
DRAFT REPORT

BELIZE: MACRO SOCIO-ECONOMIC ASSESSMENT OF THE DAMAGE AND LOSSES CAUSED BY TROPICAL DEPRESSION 16





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BELIZE

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PREFACE

Tropical Depression 16 (TD16) crept up on disparate populations in Belize over a period 8-16 October 2008. TD16 struck less than five months after the first named tropical storm of the 2008 Atlantic season, Arthur. The storm had been forecasted to dump up to 10 inches of rain over Belize and up to 15 inches in isolated areas. Arthur had devastating effects on Belize, particularly the southern regions where bridges collapsed and lives were lost. It was in the aftermath of such devastation that Belize faced TD16. The consequence of TD16 is what falls under the purview of this assessment.

Although the humanitarian crisis posed by TD16 might not appear as grave as that posed by Hurricane Dean in 2007, or Hurricane Keith in 2000, the consequences nevertheless present the need, beyond the humanitarian response, for a rapid assessment of the damage (impact on assets) and losses (effects on economic and social flows) to determine its macroeconomic, social and environmental consequences and its implications for the country.

At the request of the Government of Belize, and with the support of the United Nations Development Programme (UNDP), such an assessment was undertaken by an Economic Commission for Latin America and the Caribbean (ECLAC)-led mission in accordance with its well-established and accepted disaster evaluation methodology (ECLAC, 2004, www.eclac.cl/mexico, and ECLAC, 2007, www.eclacpos.org)¹.

This assessment will complement and expand on the emergency and humanitarian needs identified previously by the government and particularly by the National Emergency Management Organization (NEMO), the Ministry of Natural Resources and Environment and with the support of civil society organizations such as the Red Cross.

A sector-by-sector analysis was conducted which led to an overall estimation. The result of such an assessment provides a quantitative approximation to the overall damage and reconstruction costs of the event and looks into the effect on the country's macroeconomic performance as compared to the pre-hurricane targets. The final section of the report outlines some strategic considerations and priorities for projects and actions. These may require additional resources.

Baseline data for the conduct of the Macro Socio-Economic Assessment are drawn from official government data sets including: the Population and Housing Census 2000, the 2002 Poverty Assessment Report, Abstract of Statistics 2006, and other relevant data sets from the Statistics Institute of Belize and the Central Bank of Belize.

¹ This methodology has been applied since the mid-1990s in the Caribbean to assess the impact of earthquakes, hurricanes and tropical storms in Cayman Islands, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Saint Lucia, St Kitts and Nevis, Suriname and the Turks and Caicos Islands. The ECLAC DALA methodology has been used for over 30 years to assess such large-scale disasters as Hurricane Mitch in Central America, major earthquakes in Central America and Mexico, and the El Niño effect in the Andean region. More recently it has also come into use in Asia following the Tsunami of 2004.

Mission components

ECLAC prepared, with a team of experts and consultants, a multi-sector, integrated damage and loss report. This report was made possible by the cooperation, coordination and support provided by the relevant government authorities and the UNDP.

In the process, appropriate dialogue and coordination was made with the relevant national institutions. These are, namely, The Ministry of Agriculture, the local government authorities; the NEMO, the Ministry of Natural Resources and Environment and civil society organizations such as the Red Cross and Red Crescent Society.

The mission was undertaken from the 4-12 March 2009 and comprised the following ECLAC staff and consultants:

- Asha Kambon, Coordinator and Social Sector Specialist – the affected population and the social subsectors of housing, health and education.
- Michael Hendrickson, Macroeconomist, undertook the economic impact and the consequences on public finance.
- Beverly Lugay, Micro economist – supporting the work of the senior Microeconomist.
- Lancelot Busby, Microeconomist, undertook the economic impact and the consequences on commerce and the tourism sectors.
- Dr. David Smith, Coastal Engineer and Infrastructure Sector Specialist, examined the impact on roads, telecommunications, and public utilities; and
- Dr. Vincent little – Agro Economist, with specific attention to the Agricultural Sector.

The national counterpart team was coordinated by Mr. Craig Moore of the Ministry of Natural Resources and the Environment.

The mission team expresses its gratitude and recognizes that the assessment would not have been possible without the support from this group. Special mention must be made of the support provided by the CEOs, Deputy CEOs, and civil society organizations, and the private sector organizations who gave of their time to meet with members of the team in order to verify and clarify data and provide new information.

Table of contents

Preface	i
Executive summary	vii
I. Background	1
A. Description of the event.....	1
1. Evolution and decay of Tropical Depression 16.....	1
2. Rainfall associated with TD16.....	3
3. Flood levels associated with TD16.....	4
4. Emergency actions.....	4
II. Affected population	6
A. Key social dimensions of disasters	8
1. Vulnerability of women and children.....	8
III. Description of damage and losses by sector	11
A. Productive sector	12
1. Agriculture	12
2. Climate	16
3. Description, analysis and estimation of damage	17
4. The crop subsector	19
5. Grain industry	23
6. The sugar industry	25
7. Other crops	28
8. The livestock subsector	28
9. Tourism	29
10. Commerce	31
11. Petroleum sector	31
B. Infrastructure sector	32
1. Water (storage, treatment and supply) and sanitation	33
2. Transportation - Bridges	36
3. Transportation – Roads and drainage structures	42
4. Recommended mitigation actions	51
C. Social sector	52
1. Housing	54
2. Health	56
3. Education	57
IV. The macroeconomic effects	59
A. Summary damage and losses	59
1. The macroeconomic performance prior to TD16	61
2. Prices, wages and employment	61
3. Fiscal performance	61
4. Money and banking	61
5. Trade and payments	62
B. Macroeconomic performance in 2008 before the disaster	62
1. Output	62
2. Prices, wages and employment	62
3. Fiscal performance	63
4. Trade and external payments	63

C.	Performance of the economy with the disaster	63
1.	Impact on GDP	63
2.	Prices, wages and employment	65
3.	Fiscal operations of central government and debt	65
4.	Money and banking	68
5.	Trade and external payments	68
D.	Short- to medium-term economic challenges and policy options	69
1.	The fiscal and debt constraints	69
V.	Considerations to the recovery and reconstruction processes conclusions and recommendations	70
A.	General considerations	70
B.	Strategic recommendations	70
C.	Short to medium term recommendations	71

List of Tables

Table 1:	Belize: Affected population by District	8
Table 2:	Volume of major domestic agricultural exports (tonnes).....	15
Table 3:	Summary of total damage/losses of the agricultural sector.....	19
Table 4:	Summary of total damage/losses by affected district.....	19
Table 5:	Area under selected crop production, Belize (acres).....	20
Table 6:	Annual production for selected crops, Belize	20
Table 7:	Total damage to the crop subsector in Belize (BZ \$).....	21
Table 8:	Total damage to the crop subsector in Orange Walk district	22
Table 9:	Total damage to the crop subsector in Cayo	22
Table 10:	Total damage to the crop subsector in Corozol.....	22
Table 11:	Total damage to the crop subsector in the Stann Creek district	23
Table 12:	Total damage to the crop subsector in Belize district.....	23
Table 13:	Total damage to the crop subsector in the Toledo district.....	23
Table 14:	Total damage to the corn industry.....	24
Table 15:	Total damage to the rice industry.....	25
Table 16:	Sugar industry statistics, 1998/99 to 2007/08	25
Table 17:	Sugar cane areas impacted by TD16 in Orange Walk District.....	27
Table 18:	Sugar Cane Areas Impacted in the Corozal District.....	28
Table 19:	Total damage to the livestock subsector by district.....	29
Table 20:	TD16 Storm estimates for the flooding disaster recovery to Archaeological Reserves	30
Table 21:	Stay over Visitors – 2004 – 2008.....	31
Table 22:	Losses in the Petroleum Sector (BZ\$).....	32
Table 23:	Tabular Summary of Damages and Losses of the Productive Sector.....	32
Table 24:	Belize: Total effect on the social sector by subsectors.....	53
Table 25:	Belize: Houses affected by TD16 by District.....	54
Table 26:	Summary effect to the housing sector	56
Table 27:	Belize: Total effect on the health sector.....	57
Table 28:	Belize total effect of TD16 on the education sector	58
Table 29:	Summary damage and losses from TD16 on Belize	60
Table 30:	Fiscal Operations of Central Government (thousands of Belize dollars).....	66

List of Figures

Figure 1:	Accumulated rainfall for TD16 - 13-20 October 2008.....	3
Figure 2:	Ethnic Distribution of the population of Belize, 2000	6
Figure 3:	Proportion of the population poor and severely affected by TD16 by affected districts	7
Figure 4:	Agriculture contribution to GDP (2000 - 2008), 2000 constant prices	12
Figure 5:	Contribution of agricultural subsector to total GDP (2000 – 2008)	13
Figure 6:	Agriculture and subsectoral growth rates, 2000-2008.....	13
Figure 7	Value of agricultural exports (BZ\$) – 2003 – 2007	15
Figure 8:	Agricultural export as percentage of total export, 2003-2007	16
Figure 9:	Belize: Distribution of effect within the social sector	54
Figure 10:	Belize: Distribution of houses damaged or destroyed by TD16 by District.....	55
Figure 11:	Belize: GDP growth rates before and after TD16	64
Figure 12:	Balance of Payments Current account as a % of GDP before and after TD16.....	68

List of Maps

Map 1:	TD16 Approaching Belize – October 14	1
Map 2:	TD16 Approaching Belize – October 15	2

List of Boxes

Box 1:	Gender issues relevant to women and their families	9
Box 2:	Damage assessment: The ECLAC Methodology	11

Executive summary

Between 2000 and 2008, Belize had been affected by at least five major meteorological events – Hurricane Keith, a Category 5 hurricane, in September 2000; Hurricane Iris, a Category 4 hurricane, in October 2001; Hurricane Deane, a Category 4, in August 2007; Hurricane Arthur, a Category 3, in June 2008; and TD16 in September/October 2008.

This pattern of exposure to extreme weather events and the possibility of increased frequency and more intense events, as presented by the evidence of climate change in the Caribbean, is a critical development challenge facing policy makers in Belize.

Tropical Depression 16 (TD16), which is the focus of this report, threatened Honduras, Guatemala and Belize and finally made landfall in Northern Honduras on Thursday 16 October 2008. The remnants of TD16 caused widespread rainfall across Belize which resulted in life threatening floods in communities along the Mopan, Macal and upper Belize rivers. Over a period of approximately five days these waters moved down to the lower Belize River Watershed, resulting in the flooding of those communities which straddle the banks of the Belize River.

The national disaster zone expanded as rains in Mexico resulted in the swelling of the Rio Hondo and New Rivers in the northern districts of Corozal and Orange Walk. The Prime Minister, the Honourable Dean Barrow, declared the Cayo District, which was impacted by the floods, a disaster area on 22 October 2008.

The death of four individuals is directly attributed to this event.² In its wake approximately 60 communities (cities, town and villages) were impacted with over 10,000 persons, or 3.2% of the national population, having been severely affected. Many of the severely affected had to be provided with shelter, food and basic household goods. An estimated population of 125,000 persons was impacted and among the hardest hit communities many had to be relocated from their homes into government and private shelters. The average displacement of individuals was two weeks.

The Cayo, Belize, Corozal and Orange Walk Districts (communities associated with the Belize and New Rivers, and the Rio Hondo Watersheds) as well as the Stann Creek Districts were the most severely affected areas and suffered extensive damage to economic assets and infrastructure, with significant implications for livelihoods. Marginalized rural poor, including women and children living in affected areas, have been most severely impacted among national constituents.

Summary of damage and losses

Although TD16 caused significant disruption to the lives and livelihoods of a wide cross-section of the population, the financial costs of the disaster were moderate compared with Hurricane Dean and Keith that have impacted Belize in recent years. The total impact of the

² Two additional bodies were recovered from flood waters but investigation revealed that they had been washed into Belize from neighbouring countries.

disaster was estimated at BZ\$54.1million, the equivalent of US\$27.1 million. Nevertheless it is believed that the unavailability of data and information in some sectors meant that a fuller accounting might have provided for a greater financial cost. The monetary costs do not provide a full picture of the fall-out of the disaster, however, as small farm agriculture, transport networks and the natural environment were badly affected leading to a significant social and environmental cost.

Importantly, the per capita impact of the disaster at \$168 per person was relatively small. Scaling the impacts by major macroeconomic indicators highlights the modest financial costs of the disaster. Indeed, the depression led to fall-out equal to around 2% of GDP, over 5% of exports of goods and services and 2.5% of consumption. Nevertheless, underscoring the fact that the disaster was a mostly agricultural event, the total impact accounted for 25% of agricultural GDP. Fortunately, the impact represented only 2.7% of external debt, which suggests any need to acquire debt for current costs repairs should be moderate. This should be distinguished, however, from the need for substantial financing for mitigation and building back better, especially for major infrastructure, including roads and bridges.

Such mitigation costs to the infrastructure sector alone have been estimated at over BZ\$20 million.

Total damage to the agricultural sector, as presented in table 4, is estimated at BZ\$28.23 (US\$14.17) million, of which direct damage is estimated at BZ\$12.58 (US\$6.29) million and indirect losses put at BZ\$15.65 (US\$7.88) million. The crop subsector was severely impacted, accounting for 95.7% of total damage, with the livestock subsector the remaining 4.3%.

The social sector suffered a total effect of BZ\$8.5 million. The largest portion of the effect could be attributed to damage which amounted to BZ\$6.0 million or 70.3%, with losses accounting for the balance BZ\$2.5 million or 29.7%.

The subsector within the social sector which accounted for the largest proportion of the total effect was damage and losses to the housing subsector, which amounted to BZ\$7.5 million or 88% of the total effect. The health subsector followed with an effect of BZ\$0.9 million, the majority of which could be attributed to losses incurred by the health subsector in the additional services which were provided to safeguard the health of the population. The small sums attributed to damage in either the subsector of health or education, which stood at BZ\$0.06 million, could be attributed to the location and quality of the structures which accommodated these institutions. In most cases, these institutions were well set back from rivers and were built on high ground. In addition, the nature of the event reduced the threat to the structures.

Recommendations

In order to meet the challenges to development posed by events such as TD16 and the previous hurricanes and storms, the report recommended that policy makers begin to incorporate risk management measures into their long term development planning. Such measures include mitigation of conditions of existing risk and introducing measures to prevent its reoccurrence. The primary objective must be to reduce impacts of flooding in the future. By taking such

disaster risk reduction measures, policy makers can identify and encourage measures that address adaptation to climate change at one and the same time.

It is within the context of the above that the report made a number of strategic and short- to medium-term recommendations for consideration.

In regard to strategic recommendations, the report viewed as important actions for the risk management processes of government to:

- Raise awareness among the poor regarding their capacity to mitigate effects of disaster through more effective risk reduction actions at the community level;
- Encourage a debt for risk reduction and disaster mitigation swap with international development partners;
- Develop and implement an agricultural insurance scheme for Belize involving the feasibility of parametric products;

Among the short-to medium-term recommendations, the following were highlighted:

- Training should be provided for the informal construction sector to reduce the risk in informal home construction;
- Allocation of an appropriate budget for the maintenance clearing/cleaning of drains and budget for the maintenance dredging of critical river mouths in order to reduce the incident of flooding;
- Incentives and disincentives should be provided to households living in flood plains to encourage construction of homes on stilts. The modality of elevating existing houses as done in the Calla Creek should be considered; and
- Encourage standards for human waste disposal, through the introduction of new solid waste management systems for houses in the flood plains.

The evaluators based on the frequency of national events which impact Belize strongly recommended that a study which combines the impact of a series of events on the macro economic and social indicators of the country might provide a useful picture of the development challenges which face Belize.

The positive lessons learned by the negative impact of previous hurricanes were twofold. One was the sound building practices observed in newly constructed government buildings which were well set back from rivers and were built on high ground, particularly schools, health centres and most shelters. The second was in the response of the Ministry of Health to the disaster which averted a health crisis among the population.

Both signal good risk management practices which can form the foundation of an integrated Disaster Risk Management Plan.

I. BACKGROUND

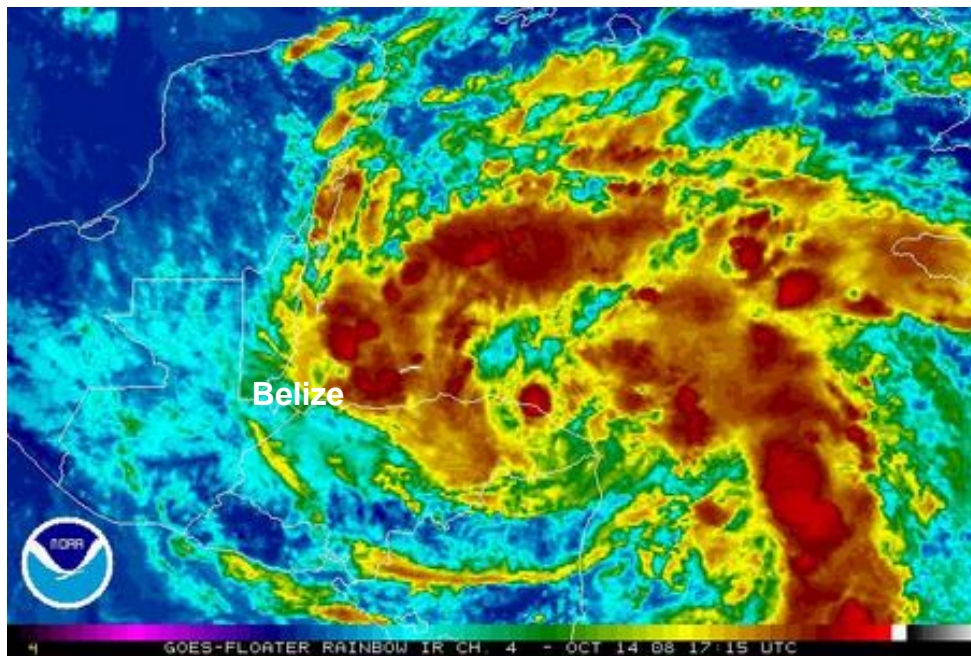
A. Description of the event

1. Evolution and decay of Tropical Depression 16

A strong area of atmospheric disturbance off the coast of Nicaragua on the 13 October 2008 evolved into Tropical Depression 16 (TD16) of the 2008 season. At 6:00 p.m. on 14 October 2008 the centre of the disturbance was located near latitude 16.2° N and longitude 83.5° W, or about 278 miles south-east of Half Moon Caye (318 miles south-east of Dangriga). At that point, the system was moving towards the north-west at a forward speed of near to 6 mph. The minimum central pressure at the time was 1003 millibars and maximum sustained winds were near 30 mph (45 km/hr) with higher gusts occurring.

TD16 was forecasted to produce total rainfall amounts of between four to eight inches over northeastern Nicaragua, northern Honduras, Belize, Guatemala, and the Yucatan Peninsula, with maximum amounts reaching 15 inches. As a result, the Government of Belize issued a tropical storm watch that extended from Belize City southward to the Guatemala Border.

Map 1: TD16 Approaching Belize – October 14

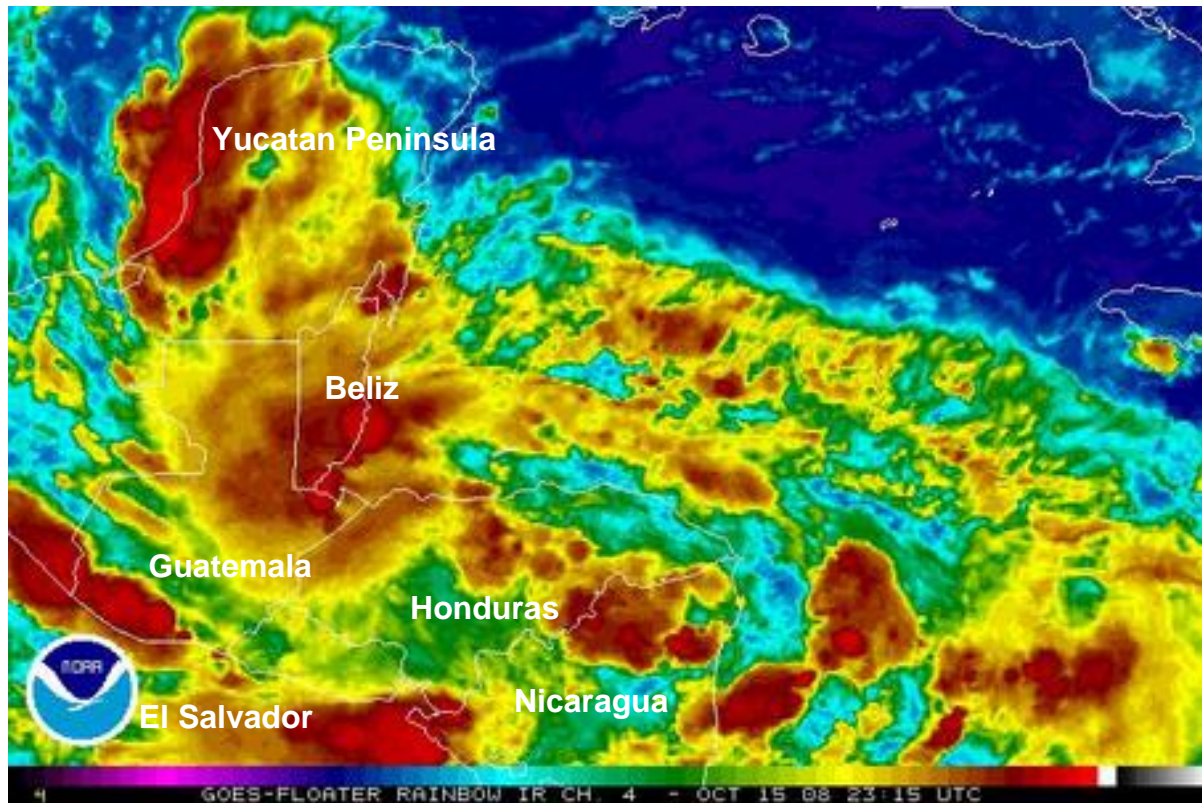


Source: (http://www.nola.com/hurricane/index.ssf/tropical_depression_16/)

By 6:00 a.m. on Wednesday 15 October 2008, the centre of TD16 became poorly organized while just off the coast of Honduras. Its estimated minimum central pressure had risen to 1006 millibars (or 29.71 inches of mercury), indicating that the system had become more disorganized. Nevertheless, at 9:00 a.m. the Government of Belize replaced the tropical storm watch for southern Belize with a tropical storm warning for the entire coast of Belize. At 9:00

p.m. the poorly-defined center of TD16 moved inland over northeastern Honduras and was located near latitude 15.3°N longitude 85.9°W, or 185 miles east-south-east of Monkey River Village.

Map 2: TD16 Approaching Belize – October 15



Source: http://www.nola.com/hurricane/index.ssf/tropical_depression_16/

By 6:00 p.m. 16 October 2008, the remnant system of TD16 meandered over southern Belize and eastern Guatemala. This remnant low produced widespread and extensive showers in the central areas of Belize and eastern sections of Guatemala. On 17 October 2008, showers were mainly over the southern and coastal portions of Belize. By 18-19 October 2008, showers shifted from the coastal regions to inland areas and a large cyclonic pattern developed over the north-western Caribbean, Belize, Yucatan, Honduras, Guatemala and El Salvador. An area of disorganized showers and thunderstorm activity associated with a low pressure system called Invest 91-L drifted westward over the Gulf of Honduras on Tuesday 21 October 2008, and produced outbreaks of moderate showers embedded with thunderstorms over northern, inland and central Belize. Following as it did immediately on the heels of TD16, this activity produced widespread flooding throughout Belize, with the worst affected areas being:

- (a) Cayo – Calla Creek; Bullet Tree Falls; Santa Familia; Succotz; Roaring Creek;
- (b) Spanish Lookout; Benque Viejo; and San Ignacio;
- (c) Stann Creek – Dangriga; Hope Creek Village; Mullins River; and Sittee River;

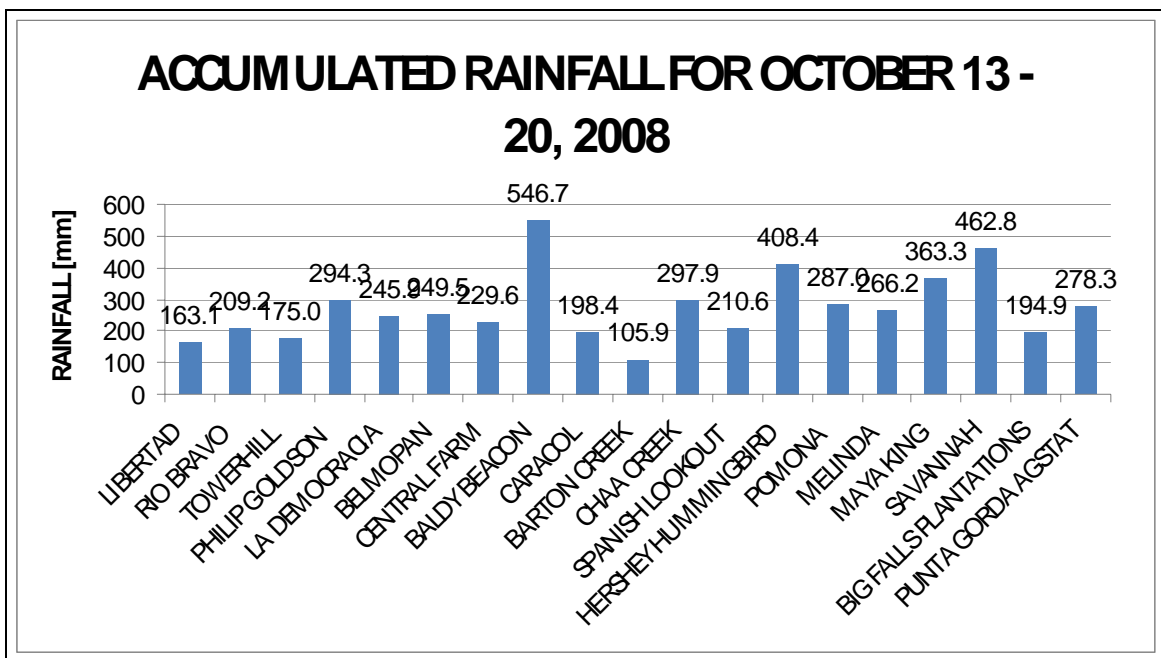
- (d) Toledo – Jordan Village;
- (e) Belize; and
- (f) Orange Walk.

2. Rainfall associated with TD16

The passage of TD16 and the subsequent low pressure system (Invest 91-L) that affected Belize, occurred during 13-20 October 2008. Resulting from these systems, the three largest accumulations of total rainfall in Belize were recorded at Baldy Beacon (in the upper reaches of the Macal Branch of the Belize River watershed), Savannah (in the minor Big Creek coastal watershed) and Hershey (in the upper reaches of the Sibun River watershed). Figure 1 shows measured amounts of rainfall in mm for a number of recording stations.

At the Baldy Beacon, Caracol, Hershey Hummingbird, Maya King, Savannah and Punta Gorda stations, the daily maximum rainfall totals were exceeded. The first two stations are located in the Belize River watershed, the third is within the Sibun River watershed, the fourth in the Big Creek watershed, the fifth in the Mango Creek watershed and the sixth in the Moho River watershed.

Figure 1: Accumulated rainfall for TD16 - 13-20 October 2008



Source: ECLAC based on official data.

The Belmopan, Central Farm, Savannah, Philip Goldson, La Democracia, Hershey Hummingbird, Maya King, Chaa Creek and Spanish Lookout rainfall stations exceeded their normal monthly values during the period 13 – 20 October 2008.

3. Flood levels associated with TD16

The runoff resulting from rainfall generated by TD16 and Invest 91-L resulted in flood events across the entire country. For the first time since the installation of the Macal River Upstream Storage Facility at Chalillo, the Macal River rose to levels similar to those of floods previous to the installation of the facility. For example, reservoir levels rose 3.61 metres above the Chalillo spillway and 2.89 metres above the Mollejon Spillway.

As a result of the overflows from these two spillways, and also due to contributions from the other tributaries that enter the main river below these facilities, the Macal River level at San Ignacio rose 5.99 metres above the low level bridge crossing. This level exceeded the Hurricane Mitch extreme level, but not the Hurricane Keith extreme level. River levels near Benque Viejo on the Mopan Branch of the Belize River, which were fed by runoff from rainfall in the eastern Guatemalan portion of its watershed, rose more than 3.21 metres above the mean Mopan River level, thereby causing unprecedented flooding within this branch of the Belize River.

As the flood waters travelled down the Belize River, they inundated the farmlands on the river banks. Near the Iguana Creek Bridge, the elevation of the flood water was approximately 9 metres above the low level bridge. The natural reservoirs in the central Belize River Valley were therefore filled to capacity. Levels in the Crooked Tree Lagoon rose 2.02 meters above the level of the causeway and exceeded both the Mitch and Keith levels for this water body by 2.34 metres and 2.24 metres, respectively. In the lower Belize River near Double Run, by the Belize Water Services Treatment Plant, river levels rose 3.79 metres above mean, therefore exceeding the Hurricane Mitch, but not the Hurricane Keith, extreme river levels.

On the Sibun River, water levels near Gracie Rock resulted in overflowing of the banks, and near Freetown the water levels rose 1.88 metres above the mean. In spite of this, the levels for this event did not exceed the Mitch nor Keith levels. It is of interest to note that flood levels at Kendal on the Sittee River caused the washout of the causeway there twice.

The Mullins River Causeway was washed out and the Southern Lagoon (Manatee Lagoon) rose 0.31 metres above the mean lagoon level. Runoff from the rainfall from these weather systems also caused flooding in the Rio Hondo and New River watersheds.

4. Emergency actions

NEMO coordinates the relief and recovery operations in the aftermath of a disaster. The government responded rapidly to TD16. The Search and Rescue Committee of NEMO sprung into action to evacuate persons in vulnerable areas and to prevent the loss of lives. A number of relief distribution posts were set up to assist those in need. A number of affected persons were provided with gas stoves, butane tanks, mattresses and other household items to replace lost items. The Ministry of Health provided medical teams and supplies to the tune of \$153,000. The Ministry of Agriculture and fisheries distributed seeds, fertilizers with the assistance of Taiwan ROC, the Food and Agriculture Organization of the United Nations (FAO) and other

agencies in the amount of \$155,544. The government has further assisted affected households in restarting production and rebuilding their lives.

II. AFFECTED POPULATION

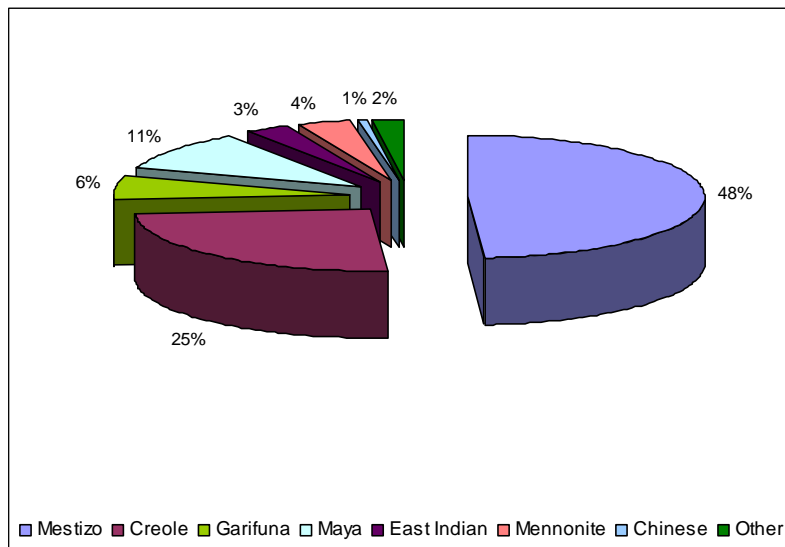
TD16 and its accompanying difficult weather systems affected the population of Belize from 16 to 21 October 2008, creating much hardship and disruption of livelihoods.

The death of four individuals was directly attributed to this event.³ In its wake, approximately 60 communities (cities, town and villages) were impacted with over 10,000 persons, or 3.2% of the national population having been severely affected. Many of the severely affected had to be provided with shelter, food and basic household goods. An estimated population of 125,000 persons was impacted, and among the hardest hit communities many had to be relocated from their homes into government and private shelters. The average displacement of individuals was two weeks.

At the mid-year estimates of population conducted by the Statistical Institute of Belize, the population was estimated at 311,480 with 51% living in the urban areas and 49% residing in the rural areas. As is often the case in events which cause disasters, not all persons are equally affected. In the case of Belize and TD16, 86% of those who were impacted by the disaster could be found living in the rural areas of country, with the remaining 14%, living in the urban environment.

The population of Belize is multi ethnic and multi cultural. The Population and Housing Census 2000, identified Mestizo, Creole, Garifuna, Maya, East Indians, Mennonites, Chinese, and other ethnic groups who comprised the Belize population. Figure 2 provides an illustration of the distribution of the various ethnicities within the Belizean population.

Figure 2: Ethnic Distribution of the population of Belize, 2000



Source: ECLAC based on official data.

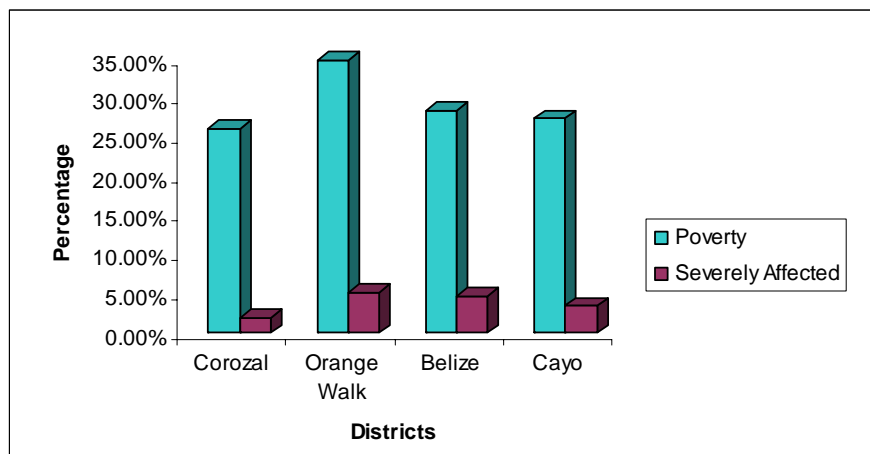
³ Two additional bodies were recovered from flood waters, but investigation suggested that they had been washed into Belize from neighbouring countries.

It is often in plural societies, such as Belize, that the population may be distributed geographically along ethnic lines. In Belize, Mestizos are concentrated predominantly in the Northern Corozal and Orange Walk and Western Central Cayo Districts; whilst the Creoles can be found mainly in the Belize (East Central) District; the Garifuna in the Stann Creek District; and the Maya and East Indians in the Toledo Districts. The Mennonites reside mainly in the Cayo and Belize. The geographical distribution suggests that certain groups may have been more affected by TD16 more than others because of their place of residence.

Poverty, as a dimension of social vulnerability, often acts as a key marker for those who would be harshly affected in the event of a natural disaster. Two reasons for this might be the precarious nature of housing conditions in which the poor reside; the limited resources which they have at their disposal to withstand the ill effects of a catastrophic event, and the limited access to resources to build back following the event.

In the case of Belize, where 33.5% of the population is defined as poor and 10.8% indigent, it was not surprising that of the four districts which were severely affected by TD16, Orange Walk, with a proportion of the poor population that is just slightly above the national average at 34.9%, was the district with the largest proportion of the affected population, as illustrated by figure 3. This District is also home to many of the Mestizo population of Belize.

Figure 3: Proportion of the population poor and severely affected by TD16 by affected districts



Source: ECLAC based on official Government data

Table 1 presents the details of those persons defined as severely affected by TD16, which amounted to 10,374 persons or 3.2% of the national population. When compared to Hurricane Keith in 2000 which had severely affected 23% of the national population and Hurricane Dean in 2007, during which 12% of the national population had been severely affected, TD16 may seem slight. Its significance, however, lies in the fact that this event affected two distinct groups of the population; (a) persons living in rural areas, many of whom were agriculturalists and subsistence farmers, and were without resources for risk transfer; and (b) poor marginalized persons who could be found in the urban setting of Belama, in Belize City. Both these groups were ill

equipped and had insufficient resources to hold them over in the wake of such extensive flooding over this long period.

Table 1: Belize: Affected population by District

	Estimated population at the time of TD16			% of population by district	Severely Affected in the aftermath of TD16	% of population affected
	Total	Male	Female			
Country Total	322100	160900	161200	100.0%	10,374	3.2%
Urban	165700	80900	84800	51.4%	1403	0.8%
Rural	156400	80000	76400	48.6%	8882	5.7%
District						
Corozal	36800	18300	18500	11.4%	694	1.9%
Urban	9300	4400	4900			
Rural	27500	13900	13600		694	
Orange walk	48300	24600	23700	15.0%	2528	5.2%
Urban	16,300	8100	8200			
Rural	32000	16500	15500		2528	
Belize	96600	47500	49100	30.0%	4550	4.7%
Urban	76800	37500	39300		1260	
Rural	19800	10000	9800		3290	
Cayo	77000	38400	38600	23.9%	2,602	3.4%
Urban	45900	22500	23400		143	
Rural	31100	15900	15200		2370	
Stann Creek	33300	17100	16200	10.3%		
Urban	12000	5800	6200			
Rural	21300	11300	10,000			
Toledo	30100	15000	15500	9.3%		
Urban	5400	2600	2800			
Rural	24700	12400	12300			

Notes: Estimated population at time of TD16 based on mid-year estimates 2008, SIB;
Source: ECLAC estimates based on official Government data

A. Key social dimensions of disasters

1. Vulnerability of women and children

The Standard Measurement of Living Conditions Survey (SMLS) conducted in 2002 reported that 39% of children 0-17 years were living in poverty. Such a situation meant that two out of every five children did not have their basic food and non-food needs met. The report concluded that such a situation had serious implications for mal-nutrition, school absenteeism and dropout and child labour in its worst forms. The report also noted that the proportion of rural children who went to school and also worked was twice as high as that of urban children.

When a situation such as this is exacerbated by disasters which disrupt the livelihoods of poor rural families, and female-headed households, the vulnerability of the children increases. Teachers who were interviewed as part of the assessment raised concern about the food security of the children who came to school following the disaster. Many pointed to the difficulties facing the children when the food aid had ended. There were reports of children generously sharing their meager lunch meal with others in class who had nothing to eat. This is important as the Living Standards Measurement Survey (LSMS) 2002 indicated that the majority (72.2%) of students had their school meals from home. If the home is unable to provide meals then a significant proportion of children could be threatened with hunger.

In Belize, 26.8% of households are headed by females and male-headed households accounted for the majority, or 73.2% of households. Female headed households (FHH) could be found more often in the urban environment causing the LSMS to describe FHH as an urban phenomenon in Belize. The report also indicated that a larger proportion of children living with a single parent were found to be living with their mother than with their father (21% compared to 1.8%). Data across the Caribbean suggests that the burden of care of poor female heads of households is greater than that of their male counterparts as they often have similar or greater demands to be met with fewer resources. The Belama community which was severely affected by TD16 is a prime example of such an urban community.

Box 1: Gender issues relevant to women and their families

- (a) Female headed households (FHH) comprise 35.5% of heads of households in Cayman. FHH traditionally have an increased burden of care than their male counterparts due to their inability to earn similar incomes and the necessity to meet similar needs with fewer resources;
- (b) Women also suffer from greater time poverty – their productive and reproductive roles leave them with little time for personal development and participation in governance and decision making around issues of recovery and reconstruction; and
- (c) Women and children are at risk of violence as the toll of the effects of natural disasters exacerbates the household conditions of poverty which can lead to domestic violence, alcoholism and breakdown in family structures.

Source: ECLAC based on official government data.

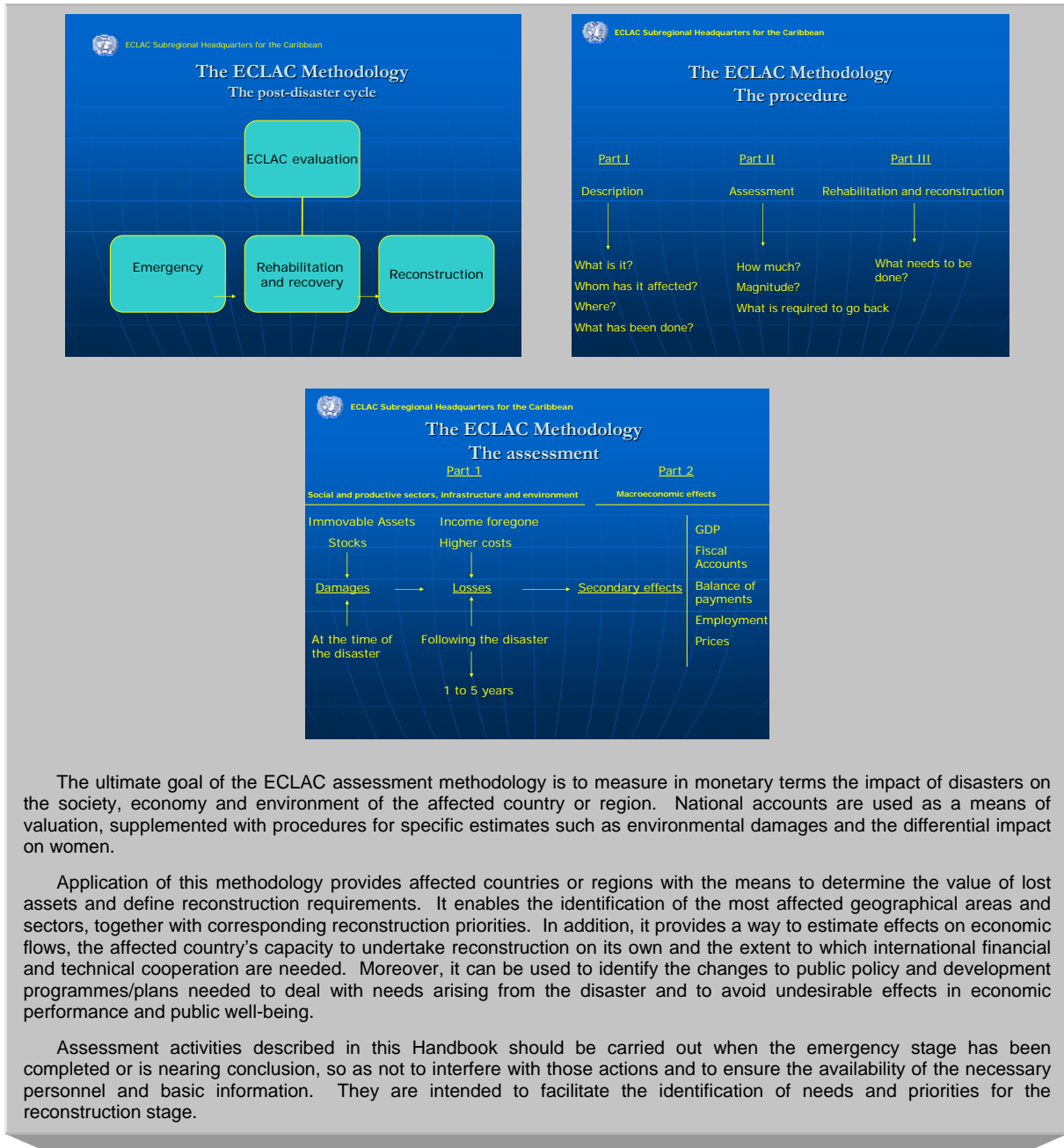
Women in rural Belize fit the typical description of small women food producers in Latin America and the Caribbean, who make a significant contribution to rural economies and the social and economic well-being of their families but whose contribution is either unremunerated or unrecorded. An example of such lack of recognition was captured in the words of a male farmer in the District of Cayo, who when asked if his wife worked, responded flatly “no”. He then, when prodded, went on to say “she does help a little with the harvesting, cleaning, packing and going to market”.

The effects on the well-being of women and their families who have suffered the ill effects of TD16 is likely to be dependent on the rapidity with which small and subsistence farmers are able to bring their livelihoods back to a state of normalcy. This is even more so as

agricultural workers were reported to be the group of workers most likely to be poor (47%) compared to those in other occupations. As well, it is dependent on the extent to which poor FHH in urban areas are provided with the necessary social protection to meet their families' needs in the aftermath of the disaster.

III. DESCRIPTION OF DAMAGE AND LOSSES BY SECTOR

Box 2: Damage assessment: The ECLAC Methodology



Source: ECLAC Handbook for estimating the socio-economic and environmental effects of disasters; diagrams: ECLAC Subregional Headquarters for the Caribbean.

A. Productive sector

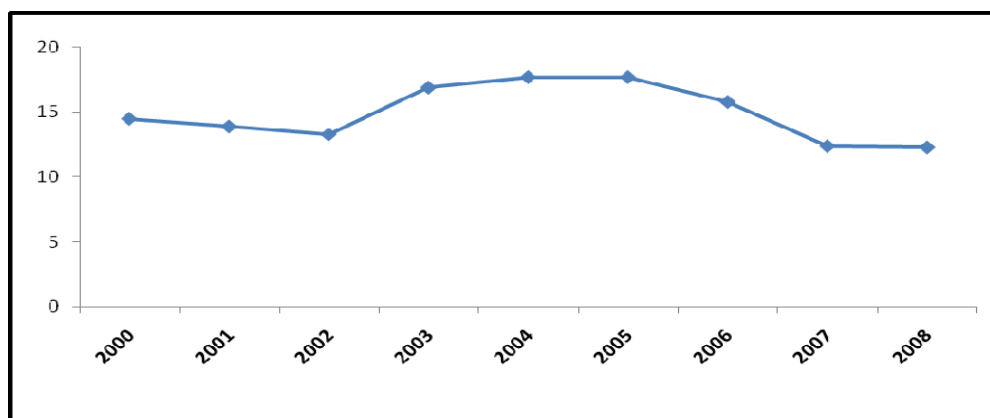
1. Agriculture

(a) Overview

The agricultural sector, including fisheries, is the dominant sector in the economy of Belize and plays an important role in the country's socio-economic development. This significant and multifunctional role is demonstrated by the sector's contribution to economic growth (GDP), food security, the generation of employment and the earnings/savings of foreign exchange. This is in light of the fact that the rural communities in Belize are largely agrarian in nature with a high dependence on agriculture for employment, income, food, energy (charcoal) and medicine.

The performance of the sector over the last nine years (2000-2008) may be characterized as fluctuating, albeit with a downward tendency over the last three years. In 2000, for instance, the sector accounted for 14.5% of total GDP compared to a high of 17.7% in both 2004 and 2005, and 12.3% in 2008. Agriculture's contribution to GDP for the period 2000 to 2008 is presented in figure 4. The decline experienced in the sector's contribution between 2001 and 2002 is attributed mainly to the declines in the crop subsector and, to a lesser extent, the fisheries subsector, linked to natural disaster, erosion of the preferential treatment for bananas in the European market and inherent structural and institutional constraints affecting crop production in the country. The significant decline in the sector's contribution to GDP that occurred between 2006 and 2008 was mainly as a result of Hurricane Dean which impacted Belize as a Category 5 hurricane in August 2006.

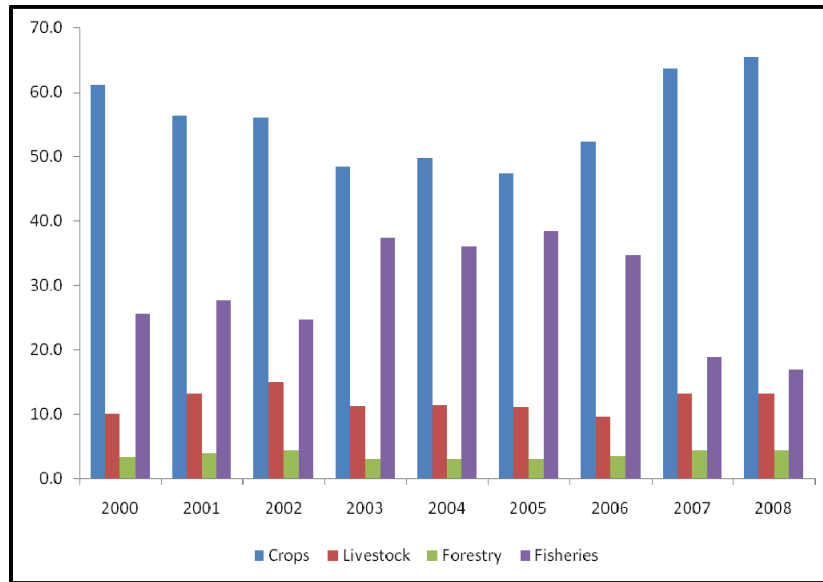
Figure 4: Agriculture contribution to GDP (2000 - 2008), 2000 constant prices



Source: ECLAC estimates based on official GoB data.

The contribution of the various subsectors to total agricultural GDP is presented in figure 5. The figure not only demonstrates the relative importance of the crop subsector to agriculture in Belize but also the significant increase in the contribution of the fisheries subsector to agriculture over the period 2003 through to 2006.

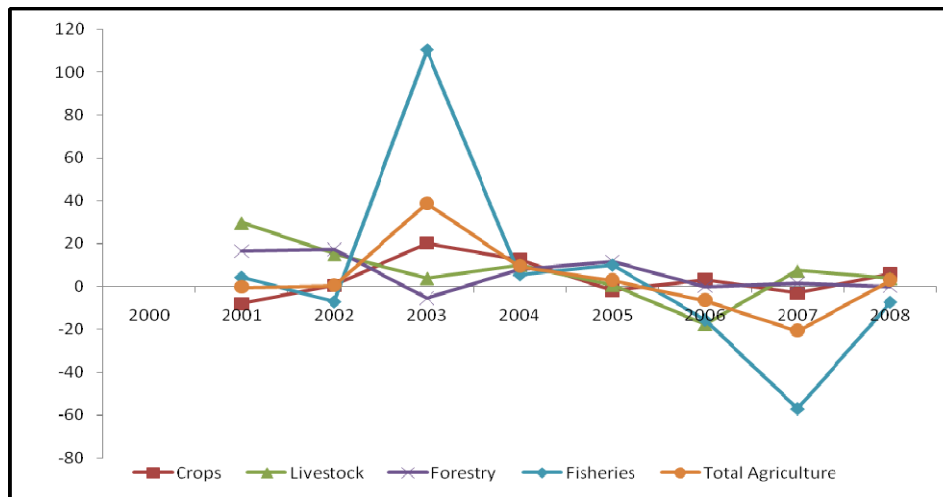
Figure 5: Contribution of agricultural subsector to total GDP (2000 – 2008)



Source: ECLAC estimates based on official Government of Belize data.

The graph in figure 6 presents the growth rate of the agricultural sector as well as those growth rates of the various subsectors of agriculture for the period under review. The figure shows that there was real growth of the agricultural sector (including fishing) in every year, with the exception of 2001, 2006 and 2007 when value-added by the sector declined by 0.4%, 6.4% and 20.7%, respectively. The good performance achieved by the sector during the 2003 to 2005 period was the result of significant expansion in the fisheries subsector (144.3%) which, in 2005, accounted for 38.5% of total agricultural GDP, compared to 24.7% in 2002. However, the fisheries subsector contribution to total agricultural GDP declined to a level of 18.9% in 2007 and 17.0% in 2008.

Figure 6: Agriculture and subsectoral growth rates, 2000-2008



Source: ECLAC estimates based on official Government of Belize data.

The crop subsector grew by 28.6% in real terms between 2000 and 2008. Despite the erosion of the preferential treatment of the sugar and banana industries in the European market, the Government of Belize has adopted the stance of most producers of those commodities in the Caribbean Community (CARICOM) region and reaffirmed its position that both industries were of extreme importance in the economy and the welfare of rural communities. As such, the industries continued to be seen as critical in the economic development process of Belize. Accordingly, the Ministry of Agriculture and Fisheries and the other stakeholders within the industries continued to implement measures to enhance the viability and sustainability of these industries.

Positive results from Belize's agricultural diversification programme are reflected in significant increases in the production and exports of selected non-traditional agri-food products such as pepper sauce, fresh oranges, black-eyed peas, red kidney beans and papayas over the period under review.

The country is relatively self-sufficient in staple food products such as corn, rice, beans, bananas, plantains, root crops and fruits. Some vegetables such as tomatoes, lettuce, broccoli, carrots, celery and cabbage are generally produced seasonally as a result of a primarily rain-fed production system and limited research for the identification of adaptable varieties. Therefore, there are periods of importations to accommodate shortfalls of supply on the local market.

The livestock subsector grew by 56.5% over the period under review; from BZ\$24.6 million contribution to GDP in 2000 to BZ\$38.5 million in 2008. However, the subsector's relative contribution to total agricultural GDP fluctuated over the period under review, from a high of 15.0% in 2002 to a low of 9.7% in 2006. The country is relatively self-sufficient in poultry, eggs, pork and beef.

The forestry subsector fluctuated slightly over the period under review with a strong upward tendency and but recorded an overall growth of 58.2%.

The fisheries subsector has demonstrated significantly strong growth between 2003 and 2005, but started to decline in 2006, with the decline becoming quite significant in 2007, when the subsector's real contribution to GDP was BZ\$53.5 million, compared to BZ\$147.2 million in 2005. There was a further 7.3% decline in the subsector's contribution to GDP in 2008, when it recorded BZ\$49.6 million. Belize is self-sufficient in seafood.

The significant decline in the fisheries subsector between 2006 and 2008 can be partly attributed to Hurricane Dean which impacted Belize in August of 2006. The marine ecosystem in northern Belize and particularly in the Bacalar Chico, Hol Chan and Caye Chaulker Marine reserves were heavily damaged as a result of the high winds and strong current and wave action associated with the hurricane. This ecosystem serves an extremely important ecological role in many life stages of multiple marine species such as feeding, nursery, spawning and refuge areas for many commercial and non-commercially important marine species. These badly damaged ecosystems are inhabited by important near-shore populations of Spiny lobster, *Panulirus argus* and Queen conch, *Strombus gigas*, which are the two most important marine species in Belize. The ecosystems are also occupied by various finfish species such as groupers, snappers and jacks.

The economic loss associated with this to this natural ecological disaster is estimated in millions of dollars.

The volume of export of agricultural commodities for the period 2001 through 2007 shows some fluctuations with a tendency towards an increase. Over the period under review, the export volume of citrus concentrates increased by 34.3% between 2001 and 2006, but declined by 28.8% in 2007. The volume of export of the other major commodities (sugar, bananas, papayas and marine products) increased by 16.5% over the same period, with a high export volume of 229.73 tonnes recorded in 2004, compared with a low of 155.97 tonnes in 2001. Belize's export basket of agricultural goods by volume for the period 2001 through 2007 is presented in table 2.

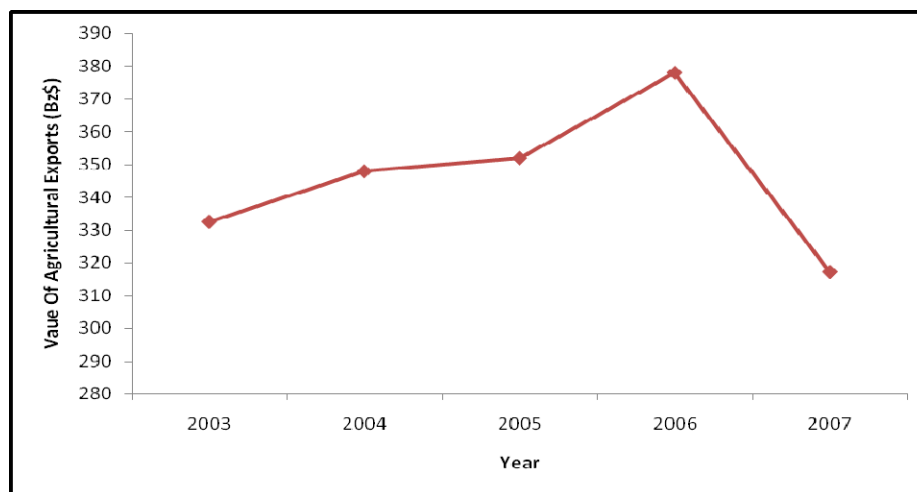
Table 2: Volume of major domestic agricultural exports (tonnes)

Item	2001	2002	2003	2004	2005	2006	2007
1 Sugar	95.51	104.94	100.15	113.93	89.55	97.85	84.10
2 Banana	50.14	41.83	73.02	82.15	76.41	70.97	61.40
3 Papayas	6.25	11.10	16.57	25.22	28.63	34.47	33.10
4 Marine Products	4.07	3.28	7.74	8.43	9.25	7.98	3.10
Sub-Total (tonnes)	155.97	161.15	197.48	229.73	203.84	211.27	181.70
5 Orange Concentrates (gallons)	4.90	3.62	4.92	6.24	8.41	6.42	n/a
6 Grapefruit Concentrate (gallons)	0.81	0.73	0.77	1.89	1.25	1.25	n/a
Sub-Total: Concentrates (gallons)	5.71	4.35	5.69	8.13	9.66	7.67	5.46

Source: ECLAC estimates based on official GoB data.

Similar to the situation regarding the volume of agricultural exports, the value of exports over the period 1997 through 2006 registered a significant increase of approximately BZ\$45.92 million (13.9%) with total domestic exports of major agricultural commodities moving from BZ\$330.76 million in 1997 to BZ\$376.68 million in 2006 (figure 7).

Figure 7: Value of agricultural exports (BZ\$) – 2003 – 2007

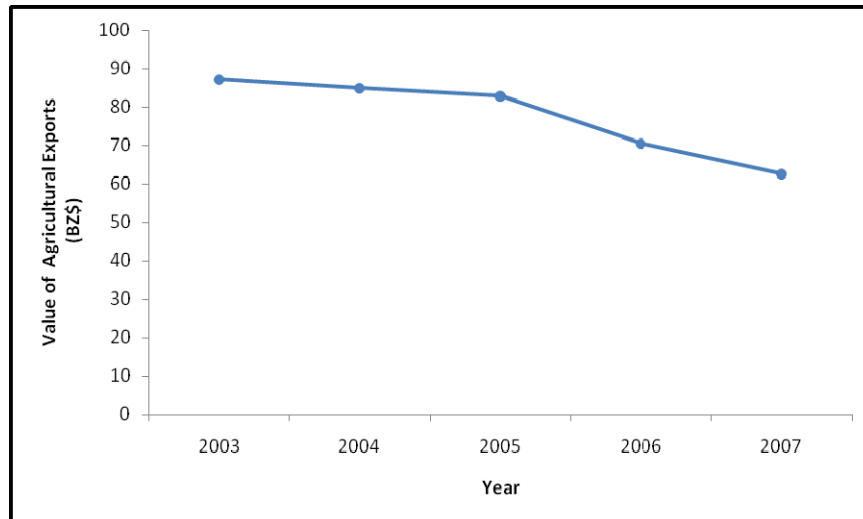


Source: ECLAC estimates based on official Government of Belize data.

The most significant contributors to this increase in exports were sugar, papayas and marine products.

Figure 8 presents the contribution of agricultural exports to total domestic exports. The figure demonstrates clearly that the agricultural sector is a major contributor to export earnings in Belize.

Figure 8: Agricultural export as percentage of total export, 2003-2007



Source: ECLAC estimates based on official Government of Belize data.

Although the agricultural sector has traditionally relied on the exports of a narrow range of commodities (citrus, sugar, bananas and marine products) through preferential arrangements to markets in the United States, United Kingdom and CARICOM, the continuing trend in the erosion of these preferential markets as a result of World Trade Organization (WTO) regulations, now forces Belize's agriculture to become more competitive and diversified. Noteworthy has been the strategic decision to remain in sugar production and to make the necessary adjustments within the industry to improve its competitiveness and efficiency in response to reforms in the European Union (EU) sugar policy. Simultaneously, the other traditional commodities of citrus and banana are also implementing programmes for improving productivity as part of their strategy to become more competitive in the global market.

2. Climate

The climate of Belize is characterized by pronounced rainy and dry seasons; annual precipitation averages about 55 inches (1,400 mm). The dry season begins in mid-January and ends in mid-May. During this period, monthly rainfall averages less than two inches (50 mm). Drought is a frequent phenomenon that limits the yield of cultivated crops.

During the rainy season, many of the soils having poor natural drainage are saturated to the surface for long periods and require drainage for production of most cultivated crops.

Planning cropping systems to make best use of the poorly drained soils during rainy season and the thin, well-drained soils during the dry season presents important challenges to farmers of the area.

Temperatures vary from a mean monthly minimum of 63.5°F during January and February of 73.5°F during April and September. Maximum temperatures range from a mean monthly of 84°F during December and January to 92.2°F in May to September. The low minimum temperature during December to February promotes sugar accumulation (ripening).

3. Description, analysis and estimation of damage

(a) Overview

Tropical Depression 16, which threatened Honduras, Guatemala and Belize made landfall in northern Honduras on Thursday 16 October 2008. The remnants of TD16 caused widespread rainfall across Belize which resulted in life threatening floods in communities along the Mopan, Macal and upper Belize rivers. Over a period of approximately five days these waters moved down to the lower Belize River Watershed, resulting in the flooding of those communities which straddles the banks of the Belize River.

The national disaster zone expanded as rains in Mexico resulted in the swelling of the Rio Hondo and New Rivers in the northern districts of Corozal and Orange Walk.

The Cayo, Belize, Corozal and Orange Walk Districts (communities associated with the Belize and New Rivers, and the Rio Hondo Watersheds) as well as the Stann Creek Districts were the most severely affected areas and suffered extensive damage to economic assets and infrastructure, with significant implications for livelihoods. Marginalized rural poor, including women and children living in impacted areas have been most severely impacted among national constituents. Estimates suggest approximately 125,000 persons were impacted.

The agricultural sector in the affected areas suffered heavy impacts, particularly in the industrialized papaya industry in Orange Walk District, the mechanized corn production in the Corozal, Orange Walk and eastern Cayo Districts, the rice industry in Orange Walk District, the banana industry in Stann Creek District, the sugar industry in the Corozal and Orange Walk Districts and subsistence/cash crop farming in Cayo and the Belize Districts. Pasture in the Cayo, Belize and Orange Walk Districts were severely degraded and there were losses in livestock in those areas.

The analysis of the impact of TD16 on the agricultural sector was conducted utilizing the ECLAC macroeconomic methodology for estimating socio-economic and environmental effects of disasters in general and, in particular, the methodological framework related to “Estimating the Effects of Disasters on the Agriculture Sector”. Within this context, the damage to the sector was categorized under two broad headings, direct damage and indirect damage/loss.

In assessing damage of the sector, only damage to assets and stocks at the time of the event was considered. The damages were, therefore, identified under four broad headings:

- (a) Damage to farmlands;
- (b) Damage to physical infrastructure and to machinery and equipment;
- (c) Damage/loss of crops that were ready to be harvested; and
- (d) Damage/loss of stock (livestock, inputs, harvested products, etc).

In assessing the direct damage, only production ready to be harvested at the time of the hurricane was taken into consideration. However, for affected annual crops that were still growing at the onset of the hurricane, losses were based on investment in labour and input.

In the case of stocks, when total losses occurred, damages were estimated at farm gate prices and inputs at replacement value. Assessments for partial loss and damage were effected on a prorated basis.

Damages caused by TD16 with negative impacts on production and income throughout the recovery period were estimated as indirect damages/losses. In addition, the costs involved in mitigating the impact of the hurricane in order to build back better were included as indirect damage/loss.

Table 3 provides a summary of the direct damage, indirect damage/loss and total impact of TD16 to the major crop industries and the livestock subsector. On-farm infrastructural damages to the crop and livestock subsectors are included in subsector damage estimates. Damages to farm roads are not included in the estimates for the agricultural sector as they are captured and addressed under damage to infrastructure. Very little damage was reported for the fisheries subsector.

Total damage to the agricultural sector, as presented in Table 4, is estimated at BZ\$28.23 (US\$14.17) million, of which direct damage is estimated at BZ\$12.58 (US\$6.29) million and indirect losses put at BZ\$15.65 (US\$7.88) million. The crop subsector was severely impacted, accounting for 95.7% of total damage, with the livestock subsector the remaining 4.3%.

With respect to the crop subsector, the corn industry was severely impacted, accounting for 32.5% of total damage to the agricultural sector, followed by the rice industry (16.2%), vegetables (13.8%), banana (12.3%), the sugar industry (11.9%) and plantains (0.1%) and the total of other crops in terms of severity of damage.

**Table 3: Summary of total damage/losses of the agricultural sector
(BZ \$)**

Subsector/industry	Damage	Losses	Total Damage/Loss
Corn	5,543,230	3,643,996	9,187,226
Rice	977,340	3,608,118	4,585,458
Vegetables	1,943,190	1,958,803	3,901,993
Papaya	948,000	1,516,200	2,464,200
Plantain	15,000	25,500	40,500
Banana	1,832,884	1,649,595	3,482,479
Sugar cane	540,027	2,767,415	3,357,442
Livestock	728,420	485,983	1,214,403
Total	12,578,091	15,655,610	28,233,701

Source: ECLAC based on official data.

Table 4 presents the damage to the agricultural sector by district. Most of the damage was recorded in the Orange Walk District, which accounted for 37.8% of total damage to the sector, followed by Cayo (28.2%), Corozal (14.0), Stann Creek (12.8%, Belize District (5.1%) and Toledo (2.0%). and the Belize district (0.8%).

**Table 4: Summary of total damage/losses by affected district
(BZ \$)**

Subsector/industry	Damage	Losses	Total damage/loss
Cayo	4,768,915	3,199,098	7,968,013
Corozal	1,343,357	2,602,443	3,945,800
Orange walk	3,428,880	7,248,776	10,677,656
Belize	935,150	516,670	1,451,820
Stann creek	1,918,459	1,706,561	3,625,020
Toledo	183,330	382,062	565,392
Total	12,578,091	15,655,610	28,233,701

Source: ECLAC based on official data.

4. The crop subsector

(a) Overview

The crop subsector is the major subsector within the agricultural sector and in 2006 contributed 8.2% and 51.9% of total GDP and agricultural GDP, respectively.

The area under production for selected crops in acres is presented in table 5, while the corresponding level of annual production is presented in table 6. The tables show significant increases in both the acreages and level of production of papayas, black beans and bananas, with significant reductions in both coefficients being recorded for cassava, coco yams, corn and plantains.

Table 5: Area under selected crop production, Belize (acres)

Crops	2000	2001	2002	2003	2004	2005	2006	2007
1. Sugar Cane	57,322	57,322	59,500	61,000	62,100	58,090	60,000	65,000
2. Papaya	481	497	780	608	1,044	1,352	1,430	
3. Bananas	4,663	5,181	4,784	6,161	5,708	6,035	6,089	
4. Plantains	1,798	2,007	1,852	1,551	1,797	999	1,048	
5. Pineapple	435	375	490	271	410	341	188	
6. Citrus	-	-	35,230	36,369	36,369	38,000	38,458	
7. Corn	35,019	30,168	35,335	31,567	31,416	29,291	26,003	
8. Black Beans	2,413	1,337	4,475	3,476	2,548	3,518	3,475	
9. Red Kidney Beans	13,266	17,056	11,582	11,799	11,429	10,027	9,100	
10. Cow Peas	5,143	5,993	6,933	4,798	5,898	5,091	5,320	
11. Cocoyam	290	327	307	223	155	131	103	
12. Cassava	203	285	626	205	176	44	43	

Source: ECLAC estimates based on official Government of Belize data.

Table 6: Annual production for selected crops, Belize

Crops	2000	2001	2002	2003	2004	2005	2006	2007
1.1 Sugar Cane (short tons)	1,089,128	1,011,214	1,150,656	1,073,247	1,149,475	929,392	1,173,468	1,239,000
1.2 Sugar (short term)	120,275	103,862	111,313	103,583	116,577	100,435	11,394	97,000
2. Papaya	12,648,699	12,321,122	24,219,340	31,824,010	61,109,421	62,705,272	73,368,900	
3. Bananas (000 Boxes)	3,625,615	3,072,567	2,600,109	4,351,359	4,767,598	4,769,053	4,879,781	3,417,000
4. Plantains	1,626,227	1,158,189	879,770	611,420	813,135	416,650	770,634	-
5. Pineapple	4,853,600	4,472,000	4,208,727	3,655,287	4,759,880	4,963,188	3,162,150	-
6. Citrus	6,619,438	7,191,904	5,353,536	5,326,747	6,705,378	8,770,967	6,913,551	6,727,000
7. Corn (000 lbs)	69,933,362	80,986,720	73,610,658	78,474,112	67,150,300	76,376,425	62,606,816	84,467,000
8. Black Beans (000lbs)	2,018,000	1,240,000	3,283,920	2,581,640	2,179,656	2,955,850	2,932,800	-
9. Red Kidney Beans (000 lbs)	9,501,267	12,796,125	4,939,496	9,667,940	6,629,920	7,621,550	5,680,700	6,255,000
10. Cow Peas (000 lbs)	6,298,925	7,198,492	8,225,356	6,902,400	5,951,000	5,049,000	4,907,100	-
11. Cocoyam (000 lbs)	2,023,720	2,841,770	1,882,225	1,034,737	581,160	618,880	576,438	-
12. Cassava (000 lbs)	2,000,600	3,557,400	12,686,800	2,706,130	2,624,350	396,600	527,645	-

Source: ECLAC estimates based on official Government of Belize data.

The crop subsector was heavily impacted by TD16, with total damage estimated at BZ\$27.02 million. The damage is estimated at BZ\$11.85 million and the losses put at BZ\$15.17 million. The corn industry was the sector most severely impacted followed by rice, vegetables, banana sugar and papaya (table 7).

Table 7: Total damage to the crop subsector in Belize (BZ \$)

Subsector/industry	Damage	Losses	Total Damage/Loss
Corn	5,543,230	3,643,996	9,187,226
Rice	977,340	3,608,118	4,585,458
Vegetables	1,943,190	1,958,803	3,901,993
Papaya	948,000	1,516,200	2,464,200
Plantain	15,000	25,500	40,500
Banana	1,832,884	1,649,595	3,482,479
Sugar cane	540,027	2,767,415	3,357,442
Total	11,849,671	15,169,627	27,019,298

Source: ECLAC based on official data.

Tables 8 through 13 present the impact of TD16 on the crop subsector on a district basis. Crop damages were greatest in the Orange Walk District, which accounted for 38.8% of the total crop losses valued at BZ\$ 10,483,623 (table 8). The most severely impacted areas in the Orange Walk District were San Estevan, San Roman, Douglas, San Lazaro, Progreso, San Antonio, Pettville, New Hope, and Blue Creek. The District suffered significant losses in the rice, papaya, sugar cane, and corn industries.

The Cayo District accounted for 26.6% of total crop losses which is valued at BZ\$7,188,138 (table 9). The main affected areas were More Tomorrow, Young Gal, Valley of Peace, Cotton Tree, Bullet Tree, and Calla Creek. The District suffered significant losses in the mechanized corn and vegetables industries.

The Corozal District accounted for 14.5% of total losses valued at BZ\$3,928,165 (table 10). The most severely impacted areas were Patchakan, Louisville, Caledonia, San Narciso, and San Victor.

Total damage to the Stann Creek District is estimated at BZ\$3,625,020, accounting for 13.4% of total crop losses (table 11). The banana industry in the Maya King area was the main crop impacted.

Damage to the crop subsector in the Belize District area is estimated at BZ\$1,228,960, accounting for 4.6% of total crop losses (table 12). Small farmers' vegetables were severely affected. The Lemonal, Burrell Boom, Crooked Tree, Spanish Creek, rancho, and Isabella Bank areas were most severely impacted.

Crop damage in the Toledo District may be characterized as minimal (BZ\$565,392), accounting for 2.1% of total crop losses (table 13). Rice and corn were the crops mainly impacted.

**Table 8: Total damage to the crop subsector in Orange Walk district
(BZ \$)**

Crop	Estimated Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Papaya	40	832,000	1,331,200	2,163,200
Corn (White)	12	8,820	10,585	19,405
Corn (Yellow)	1,000	735,000	882,000	1,617,000
VEGETABLES				
• Tomatoes	6	180,000	60,000	240,000
• Sweet pepper	5	200,000	25,000	225,000
• Water- melon	3	36,000	12,000	48,000
• Cantaloupe	2	18,000	6,000	24,000
• Cabbage	8	96,000	40,000	136,000
Others	6	132,500	35,750	168,250
Subtotal Vegetables	30	662,500	178,750	841,250
Plantain	6	15,000	25,500	40,500
Rice	2,000	840,000	3,240,000	4,080,000
Sugar cane	3,520	228,570	1,493,698	1,722,268
TOTAL	5,608	3,321,890	7,161,733	10,483,623

Source: ECLAC based on official data.

**Table 9: Total damage to the crop subsector in Cayo
(BZ \$)**

Crop	Estimated Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Corn - Mechanized	4845	3,561,075	1,594,005	5,155,080
Corn - Milpa	500	250,000	150,000	400,000
Vegetables	58	460,000	1,150,000	1,610,000
Rice	9	11,340	11,718	23,058
Total	5412	4,282,415	2,905,723	7,188,138

Source: ECLAC based on official data.

**Table 10: Total damage to the crop subsector in Corozol
(BZ \$)**

Crop	Estimated Acreage Under Production	Estimated Acreage Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Papaya	1,169	5.5	116,000	185,000	301,000
Corn (white)	8,000	12.0	8,820	10,585	19,405
Corn (Yellow)	6,000	1,000.0	735,000	882,000	1,617,000
Vegetables					
• Tomatoes	9	8.6	34,400	86,000	120,400
• Sweet pepper	4.6	4.6	18,400	46,000	64,400
• Melon	23.8	23.8	47,600	119,000	166,600
• Cucumber	4.3	4.3	8,600	21,500	30,100
• Others	25.3	16.6	24,900	62,250	87,150
Subtotal Vegetables	67.0	57.9	133,900	248,750	382,650
Sugar cane	32,000	3,060	342,857	1,265,253	1,608,110
Total	47,236	4,135.4	1,336,577	2,591,588	3,928,165

Source: ECLAC based on official data.

**Table 11: Total damage to the crop subsector in the Stann Creek district
(BZ \$)**

Crop	Estimated Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Corn	71	52,185	23,359	75,544
Banana	225	1,832,884	1,649,595	3,482,479
Vegetables	25.5	14,790	25,143	39,933
Sugar cane	24	18,600	8,464	27,064
Total	534.5	1,918,459	1,706,561	3,625,020

Source: ECLAC based on official data.

**Table 12: Total damage to the crop subsector in Belize district
(BZ \$)**

Crop	Estimated Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Corn	200	135,000	65,800	200,800
Vegetables	100	672,000	356,160	1,028,160
Total	300	807,000	421,960	1,228,960

**Table 13: Total damage to the crop subsector in the Toledo district
(BZ \$)**

CROP	Estimated Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Corn	78	57,330	25,662	82,992
Rice	300	126,000	356,400	482,400
Total	378	183,330	382,062	565,392

Source: ECLAC based on official data.

5. Grain industry

Grain and pulses such as corn, beans and rice are major staple foods for the people of Belize. Sorghum and soybean as well as corn and rice (in the form of rice bran) are used for livestock feed. Soybean is also used in shrimp farming.

Belize is self-sufficient in corn and rice. The Mennonite communities produce about 95% of the grain in the country. The major producing districts are Corozol, Orange Walk, and Cayo.

Corn is produced for human and animal consumption mainly at the domestic level. The main commercial producing districts are Corozol, Orange Walk and Cayo, where the system of production is highly mechanized. In the Toledo District the milpa system in production dominates and the output is used mainly for home consumption. Corn production in Belize in 2007 was estimated at 84.5 million lbs and was obtained from approximately 39,000 acres.

Historically, rice is an important industry in Belize and contributes significantly to the economy of the country. It is a primary source of income for a large number of families in rural communities and a major staple food. Data available from the Ministry of Agriculture and Fisheries reveal that in 2007 approximately 39.2 million lbs of paddy rice were from approximately 13,000 acres harvested. The Orange Walk District accounted for 80% of the production. The Toledo District is second with 11%, while the Cayo, Stann Creek and Belize Districts accounted for the remaining 9%.

Total damage to grain industry from TD16 is estimated at BZ\$13,772,684 or approximately 48.8% of total damage to the agricultural sector. Of this total damage to the grain industry, damage is estimated at BZ\$6,520,570 (47.3%) and losses estimated at BZ\$7,252,114 (52.7%).

Total damage to the corn industry is estimated at BZ\$9,187,226, with damage estimated at BZ\$5,543,230 (60.3%) and losses put at BZ\$3,643,996 (39.7%) (table 14). Most of the damage to the corn industry occurred in the Cayo District, which accounted for 60.5% of the total damage to that industry, followed by Corozal and Orange Walk Districts (17.9% each). Minimal damages were recorded in the Belize, Toledo and Stann Creek Districts.

Approximately 7,718 acres of corn were impacted, of which 5,345 acres (69.3% of total corn area impacted) were located in the Cayo District and 1,012 acres (13.1%) located in each of the Corozal and Orange Walk Districts. TD16 impacted the corn industry at a production stage of harvesting or close to harvesting. Most of the damage to the corn industry in the aftermath of TD16 occurred as a result of the producers' inability to harvest the corn because of flooded fields, with reported flooding lasting for a period of two to four weeks. After the flooding subsided, most farmers abandoned their fields, as it was uneconomical to harvest at the time.

**Table 14: Total damage to the corn industry
(BZ\$)**

District	Acreage Impacted (Acres)	Damage	Losses	Total Estimated Damage
Cayo	5,345	3,811,075	1,744,005	5,555,080
Corozal	1,012	743,820	892,585	1,636,405
Orange walk	1,012	743,820	892,585	1,636,405
Belize	200	135,000	65,800	200,800
Stann creek	71	52,185	23,359	75,544
Toledo	78	57,330	25,622	82,992
Total	7,718	5,543,230	3,643,996	9,187,226

Source: ECLAC based on official data.

Total damage to the rice industry is estimated at BZ\$4,585,458, with damage estimated at BZ\$977,340 (21.3%) and losses put at BZ\$3,608,118 (78.7%). As presented in table 15, the Orange Walk District was the area mostly affected, accounting for 89.0% of the total damage to the rice industry, followed by the Toledo District (10.5%).

Approximately 2,309 acres of rice were affected, of which 2,000 acres (86.6%) were located in mainly the Blue Creek area of Orange Walk District, and 300 acres located in the

Toledo District. An estimated 450 acres of rice fields were completely destroyed, while partial losses were reported for the remaining acreages.

**Table 15: Total damage to the rice industry
(BZ\$)**

District	Acreage Impacted (Acres)	Damage	Losses	Total Estimated Damage
Cayo	9	11,340	11,718	23,048
Orange walk	2,000	840,000	3,240,000	4,080,000
Toledo	300	126,000	356,400	482,400
Total	2,309	977,340	3,608,118	4,585,458

Source: ECLAC based on official data.

6. The sugar industry

Sugar production continues to be a major economic activity in Belize and has made and continues to make a significant contribution to the agricultural sector, national income and export earnings. Latest disaggregated data shows that in 2005, sugar output accounted for 9.4% of the value of total agricultural output and averaged almost 4.5% of total GDP in the last five years. The total revenue generated in the last five years (2003 – 2007) by the sugar sector averaged some BZ\$88.16 million (US\$44.08 million) per annum. Although sugar revenues declined over the past five years, its contribution to overall economic activity remains very significant.

The sugar industry is the largest industry in the agricultural sector and Belize's single-most important export product. Its contribution to total export earnings averaged about 18.2% for the last five years but with a downward tendency and was down to 17.3% in the last year (2007). Part of this negative growth can be explained by a declining and cyclical domestic production of cane and sugar (see table 16).

**Table 16: Sugar industry statistics, 1998/99 to 2007/08
(Long tons)**

Year	Acres Harvest-Ed	Sugar Cane Product-Ion (000)	Sugar Product-Ion (000)	Molasses Product-Ion (000gallons)	Cane/Acre	Cane/Sugar
1998/99	57,000	1163	116	41	20.4	10.0
1999/00	57,330	1089	120	36	19.0	9.1
2000/01	57,330	1011	104	34	17.6	9.7
2001/02	59,500	1151	111	41	19.3	10.4
2002/03	57,330	1073	103	42	18.7	10.5
2003/04	61,000	1149	117	41	18.8	9.9
2004/05	62,130	929	100	37	15.0	9.3
2005/06	58,090	1174	111	41	20.2	10.6
2006/07	60,000	1239	97	47	20.6	12.7
2007/08	65,000	980	78	40	15.1	12.5

Source: ECLAC based on official data.

Sugarcane and sugar production is concentrated in the two northern districts of Orange Walk and Corozal in the country. The socio-economic importance of the sugar industry is well

established and its income distributional impacts are relatively more widespread in northern Belize. The industry provides employment to approximately 13.7% of the working population and accounts for almost half of all the agricultural labor force, concentrated largely in the northern districts. In 2004, total direct employment was estimated at 4,860 persons, alongside 8,500 registered cane farmers. Furthermore, approximately 2,000 more people are directly involved in various other activities related to the industry. Taking into account the number of farmers and their family dependants and related activities, approximately 40,000 people rely on the sugar industry - which approximates the entire population of Orange Walk and Corozal Districts and almost 28% of the country's population in 2004. Given the industry's importance to the economy (in addition to the country's social and political life), any rapid decline of sugar production would create significant increases in the incidence of poverty, especially as sugarcane production is primarily small-farmer based and plays a significant role in providing income and mitigating poverty.

Sugarcane is grown on approximately 60,000 acres and the industry produces up to 1.2 million tons of cane, yielding between 78,000 and 120,000 tons of sugar, depending on the effect of uncertain weather patterns on cane quality in any year.

Total damage to the sugar cane industry is estimated at BZ\$3,357,442, accounting for 11.9% of total agricultural sector damage. Of the total sugar industry damage, BZ\$540,027 (17.6%) was estimated as damage and the losses put at BZ\$2,767,415 (82.4). Most of the damages were concentrated in the Orange Walk (51.3%) and Corozal Districts (47.9%). Damage to sugar cane production in the Stann Creek District was small (BZ\$27,064) and minimal in its contribution to total damage to the industry (0.8%). A total of 6,634 acres of sugar cane lands were affected.

An estimated 3,550 acres of sugar cane were impacted in the Orange Walk District. The District Sugar Growers Association branches and areas, as well as the estimated acreage affected are presented in table 17. Most of the areas affected are located along the banks of the New River and Rio Hondo River and the savannahs. Of the total acreage affected, 120 acres were completely lost due to flooding from TD16. Reduced yields as well as reduction in the quality of the cane are some of main indirect losses.

Table 17: Sugar cane areas impacted by TD16 in Orange Walk District

Branch	Area	Estimated Acres Affected
Yo Creek	Santa Cruz	150
	San Antonio	50
	Yo Creek	100
Total		300
San Roman	San Roman	300
	Total	300
Douglas	Douglas	300
	San Pablo	300
	Total	600
San Jose	San Jose	150
	Total	150
Guinea Grass	Guinea Grass	150
	Total	150
San Lazaro	San Felipe	100
	August pine Ridge	150
	Trinidad	50
	San Lazaro	150
	Total	450
Orange Walk	Santa Martha	100
	San Lorenzo	100
	Others	100
Total		300
San Estevan	San Estevan	1200
	Total	1200
Progreso	Progreso	50
	Chunox	30
	Copper Bank	20
Total		100
Grand Total		3550

Source: ECLAC based on official data.

An estimated 3,060 acres of sugar cane was impacted in the Corozal District. Table 18 presents the main areas affected in the Corozal District. Approximately 180 acres of sugar cane were totally destroyed in the Corozal District, mainly along the New River and Rio Hondo. Indirect losses were assessed for reduced sugar cane yields and cane quality, the latter of which is expected to impact significantly on the cane to sugar ratio.

Table 18: Sugar Cane Areas Impacted in the Corozal District

Branch	Areas	Estimated Acres Affected
San Victor	San Victor	150
	Buena Vista	50
Total		200
Libertad	Libertad	100
Total		100
Caledonia	Caledonia	400
Total		400
Louisville	Louisville	500
	San Clara/San Roman	50
	Concepcion	50
Total		600
San Narciso	San Narciso	500
Total		500
Patchakan	San Pedro	200
	Christo Rey	200
	Patchakan	300
Total		700
Corozal	Chan Chan	150
	Pariso	200
	Santa Elena	50
Total		400
Xaibe	Ranchito	30
	Xaibe	30
Total		60
San Joaquin	San Joaquin	100
Total		100
Grand Total		3,060

Source: ECLAC based on official data.

7. Other crops

The other crops category, which included vegetables, papaya, plantain and banana suffered substantial damage from TD16, with total impact on this group of crops estimated at BZ\$9,889,172 or 35.0% of total damage to the agriculture sector. Significant damages were recorded for the vegetable industry in the Cayo, Belize and Orange Walk Districts, while the papaya industry in the Corozal and, to a lesser extent, Orange Districts was impacted. Approximately, 225 acres of bananas in the Mayan King area of the Stann District were impacted.

8. The livestock subsector

The livestock subsector in Belize is relatively small contributing only 1.6% to total GDP and 13.2% to agricultural GDP in 2008. The subsector suffered moderate damage as a result of TD16, with damage reported mainly for poultry, pastures, feeding regimes, pigs, sheep and goats and bee hives.

The overall damage to the subsector is put at BZ\$1,214,403 of which BZ\$728,420 represents damage and BZ\$485,983 losses. Details of the damage incurred by the livestock subsector by District are presented in table 19.

**Table 19: Total damage to the livestock subsector by district
(BZ \$)**

ITEM/DISTRICT	Estimated No. of Animals/ Acres Affected	Estimated Damage	Estimated Losses	Total Estimated Damage
Cayo				
• Animals	663	445,000	276,000	721,000
• Pasture	50	16,500	12,375	28,875
• Equipment, fences, etc.	-	25,000	5,000	30,000
Subtotal Cayo	-	486,500	293,375	779,875
Corozal				
• Chicken	10	100	-	100
• Bee hives	47	6,680	10,855	17,535
Subtotal Corozal	-	6,780	10,855	17,635
Orange Walk				
• Pastures	300	99,000	74,250	173,250
• Bee hives	47	7,990	12,793	20,783
Subtotal Orange Walk	-	106,990	87,043	194,033
Belize District				
• Animals	11	9,350	5,610	14,960
• pastures	360	118,800	89,100	207,900
Subtotal Belize District	-	128,150	94,710	222,860
Grand Total	-	728,420	485,983	1,214,403

Source: ECLAC based on official data.

8. Tourism

Tourism comprises activities that cut across a number of sectors. Those activities may be grouped to derive what is loosely called the tourism sector. Tourism, defined as hotels and restaurants, contributes some 4% of GDP. Tourism comprises a number of activities and so spans sectors. It includes hotels, restaurants, water sports, natural sites and other elements of nature in Belize that are of interest to visitors. In addition, the handicraft industry is heavily dependent on tourism and can therefore be included in the broad definition of “the tourism sector”. Tourism is reported to be the major earner of foreign exchange in Belize, outstripping the earning capacity of the agricultural sector. The industry, still in its infancy, is served by several air carriers and aims at the high end of the tourist market. The industry is poised to develop further if greater investment is made into marketing the Belize tourist product. The profile of the typical stay over tourist is that of middle- to older-age tourists with an average length of stay of almost seven days. Tourist accommodation is provided by some 650 hotels and guest houses of varying quality and capacity. In the affected areas of Belize and Cayo primarily, there are at least 55 accommodation units as per the list of the Belize Tourist Board. Some of these units did not submit estimates of damage. Data collection of damage estimates was not exhaustive as some units reported that they had not been visited or polled in the estimation of damage in the preliminary estimate exercise.

The nature of the event produced a damage effect different from that associated with a hurricane. Because of the nature of the flooding and the relatively slow onset of the inundation, much loss of life and property was avoided by the proactivity of the persons and establishments affected in moving equipment and stocks to higher ground in advance of the waters. The nature of the damage was therefore water-determined. This included the cutting off of access to some of the accommodation units and tourist sites, the loss of tourists through cancellations and the loss of revenue earned by tour operators and tourist guides for a period of about two weeks.

Damage estimates are of the order of BZ\$1,169,000. Loss estimates are estimated at some BZ\$2,783,792.

Table 20: TD16 Storm estimates for the flooding disaster recovery to Archaeological Reserves

Archaeological Reserves	Admission Fees lost	Property affected	Costs of repairs to property affected	Access roads damages	Park trail systems	Total
Xunantunich	\$25,000	Hand Cranked Cable Ferry	\$150,000	\$20,000	\$3,000	\$198,000
		Submersible Pump	\$3,000		\$0	\$3,000
Actun Tunichil Muknal	\$13,590	Bridge Access	\$150,000	\$30,000	\$6,000	\$199,590
Barton Creek	\$1,960	Ranger's Quarters	\$5,000	\$50,000	\$5,000	\$61,960
Caracol	\$7,300	Conservation Repairs	\$15,000	\$150,000	\$10,000	\$182,300
No Hoch Ek	\$46,740	Nil	\$0	\$15,000	\$20,000	\$81,740
El Pilar	\$310	Conservation Repairs	\$10,000	\$18,000	\$5,000	\$33,310
Cahal Pech	\$8,492	Conservation Repairs	\$15,000	\$6,000	\$3,000	\$32,492
Altun Ha	\$30,000	Conservation Repairs	\$10,000	\$30,000	\$8,000	\$78,000
Sub-totals	\$133,392		\$358,000	\$319,000	\$60,000	\$870,392

Source: Data provided by Archaeological Institute

The damage to the archaeological sites reflects previous poor maintenance of infrastructure in an area of great importance to the country. A continuous programme of upkeep of infrastructure should be embarked on to mitigate against future similar occurrences. Discussions between the Central Government and the Tourist Board are likely to result in a solution to the present situation. The estimate of total damage has been set at BZ\$870,392, according to calculations made by the National Institute of Cultural Heritage.

The craft industry suffered loss of business as a result of the temporary closure of a number of tourist and archaeological sites. Probing of a number of shops and artisans indicates varying monthly incomes among artisans and shops. A conservative estimate based on extremely sketchy information and the consideration that not all tourist areas were impacted puts the loss figure in the craft industry to BZ\$150,000.

Table 21: Stay over Visitors – 2004 – 2008

Month	2008p	2007	2006	2005	2004
January	23,130	21,534	22,264	22,165	22,166
February	25,803	25,618	24,278	24,734	23,645
March	30,818	31,267	29,415	29,321	26,817
April	21,361	23,595	23,888	20,503	20,320
May	20,209	19,938	19,898	17,999	17,386
June	22,261	22,409	21,572	20,460	18,939
July	22,146	22,710	22,024	20,062	21,734
August	18,655	18,112	18,498	18,335	17,479
September	8,957	11,079	11,626	10,013	10,432
October	11,129	12,292	10,883	12,011	12,167
November	17,170	18,911	18,079	16,711	16,873
December	23,388	23,958	24,883	24,259	22,873
Total	245,026	251,422	247,309	236,573	230,832
Visitor expenditure	608,000,000	591,000,000	506,000,000	349,000,000	346,000,000

Source: Belize Tourism Board

10. Commerce

Commerce typically comprises the distribution sector as well as the crafts and cottage type industries that cater for the population, including services such as insurance and banking. No damage to the latter two services was reported and no statistics concerning those activities were provided. Restaurants that cater for the tourist as well as for the domestic population are, in some countries, included in the tourism “sector”. In Belize there is as yet no consensus on the inclusion of these activities. In the present assessment an attempt is made to measure the effect of the event on the wholesale and retail trade as well as on the crafts industry.

An interruption in the supply of food in the Belize River Valley and Cayo Districts resulted in the closure of the San Ignacio market for one week. Estimates of loss of income to vendors in the San Ignacio Market are of the order of BZ\$150,000. Estimating similar interruption of sales in other markets, a reasonable estimate for loss of food sales would be some BZ\$200,000 in the Belize and Cayo Districts. The loss of market sales in Stann Creek is estimated to be of the order of BZ\$35,000, based on the assumption of similar food demand per capita in the Belize and Cayo. The total estimate for loss of sales of market produce purchased in markets was therefore in the vicinity of BZ\$235,000. The shortfall in supply was not compensated for by imports. Some redistribution from unaffected production areas together with reported price increases of produce in short supply and a substitution of other foodstuffs kept supply and demand in balance.

11. Petroleum sector

The petroleum sector in Belize began in 2005 with the discovery of oil in Spanish Lookout in the Cayo District. The average daily production of crude is of the order of 4500 barrels. Today, some 507 persons are employed in the petroleum sector. Tropical Depression 16

did not bring with it any damage. The well was shut down for eight days from 21 to 28 October 2008. This does not represent a loss in production as the oil remained in the ground. Losses were incurred as a result of the delay in shipping from the port and as a result of demurrage costs that were at the rate of US\$18,000 per day. This represents BZ\$36,000 per day. Over the period of the delay, the loss for this item amounted to BZ\$576,000. Other elements of loss bring the total to BZ\$800,400. The following table represents losses to the petroleum sector as a result of TD16:

Table 22: Losses in the Petroleum Sector (BZ\$)

Losses due to delay in Shipping	576,000
Standby charges incurred as a result of loss in seismic production	70,400
Donations made by BNE Trust – School supplies in Belize River Valley and Cayo	140,000
Supplies of hampers and mattresses to the Cayo District and food supplies to Belize River Valley	14,000
Total	800,400

Source: Data supplied to Evaluation team

Table 23: Tabular Summary of Damages and Losses of the Productive Sector

Productive Sector	Damage	Losses	Total effect
Petroleum			
Shipping delay	\$0	\$576,000	\$576,000
Standby charges	\$0	\$70,400	\$70,400
Donations by BNE Trust	\$0	\$140,000	\$140,000
Supplies of hampers and mattresses	\$0	\$14,000	\$14,000
Sub-total	\$0	\$800,400	\$800,400
Tourism			
Hotel income	\$0	\$800,000	\$800,000
Hotel buildings including furniture, equipment, landscape etc	\$0	\$332,000	\$332,000
Souvenir shops	\$100,000	\$150,000	\$250,000
Hotel restaurant sales	\$0	\$750,000	\$750,000
Archaeological reserves	\$737,000	\$133,392	\$870,392
Sub-total	\$837,000	\$2,165,392	\$3,002,392
Commerce			
Market sales	\$0	\$235,000	\$235,000
Sub-total	\$0	\$235,000	\$235,000
Grand total	\$837,000	\$3,200,792	\$4,037,792

Source: ECLAC based on official data.

B. Infrastructure sector

Under this sector, the impact of TD16 on roads, bridges, telecommunications, public utilities (electricity, water and sanitation) was examined. This was facilitated through an ECLAC mission, which was carried out between 4–12 March 2009. The mission confirmed that within the infrastructure sector, telecommunications and electricity were not affected. There was

some damage observed to the water utility subsector and, by contrast, major damage to roads, culverts and bridges. A more detailed description within each subsector is given in the following text.

1. Water (storage, treatment and supply) and sanitation

A meeting was held with the Management Accountant and with the Operations Manager at Belize Water Service (BWS). It should be noted that BWS was formerly the Water and Sewerage Authority (WASA), however, in 2001 it was privatized. The company carries out water and sewerage treatment at a number of urban areas in Belize.



Stann Creek District - Dangriga
Erosion at Belize Water Services Intake;
Mitigation required: Prevent future erosion

The site investigations and interview confirmed that most damage occurred in Benque Viejo, where a water services intake was destroyed (see photo above and photos on following page). Minor damages occurred to all other systems, and these included excavation of service connections and emergency drainage works.

With regards to the damage sustained in Benque Viejo, the intake pipe (6" main PVC piping) was damaged, and also, the pipe that goes across the river was torn out. This pipe carried between 7.0 and 10.0 million gallons per month, and the demand is estimated to be approximately 6.4 million gallons per month. In addition, the electrical components on one side were blown out and the fencing destroyed.

A summary of the damage sustained throughout the country is given as follows:

(a) The main water treatment plant in Belize City, which pulls water from the Belize River, was flooded. However, no damage occurred and the operations were not affected;

(b) In Orange Walk, water supply is from wells, and no damage was observed from the flooding event;

(c) Water treatment plants are in place at Stann Creek, Benque and Belize City. All other locations make use of wells. As discussed above, damage occurred at Benque and flooding (but no damage) at the Belize City plant;

(d) In Stann Creek (Dangriga), the river bank eroded approximately 10 ft, and from a historical perspective, the erosion has exceeded approximately 50 ft. There is therefore the need to implement some river training works at this location. The intake is on a rafted system, to compensate for the fact that the river levels change so much during the year. In addition, lighting was lost at the intake, and it is estimated that river training/erosion control works will be required along approximately 150 ft of the river bank. The capacity at this location is 15 million gallons per month and the demand is 12 million gallons;

(e) In San Ignacio, there are three wells, however there was a malfunction of the main electrical components of the system and so the wells were unable to function for a while after the event;

(e) In Orange Walk, BWS had to lock off the water supply, due to the fact that a part of the distribution system was being repaired;

(f) In Belize City, the BWS had to institute a water lock-off, because of remedial works being carried out and trenching being completed; and

(g) In Crooked Tree Village, the water system is almost entirely from wells. As a result of TD16, all the old wells were contaminated and NEMO was called on to supply trucked water. The village was isolated for approximately two to three months. The latrine system in the community centre was completely flooded out and it became a major health hazard. A lot of solid waste was generated by the flooding, and was dumped in the back yards of the residents.

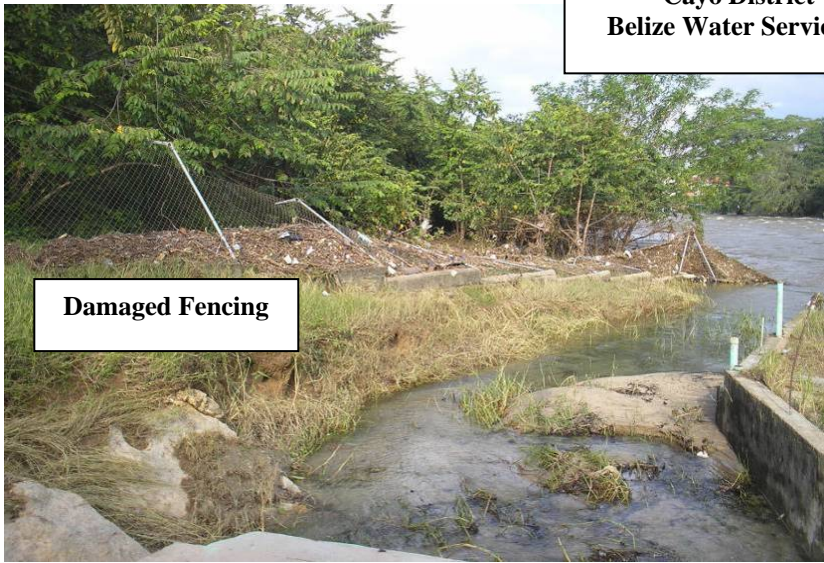


Damaged Suspended Main

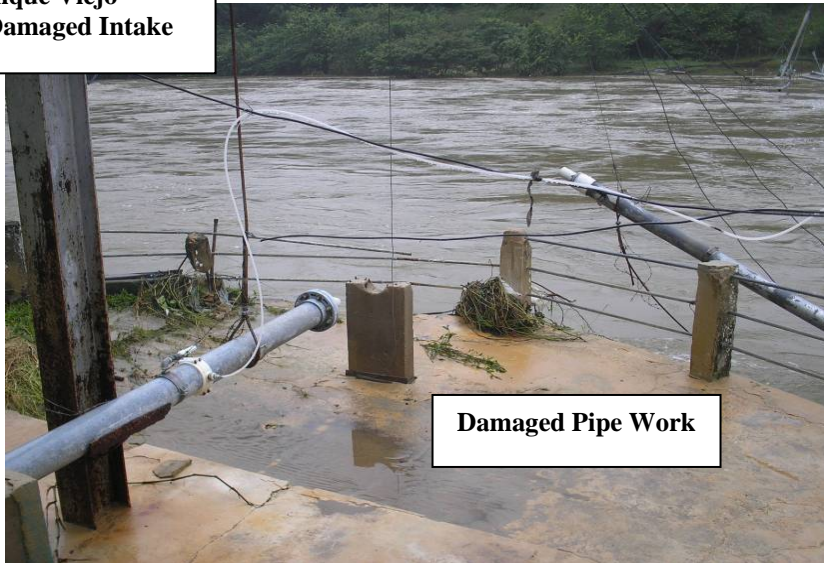


Damaged Electrical Panel

**Cayo District – Benque Viejo
Belize Water Services Damaged Intake**



Damaged Fencing



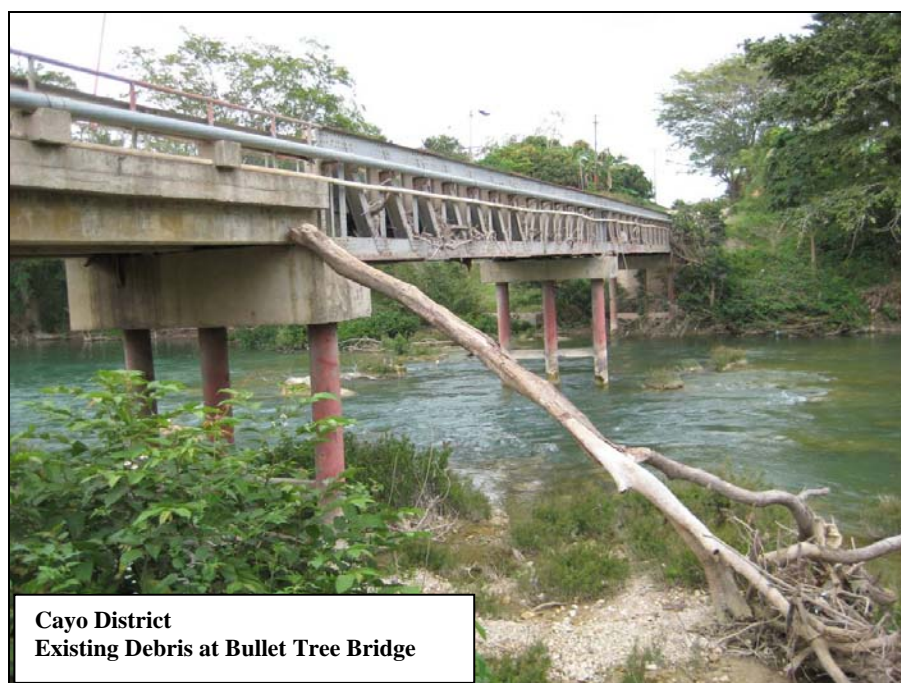
Damaged Pipe Work

A summary of damage and losses for the water and sanitation subsector is provided below.

District	Damages (BZ\$)
Belize	16,667
Cayo	237,640
Orange Walk	16,667
Stann Creek	16,66
Total Damages	287,640
District	Losses (BZ\$)
Belize	23,276
Cayo (San Ignacio/Benque)	30,448
Orange Walk	98,276
Total Losses	152,000

Source: ECLAC based on official data.

2. Transportation - Bridges



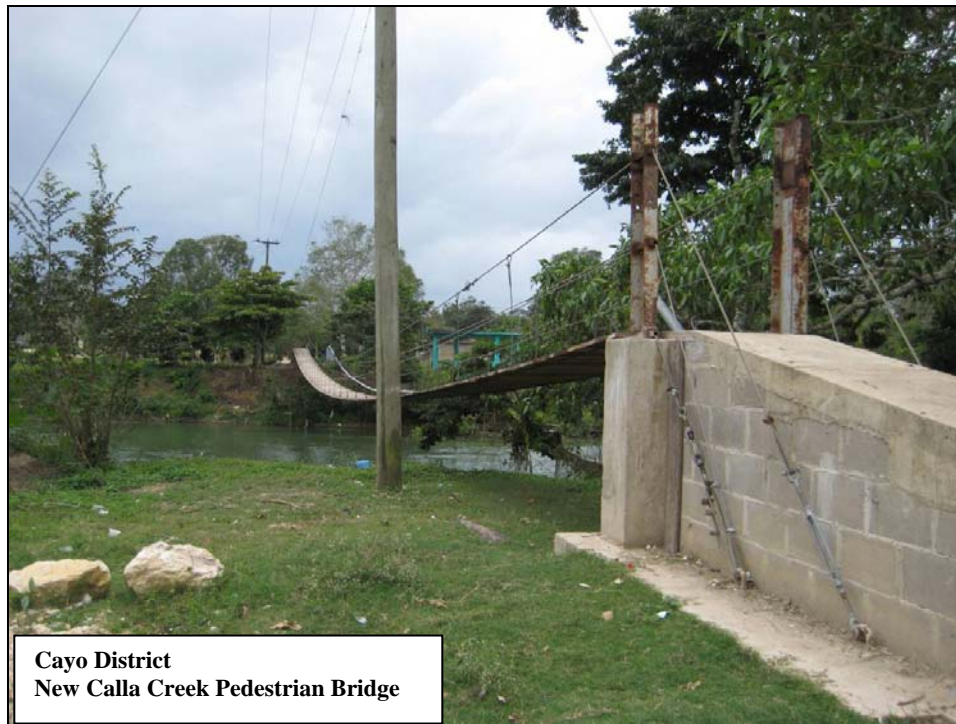
Cayo District
Existing Debris at Bullet Tree Bridge

(a) Cayo District

The town of San Ignacio in Cayo District was down for a one-week period. During that time, the water rose up to the market and the buildings on the road. The market was also closed for a week. At one of the bridges near to the town, water rose to an elevation of +5 – 8 m above bridge decking. For houses in this zone (Bullet Tree Village, see photo below), the watermark on the walls at the time of the ECLAC visit was a vivid reminder of how much flooding had taken place. Water levels remained at an elevated state for almost eight days.

The Calla Creek pedestrian bridge was washed out as a result of the flooding, however this structure was put back up as soon as the water levels receded, so that the children of the area could have access to their school. It was reconstructed to be approximately 0.4m to 0.6m above the level of the previous bridge. A water main across the bridge also had to be replaced, as this was also washed out, however the water treatment plant by the bridge was not damaged. This treatment plant is run by the village council, and not by the BWS.

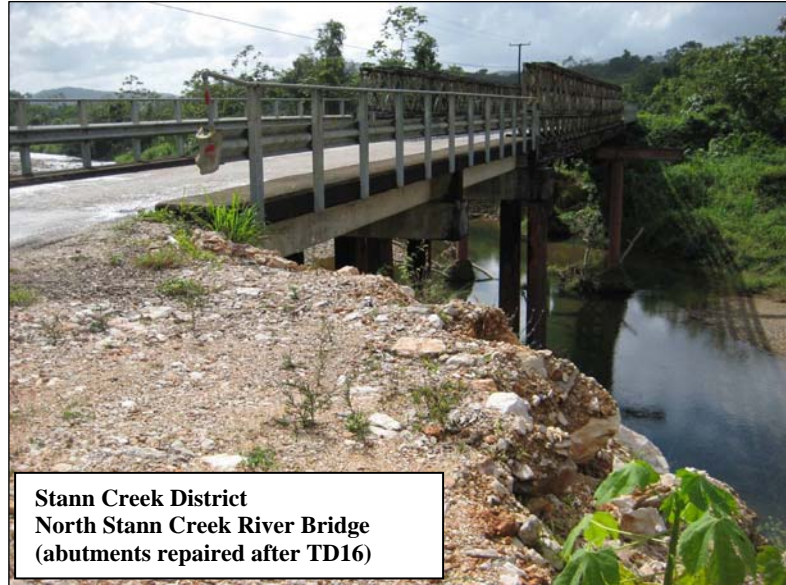
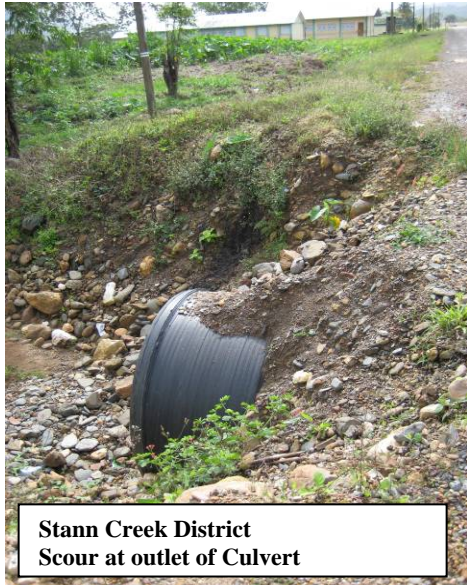
In Calla Creek, there are 52 families, with the majority of this population earning their living from subsistence farming, and excess produce being sold. The residents were housed in shelters for close to one month. It is worthy of note that after the flood event, the government was responsible for putting many or all houses on stilts.



**Cayo District
New Calla Creek Pedestrian Bridge**

(b) Stann Creek District

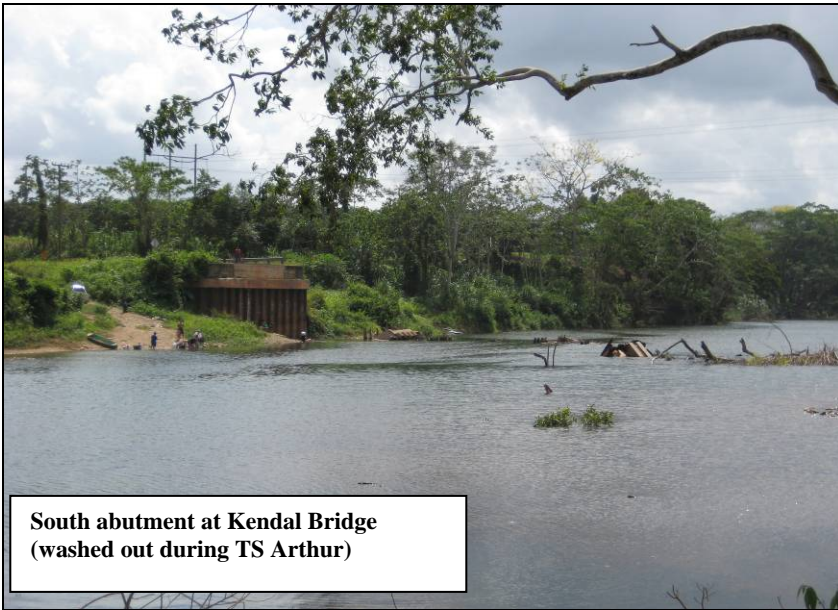
In Middle Six Village, a culvert had been washed out previously from TS Arthur and repaired before the occurrence of TD16. It performed in a satisfactory manner during TD16, however, some scour was experienced in the area of the outfall of the culvert.



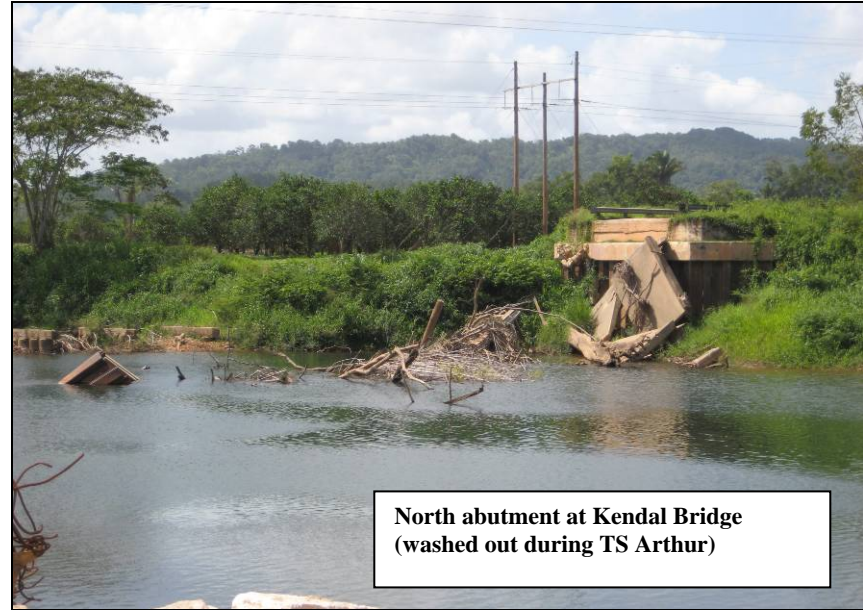
The North Stann Creek River bridge abutments experienced severe erosion during both TS Arthur and TD16. As a result, repairs had to be carried out after each storm. In general, the integrity of the bridge remained intact.

The Kendal Bridge over the City River, was washed away during TS Arthur, with concurrent damage to both north and south abutments. After that storm, a temporary bridge was installed. After TD16, further damages occurred to the abutments of the previously rehabilitated bridge, in which the approaches to the temporary works were washed away during TD16.

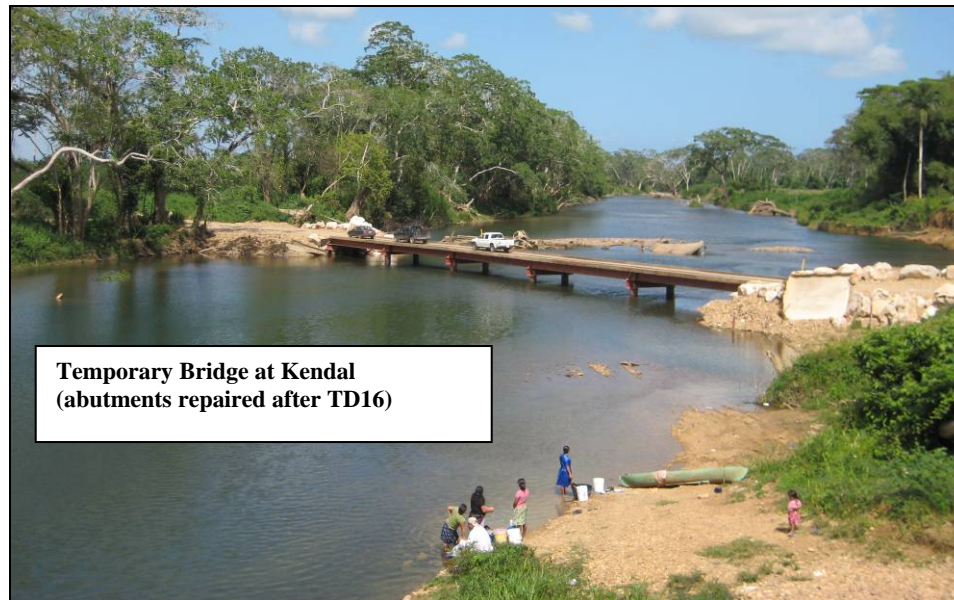
Similar problems occurred at the Mullins River Bridge, which was washed out during TS Arthur. Repairs were made and a temporary bridge installed. However there was further damage to the abutments during TD16. This necessitated further repairs to the abutments.



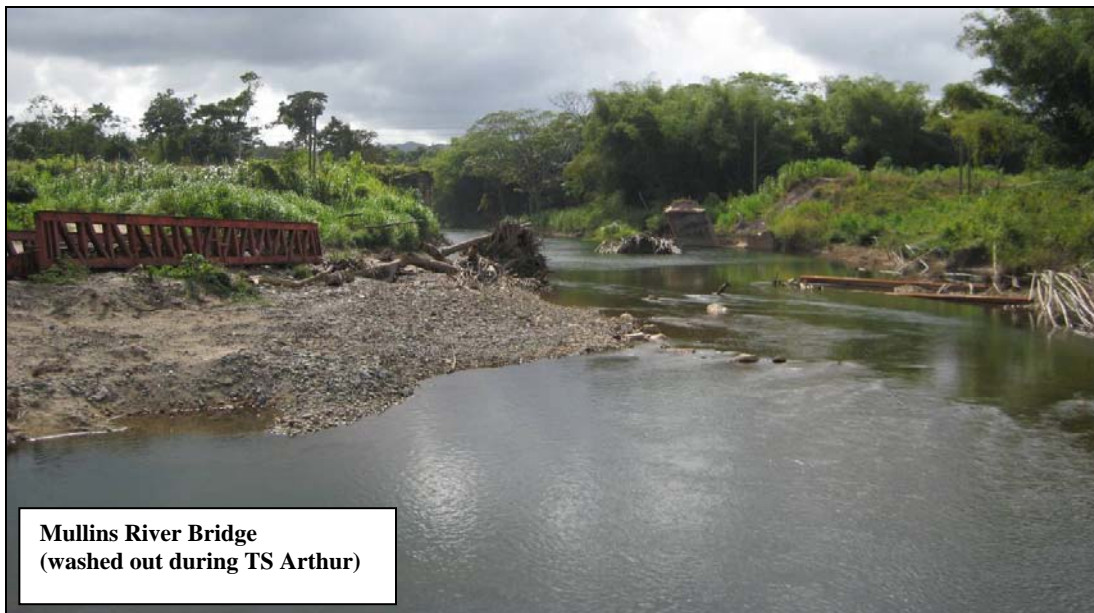
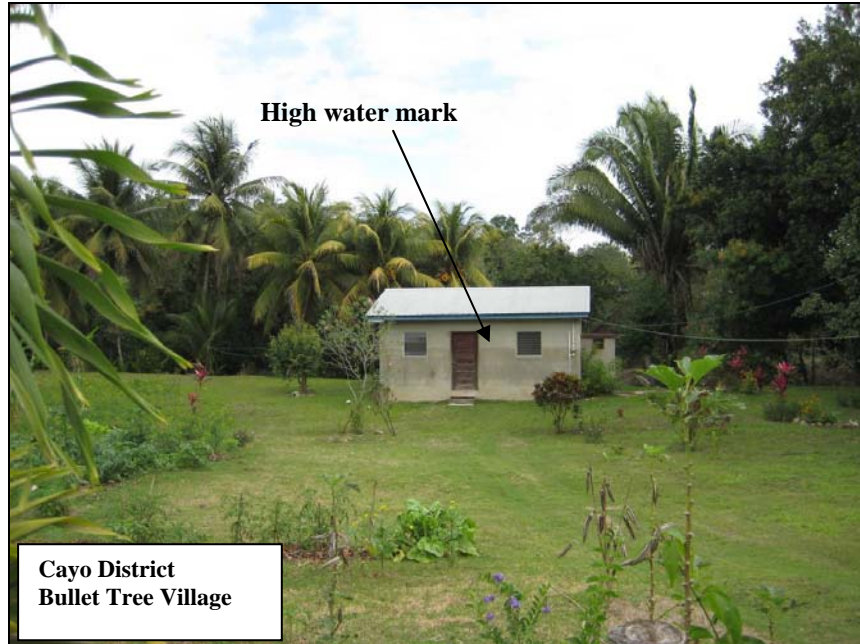
**South abutment at Kendal Bridge
(washed out during TS Arthur)**

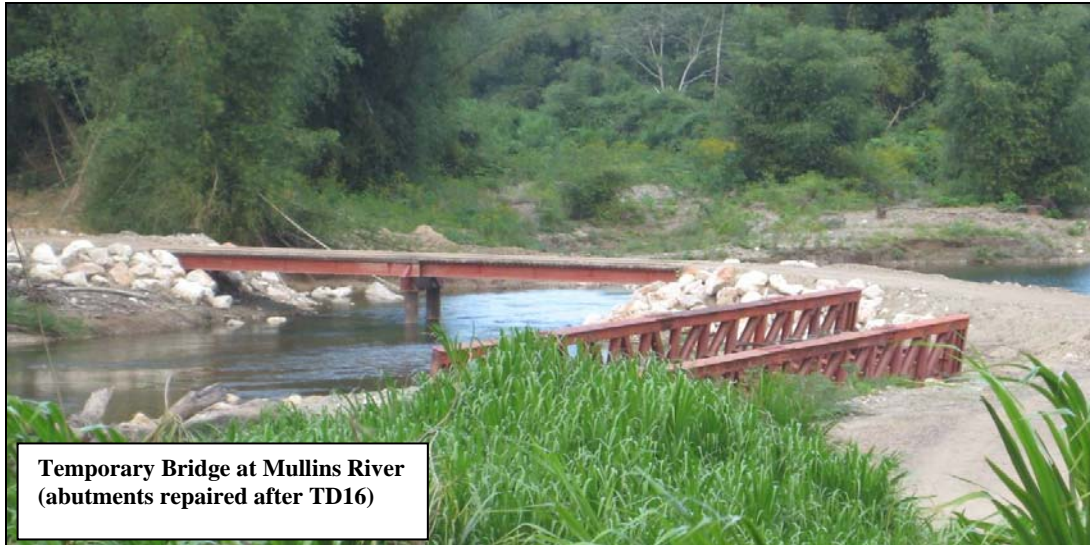


**North abutment at Kendal Bridge
(washed out during TS Arthur)**



**Temporary Bridge at Kendal
(abutments repaired after TD16)**





(c) Belize district

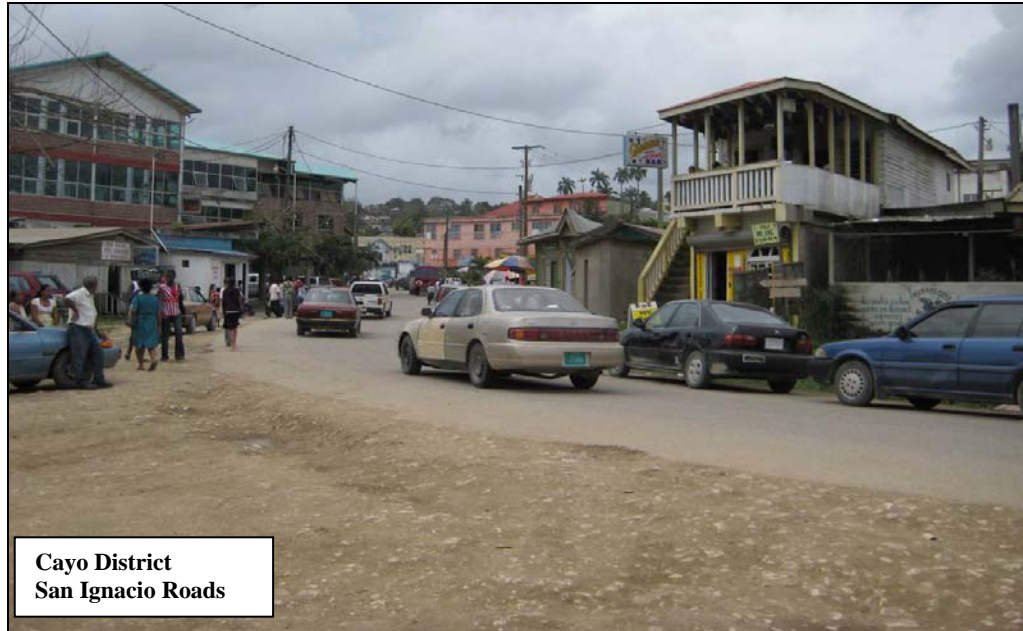
The Spanish Creek Bridge had water at or over the bridge decking, during TD16. In spite of this, however, there was no damage to this structure. At least three culverts were washed out, and the overall opinion formed was that there is a pressing need for the improvement of drainage in Belize City, with many culverts not being sized properly. In addition, between the river and the sea, there are numerous canals, however many of these are not adequately connected to the sea, this results in a lot of flooding.

A summary of damage and losses for the transportation - bridges subsector is provided below.

District	Damages (BZ\$)
Belize: Gracie Rock Road Bridge Repairs	45,000
Cayo: Calla Creek Pedestrian Bridge Branch Mouth Road and Pedestrian Bridge Baking Pot Road Bridge	125,000
Orange Walk: Santa Martha Bridge	20,000
Stann Creek: Kendall River Bridge Repairs Mullins River Bridge Repairs	110,660
Total Damages	300,660

Source: ECLAC based on official data.

3. Transportation – Roads and drainage structures



(a) Belize district

In the Belama Phase 4 area, there was over 1.2m of standing water during TD16. Most of the homes were uninsured, and so loss of contents was a problem. Residents in this phase consist primarily of a squatter community, however, the government subsequently tried to regularize their tenancy. In Belama Phase 3, the community is primarily middle income. The capacity of the drainage network in this phase has to some extent been reduced as a result of vegetation growth. Standing water in this phase was of the order of 0.6m – 0.9m during TD16, and this water remained elevated for over three weeks. This inundation time would have been much longer (perhaps of the order of months), however the Ministry of Works dug a canal to the sea and this facilitated more rapid draining of standing water. Most of the impact of TD16 in Belize City was felt in the Belama area. One of the primary problems in this area is due to the fact that the roads are almost at the same elevation as the drains themselves. This results in limited runoff from the roads to the drains, and unfortunately contributes to ponding of flood waters on the roads themselves.

Mitigation strategies adopted included the use of gravel to raise the floor elevation of the houses. It is notable that in 2007, sand dredged from the sea was used for this purpose. It is now recommended that the following mitigation strategies be adopted:

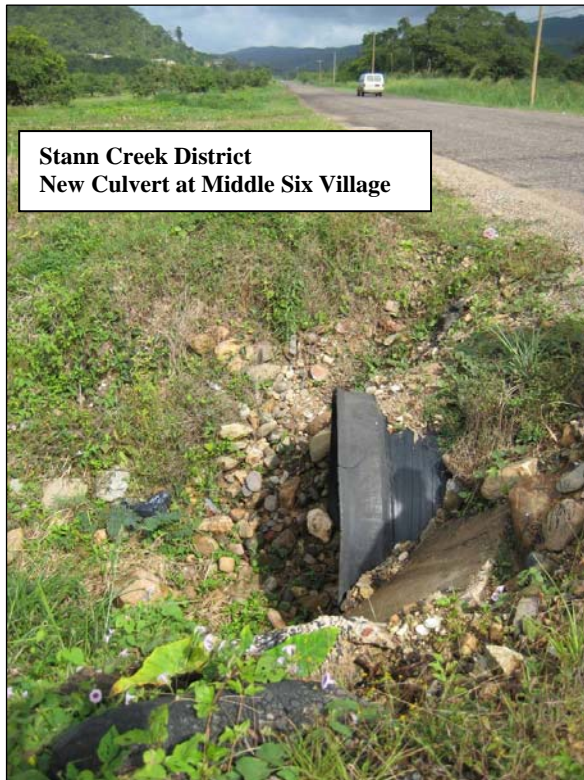
(a) The construction of proper roads with side drains, since the existing road network becomes mud in times of heavy rainfall;

(b) The regularization of tenancy of the people squatting in this area, including the setting up of a proper electrical and water supply grid, which to date have been set up locally and pose a serious health hazard; and

(c) The training of local residents in recommended construction techniques for the informal housing sector.

The Burrel Boom community was cut off from its surrounding areas for a period of approximately one week. In particular, the road access to the bridge flooded on both sides, cutting off access to this area.

In the Flowers Bank community, which includes about 40 families, the residents were trapped for almost three weeks, as they could neither get in nor out of the community. It is recommended that the road be raised so that the community will no longer be isolated and trapped during times of heavy rainfall.



**Stann Creek District
New Culvert at Middle Six Village**

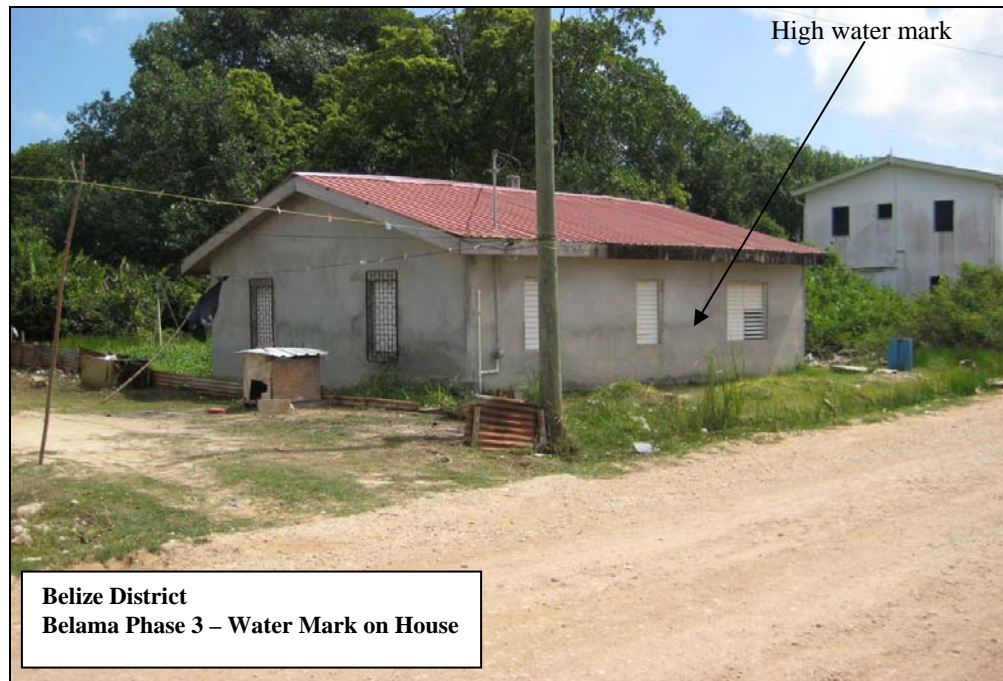
For Lemonal, the water reached almost up to the bridge, and the houses near to the Belize River were completely inundated. There were no problems with electricity in this community, and potable water was provided, so that there were no problems encountered in this regard.

In Isabella Bank, approximately six families, of a total of 39 families in the community, were affected by the event. The majority of residents from this community work in Belize City. After the event, trucks brought in water several times, although some of the residents have wells. Although the community is located adjacent to the Belize River, the village was never cut off or isolated due to road flooding. In addition, many of the houses are already on stilts, so the damage was minimal.

In Rancho, approximately nine families were affected, and one house was fully under water. Most of the residents in this area are involved in farming. For a period of three weeks after TD16, a boat was used to cross the waterway in front of the bridge. Water was supplied through NEMO by trucks, and this was stored in tanks by the residents. The flood waters in the vicinity of the bridge remained for about three weeks, whereas in other nearby places, water remained ponded for approximately two months.

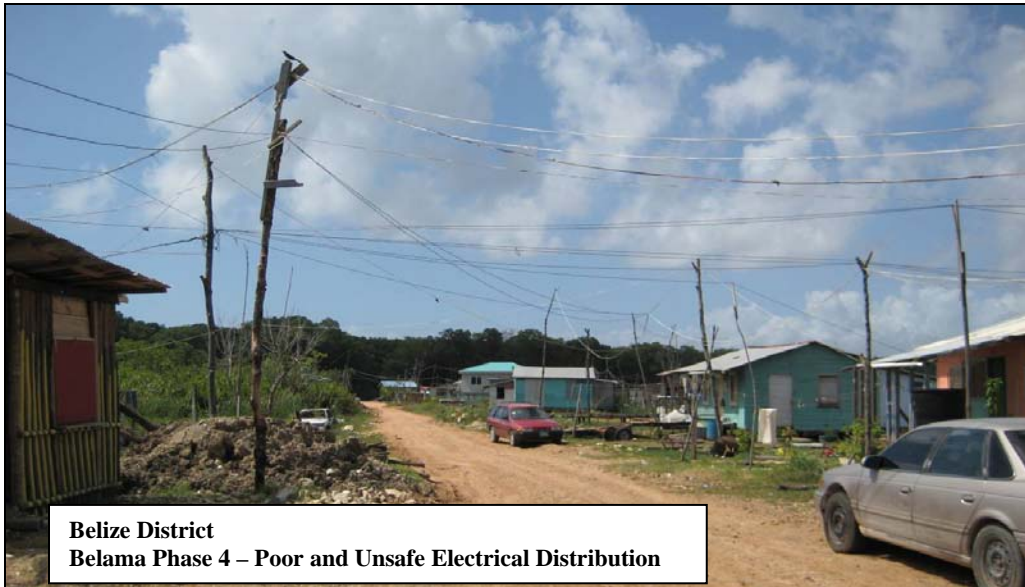
In Crooked Tree Village, the entire road was under water by between 0.9m and 1.2m, and this was the only entrance and exit road from the community. Flood waters remained for a period

of two to three months, and the community was isolated for that entire time. When the waters finally receded, the entire road had to have a fresh coat of gravel spread on it. The flooding resulted in a lot of the vegetation being killed off, however new growth has started to be regenerated. Of a total of 248 families, 29 were affected. Most of these residents work in Belize City. The community centre will now have to be rehabilitated, and the village has applied to the Ministry of Works to construct a septic tank with a soak-a-way pit. It should be noted that the local churches also housed families after the event.



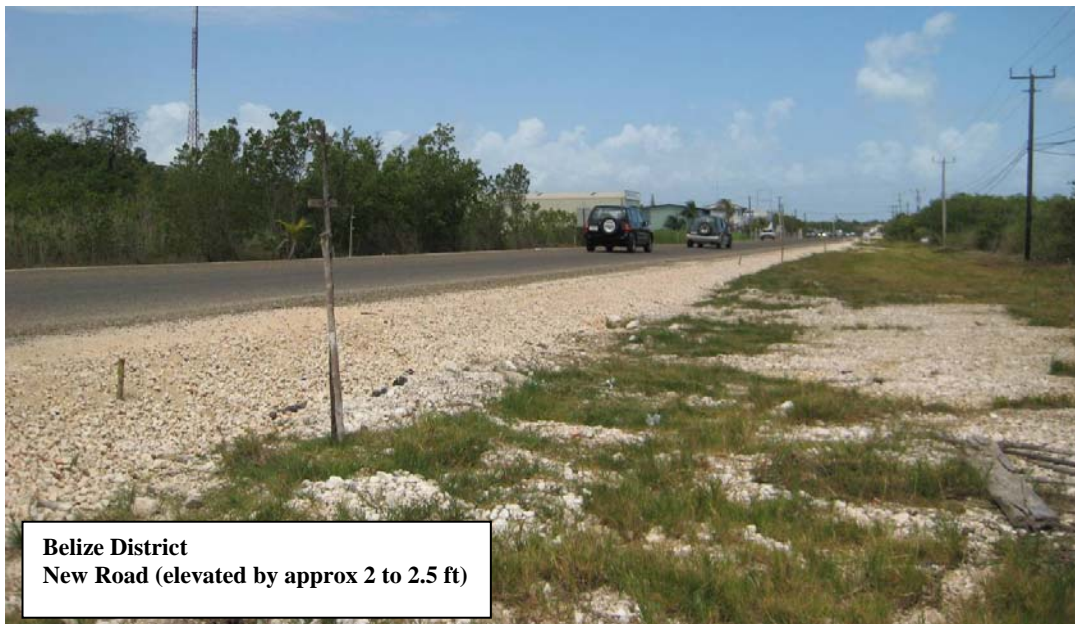


**Belize District
Belama Phase 3 – Poor Drainage**



**Belize District
Belama Phase 4 – Poor and Unsafe Electrical Distribution**







Belize District – Flowers Bank Community
Community isolated for 3 weeks; need to raise road elevations



Belize District – Crooked Tree Village
Community isolated for 2 to 2.5 months due to water levels over causeway;
Causeway badly damaged

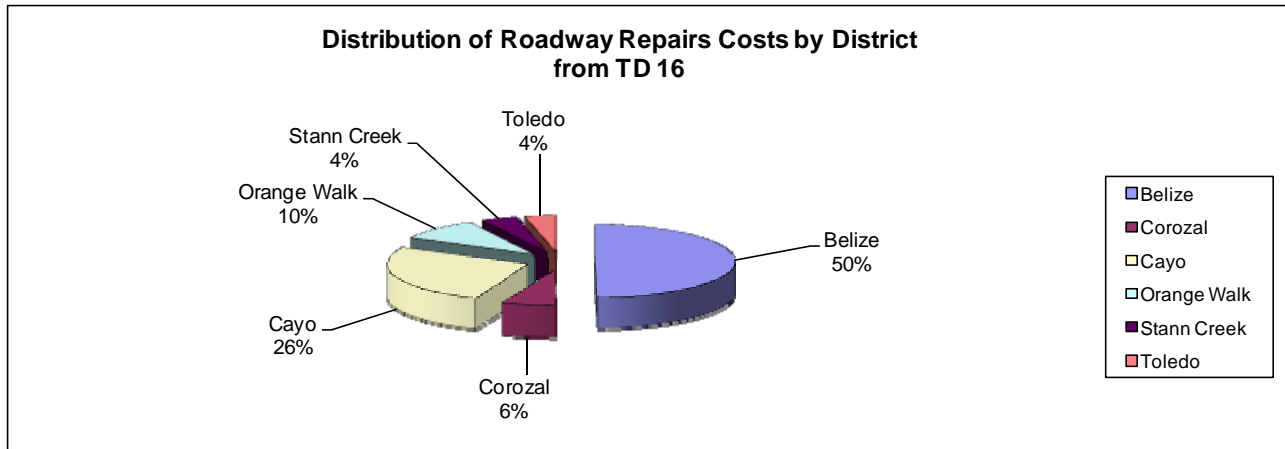
A summary of damage and losses for the transportation – Roads and drainage subsector is provided below.

<u>District</u>	<u>Damages</u>
Repairs to roadway by district	
Belize	5,798,258
Resurfacing Roads	
Replacement of Culverts	
Clearing Debris	
Replacement of Culvert with Bridge	
Replacement of Retaining Wall/ River Erosion Protection	
Road Reconstruction	
Corozal	742,202
Road Reconstruction	
Resurfacing Roads	
Cayo	3,082,385
Install Culvert	
Road Reconstruction	
Resurfacing Roads	
Clearing Drains and Culverts	
Clearing Debris	
Orange Walk	1,120,030
Road Reconstruction	
Resurfacing Roads	
Replacement of Culverts	
Bridge Remedial Works	
Repair Drainage Appurtenances	
Clearing Drains and Culverts	
Stann Creek	501,648
Clearing Drains and Culverts	
Repair Drainage Appurtenances	
Resurfacing Roads	
Toledo	412,847
Clearing Debris	
Resurfacing Roads	
Clearing Drains and Culverts	
Replacement of Culverts	
Total Damages	11,657,370

Losses	
Boats used to transport and relocate	124,740
Cars and Buses	298,552
Allocation of Government Vehicles	114,000
PWD Clean Up Costs	369,000
TOTAL LOSSES	906,292

Source: ECLAC based on official data.

In addition, a schematic of the distribution of costs associated with roadway repairs is shown following.



Source: ECLAC based on official data.

4. Recommended mitigation actions

A number of mitigation and rehabilitation strategies have been recommended for implementation. The main ones are:

(a) Replacement of the temporary bridge at Kendall. The original bridge was washed away during the preceding flood events. As a result of this, a temporary bridge was installed. It is now strongly recommended that this bridge be replaced by a permanent structure, as the soffit of the deck is too low to provide adequate conveyance capacity during flood events. It can be clearly seen in the preceding photographs that the temporary bridge is at a significantly lower elevation than the original bridge. In addition, the temporary bridge has no side rails, making transit across the bridge in flood events a hazardous activity. The bridge should be designed to convey a flood flow equivalent to not less than the one in 50 year event, and should be located with an appropriately high deck elevation;

(b) Replacement of the temporary bridge at the Mullins River. In this case, the original bridge, which was a steel trestle structure, was washed away during the previous flooding events. A temporary bridge has been installed at the location of the damaged bridge, and this now consists of steel girders, with a driving surface on top. The temporary bridge is low, and the temporary abutments appear to be inadequately reinforced against hydraulic forces, leading to the conclusion that in another (subsequent) flood event, this temporary bridge could also be washed out. As such, it is now strongly recommended that a permanent bridge be designed and constructed at this location. The bridge should be designed to convey a flood flow equivalent to not less than the one in 50 year event, and should be located with an appropriately high deck elevation;

(c) Replacement of the culverts at Mexico Creek (Mile 46 marker, Belmopan to Belize City Highway, commonly known as Ten Cents Creek)) with a proper bridge. Presently, this creek flows underneath the main highway through a system of culverts. Visual inspection of the waterway in the vicinity of the waterway indicates that the existing culverts do not have adequate capacity to convey flood flows. This situation therefore leads to a condition of flooding in the vicinity of the culverts. This in fact occurred during and after TD16, and in fact is reported to occur at even less extreme flood events (personal communication from the Ministry of Works). It is therefore strongly recommended that a proper bridge be designed and constructed at this location, given the importance of maintaining an open and passable corridor between Belmopan and Belize City during and after hazard events triggering excessive rainfall and flooding;

(d) It has been identified that the Stann Creek area is one of the worst zones in Belize in terms of an adequate equipment fleet. It is therefore recommended that the needs of this district be properly assessed and the equipment fleet be upgraded to better match the requirements;

(e) Some institutional strengthening of the Ministry of Works is required. There is a need to have an additional two engineers on staff, both with some experience in road and drainage design procedures. Existing budgets, however, only allow the ministry to bring on

recently graduated engineers. Because of this, it is recommended that a series of in-house training courses be mounted to aid the professional development of these engineers. There is also a need to strengthen the capacity of the ministry in the areas of the Survey Department and the Geotechnical Department;

(f) Presently, the standard for design calls for the use of the one in five year return period to be used in the design of culverts. Given the frequency of flooding that has taken place, and the disastrous consequences that occur, it is recommended that the design standard for main drainage channels be increased to the one in 25 year event; and

(g) There is a need to obtain and apply proper topography to carry out drainage structures and also to facilitate an appropriate land development plan.

A summary of the estimated costs for the primary recommended mitigation strategies is given in the table below.

<i>District</i>	<i>Mitigation Cost</i>
Belize	
Corozal	
Cayo	
Mt. Pleasant - Mile 46 "Ten Cent" Creek	300,000
Orange Walk	
Stann Creek	
Kendal River Bridge	12,000,000
Mullins River Bridge	8,000,000
BWS Dangriga Water Treatment Erosion Protection	50,000
Toledo	
Total Mitigation Strategies	20,350,000

Source: ECLAC based on official data.

C. Social sector

Table 24 indicates the extent of damage and loss within each subsector of the social sector. According to the Damage and Loss Assessment (DALA) methodology applied by ECLAC, the three subsectors of the social sector include housing, health and education.

In the housing sector all structures used as dwellings, along with their sanitary facilities are considered and in the health sector all structures used to provide health services such as hospitals and health centres are considered. In the subsector of education, not only are educational facilities and their sanitary facilities considered but so, too, are sporting facilities, museums, and heritage sites.

The largest portion could be attributed to damage which amounted to BZ\$8.5 million or 70.3%, with losses accounting for the balance of BZ\$2.5 million or 29.7%.

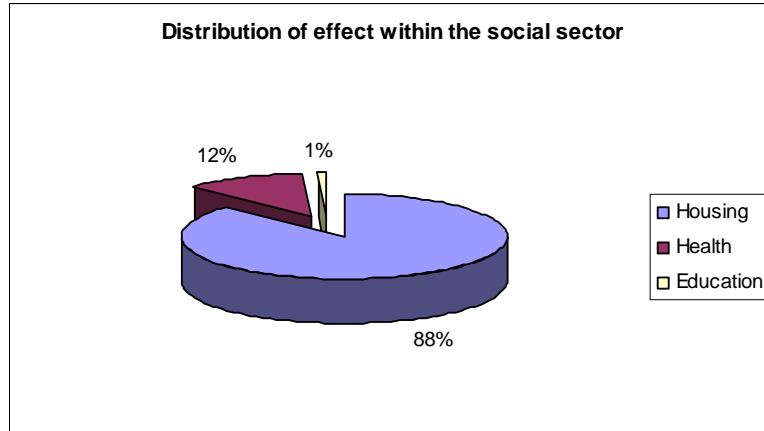
Table 24: Belize: Total effect on the social sector by subsectors

Subsector	Damage	losses	Total Effect
Housing	5,897,420.00	1,628,000.00	7,525,420.00
Health	92,416.00	898,982.51	991,398.51
Education	41,803.80	20,000.00	61,803.80
Total	6,031,639.80	2,546,982.51	8,578,622.31

Source: ECLAC estimates based on official Government data

The housing subsector accounted for the largest proportion of the total damage and losses, which amounted to BZ\$7.5 million or 88% of the total effect. The details appear in table 24. The health subsector followed with BZ\$0.9 million, the majority of which could be attributed to losses incurred by the health subsector in the additional services which were provided to safeguard the health of the population. The small sums attributed to damage in either the subsector of health or housing can be attributed to the location and quality of the structures which house these institutions, which in most cases had a good setback from rivers and were built on high ground. In addition the nature of the event reduced the threat to the structures.

Figure 9 illustrates the distribution of the effect of TD16 within the social sector and points to the negligible effect which the education subsector experienced.

Figure 9: Belize: Distribution of effect within the social sector

Source: ECLAC based on official Government data

1. Housing

Some 814 houses were severely affected by the events of TD16 as detailed in table 25. Of those, 12 were totally destroyed; the majority 802 was badly damaged requiring repair. This represents 1.14% of the national housing stock. It is important to note that Hurricane Dean in 2007 damaged, 1,175 houses or 2% of the national housing stock.

Most Belizeans live in undivided private dwellings which accounted for 83.3% of households and were more commonly found in the rural parts of the country. It is not surprising that multiple dwellings were most frequently found in Belize City, which is the most densely populated area in the country.

Table 25: Belize: Houses affected by TD16 by District

District	Population	Households	Houses destroyed	Houses damaged	Total affected
Country Total	322100	71,578	12	802	814
Urban	165700	36,822			
Rural	156400	34,756			
District					
Corozal	36800	8,178	1	42	43
Orange Walk	48300	10,733	2	265	267
Belize	96600	21,467	5	333	338
Cayo	77000	17,111	4	162	166
Stann Creek	33300	7,400			
Toledo	30100	6,689			

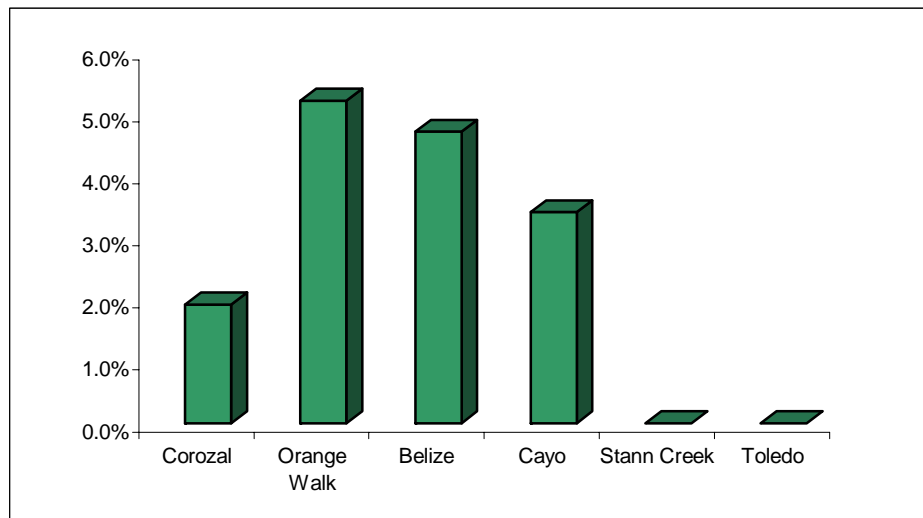
Source: ECLAC estimates based on official data

In Belize, 62.6% of households owned/hire-purchased their dwelling unit, however rural areas have the highest percentage of owned/hire-purchased dwellings (72.5%) and the highest percentage of houses rented free (17.5%).

Nationally, the most common materials used for the outer walls were concrete (42.1%) and wood (41.7%). However, as much as 68% of the dwellings in the rural areas are not built with concrete outer walls as wooden walls are more common. There were 7.9% of dwellings made of both wood and concrete and 6.1% made of sticks/palmetto. The report also noted that 59.5% of poor rural households had inadequate roofing.

It is not surprising that houses continue to suffer from damage in Belize City as it was reported in the 2002 LSMS that 7.1% of dwellings were built with outer walls of plywood. Figure 10 indicated that approximately 1.6% of the housing stock in Belize City was severely affected by TD16.

Figure 10: Belize: Distribution of houses damaged or destroyed by TD16 by District



Source: ECLAC estimates based on official Government data.

Much of the housing that was damaged or destroyed by TD16 was of a precarious nature. In many instances they were built, without knowledge or regard for building codes, on low lying, flat ground prone to floods without the necessary placement on stilts. In other instances they were old and of a poor quality.

Many of the damaged houses were uninsured or uninsurable, leaving the replacement or repair squarely on the shoulders of the already poor and indigent families occupying the dwellings.

Table 26 presents the details of the damage and loss which amounted to BZ\$7.5 million or 78.4% which accounts for destruction of houses, repairs for houses damaged and damage to household furnishings caused by TD16, and the remainder 21.6% accounting for losses incurred

in the cleaning and removal of debris. This may be an underestimation of damage and loss as not all costs had been captured.

Table 26: Summary effect to the housing sector

Total Effect	7,525,420.00
Damage	5,897,420.00
i. reparation of damaged houses	4,653,620
ii. Replacement of destroyed houses	511,200.00
iii. Damage to household furnishings	732,600.00
Losses	1,628,000.00
i. Cost of cleaning and removal of debris	1,628,000.00

Source: ECLAC based on official data.

2. Health

The four most affected districts, by TD16, are being serviced by three of the country's four regional health authorities: the northern, central and western authorities. Together these Authorities service some 258,700 or 80% of the national population.

The Northern (NHR) provides services to the Orange Walk and Corozal Districts, the latter having been the most affected District; while the Central (CHR) provides services to Belize District both Belize City and rural areas, which included the Belize River Valley which was severely impacted and the Belama Phases of Belize City which was also impacted; and the Western (WHR) provides services to the Cayo District which had also experienced severe flooding in areas such as Calla Creek, Bullet Tree and others.

It was a credit to the health care managers and providers that no serious outbreak occurred in light of the vulnerable health conditions under which many households live. As an example the LSMS of 2002 indicated that pit latrines remained, by a large margin, the most common toilet facility in the rural areas: 65.2% of rural households. In light of the nature of TD16 and subsequent flooding, the health of persons living in those areas was at risk.

In addition, the report had indicated that the need for safe drinking water was evident in the rural areas, where 40.8% of the households were drinking water from a private vat/drum/well which was not piped, and 5.7% were drinking water from the river, stream, creek, pond, or spring.

The Ministry of Health's Epidemiological Profile for TD16 (as at 26 October 2008) suggested as many as six surveillance teams had been deployed, two in the northern, four in the central and two in the western region. Reports indicated that cases of skin infections, fever cough, diarrhea and injuries were seen and treated.

Table 27 details the total effect on the health sector suggesting that the total effect was just below BZ\$1 million. Damage was slight accounting for BZ\$0.092 million or 9% of the total effect. Losses to the health sector amounted to BZ\$0.89 million or 91% of total effect.

This was not unexpected as the public health campaigns to safeguard the population's health absorbed a significant number of health care professionals; occurred over a very wide swath of the country as affected people were isolated and wide spread; and required additional health supplies.

Table 27: Belize: Total effect on the health sector

Total Effect	991,398.51
Damage	92,416.00
i. Reparation of structurally damaged health centre	92,416.00
Losses	898,982.51
i. Mounting of public health campaign	14,745.00
ii. Fuel transport and subsistence	80,348.00
iii. Medical supplies	252,457.00
iv. Insect vector control (insecticides)	40,476.89
v. Medical staff	217,369.82
vi. Human services staff	64,298.00
vii. Equipment	150,000.00
viii. water sampling testing	73,130.80
ix. Health Education	6,157.00

Source: ECLAC estimates based on official Government data

3. Education

Damage to the education sector was minimal as detailed in table 28, making the economic cost very low but with the possibility of yet to be felt social costs. The total effect amounted to BZ\$0.061 million. Of this sum damage to school buildings, furnishings and materials accounts for 68% of the total effect and losses make up the balance of 33%.

This was due in part to the nature of TD16, its localized impact, and to the fact that many schools in the affected districts have been constructed in flood safe zones i.e. built further back from the river's edge and built on higher ground. One school reported severe damage. In all approximately 2000 children, however, or 4% of children who attend school in the four affected communities were distressed.

TD16 disrupted school attendance, which was severe, as access to school buildings was made difficult, as rivers broke banks and roads were completely submerged. Some schools were also used as shelters causing damage to facilities and particularly sanitary facilities. In addition many households were isolated by the floods making it dangerous for children to leave home to attend schools. In many instances children had to be reassigned to alternative schools for periods of one week to as much as six weeks.

Teachers interviewed raised concerns about the capacity of the children affected to achieve the level of performance expected had their school term not been disrupted.

Table 28: Belize total effect of TD16 on the education sector

Total Effect	61,803.80
Damage	41,803.80
i. Buildings	28,500.00
ii Furniture	2,165.00
iii. School supplies	11,138.80
Losses	20,000.00
i. Relocation of children	
ii. Clearing and sanitizing of school damaged from use as shelters	20,000.00
iii. Repair of sanitary facilities	
Assumption: 10 schools used as shelters each requiring clean up costs of 2,000	

Source: ECLAC estimates on official Government data

IV. THE MACROECONOMIC EFFECTS

A. Summary damage and losses

Although TD16 caused important disruption to the lives and livelihoods of a wide cross section of the population, the financial costs of the disaster were moderate compared with Hurricanes Dean and Keith that impacted Belize in recent years. The total impact of the disaster was estimated at BZ\$54.1million, the equivalent of US\$27.1 million. Nevertheless it is believed that the unavailability of data and information in some sectors meant that a fuller accounting might have provided for a greater financial cost. The monetary costs do not provide a full picture of the fall-out of the disaster, however, as small farm agriculture, transport networks and the natural environment were badly affected leading to a significant social and environmental cost.

Importantly, the per capita impact of the disaster at \$168 per person was relatively small. Scaling the impacts by major macroeconomic indicators highlights the modest financial costs of the disaster. Indeed, the depression led to fall-out equal to around 2% of GDP, over 5% of exports of goods and services and 2.5% of consumption. Nevertheless, underscoring the fact that the disaster was mostly an agricultural event, the total impact accounted for 25% of agricultural GDP. Fortunately, the impact represented only 2.7% of external debt, which suggests that any need to acquire debt for current costs repairs should be moderate. This should be distinguished, however, from the need for substantial financing for mitigation and building back better, especially for major infrastructure, including roads and bridges.

Summary of total impact by type	BZ\$	Per cent
Damage	31.64	62
Losses	22.46	38

Total impact in relation to key macroeconomic variables:

- (a) 2% of GDP;
- (b) 25% of agricultural GDP;
- (c) 3.4% of exports of goods and services;
- (d) 10.6% of gross domestic investment;
- (e) 2.5% of consumption; and
- (f) 2.7% of external debt.

The profile of the impact is best reflected by variation among the sectors. Agriculture because of its vulnerability to hydrometrical events suffered the brunt of the fall-out in this case, representing 25% of the total impact. Crop damage was quite severe in some staples and other crops. Corn and rice were buffeted with damage and losses of almost \$14 million, accounting

for almost 49% of the total impact on the agriculture sector. Vegetables, banana and sugar also suffered important damage that would impact on yield in the next crop. The livestock subsector, an important contributor to protein nutrition, was disrupted by the tropical depression with poultry, pigs, sheep and goats affected.

Table29: Summary damage and losses from TD16 on Belize

Sector and subsector	Damage and losses				
	Total Impact	Total Impact	Damage	Losses	% of total
	US\$ thousands	BZ\$ thousands			Impact
Total	27052.065	54104.13	31642.42	22461.71	100.0
Productive sectors	16110.745	32221.49	13365.08	18856.41	59.6
Agriculture	14091.845	28183.69	12528.08	15655.61	52.1
Corn	4593.595	9187.19	5543.2	3643.99	17.0
Rice	2292.73	4585.46	977.34	3608.12	8.5
Vegetables	1950.995	3901.99	1943.19	1958.8	7.2
Papaya	1232.1	2464.2	948	1516.2	4.6
Plantain	20.25	40.5	15	25.5	0.1
Banana	1741.25	3482.5	1832.9	1649.6	6.4
Sugarcane	1653.725	3307.45	540.03	2767.42	6.1
Livestock		1214.4	728.42	485.98	
Petroleum	400.2	800.4		800.4	
Tourism	1501.2	3002.4	837	2165.4	5.5
Commerce	117.5	235		235	
Social Sectors	4289.3	8578.6	6031.6	2547	15.9
Housing	3762.7	7525.4	5897.4	1628	13.9
Education and culture	30.9	61.8	41.8	20	0.1
Health	495.7	991.4	92.4	899	1.8
Infrastructure	6652.02	13304.04	12245.74	1058.3	24.6
Roads and transport	6281.85	12563.7	11657.4	906.3	23.2
Bridges	150.35	300.7	300.7		0.6
Water and Sanitation	219.82	439.64	287.64	152	0.8

Source: ECLAC, calculations based on official data.

1. The macroeconomic performance prior to TD16

Natural disasters have repeatedly affected the growth cycle in Belize, particularly due to the importance of agriculture and, to a lesser extent, tourism to the economy. In 2007, economic activity slowed, with growth of 1.6% compared with 5.3% in the previous year. Activity was undermined by Hurricane Dean, which knocked out agricultural production in some major crops. Output of papaya, sugarcane, bananas and citrus declined as a result of crop damage. In other agriculture, shrimp and tilapia production contracted due in part to the closure of the largest shrimp farm. Nevertheless the decline in primary activity was partly offset by manufacturing and services, as higher petroleum production boosted activity which was also buoyed by increased stay-over tourist arrivals and spending.

2. Prices, wages and employment

Inflation moderated in 2007, falling to 2.3% from around 4% in the previous year. However, impulses for higher prices were provided by food prices, which shot up by 5.3%, reflecting higher international food prices, especially corn that has been affected by its demand for ethanol production. Costs of household goods, clothing and footwear also rose in line with their imported input contents, while downward price pressures came from transport and communication on account of lower fuel prices at the pump. Unemployment fell from 9.4% in 2006 to 8.5% in 2007, linked to employment gains in agriculture, distribution, tourism and manufacturing. Growth in employment would have cushioned the fall-out in welfare stemming from the slowdown in activity.

3. Fiscal performance

Fiscal performance was boosted by a fortuitous inflow of grants, supported by dynamic receipts from the general sales tax (GST), petroleum taxes and land sales. These led to a reduction in the overall deficit from 1.9% of GDP in 2006 to 1.2% of GDP in 2007. On the policy front, Parliament established the crucial Petroleum Revenue Management Fund during the year to ensure the sustainable use and management of petroleum receipts. A portion of the funds will be invested to generate a revenue stream for the benefit of the population, while part could be used for government projects and budget support, but not for current outlays or debt payments.

Natural disasters always highlight underlying weaknesses and challenges in an economy, and although the debt restructuring in 2007 provided some fiscal breathing space, the reality is that debt sustainability remains a major challenge for the authorities.

4. Money and banking

Somewhat contrary to expectations, money growth expanded significantly during the year fuelled by a surge in credit and foreign exchange inflows. Robust growth in household demand for credit bolstered the domestic component of money supply, while net foreign assets were bolstered by tourism receipts, remittances and foreign direct investment (FDI). After easing due to tourism receipts and other inflows in the first quarter of the year, liquidity tightened during the rest of the year. The weighted average interest rate spread increased by 20

basis points to 8.3%, the lowest end of year margin in 16 years. Despite monetary expansion, monetary policy was benign, with the Central Bank's cash reserve requirement remaining stable at 10%.

5. Trade and payments

The balance of payments current account deficit doubled to 4.1% of GDP. The widening of the deficit was driven by an expansion in the trade deficit (17.1%) as slower growth in imports was matched by the collapse of growth in exports. With the exception of petroleum, merchandise exports suffered across the board declines linked to the impact of Hurricane Dean in agriculture and reduced output of marine products, including shrimp and lobster. Citrus production was affected by TD16, while banana production was buffeted by sigatoka disease and cuts stemming from changes in the EU import regime.

B. Macroeconomic performance in 2008 before the disaster

1. Output

Despite the gathering slowdown in the world economy during the first three quarters of 2008, prior to TD16, the performance of the Belizean economy was quite dynamic. Growth was significantly above trend, the fiscal surplus was moderate, money growth was buoyant and although the balance of payments deficit expanded sharply in line with robust growth, it was adequately covered by capital inflows, especially the more development boosting foreign direct inflows and a slowdown in debt repayments.

The economy recorded dynamic growth of 5.3% for the first nine months of 2008, relative to the similar period of 2007, the highest rate registered for this period since 2003. Growth was bolstered by a welcomed expansion in petroleum production (18.1%), which pushed growth in manufacturing to 5.6%. A surge in hydroelectricity generation from the Chalillo Dam also contributed to the growth impetus. Agriculture recovered (5.9%) due to higher output of bananas and citrus, reflecting in part improved management and agronomic practices; offsetting declines in sugarcane and papaya production. Meanwhile, dampening effects came from sluggish tourism associated with reduced arrivals and a slower pace of condominium development. The hotel and restaurant subsector, contracted by 2.1% in the wake of these outcomes.

2. Prices, wages and employment

Conforming to the trend of higher international prices, the rate of inflation spiked by 9.6% year-on-year to August, the highest rate posted for the past two decades. Prices were propelled by higher fuel costs, the hike in food prices and an increase in the price of imports in general. The price of food staples including rice, flour, bread and chicken were all up affecting the consumption basket of the poorest households. Although fuel prices remained high overall, fortuitously, by the third quarter they started to trend downwards in line with reduced international demand on the heels of recessionary conditions. Employment was bolstered by the strong growth momentum and public sector wages growth was contained.

3. Fiscal performance

Fiscal performance for the first half of 2008/09 was buttressed by robust returns from the general sales tax, which overshot expectations. This was complemented by fortuitous grants flows of \$50 million lump sum grant from Taiwan and Belize Bank's refund of the \$20 million of grant receipts from the Government of Venezuela. With these developments revenue surged by 18.6%, and, complemented by a 7.6% decline in expenditure, led to a Central Government overall surplus of 4.0% of GDP and a primary surplus of 5.9% of GDP. In a prudent move, government used the fiscal surplus to eliminate a portion of its domestic debt by reducing its overdraft balances by almost \$15 million and making amortization payments of \$15.9 million. Reflecting continuing debt consolidation, the public sector debt declined by 0.9% as amortization payments of \$81.4 million and downward valuation adjustments of \$0.5 million surpassed loan disbursements of \$64.2 million.

4. Trade and external payments

Important, fiscal consolidation was not matched by an improvement in the balance of payments current account, implying that government savings was offset by private sector dissaving.⁴ Indeed, the current account deficit at \$248.6 million was three times the level reached in September 2007. The impetus for the widening current account deficit came from both imports and exports. Goods imports were driven by purchases of telecommunications equipment, construction materials and food supplies. Higher dividend payments and international freight charges also contributed to the ballooning deficit. Meanwhile, on the export side, higher receipts from goods exports and grants were offset by falling tourism receipts.

C. Performance of the economy with the disaster

The fall-out from TD16 will carry over from the latter part of 2008 when the event occurred, over into 2009. In some sectors and activities, the bulk of the effects will be felt in 2009. Damage and losses were concentrated in infrastructure and agriculture and this would determine the profile of the impacts on GDP and prices, fiscal operations and money balances and the balance of payments.

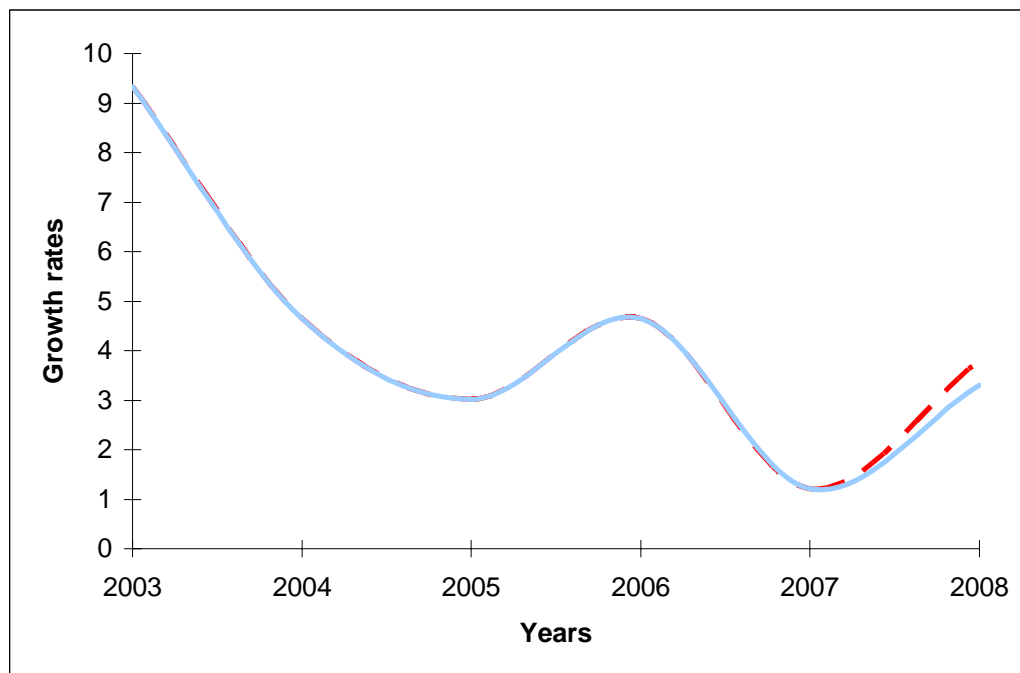
1. Impact on GDP

Tropical Depression 16 was mainly a stock event, with impacts mainly borne by capital assets, rather than the loss of income (flows). As a result, the fall-out in GDP was less than might usually be expected for these kinds of hydro-meteorological events. Therefore, TD16 was estimated to contribute to a 0.5% decline in real GDP growth in 2008 (see figure 11 below). Although this is not inconsequential, it is smaller than could have been the case. The brunt of the contraction in GDP is expected to be in the agriculture sector (3.9%), which bore a

⁴ Some studies, particularly for developed countries have shown that households become Ricardian (i.e. save in the expectation of having to pay higher taxes in the future) when government debt exceeds certain minimum thresholds. Either this might not hold for Belize, or households might have anticipated that with efforts at debt consolidation, the future tax burden would be quite bearable.

disproportionate share of the effects. Within agriculture, the crop subsector was buffeted and projected to decline by 5.11%. The corn crop suffered major damage, and along with rice, vegetables and bananas which were also badly affected, would limit domestic food supplies in the short term. Crucially, the most severely affected areas were in poorer communities and this could impinge on food security and nutrition for households in these areas. The tourism sector is expected to decline by around 1%, reversing previous projected growth of 1.3%. Flood damage to a number of tourist properties, including small hotels and guest houses, led to tourist cancellations and lower room rates that affected value added in the sector.

Figure 11: Belize: GDP growth rates before and after TD16



Source: ECLAC based on official data

Real estate, renting and business services were expected to decline by 0.9%, reflecting impacts on housing and some business properties. Community, social and personal services were projected to decline by 0.3%, thereby maintaining growth in excess of 8%. A number of community centres and other social amenities were affected, underscoring the fact that the social costs are significant, even where the economic costs might have been small relative to other disasters such as Hurricane Keith.

The petroleum subsector was affected by a disruption in shipping of fuel, therefore value added in the sector was expected to fall by 0.4%, compared to budgeted growth of over 50%. The contained impact on the sector was fortuitous in that in the last two years it has provided an important spurt to the growth momentum, thereby providing some degrees of freedom in government's tax receipts and ability to undertake development programmes. Meanwhile, despite the major damage to roads, bridges and culverts, the bulk of the costs in these areas were

stock damage and would entail substantial future mitigation costs. Consequently, real output in the sector is projected to decline by only 0.24%, leading to a growth outturn of over 7%.

2. Prices, wages and employment

The disruption in domestic food supplies is expected to lead to some feed through to higher inflation in the economy. This no doubt would be aggravated by the fact that food prices though declining have remained above trend levels. Therefore, the rate of inflation is expected to overshoot the budget target in 2008. Consequent on governments outlays on relief and rehabilitation in the aftermath of TD16, there was higher spending on relief supplies, clean-up and preliminary rehabilitation of some roads and bridges which led to increased expenditure on wages and salaries. However, this is short-term and one-off spending in some areas. The impact on employment is expected to be mixed, as the damage to the agriculture sector would adversely affect output in the sector in the short term. Employment in small commerce and tourism was also expected to slow as operators recover from damage and loss of business. On the other hand, employment in construction will increase as government undertakes reconstruction and rehabilitation works both in 2008 and in 2009.

3. Fiscal operations of central government and debt

TD16 has necessitated relief, reconstruction and rehabilitation works which, when aligned with the impact on revenues as a result of the disaster, is expected to lead to some deterioration in the fiscal situation in 2008 and 2009. Developments are expected to lead to an overall fiscal deficit of 0.1% of GDP, reversing the projected surplus of 0.7% of GDP. Incidentally, total revenue plus grants is estimated to increase marginally by 0.3% due to an increase in grant receipts, a portion of which was related to TD16. Apart from grant receipts, though, the other major revenue heads were expected to suffer some dampening effects as a result of the tropical depression. Tax proceeds were expected to decline by 3%, as taxes on income and profits, international trade and transactions and property tax turn in lower receipts in the aftermath of the depression. Non-tax receipts were projected to fall by around 1%, as proceeds from licenses, property income and other heads declined.

Table30: Fiscal Operations of Central Government (thousands of Belize dollars)

			Pre-TD16	Post-TD16
	2006	2007	2008	2,008.0
In thousands of Belize dollars				
Total Revenue and Grants	601,276	767,126	793,979	796,098.1
Total revenue	575,996	679,929	730,773	713,929.3
Current revenue	566,008	651,564	721,526	704,784.7
Tax revenue	514,495	576,970	631,084	615,051.3
Taxes on Income & Profits	136,659	164,646	216,440	210,610.1
Petroleum Operations	-	14,655	49,951	48,452.7
Windfall Tax from Petroleum				0.0
P.A.Y.E.	37,653	42,542	49,017	48,036.5
Arrears	1,032	4,707	1,540	1,539.6
Withholding	2,881	3,768	4,180	4,179.8
Gross Receipt (business tax)	95,050	98,876	111,696	108,344.8
I TAX Penalties/Int	34	96	35	35.0
I TAX Penalties	10	2	22	21.6
Taxes on property	4,393	5,960	6,729	6,627.6
Taxes on goods and services	207,838	231,789	253,188	248,124.0
Entertainment tax	3	-	1	0.7
Stamp duties (other dept.)	25,169	23,246	25,092	24,590.0
Toll Fees	207	196	195	194.8
Taxes on foreign currency transactions	10,755	13,434	14,890	14,890.3
Excise Duties	21,934	22,707	23,627	23,626.6
Sales tax	72,569	422	31	31.2
Sales Tax penalties & Interest	197	157	-	0.0
General Sales Tax	77,004	171,550	189,261	189,261.2
General Sales Tax Penalties	-	47	51	51.5
General Sales Tax Interest	-	30	40	39.6
Int'l trade and transactions	165,606	174,576	154,728	149,689.6
Import duty	82,595	91,522	100,674	95,640.5
Revenue replacement duty	59,202	56,527	23,867	23,867.2
Goods in transit charge	970	983	1,005	1,000.3
Goods in transit Social Fee	5,276	5,737	6,218	6,217.6
Indexed Environment Receipts	17,506	19,717	22,847	22,846.6
Export Tax	57	89	117	117.4
Non-Tax Revenue	51,513	74,594	90,442	89,733.4
Property income	1,356	12,643	9,929	9,531.6
Licenses	10,499	12,287	15,554	15,242.8

Table30 ... cont'd

Other	39,658	49,664	64,959	64,959.0
Repayment of Old Loans	4,578	541	10,185	10,184.6
Government Depts.	19,642	27,178	24,982	24,981.9
Rents and Royalties	15,437	21,945	29,793	29,792.6
Non-Petroleum Rent & Royalties	10,655	12,775	12,413	12,413.0
Other Revenue From Petroleum Operations	4,782	9,170	17,380	17,379.6
Other Revenue (PSA + W.I)				0.0
Capital revenue	9,988	28,366	9,247	9,144.6
Sale of crown lands	0	20,790	5,096	4,994.6
Sale of equity/property	3,576	6,009	4,150	4,150.1
Return of Equity/land	6,412	1,566	0	0.0
Grants	25,280	87,197	63,207	82,168.8
Total expenditure	648,578	795,119	774,410	797,926.0
Current expenditure	550,832	636,095	612,227	627,832.7
Wages and salaries	218,075	230,048	242,640	248,706.0
Pensions	39,016	40,490	42,612	42,612.5
Goods and services	104,676	158,387	144,955	152,202.2
Interest payments	141,973	134,885	105,622	105,621.8
Domestic	24,000	25,318	22,837	22,837.3
Foreign	117,972	109,567	82,785	82,784.5
Subsidies & current transfers	47,093	72,284	76,398	78,690.1
Foreign	4,511	6,939	4,611	4,749.0
Domestic	42,582	6,939	74,288	76,516.1
Capital expenditure & net lending	97,746	159,024	162,183	170,093.4
Development expenditure	93,311	116,619	174,329	182,239.7
Capital II	67,869	77,391	93,708	98,393.6
Capital III	25,442	39,228	80,621	83,846.1
Net lending	4,435	42,405	-12,146	-12,146.3
Unidentified Expenditures	0	0	0	0.0
Current account balance	15,176	15,468	109,299	76,952.0
Primary Balance	94,671	106,891	125,191	106,891.4
Overall balance	(47,302)	(27,994)	19,569	-1,828.0

Source: ECLAC, calculations based on official data

Expenditure was expected to increase by 3% to around 30% of GDP, reflecting higher current and capital spending. Current expenditure was estimated to increase by some 3%, driven by a 5% increase in outlays on goods and services. Higher spending on goods and services reflected the costs of food, generators and other supplies for relief and rehabilitation. Capital spending was estimated to expand by 5% as government undertook rehabilitation works on roads, bridges and public properties. Nevertheless, there is need for major mitigation works that involve building back roads and bridges to improved standards. Therefore, the bulk of

government spending on major capital works relating to TD16 is expected to occur in fiscal year 2009/10.

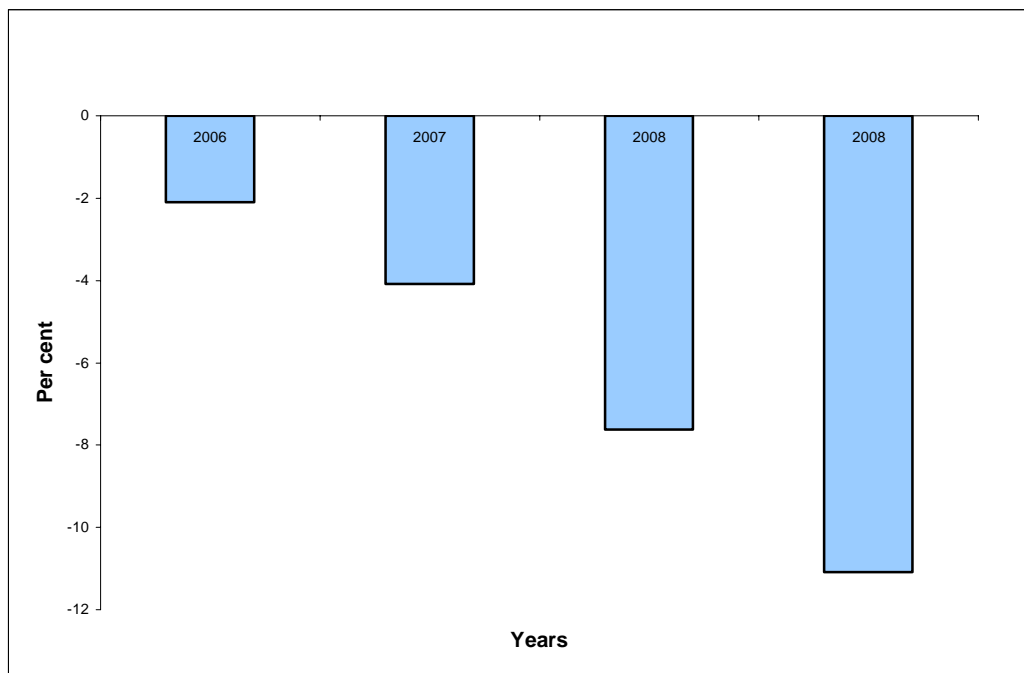
4. Money and banking

Money growth is expected to slow as a result of the decline in economic activity. Accumulation of banking sector deposits was expected to taper off somewhat after the disaster, as affected households and firms focus on rebuilding. In addition, the buoyant growth in credit prior to the disaster would have been curtailed, although credit to agriculture and construction were expected to increase to facilitate the rehabilitation and reconstruction effort.

5. Trade and external payments

The balance of payments current account deficit is expected to expand from the initially projected 7.6% of GDP to 11.1% of GDP. Banana and citrus are expected to return reduced export receipts as a result of crop damage, while sugar exports will be down in the next crop in 2009. Meanwhile, imports are projected to increase to provide for relief and rehabilitation and reconstruction, especially of roads and bridges. On the services side, tourism receipts are expected to decline as a number of properties were damaged and therefore unable to host visitors for some time.

Figure 12: Balance of Payments Current account as a % of GDP before and after TD16



Source: ECLAC, based on official data

D. Short- to medium-term economic challenges and policy options

1. The fiscal and debt constraints

TD16 has increased the pressures on government finances in an already difficult environment. Prior to the event, the fiscal position had stabilized somewhat, with the fiscal position set to return a surplus of around 0.7% of GDP. Belize would need to be provided some fiscal space to engage in above budgeted fiscal spending to facilitate a speedy recovery of economic activity. Belize had received financing under the International Monetary Fund (IMF) emergency assistance for natural disasters to the tune of US\$6.9 million. However, given the disruption of productive activity and the need to undertake infrastructure works, which entail mitigation expenditure, further resources would be required. Belize would therefore need to borrow further resources from the Caribbean Development bank (CDB), the Inter-American Development Bank (IDB) and other creditors. These must be one-off borrowings to rebuild infrastructure and to stimulate recovery in the productive sectors. Thereafter, the fiscal and debt positions should be returned to levels consistent with medium-term sustainability.

Moreover, the impact of the floods cannot be completely divorced from the fall-out from the global financial and economic crisis. The crisis would reduce demand for Belize exports, lead to a slowdown in foreign direct investments, squeeze remittance inflows and dampen economic growth. In the wake of the G20 Summit announcement of a financial package of over \$1 trillion for countercyclical stimulus packages in developing countries, Belize should make a case for a portion of the stimulus funds on the basis that recessionary impulses are affecting the economy both as a result of the floods and contagion from the global economy, two events outside the purview of domestic policy.

Given the frequency of the impacts of natural disasters, government along with civil society needs to draft a comprehensive disaster management plan. Such a plan would deal with prevention, relief, recovery and mitigation measures that are tailored to different types of disasters. Importantly, given the scarcity and high opportunity cost of resources a determination should be made of the average level of risk that government would insure against in the event of different types of disasters. The aim here is to prudently insure against a reasonable level of fall-out, while not diverting too much resources that could be used for current productive development projects.

V. CONSIDERATIONS TO THE RECOVERY AND RECONSTRUCTION PROCESSES: CONCLUSIONS AND RECOMMENDATIONS

A. General considerations

A key element for consideration that won agreement among all the sector specialists was the extent of vulnerability of Belize and its frequent exposure to natural meteorological events that can result in a disaster.

Between 2000 and 2008, Belize has been affected by at least five such major meteorological events – Hurricane Keith, a Category 5 hurricane in September 2000; Hurricane Iris, a Category 4 hurricane in October 2001; Hurricane Deane, a Category 4 in August 2007; Hurricane Arthur, a Category 3 in June 2008; and TD16 in September/October 2008. This pattern of exposure to extreme weather events and the possibility of increased frequency and more intense events, as presented by the evidence of climate change in the Caribbean, is a critical development challenge facing policy makers in Belize.

The assessment team was also aware of the contiguity of the borders of Belize, Guatemala and Mexico which may minimize the extent to which Belize can mitigate against a recurrence of the flooding that accompanied Tropical Depression 16. To reduce the impact of such flooding in the future may require the revisiting of the cooperation agreements that exist between the three countries with a view to supporting greater joint risk reduction mechanisms, if this is not already in train.

In order to meet the challenges to development, posed by events such as TD16 and the previous hurricanes and storms, it is recommended that policy makers begin to incorporate risk management measures into their long-term development planning. Such measures include mitigation of conditions of existing risk and introducing measures to prevent its reoccurrence. The primary objective must be to reduce impacts of flooding in the future. By taking such disaster risk reduction measures, policy makers can identify and encourage measures that address adaptation to climate change at one and the same time.

It is within the context of the above that the assessment team proffers the following recommendations for consideration.

B. Strategic recommendations

(a) Integrate Disaster Risk Reduction (DRR) into long-term development planning and policy measures;

(b) Raise awareness among the poor regarding their capacity to mitigate effects of disaster through more effective risk reduction actions at the community level;

(c) Encourage a debt for risk reduction and disaster mitigation swap with international development partners;

(d) Develop and implement an agricultural insurance scheme for Belize involving the feasibility of parametric products;

(e) Improve data collection and management particularly for DRR;

(f) Strengthen social protection measures that support poor FHH in times of disaster with special public awareness campaigns and incentive measures to encourage DRR to be adopted by such families; and

(g) Provide more training for women farmers in DRR and women who work on farms as part of family farms.

C. Short-to medium-term recommendations

(a) Strengthen programmes that increase value added in the agricultural sector;

(b) Build capacity in disaster damage assessment within all sectors to ensure a consistent framework for the preparation of reports;

(c) Strengthen database systems within the agricultural sector to ensure the availability of reliable baseline data;

(d) Ensure that disaster shelters have a maintenance and upgrade schedule before the start of the hurricane season;

(e) The use of an approved building code in the design of structures is encouraged. For private homeowners, it may be appropriate to promote types of hurricane resistant construction that can be adopted relatively easily (i.e. use of hurricane straps, pitch of roof line, etc.);

(f) Training should be provided for the informal construction sector to reduce the risk in informal home construction;

(g) Undertake a detailed hydraulic analysis of highways leaving Belize City, and the determination of appropriate number of culverts and/or bridges required to adequately drain adjacent lands following a design event. It may also require the raising of the roadway in specific locations, depending on the results of the analyses;

(h) Upgrade culverts to bridges in locations where the design flows are expected to be large;

(i) Set a suitable design standard for highway culverts and drains. The one in five year standard that is presently applied is not sustainable. Note that a 1 in 50-year criterion is used for bridge design;

(j) Allocation of an appropriate budget for the maintenance clearing/cleaning of drains and budget for the maintenance/dredging of critical river mouths in order to reduce incidents of flooding;

(k) Strengthening of capacity in the Ministry of Works (PWD), to upgrade engineering resources of this office;

(l) Strengthening of the linkages between the Met Office and the PWD, to better assist in the design of culverts and bridges through more accurate hydrologic and hydraulic evaluations;

(m) Reduce the risk to the tourism sector through more attention to maintenance of infrastructure, both in terms of access to tourist sites and the maintenance of roads and bridges used by all commuters, of whom tourists are a part;

(n) Increased investment is needed for promotion of the tourism product in order to expand the sector's income throughout the year as a risk reduction mechanism;

(o) The diversification of the tourism product would benefit from the price elasticity of demand in the tourist market and thereby raise the average occupancy rate of tourist accommodation units;

(p) Incentives and disincentives should be provided to households living in flood plains to encourage construction of homes on stilts. The modality of elevating existing houses as done in the Calla Creek should be considered;

(q) Encourage standards for human waste disposal, through the introduction of new solid waste management systems for houses in the flood plains; and

(r) The planning regulations should be expanded to include the concepts of "set back" and "step-up" for all construction on river banks, in order to reduce the vulnerability of these structures.

The evaluators, based on the frequency of national events which impact on Belize, strongly recommend that a study which combines the impact of a series of events on the macroeconomic and social indicators of the country might provide a useful picture of the impacts of such natural events on the development challenges which face Belize.

The positive lessons learned by the negative impact of previous hurricanes were two fold. One was the sound building practices observed in newly-constructed government buildings which had good setbacks from rivers and were built on high ground, particularly schools, health centres and most shelters. The second was in the response of the Ministry of Health to the disaster which averted a health crisis among the population. Both signal good risk management practices which can form the foundation of an integrated Disaster Risk Management Plan.



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