STATUS OF HAZARD MAPS VULNERABILITY ASSESSMENTS AND DIGITAL MAPS

BELIZE COUNTRY REPORT

THE CARIBBEAN DISASTER EMERGENCY RESPONSE AGENCY (CDERA)

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Preface

From 2002 – 2005, the Caribbean Disaster Emergency Response Agency (CDERA) is implementing two major regional initiatives which are designed to reduce vulnerability to natural and technological hazards. These are the Japanese International Cooperation Agency (JICA) supported Caribbean Disaster Management (CADM) Project and the Canadian International Development Agency (CIDA) supported; Organization of American States executed Caribbean Hazard Mitigation Capacity Building Programme (CHAMP). The hazard mitigation planning component of the latter is being implemented in close collaboration with the Caribbean Development Bank's Disaster Mitigation Facility for the Caribbean. Hazard maps, vulnerability assessment studies, and digital maps are critical inputs to both initiatives.

This survey reviewed the status of these thematic activities in sixteen (16) CDERA Participating States, Haiti, Martinique, Suriname and Puerto Rico over the period August – October 2003. The objectives of the Survey were as follows:

1. To determine the status of hazard maps and vulnerability assessment studies and their use in the socio-economic planning and management of the Caribbean.
2. To determine critical success factors, gaps and best practices in the preparation and use of hazard maps and vulnerability assessment studies in the Caribbean.
3. To compile a database of hazard maps, vulnerability assessment reports, and digital maps available in the Caribbean.

Hazards considered under the survey included natural hazards such as floods, hurricanes, landslides, coastal disasters (surge, wave, and erosion), earthquakes, and volcanic eruptions as well as technological hazards. The types of vulnerability assessment considered were structural, economic, and human assessments.

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Status of Hazard Map, Vulnerability Assessments, and Digital Maps in the Caribbean: Belize

1.0 Introduction

1.1 Physical and socio-economic background

Belize is located in Middle America, bordering the Caribbean Sea, between Guatemala and Mexico. Its geographical coordinates are 17° 15´N, 88° 45´W. The highest peak in the island is Victoria Peak, 1,160m. The climate is tropical; very hot and humid; its rainy season is in the months of May to November, and the dry season from February to May. Its terrain is mainly flat, swampy coastal plain with low mountains in south. Arable land potential, timber, fish, hydropower are the country's natural resources. Belize has been prone to cyclical hurricane damage, tidal wave, floods and wind damage to property and infrastructure. The man-made hazards range from chemical fires and/or spills. These issues have severely wounded the economy.

Belize has 6 political districts. Each has a main town with adjacent villages. The northern half of the country is relatively flat. The well-formed rivers in these areas are often prone to ponding and backwater effects. Three districts that are located in this area are Belize, Corozal, and Orange Walk. The first two are the coastal districts. The southern-most part of Belize is characterized by mountain ranges. The land is drained by relatively fast moving rivers that often results in flash flooding. The Cayo, Stann Creek, and Toledo districts are located within this territory. Cayo is in the mountainous countryside, while the latter districts are situated on the coastal strip.

Belize possesses the second largest barrier reef in the world. The reef exists from the northern tip of the country all the way to the south. This, however, engenders storm surges due to the shallow bay in the lee of the reef.

The population census of 2003 produced an estimate of 266,440 persons. The same year, the population is expected to grow by 2.44%. The labour force comprises 90,000 persons. There is, however, a notable shortage of skilled labour and all types of technical personnel.

1.2 Major disaster issues confronting the country

Hurricanes have had the most devastating effect on Belize. Belizeans have experienced damage due to high winds and storm surges. Statistics gathered have shown that the coastal towns and areas of Belize are extremely exposed. Flooding manifests itself as flash floods in the upper reaches. In the lower catchment areas, flooding is caused by ponding. Here, water levels remain

elevated for long periods such as two to three weeks. Data has shown that flooding occurred due to tropical depressions, hurricanes, or cold fronts.

Fire disasters have occurred mainly within the urban centers and in forested areas. Belize City holds the top spot for the number of fires in the community. In this area, houses are tightly packed and made of timber. There are also the issues of low water pressure and an inadequate distribution of fire hydrants. Additionally, fires are started when butane spills during the refilling process when tankers deliver butane on a house-to-house basis. The proximity of Belize to the boundary of three tectonic plates makes it prone to seismic hazards. Volcanic eruptions in Mexico and Guatemala have had some minor effects on Belize due to ash fall. In addition, the country is affected by landslides.

2.0 Hazard Mapping Initiatives

Table 1, shows the particulars of hazard maps that have been prepared for Belize.

Table 1: Hazard Mapping in Belize

Type	***Purpose***	***Coverage***	***Scale***	***Date Produced***	***Primary Sources***	***Author***
Wind Hazard Maps	Assessment of potential hazards generated by tropical storms	National	1:50,000	1995	www.oas.org/en/cdmp	OAS/USAID
Coastal Storm Surge Hazard Maps	Assessment of potential hazards generated by tropical storms	Ambergris Cay; Belize City; Dangriga; Monkey River Town; and Punta Gorda	1:50,000	1995	www.oas.org/en/cdmp	OAS/USAID
Flood Risk	To determine flood risk category	National	1:50,000	1999	Land Information Centre	Land Information Centre

2.1 Methods of Preparation and Distribution

2.1.1 Wind Hazard Maps

The Arbiter of Storms (TAOS) model was used to produce a wind hazard map at a national level. One map was created for each of the Saffir/Simpson 5 hurricane categories and the following class interval of wind speed was used: Categories 1,

2, and 3 (30-35m/s; 35-40m/s; 40-45m/s; 45-50m/s; and 50-55m/s); Category 4 (30-35m/s; 35-40m/s; 40-45m/s; 45-50m/s; 50-55m/s; 55-60m/s; and 60-65m/s); Category 5 was extended to 75m/s. Modeling the effects of terrain on upper level winds were used to determine the surface. The aforementioned surface was achieved by using a boundary layer model and the TAOS upper level wind model. Winds were calculated at 1000-meter intervals. This resulted in a raster GIS data base. The maps show the highest 1-minute average wind detected at each location.

2.1.2 Coastal Storm Surge Hazard Maps

The TAOS model was used to produce a coastal storm surge hazard map for the following coastal locations: Ambergris Cay; Belize City; Dangriga; Monkey River Town; and Punta Gorda. A set of parallel tracks was developed and spaced so that when combined, the maximum water level along the shoreline for any storm would be of similar strength. These tracks were also used to create the wind hazard maps. Here, a model storm was run along each track using the TAOS 4 km/cell model. Ultimately, a storm surge map is produced. The Maximum Envelop of Water (MEOW) map for the storm and forward speed were created by combining the results of all the runs for each Saffir/Simpson category.

Bathymetry and topography for the model were derived from the United States Defense Mapping Agency Digital Terrain Model (DTM), United States Geological Survey (USGS) ETOPO data sets. The Government of Belize supplied the satellite imagery needed.

2.1.3 Flood Risk Map

The flood risk map was derived from the national land systems dataset. The map contains the following categories of flood risk: annual; 20years; and exceptional (1000 years). The map is distributed a hard copy and image (jpeg) digital files.

2.2 Users and uses

These maps are currently not being used but there are plans to use them. The National Emergency Management Organization (NEMO) Secretariat would utilize the Wind Hazard and the Coastal Storm Surge Hazard maps for mitigation planning, specifically for hurricanes. The Meteorology Department needs them for hurricane forecasting. However, the Hydrology Department and the Coastal Zone Management Authority and Institute would use the maps as flood risk maps and for coastal zone management respectively.

The Ministry of Transport and Works, the Meteorology Department, and NEMO would use the Flood Risk map for disaster preparedness. The maps will be used for agricultural suitability and planning by the Ministry of Agriculture and by

students for research purposes. All communities will also use the map for Community Disaster Management.

2.3 Current conditions and limitations

The Wind Hazard Maps for Belize and the Coastal Storm Surge Hazard Maps for Belize had one disadvantage: It made use of 20 metres contour, which is too large a scale to be effective. The flood risk maps are generally too coarse for local application.

2.4 Respondents

The respondents to the hazard map survey questionnaire were:

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Land Information Centre
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3.0 Vulnerability Assessment Studies

Table 2 shows the details of vulnerability assessment studies undertaken in Belize.

Table 2 – Vulnerability Assessment Studies

Type	Purpose	Coverage	Date Produced	Primary Source	Author
Hurricane	To secure the provision of five regional shelters, to institutionally strengthen the National Emergency Management Organization	National	May 2001	Ministry of Economic Development	Smith Warner International
Flood		National	May 2001		Smith Warner International
Seismic Activity, Landslides, Volcanic Ash		National	May 2001		Smith Warner International
Flood	To better understand the problem of flooding in the Belize River, (Macal tributary.)	Macal watershed	2001	http://www.oas.org/cdmp/document/blzriver/belize.htm	Dr. Ross Wagenseil
Hurricane	To assess the vulnerability of villages to hazard and risk.	National	February 2000	NEMO	Smith Warner International
Flooding & Inundation					
Fires					

3.1 Methods of Preparation and Distribution

3.1.1 Regional Shelter-Site Location Analysis

Using the result of storm surge and hydraulic/hydrologic computations supported by historic knowledge of hurricane disaster, location of shelters were selected such that they will be remote from the effect of hurricanes, flood, landslides, and seismic activities.

3.1.2 Investigations of the Belize River

Flow Simulation Modeling was the primary method used. This technique merges field data and the laws of physics into a computer program which mimics a natural system. This allows for a combination of factors to be tested in a controlled and systematic manner. Simulation modeling is divided into 3 phases

namely, spatial structure, variations of flow friction, and dynamics of rainfall and runoff over time.

3.1.3 Hazard and Risk Assessment

A detailed inventory of assets, lifeline assets, infrastructure, and shelter capacity was conducted. Meetings were held with District Representatives and visits to the villages within each district were made. Questionnaires were designed and administered in order to acquire the necessary information.

The inventory of assets and lifeline assets sought to place a value on the infrastructure in the villages. The latter was able to yield an estimation of public and private transportation; water plants; major access roads; electricity plant; private housing, medical facilities/supplies and communication services.

The aforementioned included other information that was used in the analysis. Other information included, general information about the town or village; the topography of the area; population; transportation capabilities; private business; agriculture and emergency shelter capacity.

The Belizean government sought to ascertain the suitability of emergency shelters. Information collected needed to reflect an estimation of their size and capacity to house people. Other required information included identification of buildings which could be used as new shelters; an indication of these very buildings' resistance against the elements of weather; recommendations in order to keep the buildings in a functioning manner, and an indication of the amenities available in the shelters.

An essential part of the process of preparing the study is ascertaining the relationship between a hurricane category and observed damage. This is very important when determining the criteria against which the suitability of the shelters is judged.

3.2 Users and uses - No information was provided.

3.3 Current condition and limitations

Nearly all of the hazard mapping and vulnerability assessment effort undertaken in Belize suffered from the inadequacy of data; in particular elevation data. The use of low resolution is compounded with the lack of data currency. These have subsequently reduced the use of the results to regional planning as opposed to local planning.

3.4 Critical success factors

The critical success attributable to the efforts made so far is the availability of external funding that largely sponsored the works done to date.

4.0 Digital Maps

Table 3 provides the listing of digital maps that are available in Belize.

Table 3: Available Digital Maps

Theme	*Input Scale*	*Year produced*	*Coverage*	*Primary source*	*Format*
Flood risk	1:50,000	1992	National	L.I.C	Shapefile
	1:50,000	2000	Coastal	UK DOS	Shapefile
Land use	1:50,000	-	-	-	Shapefile
	1:50,000	1960	National	UK DOS	Shapefile
Vegetation	1:50,000	1995	National	L.I.C	Shapefile
Soils	1:200,000	1986	National	UK DOS	Shapefile
Roads	1:50,000	1992	National	L.I.C	Shapefile
Rivers	1:50,000	1992	National	L.I.C	Shapefile
Bridges/Culverts	1:50,000	1960	National	UK DOS	Shapefile
Rainfall	1:50,000	1992	National	M.E.T	Shapefile
Population	1:50,000	2000	National	Central Statistics Office	Shapefile
Watershed	1:50,000	-	National	L.I.C	Shapefile

Datum: NAD 27
Projection: Transverse Mercator, Clarke 1966

5.0 Conclusions and Remarks

The survey revealed an event-based approach to hazards mapping and vulnerability assessment. While the country has well organized national GIS datasets, the datasets are dated and of low resolution for meaningful local analysis of risk and hazards.