



Honduras

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Vulcanology and Sabo Engineering in Honduras

By Ing. Martín Pérez Lara
Lima, Peru 21/25 Nov 2005



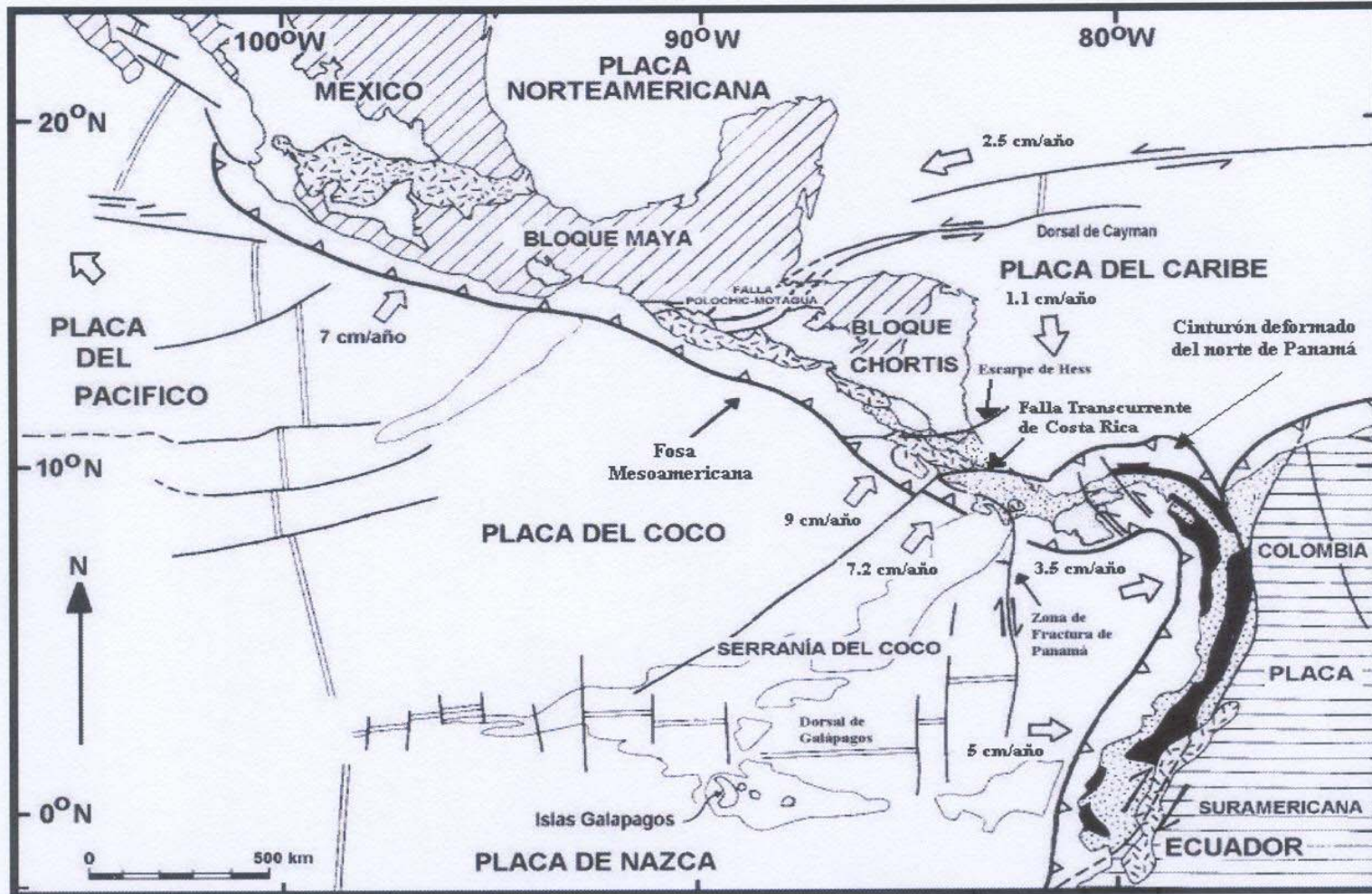
Vulcanology in Honduras

- SEISMICITY AND TECTONIC LOCATION
- Honduras are located in the Central American region that is characterized by a series of geotectonic fractures at global level and also exposed to local faults in all the countries that conform it, since in the north, in the Atlantic, they are interacting the Plate of North America and the Plate of the Caribbean, divided by the Grave of the Great Cayman. In the South part, in the Pacific, the Coconut Plate is distinguished throughout all the Central American countries (zone of subduction) forming the Grave of Mesoamérica.

...Seismicity

- This geologic structure arrives until the crest from Coconuts at level of the border between Costa Rica and Panama. The Plate of Is born acts at level of Panama, through the Galápagos Plate with parallel movement to the block of Panama that also affects to Costa Rica through a transcurrente fault (To see annexed Figure). This tectonic structure generates important activity seismic and has caused great destructive tremors in the Central American region.

Location of Honduras

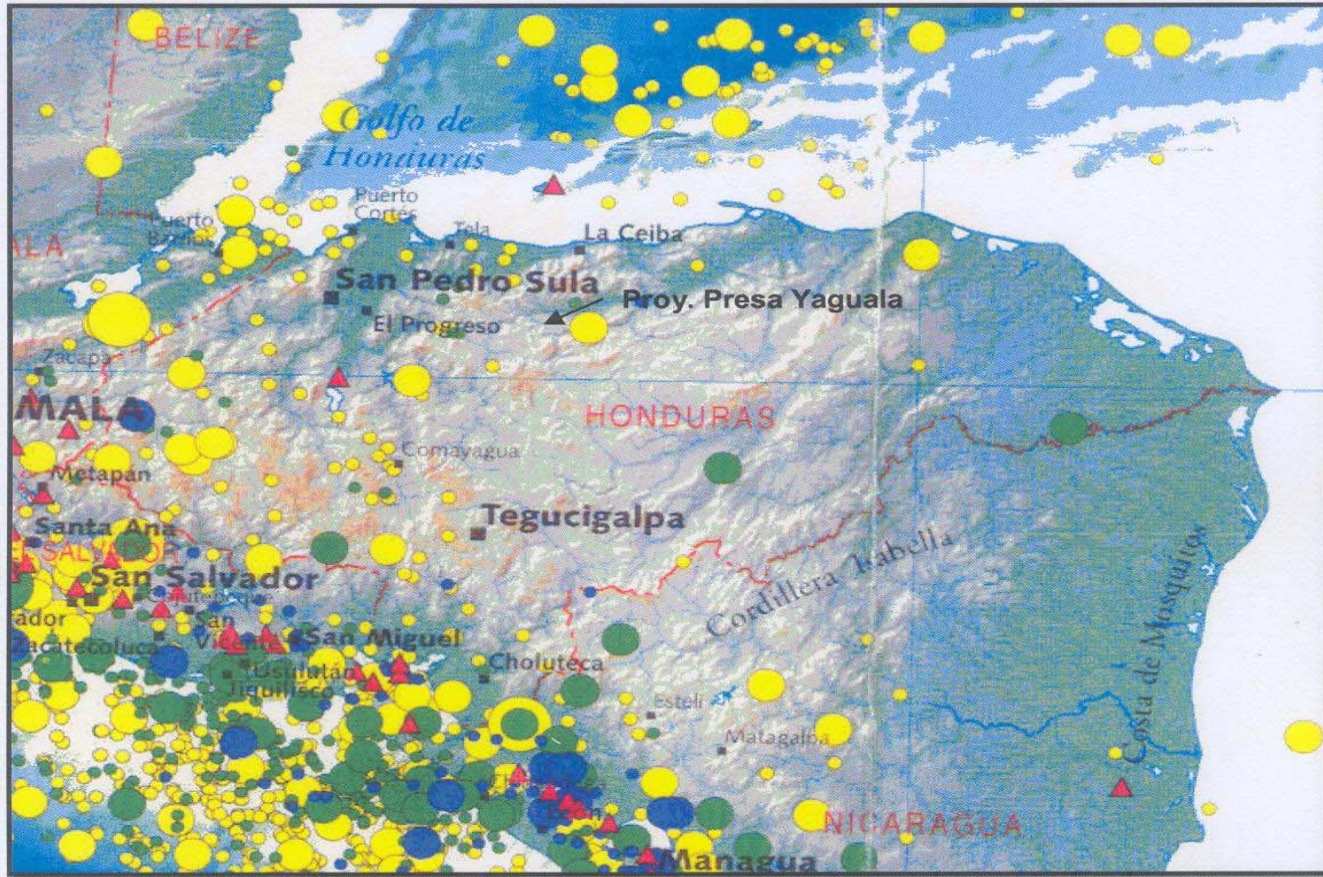


Distribución de las Placas Tectónicas en América Central (sus movimientos relativos y las estructuras tectónicas más importantes)

Volcanic threatens

- Central America, as it leaves from the Fire Belt of the Circunpacific is holds to the volcano threat in permanent activity. They are considered more than 20 active volcanos in the region. In Honduras registries of recent eruptions are not only had, due to it does not exist a permanent monitoring in volcanic aspects, taking place solely registries of minimum tremors, through seismographs of the National University of Honduras, UNAH.

Seismicity in Honduras



Acercamiento de la Sismicidad de Honduras del Catálogo Centroamericano 1900-1994

... **Volcanic threatens**

- The main events by natural disasters in volcanic matter that affect the Honduran territory register mainly in the neighboring countries of Nicaragua, Guatemala and El Salvador, by previous the advances in Sabo Engineering, is oriented mainly to the prevention and mitigation in cases of hurricanes, common storms and tropical depressions for Honduras.

Pico Bonito, La Ceiba, Honduras





La Celba



GOLOSON INTL AIRPORT

El Pino

El Porvenir

Pico Bonito

Cerros de

Monte Jose Leon

Monte El Paraiso



Image © 2005 EarthSat
Image © 2005 DigitalGlobe

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Pointer 15°43'04.89" N 86°56'47.81" W elev 50 ft

Streaming ||||| 100%

Eye alt 31314 ft



Cerro Tigre

Amapala



Image © 2005 EarthSat
Image © 2005 DigitalGlobe

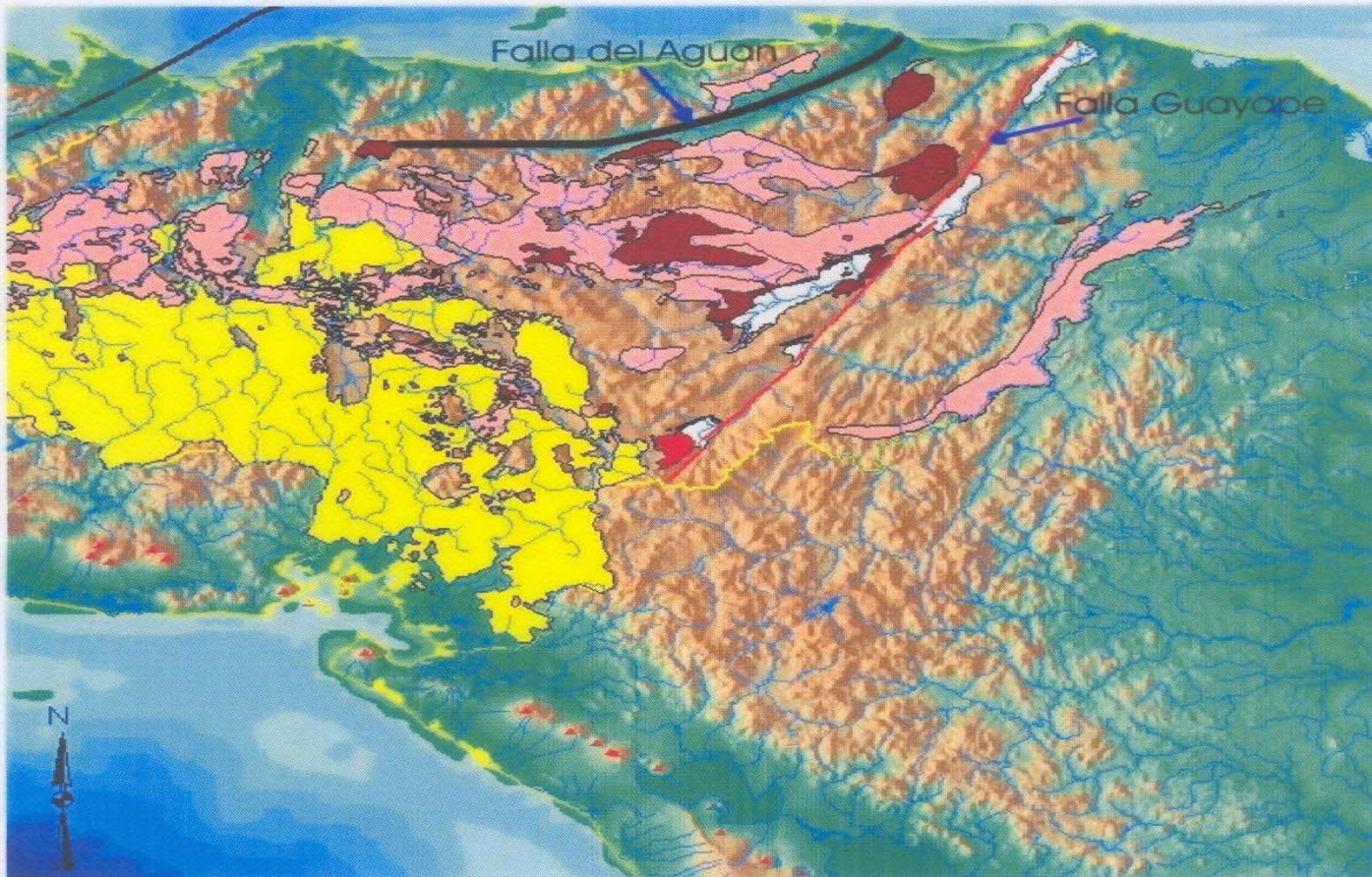
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Pointer 13°15'41.68" N 87°38'19.78" W elev 1271 ft

Streaming ||||| 100%

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Faults in the North region of Honduras



100 0 100 200 300 Kilometers

Localización de la Fallas del Aguán y de Guayape

Review of Seismic Activity in the North Zone of the Country

Fecha	Lugar	Intensidad M. Mercalli	Mag. Richter	Fenómenos y Daños
07-1764	Trujillo, Litoral Mosquito	VIII	6.0- 6.50	Terremoto que causó la destrucción de 108 casas en el puerto de Trujillo y cobró varias víctimas (Según el Obispo, fue la erupción del Monte Blanco, un volcán al Este de Trujillo).
16-09-1773	Omoa			Un temblor seguido de un diluvio y viento fuerte que inundó la población.
6-1780---12-1781	Omoa	VI-VII	4.9-5.4	Según lo describe un preso inglés que estuvo en el fuerte de San Fernando de Omoa entre Junio de 1780 y Diciembre de 1781: "Mientras permanecí en el fuerte fuimos sacudidos varias veces por tremendos terremotos. Uno de ellos tan severo, que a pesar del sorprendente peso de la instalación, estremeció sus bases y los estupendos muros se rajaron de arriba a abajo."
19-10-1820	Villa de Omoa y San Pedro Sula		5.5	Fuerte terremoto que destruyó la Villa de Omoa, y en SPS varias casas y la iglesia se cayeron y hubo varias víctimas. Ocurrieron agrietamientos y deslizamientos. Peraldo y Montero atribuyen este sismo a la extensión de la falla de Motagua en el mar Caribe y estiman el epicentro al Oeste de Omoa (frente a lo que es hoy Puerto Cortés) siguiendo el curso de la falla.
2-2-1825	Islas de la Bahía (Roatán), Golfo de Honduras	VI	5.0-5.5 (Sutch1981)	Peraldo y Montero atribuyen este sismo al segmento marino de la falla Motagua llamada falla Swan. y estiman el epicentro a 16.70°N-86.20°W. La intensidad estimada en Belice a unos 200 km del epicentro (y donde hubo alarma) sería cerca de VI indicando una probable magnitud Ms de 7.0. Produjo tsunami local.

...Seismic Activity

Fecha	Lugar	Intensidad M. Mercalli	Mag. Richter	Fenómenos y Daños
2-1826	Isla de Roatán			Sismo
22-23/6-1836	Omoa y Centro América			Sismo
1839	La Mosquitia			Un fuerte sismo de aproximadamente 5 segundos de duración que fue sucedido por otro temblor y oscuros nubarrones que taparon el sol.
30-1-1846	Omoa-Puerto Cortés			Sujeto a investigación, pues se reportan daños en Puerto Santo Tomás (Lago Izabal), que es vecino a Omoa y Pto. Cortés. Se reporta haber afectado una pequeña colonia de Belgas fundada en el Rio Polochic.
8,18/8-1851	Trujillo	VI	5.50	2 Temblores
11-14/11-1851	Tegucigalpa, Trujillo	VI-VIII	6-6.5	Según Montessus (1888. en Sutch, 1981) el temblor del 14 de Noviembre destruyó algunas casas en Tegucigalpa. Se asigna Intensidad MM de VIII y magnitud entre 6.0 y 6.5.
9-2-1853	Guatemala y Trujillo	VI	6- 7	Un fuerte temblor de movimiento horizontal y vertical
26/8-3/12-1853	Guatemala y Trujillo			Por varios meses la tierra tembló en Trujillo ocasionando muchos daños
15-4-1854	Omoa, Trujillo	IX		Sismo

**Sabo engineering in
Honduras: Hydraulic Works
Department DGOP-SOPTRAVI**



Hydraulic Works

Functions

The Hydraulic Work Department, of the Main directorate of Public Works, SOPTRAVI, is the one in charge to carry out the protection against the Control of Floods, Erosion and Sedimentation to the Populated Zones, Productive Agriculturists and Cattle dealers, to the Tourist zones, the existing infrastructure. Making necessary civil works in the diverse rivers of the country as much in it causes like in the margins, in addition it makes the improvement of channels for the river communications, optimal earth rehabilitation for the Agricultural operation contributing to the rational use integrated of the resources water, earth and forests, in the river basins and hydrographic river basins of the National territory.

Objectives

- ◆ To study, to plan, to design, to construct and to supervise works for Control of Floods, Erosion and Sedimentation like being: Greater and smaller, imprisoned embankments, dredged, canalizations, drainages, walls, coatings, structures.
- ◆ To prevent the natural disasters.
- ◆ To guarantee the maintenance and rehabilitation of existing hydraulic works.

**Recent projects Developed by
the Hydraulic Work
Department DGOP SOPTRAVI**



COATING WITH Rocks Moramulca River-Valle And FRANCISCO MORAZAN

WORKS OF EROSION CONTROL OF IN HIDROELECTRICAL CENTRAL NACAOME





DREDGED And CANALIZATION IN THE CHOLUTECA RIVER ,OROCUINA

PROTECTION OF SLOPE WITH GABION, BONITO RIVER



SLOPE PROTECTION, BONITO RIVER



CANALIZATION TOCOA RIVER, TOCOA , COLON



DRAINAGE WORKS TOCOA, COLON



CONSTRUCTION OF EMBANKMENT AND CANALIZATION CHOLUTECA RIVER, CHOLUTECA



CANALIZATION WORKS CANGREJAL RIVER





CONSTRUCTIVE PROCESS CANGREJAL RIVER



CANALIZATION CHIQUITO RIVER, MDC, F.M. 20/10/2002



DREDGED OF CHIQUITO RIVER, MDC. F.M.

22/10/2002



CANALIZATION WORKS IN CHOLUTECA RIVER, BO. LA BOLSA MDC. F. M.



Finalized works of Canalization Choluteca River MDC. F.M.

**the Floods Control In the
Department of Atlantida,
North Region of the Country**

PROBLEMATIC

The Zone of the Atlantic Coast is one of the areas that but are affected annually by the climatologic conditions that bring with himself the presence of the cold, Strong fronts winter, Tropical Storms and Hurricanes. Being this one of the zones of the country with high volume of annual precipitation.

The Rivers of the zone end at the Atlantic Ocean and their short length and pending fort are characterized by that causes that its channel crosses with strong speed causing damages to the road infrastructure that this located on the foot of the high river basin and specially the productive floods in the populated centers and zones that are located in the flood plain that extends from the average river basin to the coastal zone. The region is characterized by being of ample agro-industrial and tourist productive potential. Dedicating itself mainly to the culture of African Palm, milky Fragmentation hand grenade, Orange, Cattle ranch, banana tree, banana, products. In General the River basins in their high part nevertheless present/display one better condition in relation to the rest of the country with few problems of deforestation, being their waters crystalline and apt for the use domestic servant, specially after the Occurrence of the Mitch Hurricane in Honduras increase the sediment production that is deposited in the low river basins contributing to the problems of under flow of the rivers.



Location

The Department of Atlantida occupies a Geographic position between the North latitudes $15^{\circ} 30'$ and $15^{\circ} 55'$, long. W. $87^{\circ} 50'$ y $86^{\circ} 30'$. Its area is of 4.372,10 Km².

- **Weather**

The weather is warm in its majority but it is refreshed by breezes of the sea.

The main problems to solve in the sector are the following ones:

- Control of floods in the parts mediantes and low of the river basins
- Erosion control that presents in the margins
- Drag sediments Sliding earth landslides and avalanches

Between the short term objectives they consider the mitigation of risks of floods in the centers populated bordering to the rivers with the zone and to guarantee the life utility of the economic investments in the low zones threatened by the floods which entailed to generate a better standard of life to the settlers of the department of Atlantis, improving the continued handling of the study area, avoiding the erosion of the ground by bad you practice agricultural, it destroys and it burns of forests, protecting the river basins by means of the appropriate work execution of handling to resist the erosion and sedimentation through structural and nonstructural works.

Cover Area

the zone of attention includes/understands an area of approximately 4.372,10 Km2 in which are eight main river basins.

Beneficiaries

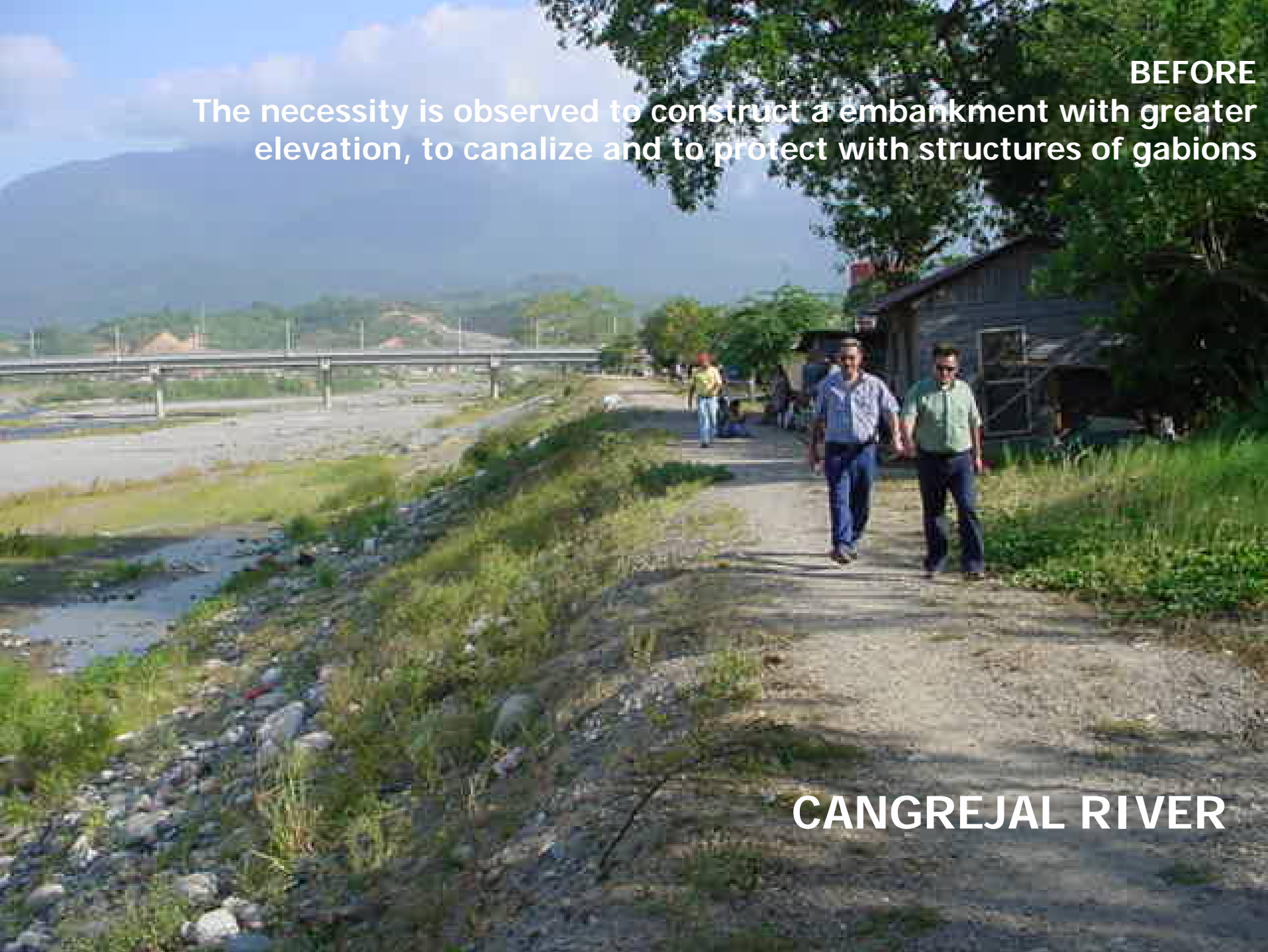
By means of the Construction of Protective installations that They control the water flow and drag Sediments benefited the following Communities::

DEPARTMENT OF ATLÁNTIDA				
TOTALY	HOUSE	POPULATION		
		TOTALY	MENS	WOMENS
	80,629	315,755	155,203	160,552
1. LA CEIBA	34,043	127,476	61,054	66,422
2. EL PORVENIR	3,639	13,789	6,897	6,892
3. ESPARTA	3,598	15,468	7,921	7,547
4. JUTIAPA	6,163	27,494	13,973	13,521
5. LA MASICA	5,267	22,630	11,372	11,258
6. SAN FRANCISCO	2,649	10,680	5,318	5,362
7. TELA	20,641	78,537	38,789	39,748
8. ARIZONA	4,629	19,681	9,879	9,802

**Projects Implemented
recently by the Hydraulic
work Department DGOP
SOPTRAVI in the Department
of Atlantida**

BEFORE

The necessity is observed to construct a embankment with greater elevation, to canalize and to protect with structures of gabions



CANGREJAL RIVER

After

The proposed works have been made, Embankment, canalization and Coating of Slopes



CANGREJAL RIVER

The construction is observed of embankment, canalization and coating of gabions until certain height.



RIO CANGREJAL



Constructive process of Gabions, Cangrejal La Ceiba, Atlántida



**Operation of Embankments in Rainy season, Cangrejal river ,
the Ceiba, Atlantis**

PROYECT LEAN RIVER

The works of canalization in the river right margin



The works of canalization are made the material in the right is placed like protection



LEAN RIVER

**DESTRUCTION OF EMBANKMENT And ACCUMULATED MATERIAL
IN CHANNEL DANTO RIVER**



EMERGENCY ACTIONS REGIONAL WORKS MACHINERY OF CEIBA FOR CONSTRUCTION OF EMBANKMENTS And SEDIMENT CONTROL DANTO RIVER



AERIAL VIEW PROYECT DANTO RIVER



AERIAL VIEW PROYECT DANTO RIVER









Embankment Constructive Process de Bordos, Río Papaloteca, Jutiapa, Atlántida



Embankment, Papaloteca River, Jutiapa, Atlántida



Embankment , Papaloteca River, Jutiapa, Atlántida

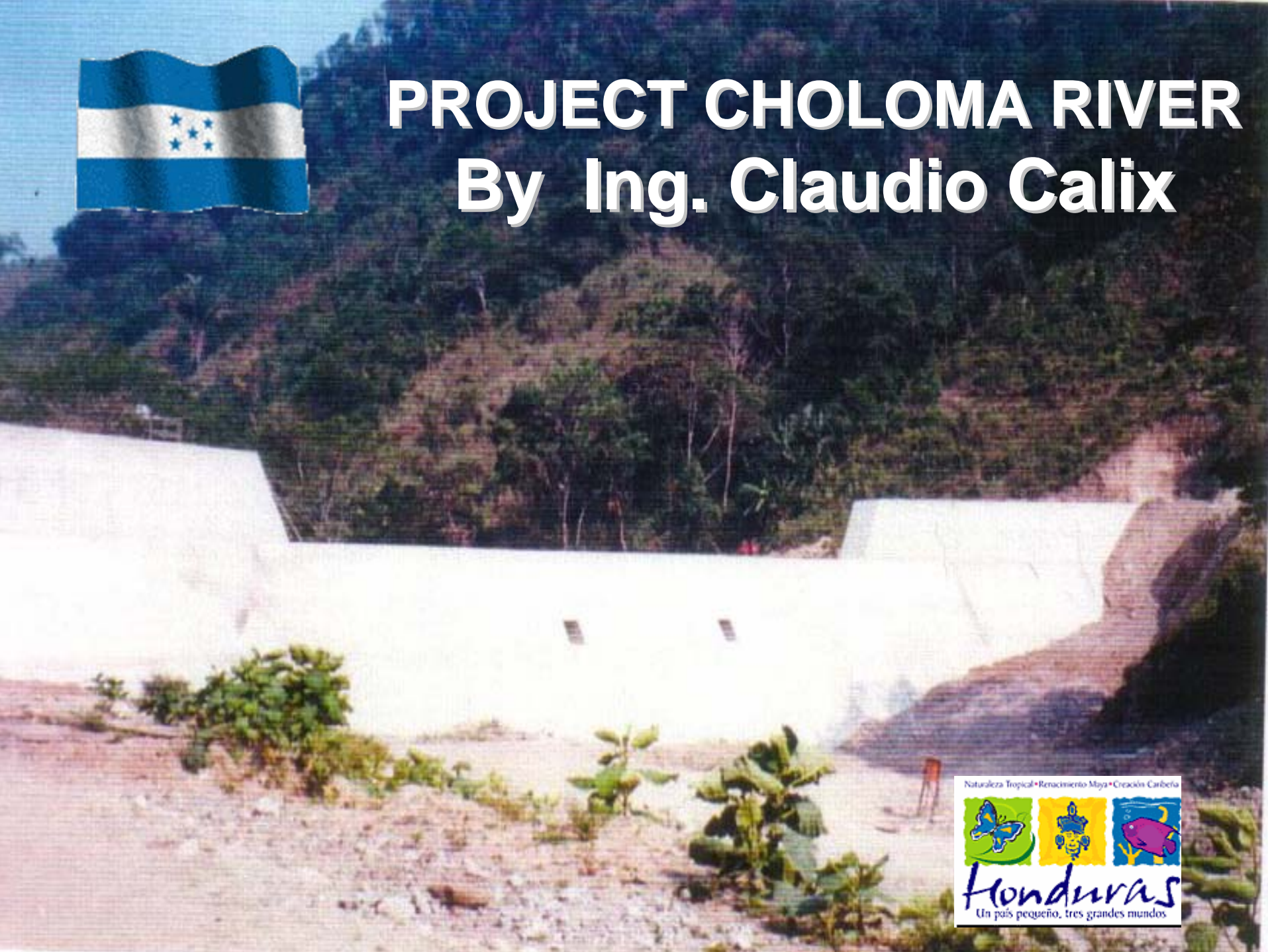
Sabo Project Choloma River

- The developed recent project in its constructive phase by cooperation of the Government of Japan in Honduras, is the project of the Rio Choloma in the Department of Cortes, Honduran North region between years 1998/2001



PROJECT CHOLOMA RIVER

By Ing. Claudio Calix



PROJECT CHOLOMA RIVER

- Antecedents: In 1974 the Fifi Hurricane It cause to severe damages of floods and avalanches in the Valley of Sula causing extensive collapses of hills in the Mountain range of the Merendon which has 1.700 a peak altitude of m.s.n.m., specially in the river basin of the Choloma River. 4.000 damaged houses, 2.500 dead people and 20.000 people damaged in the area of Choloma with a total of 10.000 deaths in the Valley of Sula caused by the drags and sediment flows were reported.

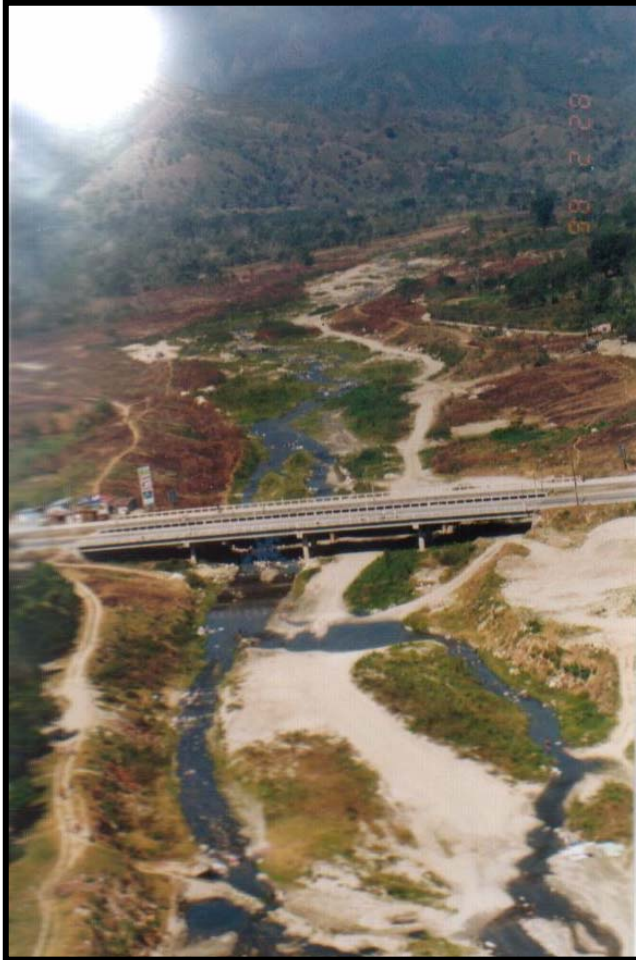
Choloma River



... Choloma River

- Since then great amounts of sediment runoff of the Mountain range of the Merendon have blocked the channels of the rivers causing floods. Although the Valley of Sula is the productive area but of Honduras that produces most of products for export as banana and sugar and recently several industrial parks have been developed, this area is extremely vulnerable to the problems of erosion, sedimentation and flood.

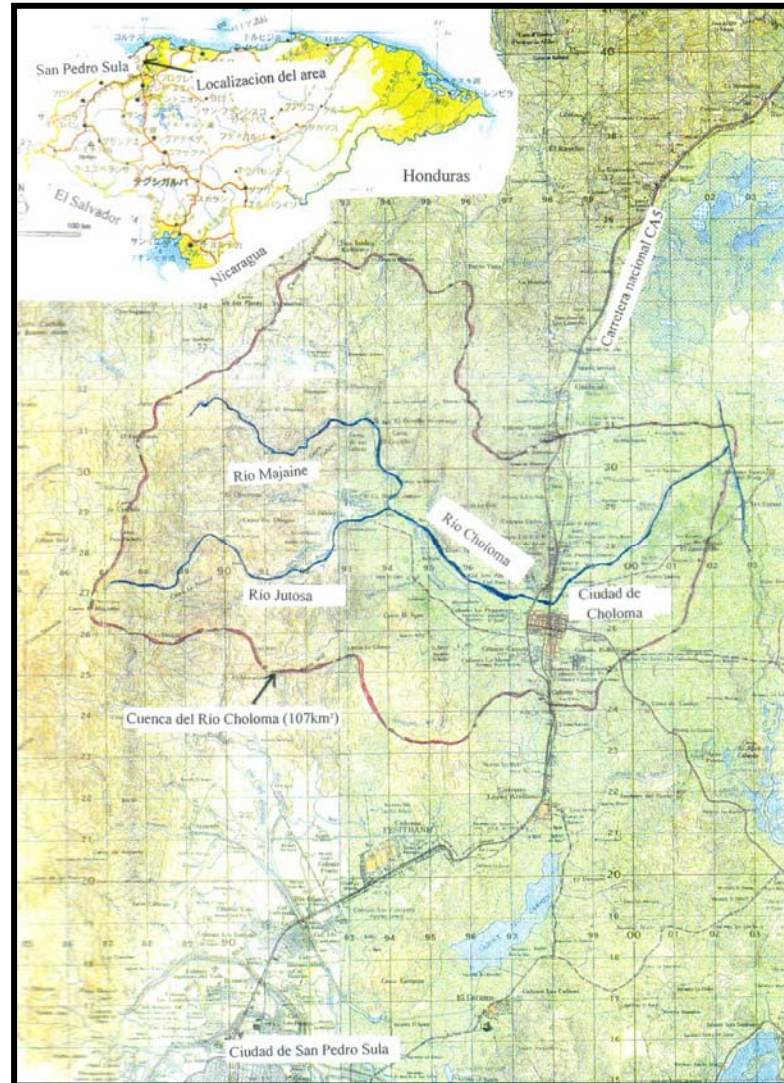
Choloma River



Choloma River



Map of Location, Project Choloma River



... Choloma River

- In order to create optimal measures to mitigate the damages of erosion, sedimentation and floods, additional examinations of field and studies (Topographical surveys longitudinal, cross-sectional and leveling in the area of the river basin, geologic investigation and ecological study and quality of water) avalanches flows of and flood were made of the situation of during and after the Fifi Hurricane.

Perspective of the Project



... Choloma River

- With the purpose of preparing a plan adapted for the erosion control made a study supported by the Agency of Cooperation the International of Japan (JICA), of sediment production which was carried out using aerial photo-interpretation, analyses of topographic maps and observations of field of last floods

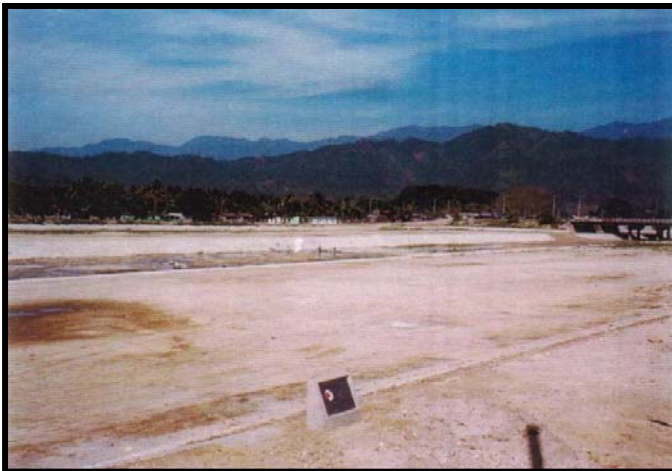
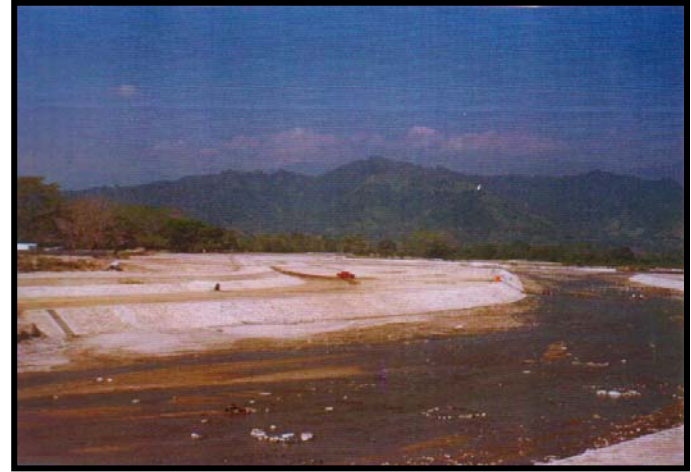
... Choloma River

- The works to control the erosion and sediments were planned with the purpose of reducing the excess of sediment unloading to obtain the permissible sediment unloading in the control post of design, by means of the reduction of the production and sediment unloading and controlling the sediment unloading with optimal structures like slope works, prey of control (to control the sediment unloading, the consolidation of the bed of the river and margins and to control the flow of the avalanche), prey of consolidation (for the consolidation of the deformed section of the river) and works of channel (are made up of consolidation prey, beams of the bed of the river and coatings).

Choloma River



Choloma River



Choloma River



Consolidation Dam



Majaine Dam



...Choloma River

- After the execution of the project it is counted to the date with the construction of three (3) sediment control dams three (3) consolidation Dams of the bed of the river, construction of embankments guides, reconstruction of the railroad bridge, works of canalization and protection of both margins of the river.

**Master Plan
Tegucigalpa and
Comayaguela M.D.C. in the
Department of Francisco
Morazan**

Master Plan for flood and landslides control in Tegucigalpa

- The developed recent project but in the phase of study by means of no reimbursable financial cooperation of the Government of Japan in Honduras, is the Masterful Plan for Control of Floods and sliding in the Choluteca river, Tegucigalpa and Comayaguela M.D.C. in the Department of Francisco Morazan, central region of Honduras between years 2001/2002



asa de inundación

Sin bolos





Sim bolos

- Anteriores
- A
- B
- C

de peligro: A > B > C)
 Sentido del deslizamiento
 Areas afectadas por deslizamiento
 (Solo categoría A)



Categoría de peligro

A

El Grado de Peligro de Desli

Estados anormales y caracteris ticas topograf

Bloques en los cuales se produjeron grietas principales (grietas primarias) o grietas de pl. Los bloques pueden estar moviendo ahora o movieron recientemente. Parece inestable.



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Thank you very much