000	\$365,000	\$0	\$300,000
Disaster Preparedness and Response	\$318,000	\$344,000	\$318,000	\$161,500	\$100,000	\$532,000
Sustainable, Resilient Coastal Communities	\$584,000	\$613,000	\$0	\$178,500	\$525,000	\$799,000
Economic Revitalization	\$0	\$0	\$0	\$0	\$0	\$200,000
Transnational Watershed Management	\$0	\$0	\$0	\$0	\$0	\$1,100,000
Total Country Budget	\$4,325,000	\$4,326,000	\$1,921,000	\$1,679,000	\$625,000	\$4,224,000
Total Project Budget	\$17,100,000					

The Department also executed an agreement with the USAID Mission in Nicaragua for the Nicaragua Small Shrimp Producer Assistance Program. The budget for activities under this agreement totaled \$1,280,000. Direct contributions to the program by the Department included organizing and sponsoring a workshop in March 1999 in Tegucigalpa, Honduras to bring the region's hydrology and meteorology agencies together to discuss needs for improving their capabilities for early warnings and disaster response. This workshop provided some preliminary information needed to develop the Department's implementation plan. The Department also contributed RAMSDIS satellite workstations to Belize and Panama. These additional workstations allowed all seven Central America countries to share in the satellite data from the ingest system installed in Costa Rica. Both contributions came through the NOAA/National Weather Service.

KEY ACCOMPLISHMENTS

The Department's Problem Areas as defined earlier were developed and organized in a logical progression for the Central America reconstruction program as noted below.



The intent of the DOC program was to concentrate on reconstructing base infrastructure, developing forecast and early warning system capabilities, promote disaster preparedness (through mostly capacity building), then promote sustainable communities (the DOC effort focused on coastal communities – an area of expertise for one of its bureaus, the National Oceanic and Atmospheric Administration), and then support economic revitalization. Due to the short amount of time available to complete the program, the Department worked in all these areas simultaneously but none-the-less contributed to the overall recovery of the region.

Many of DOC's activities were designed specifically to mitigate impacts of future extreme natural events (e.g., floods and droughts) and man-influenced disasters (e.g., oil spills caused by a natural event). Some examples are as follows:

- X Installation of prototype flood warning and forecast systems
- X Installation of satellite imagery, satellite-based rainfall estimates, and satellite-based forest fire detection capabilities
- X Installation of automated weather stations, rain gages, tide gages, and stream gages
- X Implementation of a regional climate prediction system
- X Assistance with the development of hazardous spill contingency plans
- X Development of Environmental Sensitivity Index maps
- X Assistance with identification of essential facilities that are at risk of damage or failure in an earthquake or hurricane

Proper use and maintenance of these systems will allow Department counterparts in the region to better forecast and manage disasters. In addition, implementation of many Department activities created the necessity for closer cooperation among the various agencies in each country – coordination that, in previous disasters, had not occurred especially during Hurricanes Mitch or Georges. For example, the hydrometeorological services now have more timely and precise data to provide the emergency management agencies and so these emergency management agencies now are beginning to rely more on the hydrometeorological agencies. The Department believes that with the improved tools and the more coordinated activities, that the region's early warning, disaster preparedness and response capabilities for potential natural disasters are greatly improved. It is anticipated that what will be evident is an incremental improvement. In addition, some of the Department's programs directly benefit the United States – an example includes access to additional, higher quality meteorological data from the upper air system and weather station and rain gage networks to support tropical weather analyses and forecast models.

Examples of successful applications of the Department's programs include – the regional climate prediction system used to develop long-term outlooks for rainfall in the region. The primary mechanism for developing these outlooks is a region-wide forum where a consensus outlook for rainfall and its departure from 'normal' is compiled. The regional forum in the spring of 2001 provided an outlook of a higher probability of below normal rainfall along the Pacific Coast for the following three months. This was disseminated to all users such as the agriculture sector. The outlook proved accurate, as the 2001 rainy season was a much below normal in that area – a drought in some regions. These fora have now become institutionalized in the region and are occurring regularly without DOC support. Another example is the use of the new satellite RAMSDIS workstations during Hurricane Michelle in October 2002. The hurricane caused widespread destruction primarily along the north coast of Honduras. At one point, it appeared to the general public and emergency managers in Honduras that Michelle was on a similar track as Hurricane Mitch causing great concern. However, the meteorological service in Honduras (Servicio Meteorologia Nacional, SMN) used the satellite imagery and satellite-based rainfall estimates to show that the hurricane was moving away from Honduras and to show where the heaviest rainfall had occurred. This greatly assisted emergency managers in relief and recovery efforts.

OTHER CONSIDERATIONS

The Department designed its programs with a great amount of consideration for the level of sophistication for the programs and equipment to be implemented and installed in the region. Of primary consideration was a selection of 'appropriate technology' – technology that was consistent with the capabilities within each country and that could be sustained if the counterparts also aggressively worked to sustain the equipment and programs that were installed. Discussions were held with counterparts prior to implementation to better determine what was needed, where it was needed, and what realistically could be sustained. For example, installations of automatic weather stations in each country were prioritized – with those most critical for providing key observations for weather forecasting considered first (including replacement of equipment lost or damaged during the hurricanes) and with the number of stations to be installed based how many could be expected to be maintained with available or minimal increases in resources. In addition, design and implementation of flood warning systems took into account the needs of at-risk communities and their capabilities and desires to operate and support these systems. In selecting the equipment that was to be installed, the Department decided to improve on the level of sophistication of equipment that was being replaced or supplemented in each country. The rationale for this decision was based on the need to improve the capabilities and operations of the counterparts rather than have them remain at status

quo. The idea was that by providing sustainable, appropriate technology and improving their capabilities, the counterparts could then provide more and better services that would make them more valuable within their government (and obtain more support and resources), attract stakeholders, and encourage investment from other donors – especially if they could show their ability to sustain the equipment and programs installed during the Hurricane Reconstruction Program. For some activities, this approach is beginning to show results. For example, the counterpart agency in El Salvador is now providing a major stakeholder (hydroelectric utility) with hydrologic forecasts using the forecast system implemented by the Department as part of the Río Lempa watershed management activity.

In general, the Department's counterparts are still struggling with allocating the proper resources to address the sustainability issues. Most of the counterpart agencies in the region are still under-funded in the areas of disaster mitigation and disaster management. There are too few professionals; there is a lack of visibility within the government and with the public (in some cases the only visibility is negative); and there is no support for items like vehicles, gasoline, or per diem to allow maintenance of field monitoring networks. During implementation, the Department did what it could to correct these issues – improve visibility, improve inter-agency coordination, initiate planning activities, and improve support within the government. The Department also supported applications for counterpart funding to help with sustainability of the programs. However, the Hurricane Reconstruction Program was too short to properly address all these issues during implementation. Consequently, the Department has decided to continue to help support programs such as hydrometeorological data collection in the region. To do this, a web site is being maintained that can be used to access and display the real-time data – this should help counterparts maintain data access as well as provide data (and a need for data) to stakeholders and other users. The Department expects to continue to support this web site well into the future – see www.nws.noaa.gov/oh/hads/

At this time, additional funding is most likely still required to support sustaining the programs and equipment installed by the Department and to protect the investment made by USAID. Special emphasis should be on training and equipment maintenance. More than 15% of the DOC budget went specifically to formal training and capacity building activities with additional resources to informal training and information exchange, more time and resources should have gone to training of counterparts – however the limited time to implement the project impacted on the ability to provide more needed training. In addition, follow-on activities to assess implementation of the technical guidance, systems and programs provided by the DOC to ensure the proper implementation, provide feedback as to their usefulness in mitigating disasters specifically in political and social environments such as Central America, and to ensure sustainability would be valuable and maybe should be built into future projects. A relatively small amount of financial support for sustaining and maintaining systems and programs and for planning (e.g., maintenance plans, strategic plans) can be useful in leveraging the large amount of funds invested during the Hurricane Reconstruction Program. Support for many programs can be accomplished on a regional level (e.g., field monitoring network maintenance) more efficiently than on a country-by-country level.

The Department feels that if initial funding was provided to allow more due diligence and ground-truthing at the beginning of the program – shortly after the hurricanes, that perhaps stronger and/or more focused programs could have been designed and implemented. The USAID missions were extremely helpful in helping the Department's bureaus in determining needs throughout the region but with the large post-hurricane workloads imposed on the missions, their available time to support these initial efforts was limited. Therefore funding to the USG agencies to determine critical needs and then develop more comprehensive proposals may have helped with program development.