



# **STATUS OF HAZARD MAPS VULNERABILITY ASSESSMENTS AND DIGITAL MAPS**

## **TRINIDAD AND TOBAGO COUNTRY REPORT**

**THE CARIBBEAN DISASTER EMERGENCY  
RESPONSE AGENCY (CDERA)**

October 2003

## Table of Contents

	Page
Preface	1
1.0 Introduction	2
1.1 Physical and socio-economic background	2
1.2 Major disaster issues confronting the country	2
2.0 Hazard mapping initiatives	3
2.1 Methods of preparation and distribution	4
2.1.1 Seismic Hazard Maps	4
2.1.2 Storm Hazard Map	5
2.2 Users and uses	5
2.3 Current condition and limitations	5
3.0 Vulnerability Assessment Studies	5
4.0 Digital Maps	6
5.0 Conclusion and Remarks	8

## 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.

This report was prepared by the Jacob Opadeyi, Shahiba Ali, and Eva Chin of the Centre for Geospatial Studies, Faculty of Engineering, The University of the West Indies, St. Augustine, Trinidad and Tobago.

# Status of Hazard Maps, Vulnerability Assessments and Digital Maps in the Caribbean: Trinidad and Tobago

## 1.0 Introduction

### 1.1 Physical and socio-economic background

The twin-island republic of Trinidad and Tobago is located in the southern Caribbean, to the northeast of Venezuela. The country's geographic coordinates are 11°00' N, 61°00' W. El Cerro del Aripo, 940 m, is its highest point. Its total area is 5,128 sq km.

- Deleted: The two islands are
- Deleted: between the Caribbean Sea and the North Atlantic Ocean
- Deleted: "
- Deleted: "
- Deleted: T
- Deleted: is tropical
- Deleted: ranges
- Deleted: with some hills and low mountains

The country experiences a tropical marine climate. The rainy season occurs from June to December. The country is covered mostly by three ranges of moderate to low relief separated by rolling plains. Its natural resources, petroleum, natural gas, and asphalt have made the country one of the more successful countries in the chain of islands.

Seventy-six percent of the land is used for other purposes, arable lands account for approximately 15%, and just over 9% is used to cultivate permanent crops. The services sector clearly makes the largest contribution to Gross Domestic Product (GDP) of 55%. This is closely followed by the industry sector, 43.2% while agriculture adds 1.6%. Its primary industries are petroleum, chemicals, tourism, food processing, cement, beverage, and cotton textiles.

According to 2000 estimates, the labour force is made up of 564,000 persons. Sixty-four percent of the labour force is employed in the services sector, construction and utilities employs 12.4%, manufacturing, mining, and quarrying 14%, and agriculture 9.5%. These estimates were done in 1997. In 2002, the unemployment rate was calculated as 10.8%. However, 21% of the population lives below the poverty line.

The country is inhabited by 1,104,209 persons, according to census estimates in July 2003. Negative population growth of -0.68% is expected. The country's literacy rate is 98.6%.

### 1.2 Major Disaster Issues Confronting the Country

Trinidad and Tobago faces a number of natural disaster issues. The location of the islands in the extreme south of the Caribbean means that there is very little risk from hurricanes. In fact, Trinidad has never been hit by a major hurricane and Tobago has only experienced two since 1963. However, the islands are subject to tropical storms and the associated heavy rainfalls result in flooding and landslides. The islands are both prone to occasional and generally moderate earthquakes. Although, in 1997 Tobago did suffer extensive earthquake damage and in October 2000 Trinidad experienced an earthquake of magnitude 5.8. The islands are also at risk to recurrent drought.

- Deleted: ed
- Deleted: measuring
- Deleted: on the Richter scale

Trinidad has a significant amount of industrial development and is at risk to a range of industrial hazards. These hazards include water and air pollution from industrial waste

or accidental emissions. The risk is greatest in the areas surrounding industrial estates such as the Couva Point Lisas Industrial Estate. Oil pollution of beaches from oilrigs off the east coast has been an environmental concern for a number of years. Poor quarrying practices have contributed to the destruction of forested areas and the contamination of rivers.

Increased built development has created a number of issues. The clearing of hillsides has contributed to run-off and flooding. Air pollution within Port of Spain caused by the burning of garbage in the city dump is a major environmental issue. Malfunctioning sewerage disposal plants are contaminating coastal waters.

Agricultural activities have also created potential disaster issues for the country. Deforestation and in particular illegal logging has resulted in soil erosion and pollution of waterways. The clearing and burning of hillsides for agriculture has contributed to increased rates of soil erosion and flooding. The use of agricultural chemicals is polluting aquifers.

## 2.0 Hazard Mapping Initiatives

The study was informed that only one hazard mapping project has not been undertaken in recent times in Trinidad and Tobago. Table 1 shows the details of the seismic hazard map prepared for the country.

**Table 1 – Hazard Maps in Trinidad and Tobago**

<b>Type</b>	<b>Purpose</b>	<b>Coverage</b>	<b>Scale</b>	<b>Date produced</b>	<b>Primary sources</b>	<b>Authors</b>
Seismic	To map horizontal ground acceleration, expected maximum Mercalli Intensity and horizontal ground velocity	National	0.25° grid resolution	1999	OAS/CDMP <a href="http://www.oas.org/en/cdmp/docume nt/seismap/trinidad.htm">http://www.oas.org/en/cdmp/docume nt/seismap/trinidad.htm</a>	Seismic Research Unit, UWI, Trinidad.
Seismic	To map general level of earthquake hazard in the Caribbean in the terms of the Modified Mercalli Scale and PGA and SGA values	National	0.25° grid resolution	1999	Seismic Research Unit	Seismic Research Unit

Field Code Changed

Storm	Preparation of an atlas of probable storm effects	Tobago	~1km <sup>2</sup> grid resolution	2000	OAS/USDE/CDMP; CIMH	Caribbean Institute for Meteorology and Hydrology (CIMH)
-------	---	--------	-----------------------------------	------	---------------------	--

## 2.1 Methods of preparation and distribution

### 2.1.1 Seismic Hazard Maps

A search on the Internet revealed that two sets of seismic hazard maps were prepared for Trinidad and Tobago, by the Seismic Research Unit, one, done in 1999, as part of the regular dissemination of information that the Unit routinely performs and the other for the Caribbean Disaster Mitigation Project (CDMP) in 1999. The first set of seismic hazard maps showed levels of ground shaking using the Modified Mercalli (MM) scale of earthquake intensities and Peak Ground Acceleration (PGA) with 10% probability of exceedance in any 50-year period and One-Second Spectral Ground Acceleration (SGA) for the same probability. Trinidad and Tobago falls into High Hazard category of earthquake intensity on the MM scale. The Seismic Research Unit will update the MM maps, and the PGA and SGA maps in the near future. Maps are posted at URL: [http://www.uwiseismic.com/SRU\\_Site01/Earthquakes/eq\\_ec\\_seismicity\\_hazmm.html](http://www.uwiseismic.com/SRU_Site01/Earthquakes/eq_ec_seismicity_hazmm.html)

The methodology for arriving at the *Eastern Caribbean Seismicity* seismic hazard maps for Trinidad and Tobago, showing PGA and SGA values, is given at: URL: <http://seismo.ethz.ch/gshap/northam/report.html>

The second set of seismic hazard maps was prepared for the CDMP Hazard Mapping and Vulnerability Assessment workshop in 1999. These maps showed seismic hazard maps of Horizontal Ground Acceleration, Expected Maximum Mercalli Intensity and Horizontal Ground Velocity for Trinidad and Tobago. The maps were prepared using types and intensities of earthquakes, distribution of faults, thrusts and volcanoes in the region. Recurrence models were used to determine how future earthquakes would occur. All this information was combined to produce expected earthquake spectra that showed how amplitude would vary with frequency. Maps of ground acceleration, ground velocity and Modified Mercalli Intensities for Trinidad and Tobago, done at a scale of 0.1° grid resolution, are posted at: URL: <http://www.oas.org/en/cdmp/document/seismap/windward.htm>

Source of this information:

URL: <http://www.oas.org/en/cdmp/hazmap/Grenada/atwell.htm#Introduction>

### 2.1.2 Storm Hazard Maps

An Internet search revealed that a storm hazard assessment, that included the island of Tobago, was done for the Caribbean basin through the Caribbean Disaster Mitigation Project (CDMP) by the Caribbean Institute for Meteorology and Hydrology (CIMH). The map for Tobago, contained in the *Atlas of Probable Storm Effects in the Caribbean*, shows the likely estimates for storm surge, wave height and wind speeds for the 10-25, 50, and 100-year return periods, associated with the passage of a hurricane. The scale of the map is approximately 1km<sup>2</sup> grid of the Caribbean Basin, using the Plate Carrée projection and WGS84 datum.

The storm hazard map utilized The Arbitrator Of Storms (TAOS) model to produce the maximum likely estimates of surge, wind speeds and wave height.

The map is distributed via the Internet and can be found at:

<http://www.oas.org/en/cdmp/document/reglstrm/index.htm>

### 2.2 Users and uses

The seismic hazard maps are intended to be used for developing earthquake resistant designs; determining how soils will react during an earthquake event; for microzonation; public education; informing disaster emergency management and land use planning.

The storm hazard map is intended for use by coastal engineers, regional planners, emergency management personnel and lending and insurance agencies for vulnerability assessments.

### 2.3 Current condition and limitations

No information was available on the current condition and limitations of the seismic and storm hazard maps.

### 3.0 Vulnerability Assessment Studies

The study was informed that no vulnerability assessment study has been undertaken or completed in recent times in Trinidad and Tobago. It is, however, worthwhile to report on the following initiatives being undertaken by the country.

The country has embarked on the development pilot projects for flood early warnings systems in the following communities in Trinidad: Caparo, Caroni, Oropouche, San Juan, and St Joseph.

A landslide hazard and vulnerability study for the country is soon to be completed. This study is sponsored by the National Emergency Management Authority (NEMA) and

executed by the Civil Engineering Department of the Faculty of Engineering at the University of the West Indies. This report will be updated on completion of the study.

A study of hydrologic and agricultural droughts was undertaken by the Water Resources Agency and the Ministry of Agriculture. The study is being validated by the Meteorological Service. Efforts to get information on this project have proved futile.

#### 4.0 Digital Maps

Table 2 shows details of digital data themes available in the country.

**Table 2 – Digital Maps Available in Trinidad and Tobago**

Data Theme	Scale of Input map	Year map was produced	Area Covered	Digital file format	Datum	Projection	Primary Source			
Contours	1:50,000	1998	Trinidad	ArcInfo	Naparima	UTM 20	TCPD			
Land use										
Geology										
Roads										
Rivers										
Land use	unknown	unknown	Urban Areas							
Social facilities	unknown	unknown								
Soils	1:25,000	??	Trinidad				CGS and TCPD			
Rivers										
Roads										
Soils		??	Tobago						??	Cassini
Rivers										
Roads										
Roads	1:2,500	1994	Most parts of Trinidad	.DGN	Naparima	UTM 20	LSD			
Buildings										
Vegetation										
Drainage										
Spot heights										
Heights										
Orthophos				unknown					GeoTIFF	
Coastlines	1:25,000	??	Trinidad	shapefile	Naparima	UTM 20	LLWD & CGS			
Contours										
Land cover		2000			Naparima	UTM 20	LLWD			
State lands	1:10,000	2001								
Flood prone areas	1:25,000	2002								
Irrigable Agricultural Lands	1:25,000	2002								
Watersheds	1:25,000	2002								
Agricultural Districts	1:25,000									
Enumeration Districts	1:10,000									
Agriculture	1:10,000		Caroni							
Administrative boundaries	??		Trinidad							
Roads	1:25,000	1994	Trinidad	Shapefile	Naparima	UTM	CSO			
Populations										
Social facilities										
Communities										

TCPD: Town & Country Planning Division  
 CGS: Centre for GeoSpatial Studies, UWI  
 LSD: Lands and Surveys Division  
 CSO: Central Statistical Office  
 UTM: Universal Transverse Mercator

## Respondents

←..... Formatted: Bullets and Numbering

Ron Bryce  
Land and Water Division  
Min. of Agriculture  
Piarco, Trinidad  
Tel: 642-0267

Kamal Maharaj  
Town and Country Planning Division  
Port of Spain, Trinidad  
Tel:

Lizabeth Hamilton  
Lands and Surveys Division  
Port of Spain, Trinidad  
Tel – 625 0427  
Email: [lmp@tsst.net.tt](mailto:lmp@tsst.net.tt)

Harold Wall  
Central Statistical Office  
Port of Spain, Trinidad  
Tel: 624-8419; Fax: 625-3802  
Email: [haroldwall@yahoo.com](mailto:haroldwall@yahoo.com)

## 5.0 Conclusions and Remarks

The lack of data on previous hazard mapping and vulnerability assessment studies is a reflection that the country is less prone to natural hazards in comparison to the other Caribbean States. Flooding and landslide are, however, perennial hazards in different parts of the country hence, the new interest in the development of flood early warning systems and landslide modeling. The country is, however, highly prone to industrial hazards and it is important that hazard mapping and vulnerability assessment be undertaken in its industrial estates.