

# **ASSESSMENT OF THE SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT OF HURRICANE DEAN ON JAMAICA**



**Planning Institute of Jamaica  
October, 2007**

## **TABLE OF CONTENTS**

	<b>Page</b>
<b>Executive Summary</b>	<b>i</b>
<b>Preface</b>	
<b>I. Introduction</b>	<b>2</b>
<b>II. Social Sectors</b>	<b>15</b>
<b>III. Productive Sectors</b>	<b>25</b>
<b>IV. Infrastructure</b>	<b>46</b>
<b>V. Impact on the Environment</b>	<b>61</b>
<b>VI. Summary of Damage and Losses and Macroeconomic Effects</b>	<b>71</b>
<b>VII. Guidelines for a Rehabilitation and Reconstruction Programme</b>	<b>79</b>

## **Executive Summary**

As at October 26, 2007 the preliminary estimate of the damage and losses incurred by the Jamaican economy due to the passage of Hurricane Dean on August 19, 2007 was \$23.05 billion (US\$ 329.34 million). See Table 1.

Damage and losses in the productive sector represented the greatest portion of impact accounting for over 50.0 percent of the estimated total. See Figure 1. Most of the cost was incurred within the agricultural sector and is related mainly to projected loss of revenue associated with damage to traditional export crops such as bananas, sugar and coffee. Domestic agriculture, particularly ground provisions, vegetables and pulses, and fruit crops experienced significant impact. While damage to road infrastructure was relatively minimal, there were instances of severe erosion of sea defence which led to the damage of coastal roads in St. Thomas, Portland and St. Andrew and disruption of social and economic activities.

With the effect of Hurricane Dean, the economy is expected to grow by 1.1 per cent for 2007 instead of the 2.1 per cent forecast prior to its passage. This will result from losses in output flows primarily in the Agriculture, Forestry & Fishing, Mining & Quarrying and Electricity & Water sectors. However, the Construction & Installation and Distributive Trade sectors are estimated to be positively impacted by the effects of the hurricane. The Construction & Installation sector is expected to benefit from reconstruction activity. An expansion in activity in the Distributive Trade sector is predicated on projected higher gross sales associated with preparations prior to the hurricane and reconstructive work in the aftermath of the passage of the hurricane.

The social cost of the hurricane was fairly substantial. Approximately 6.7 per cent of the total population or some 179 552 persons from 169 communities were directly affected by the natural disaster. At the peak of the event, a total of 213 shelters were opened across all parishes housing 5 169 persons. The parishes with the highest number of persons in shelters were Portland, Kingston and St. Andrew and St. James with 914; 714; and 555 persons respectively. Up to seven days after the event, 11 communities in the parishes of St. Thomas and Kingston and St. Andrew were still marooned and over 500 persons remained in emergency shelters island-wide. However, by August 26, electricity had been restored to approximately 80 percent of customers and water supplies to close to 90 per cent.

Some 518 schools and public educational institutions and an estimated 70 000 houses were damaged. At the time of the preparation of this report, it was indicated that over 55 per cent of houses assessed had experienced major damage and over 39 per cent were totally destroyed. Most of these were in poor and vulnerable coastal communities such as Old Harbour Bay, Rocky Point and Portland Cottage along the south coast.

The impact on livelihood is considered significant as some 56 537 food crop and 7 170 livestock farmers, and over 3 500 fisher folk were directly affected. The income of some 3 000 banana workers was also affected. The negative impact on crop losses and timing of the hurricane was particularly bad in farming communities as many families which lost crops and income would have been preparing for back to school expenditures.

The Ministry of Health confirmed six (6) deaths due to Hurricane Dean, 4 males and 2 females

resulting from falling concrete block, flying debris, wind effect and roof collapse and two indirect deaths from electrocution. Hospital and sentinel surveillance sites reported 628 injuries between August 19 and 25.

**Table 1:** Preliminary Costs of Damage and Losses caused by Hurricane Dean (\$million)

Sector and Sub-sector	\$million				
	Direct	Indirect	Total	Private	Public
<b>Total</b>	<b>14,392.15</b>	<b>8,661.78</b>	<b>23,053.92</b>	<b>18,753.69</b>	<b>4,300.24</b>
<b>Social</b>	<b>6,994.24</b>	<b>80.18</b>	<b>7,074.42</b>	<b>5,961.68</b>	<b>1,112.74</b>
Housing	5,961.68		5,961.68	5,961.68	
Education and Culture	727.86		727.86		727.86
Health	218.35	80.18	298.53		298.53
Correctional Facilities	77.08		77.08		77.08
Heritage Sites	9.27		9.27		9.27
<b>Productive</b>	<b>3,957.68</b>	<b>7,708.60</b>	<b>11,666.28</b>	<b>11,451.08</b>	<b>215.20</b>
Domestic Crop	904.37		904.37	904.37	
Livestock	74.50		74.50	74.50	
Greenhouse/Protected Cultivation	52.47		52.47	52.47	
Agricultural Crops*1	2,357.45	5,603.00	7,960.45	7,960.45	
Fisheries*2	310.00	75.60	385.60	385.60	
Irrigation	17.20	0.00	17.20	0.00	17.20
Mining		2,030.00	2,030.00	2,030.00	
Tourism	43.69	0.00	43.69	43.69	
Manufacturing		0.00	0.00	0.00	
Relief Assistance (Agriculture)*3	198.00	0.00	198.00	0.00	198.00
<b>Infrastructure</b>	<b>3,440.23</b>	<b>150.00</b>	<b>3,590.23</b>	<b>1,340.93</b>	<b>2,249.30</b>
Electricity*4	1,073.25		1,073.25	1,073.25	
Water Supply and Sanitation	52.00	150.00	202.00		202.00
Transport/Roads and Bridges	2,047.30		2,047.30		2,047.30
Telecommunications*5	267.68		267.68	267.68	
<b>Environment</b>	<b>0.00</b>	<b>120.00</b>	<b>120.00</b>		<b>120.00</b>
Forestry			0.00		0.00
Waste Management		120.00	120.00		120.00
<b>Emergency Operations</b>		<b>603.00</b>	<b>603.00</b>		<b>603.00</b>
Government Relief Assistance		580.00	580.00		580.00
ODPEM Recovery Activities		23.00	23.00		23.00

**Source:** Compiled by the PIOJ with data from various agencies

\*1 Agricultural crops include citrus, coffee, cocoa, banana and sugar

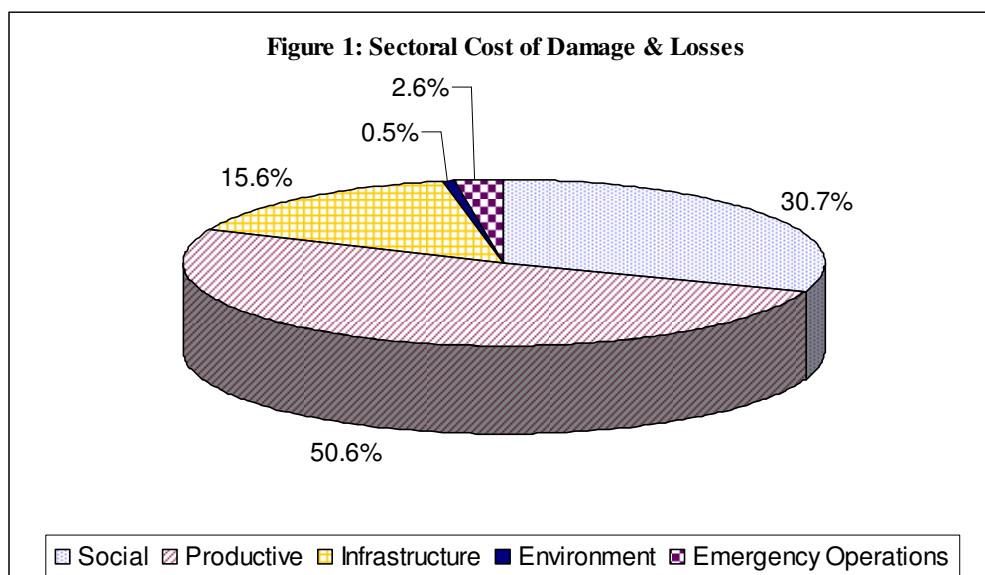
\*2 Calculations for Indirect cost based on 52,500 lost fish traps with an average catch 2kg of fish and harvested 3 times within a 2 week period at a cost of \$240/kg

\*3 Includes funds provided by the MOA to purchase and distribute fertilizer, assistance to farmers who lost greenhouses, rehabilitation of fruit trees, assistance to fishermen and banana farmers and a grant to the Sugar Industry

\*4 Calculated at approximately 75% of JPS claim to OUR for Hurricane Ivan (1.431 billion)

\*5 Includes preliminary estimates of damage to Cable & Wireless, Digicel and Post & Telecommunications infrastructure

Environmental impacts of Hurricane Dean included **damage to coastal and inland ecosystems from storm surge**, and defoliation; destruction of wildlife habitats, landslides and vegetation damage (Table 2). Due to the southerly path taken by the hurricane, most of the impacts occurred in the southern part of the country. The parishes experiencing the worst environmental damage were Portland; Clarendon; Manchester; St. Elizabeth; Hanover and Westmoreland; St. Thomas; Kingston & St. Andrew and St. Catherine.



**Table 2:** Summary of Impacts on Ecosystems by Parish by Hurricane Dean

			HABITAT					
	Beaches		Marshlands		Mangroves		Forests	
IMPACT	Erosion		Lateral Compression		Crown Damage			
PARISH	Level	% Affected	Level	% Affected	Level	% Affected	Level	% Affected
Clarendon	High	100	Low	100	Low	40	Low	90
					Moderate	30	High	10
					High	30		
Manchester	Moderate	100	Moderate	100	Low	20	Low	95
					Moderate	50	Moderate	5
					High	30		
St. Ann							Low	100
St. Catherine	Moderate	40					Low	95
	High	60					Moderate	5
St. Elizabeth	Moderate	100	Low	100	Low	50	Low	95
					Moderate	30	Moderate	5
					High	20		
St. James							Low	100
St. Thomas	Moderate	20			Low	60	Low	95
	High	80			Moderate	40	Moderate	5
Portland	Moderate	40					Low	90
	High	60					Moderate	10
Trelawny							Low	100
Westmoreland							Low	100
St. Mary							Low	100

Source: National Environment and Planning Agency, 2007

Crown Damage: 0-25% - Low; 26-50% - Moderate; > than 50% - High

## **Lessons Learnt**

The impact of Hurricane Dean highlighted issues relating to continued improper land use, building practices and coastal roads design and construction. A considerable portion of the impact resulted from inappropriate location of settlements, for example communities such as Portland Cottage, and Rocky Point in Clarendon and Caribbean Terrace, St. Andrew. The areas affected in Clarendon, St. Catherine, Kingston, St. Thomas and St. Elizabeth are below 10 metres threshold and are therefore prone to flooding. (Figure 5.1).

Planning and design defects were evident and were contributory factors cited with respect to damaged housing in Rocky Point, Clarendon, Portland Cottage, Clarendon, Old Harbour, St. Catherine and White Horses, St. Thomas. In the past, building practices incorporated more mitigation measures and the housing stock were better able to withstand wind and flood impact. Older buildings were likely to be built on stilts with a finish >2ft above ground level compared with newer buildings with a finish of < 1 ft above ground level.

**Coastal Roads:** A common feature of coastal roads in Jamaica is that they are constructed in low lying areas and are therefore prone to flooding and subsequent damage. As evidenced, roads such as Roselle and Palisadoes have been subjected to frequent flooding. The imperative of engineering coastal roads with adequate height (above sea level), drainage, central slope and protective structures to minimize effects from coastal hazards was again underlined.

## **PREFACE**

This report is prepared to document impact on affected population; estimate costs of damages and losses; identify geographically affected areas; and identifying the financial priorities for rehabilitation and reconstruction.

The assessment was prepared by the Planning Institute of Jamaica in close collaboration with the Office of Disaster Preparedness and Emergency Management (ODPEM), and the National Environmental Planning Agency. Data and information were provided by various ministries and agencies of the Government of Jamaica as well as several non-government institutions and private sector entities. These include, among others:

- The Meteorological Office
- Ministry of Labour and Social Security
- Ministry of Health
- Ministry of Education and Youth
- National Works Agency
- Ministry of Water, Housing, Transport and Works
- Ministry of Agriculture and Lands
- RADA
- Insurance Association of Jamaica
- National Water Commission
- Jamaica Public Service

The assessment was made following the standard ECLAC methodology for Estimating the Socio-economic and Environmental Effects of Disasters. The information supplied in the report is preliminary and subject to revision. The cut-off point for data used in the report was October 26, 2007.

# I. INTRODUCTION

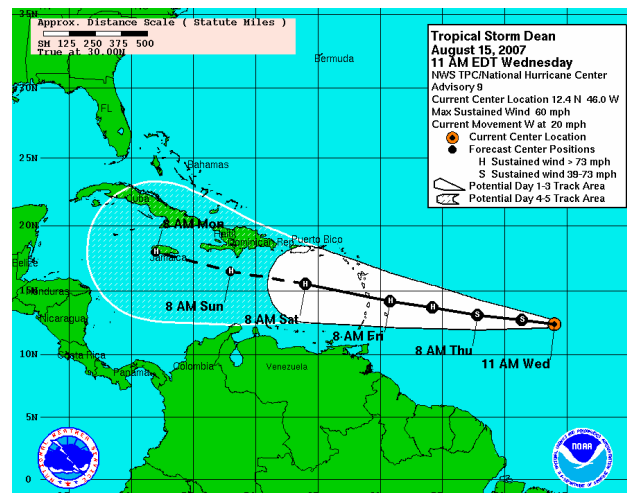
## 1. Description of the Event

### Meteorological Phenomenon

#### Hurricane Dean and its passage

Tropical Depression #4 developed over the far eastern Atlantic near latitude 12.0° North, longitude 31.6° West on August 13 at 1500 UTC and showed signs of strengthening as it moved quickly towards the west. The depression was upgraded to Tropical Storm Dean on August 14 at 1500 UTC and continued on a more or less westward track while continuing to strengthen. On the 15th at 1500 UTC forecast models indicated that the system could have some impact on Jamaica on Monday, August 20. (See Figure 1.1).

Tropical Storm Dean was upgraded to a hurricane on August 16 and continued to strengthen as it moved quickly towards the west. It was further upgraded to a category 2 hurricane on August 16. The forecast track was now for Hurricane Dean to make landfall in the Eastern Caribbean, somewhere in the vicinity of Martinique and to pass just south of Jamaica during the afternoon of Sunday, August 19.



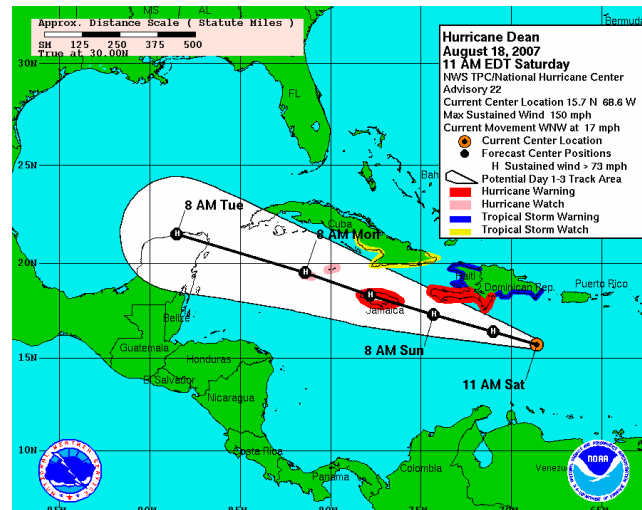
**Figure 1.1:** Tropical Storm Dean at 1500 UTC, August 15, 2007. Projected to impact on Jamaica

Once Hurricane Dean crossed into the Caribbean Sea, environmental conditions became more favourable for continued strengthening, the Meteorological Service, Jamaica (MET) issued Bulletin #1 at 1500 UTC on Friday, August 17 indicating that Hurricane Dean (close to 1500 kilometres (940 miles) east southeast of Morant Point, Jamaica), posed a possible threat to the island. At this time, MET issued an immediate evacuation order for all Fishers on the cays and banks and an advisory for all other small craft operators in coastal waters to return to port and those in port were advised not to venture out.



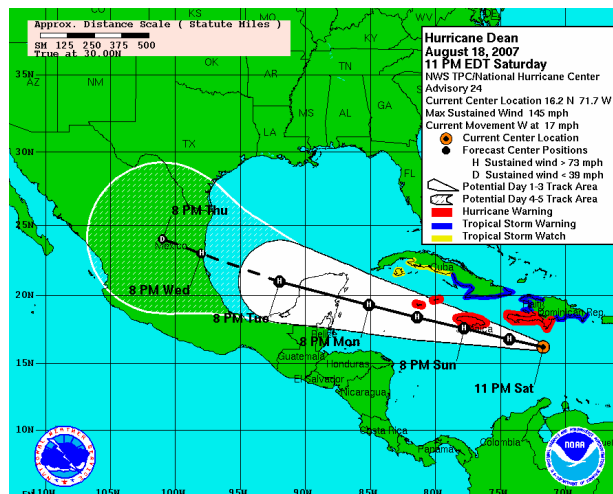
Hurricane Dean was upgraded to a major hurricane (Category 3) with sustained wind speeds near 205 km/h (125 mph) on the 17<sup>th</sup>. The Hurricane Watch was continued for the island overnight while Hurricane Dean strengthened to become a dangerous category 4 hurricane at 1200 UTC.

MET upgraded the Hurricane Watch to a Hurricane Warning on Saturday August 18. The forecast was for Hurricane Dean to move south of Hispaniola overnight and then to make landfall over eastern Jamaica during the afternoon on Sunday, August 19 before tracking across the island Sunday evening/night. (See Figure 1.2).



**Figure 1.2:** Hurricane Dean at 1500 UTC, August 18, 2007.

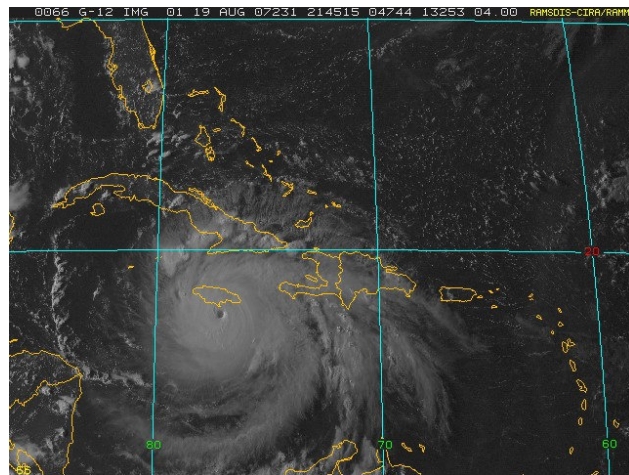
The outer bands of the hurricane were forecast to start affecting the island by late Saturday night with increasing cloudiness, showers and gusty winds. On August 19 (10 p.m. local time Saturday night) the forecast track was adjusted to indicate that the eye of Hurricane Dean could now move very close along the south coast of Jamaica on Sunday afternoon and through the evening (see Figure 1.3). The forecast was for the outer bands of the hurricane to start affecting the island by early Sunday morning with periods of showers and gusty winds reaching near gale force. With Dean's approach, heavy rainfall was expected to spread across the island with the potential for severe flash flooding and landslides. Storm surge flooding of 1.5-3 metres (7-9 feet) above normal tide levels along with large and dangerous battering waves were also forecast near the centre of Dean, especially over southern coastal areas.



**Figure 1.3:** Hurricane Dean at 0350 UTC, August 19, 2007.

Weather conditions associated with Hurricane Dean started to affect Jamaica, especially eastern parishes at around 1245 UTC (0745 hours local time) on Sunday morning August 19. MET indicated that these conditions could spread westward to influence the entire island and as the eye of Hurricane Dean moved closer to the island, weather conditions progressively deteriorated (see Figure 1.4). Hurricane Warnings remained in effect for Jamaica as heavy rains associated with Hurricane Dean began to affect the eastern sections of the island as the system approached.

Hurricane Dean continued west just off the south coast with an average forward speed of 31 km/h (19mph) to pass between the Pedro Banks and the mainland. The eye of Hurricane Dean was located at its possible closest position to the mainland at 1800 hours local time when it was estimated to be about 35 kilometres (21 miles) south of Portland Point, central Jamaica. An hour later on the 20th at 0000 UTC (1900 hours local time Sunday night) the eye of Hurricane Dean was located about 40



**Figure 1.4:** Satellite imagery of Hurricane Dean near its possible closest position to mainland Jamaica on August 19, 2007 at 2145 UTC (1645 hours local time)

kilometres (25 miles) south of Lover's Leap, St. Elizabeth. Between this time and the next half hour wind speeds reaching 165 km/h or 103mph; category 2 hurricane force wind speed were reported at Munro just to the north of Lover's Leap.

The Hurricane Warning in effect for Jamaica was downgraded to a Tropical Storm Warning in at 1500 UTC on August 20. The final Bulletin was issued by MET on the 20th at 1800 UTC lifting all warning messages for the island.

### **Meteorological Data Analysis**

Data collection associated with the passage of Hurricane Dean has been limited due to a number of challenges: At the Norman Manley International Airport, the weather station tower was blown

down just after 1800 UTC (1300 local time) on Sunday, August 19, which resulted in the loss of data. Data from the station located at the Pedro Bank were limited due to communication difficulties. Rainfall data is limited as a result of the loss of a number of rain gauges and the fact that manual collection of data from most of the stations in remote areas was not possible due to the inaccessible roadways. Available data associated with the passage of Hurricane Dean are presented as follows:

*Folly Point (Portland):*

Data recorded at the Folly Point automatic weather station located in north-eastern Portland indicated that there was a gradual increase in wind speed and the resultant gradual decrease in the atmospheric pressure to the point of the maximum sustained wind speed. The maximum wind speed recorded was 43.6 knots or 80.7 km/h or 50.1 mph at 1928 UTC (1428 hours local time) on the 19th. The minimum pressure recorded was, however, not at the time of maximum wind but lagged by one and a half to 2 hours to be recorded as 1000.0 millibars at 2058 UTC and 2128 UTC (that is 1558 and 1628 hours local time) respectively. After the passage of the trough line there was a gradual decrease in wind speed and a gradual increase in atmospheric pressure. Tropical storm force winds were recorded at Folly Point between 1828 UTC and 2258 UTC (1328 and 1758 hours local time). Rainfall amounts recorded at Folly Point on August 19 was 106.4 mm with a maximum half-an-hour rainfall of 14.4mm between 2258 and 2328 UTC and a 1 hour maximum rainfall amount of 25.0 mm between 2228 and 2328 UTC on the 19th (see Appendix 1 for Folly Point data).

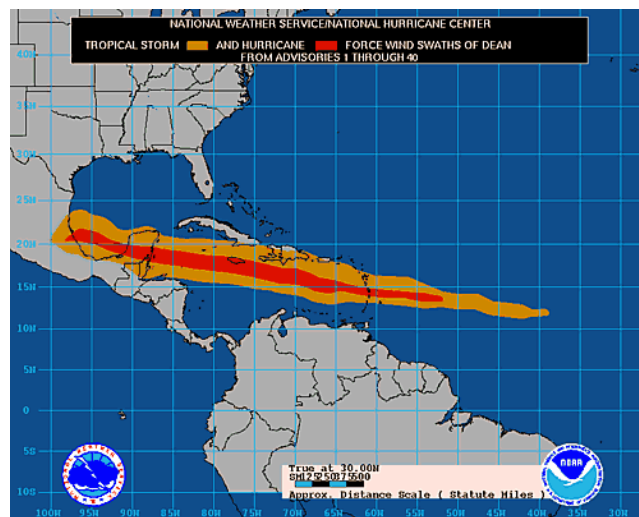
*Morant Point (St. Thomas):*

At the Morant Point automatic weather station located in eastern St. Thomas, the average one hour winds increased gradually to a maximum of 54.5 knots or 100.8 km/h or 62.7 mph at 1747 UTC (1247 local time) and then gradually decreased thereafter. There was a corresponding gradual decrease in atmospheric pressure to a minimum of 999.1 millibars at 2047 UTC (1547 local time ), lagging the maximum wind speed by about 3 hours and then there was a gradual increase in the pressure afterwards. Tropical storm force winds were experienced at Morant Point between 1647 UTC and 2347 UTC (1147 and 1847 hours local time) (see Appendix 2 for Morant Point data).

## Reports from Ham Radio Operators:

One Ham Radio Operator in Stony Hill, St. Andrew reported maximum sustained wind speeds of 120 km/h or 75 mph and a corresponding atmospheric pressure of 992 millibars at 2219 UTC (1719 hours local time) on Sunday August 19. Another operator in Portmore, St. Catherine reported maximum sustained wind speeds of 158 km/h or 98 mph at about 2030 UTC (1530 hours local time), while a third operator in Munro, St. Elizabeth

reported sustained wind speed of 165 km/h or 103 mph between 0000 and 0030 UTC on the 20th (1900 and 1930 hours local time Sunday August 19) before the instrument broke. Wind speeds reported in Portmore and Munro indicated Category 2 hurricane force winds, while those reported in Stony Hill were category 1 hurricane force winds. These seem to be consistent with the swath of the wind data from the National Hurricane Centre (see figure 1.5) indicating that Jamaica should have experienced hurricane force winds.



**Figure 1.5:** Hurricane and Storm force wind profile associated with Dean.

## Rainfall

Most of the rain gauges along the south coast of the island were either washed away or blown away. As a result, just a few stations were able to report rainfall (Appendix 3). Of those stations able to report rainfall, Ingleside in Manchester reported the maximum 24 hour rainfall of 342.9 mm. This was followed by amounts of 256 mm recorded at the Sugar Industry Research Institute (S.I.R.I.) station also in Manchester. This amount represents 183 % of the normal rainfall expected for that station for the month of August. In St. Thomas, the amount of rainfall recorded over the 2-day period August 19 and 20 for Morant Bay was 331.5 mm or 217% of the normal expected for that station for the month of August. Norris also in St. Thomas followed with 24 hour rainfall amounts of 210 mm on the 19th. In St. Catherine, the two Bernard lodge stations (Blair Pen 251% and Phoenix Park 211%) reported in excess of 200% of normal rainfall

expected for the month of August. Other stations reporting in excess of 100% of normal rainfall were: Kingston & St. Andrew; Norman Manley International Airport (130.2 mm or 161% of the normal for August); New Yarmouth in Clarendon 158% and Monymusk in Clarendon 117%. Windsor Park in St. Catherine received (127%) of normal rainfall expected for the month of August.

The maximum 24 hour rainfall amounts associated with the passage of Hurricane Dean was 133.4 mm (see Appendix 4). In general, no significant flooding was associated with the passage of Hurricane Dean. This may be attributed to the fact that Hurricane Dean was traveling quite quickly as it moved offshore the south coast. Some level of flooding was, however, reported in eastern parishes which had possible saturated ground conditions resulting from heavy rainfall the previous week.

## **2. Emergency Actions**

In preparation for Hurricane Dean a fully functional National Emergency Operations Centre (NEOC) was activated on August 19 and a mandatory evacuation order was issued for some 25 coastal and flood prone communities in Portmore and Nightingale Grove in St Catherine, Bull Bay St. Andrew, Seaforth and Bath in St. Thomas, and Port Royal in Kingston. In response to the impact of the event, the Office of Disaster Preparedness and Emergency Management (ODPEM) carried out several emergency activities. Within 12 hours of the event, two rapid aerial reconnaissance flights were undertaken primarily along the southern parishes of the island. These flights covered the parishes of Westmoreland, St. Elizabeth, Manchester, Clarendon, St. Catherine, Kingston & St. Andrew, St. Thomas, Portland and St. Mary. Within three days of the event 12 damage assessment field visits were conducted by the ODPEM in the parishes of St. Catherine, Clarendon, Manchester, St Elizabeth and Kingston and St. Andrew. Food drops were also made to 10 marooned communities (Westphalia, Halls Delight, Hagley's Gap, Penlyne Castle, Tower Hill, Lime Tree, Big Tree Pear, Somerset, River Head and St. Peter) and water tanks and stations set up in affected communities like Portland Cottage, Old Harbour and Old Harbour Bay.

At the peak of the event a total of 213 shelters were opened across all parishes housing 5,169 persons (Table 1.1). The parishes with the highest number of persons in shelters were Portland,

Kingston and St. Andrew and St. James with 914; 714; and 555 persons respectively. By August 24, 5 days after the event, 1 293 persons remained in 58 shelters in 9 parishes, down from the 6 445 persons in 268 shelters in the days immediately following the event.

**Table 1.1:** Number of Persons in Shelters, August 19,2007

PARISH	NO. OF SHELTERS	NO. OF PERSONS
Trelawny	19	451
St. Thomas	14	264
St. Mary	5	68
St. James	22	555
St. Catherine	16	394
St. Ann	19	461
Portland	31	914
Manchester	21	90
KSA	21	714
Hanover	17	268
Clarendon	11	415
Westmoreland	8	352
St. Elizabeth	9	223
<b>TOTAL</b>	<b>213</b>	<b>5169</b>

Source: ODPEM

The emergency distribution of critical relief supplies commenced the day after the event and was undertaken through the combined efforts of the ODPEM, MLSS, Local Authorities and other volunteer organisations. The National Welfare Sub-committee established 30 registration centres in Kingston & St. Andrew for persons who were severely impacted by the event. At August 25, a total of 13 026 relief items were distributed islandwide. These included foam pads, collapsible water containers, plastic plates, forks, spoons, rain coats, plastic sheeting, canned food, hygiene kits, adult blankets, tarpaulins, lanterns, bottled water, and flash lights. The cost of emergency activities coordinated and executed by the ODPEM was estimated at \$ 4.8 million.<sup>1</sup>

The Government of Jamaica's relief assistance took the form of two special hurricane relief benefits package amounting to some \$580 million dollars. Over 90 000 households registered under the Programme for Advancement Through Health and Education (PATH)<sup>2</sup> received cash grants valued at \$2 000 each, while some 75,000 National Insurance Scheme (NIS) pensioners

<sup>1</sup> This figure does not include Jamaica Defense Force (JDF) activities and parish level recovery activities.

<sup>2</sup> PATH is a programme funded by the Government of Jamaica and the World Bank, aimed at delivering benefits by

and elderly received a special payment of \$5 000.

### **3. International Assistance**

In the period immediately following the event, contributions in cash and kind from the regional and international community as well as the International Development Partners (IDPs), totaled an estimated US\$1.4 million. These resources were mainly channeled through government agencies and non-governmental organizations.

For the recovery and reconstruction phase, approximately US\$5.9 million in cash and kind have been donated and pledged by several countries, international donors as well as the private sector.

Further discussions will be conducted between the Government of Jamaica and the IDPs regarding loans and grants which can be accessed to facilitate the recovery and reconstruction efforts over the short to medium term.

### **4. Affected Population**

The projected population when Hurricane Dean struck the island on August 19 was 2.68 million. Approximately 6.7 per cent of the total population or some 179 552 persons<sup>3</sup> from 169 communities were directly affected by the natural disaster. Table 1.2 and Figure 1.6 indicate that the most severely impacted parishes and communities were:

- 1 Kingston & St. Andrew - Bull Bay, Caribbean Terrace,
- 2 St. Catherine - Old Harbour Bay,
- 3 Clarendon - Rocky Point and Portland Cottage.
- 4 St Elizabeth – Southern belt
- 5 Manchester – Southern sections including Cross Keys, Prattville and Alligator Pond
- 6 St. Thomas

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way of cash grants to the most needy persons in the society

<sup>3</sup> Calculations based on number of households assessed by MLSS as at October 8, 2007

**Table 1.2: Jamaica: Estimated Population Affected by Hurricane Dean**

	<b>End of Year Population 2003</b>	<b>%</b>	<b>End of Year Population 2004</b>	<b>%</b>	<b>End of Year Population 2005</b>	<b>%</b>	<b>End of Year Population 2006</b>	<b>%</b>	<b>Projected Population At the time of Hurricane Dean (August 19, 2007)</b>	<b>Estimated Population Affected during Hurricane Dean</b>
<b>Jamaica</b>	<b>2,635,673</b>	<b>100.0</b>	<b>2,648,224</b>	<b>100.0</b>	<b>2,660,723</b>	<b>100.0</b>	<b>2,673,815</b>	<b>100.0</b>	<b>2,682,278</b>	<b>179,552</b>
<b>Kingston and St. Andrew</b>	653,379	24.8	656,062	24.8	658,759	24.8	661,594	24.7	663,688	30,624
<b>St. Thomas</b>	92,587	3.5	92,917	3.5	93,243	3.5	93,596	3.5	93,892	21,049
<b>Portland</b>	80,866	3.0	81,131	3.1	81,393	3.1	81,678	3.1	81,936	7,730
<b>St. Mary</b>	112,614	4.3	112,909	4.3	113,204	4.2	113,529	4.3	113,888	6,925
<b>St. Ann</b>	169,477	6.4	170,382	6.5	171,282	6.4	172,220	6.4	172,765	2,136
<b>Trelawny</b>	74,163	2.8	74,347	2.8	74,713	2.8	75,097	2.8	75,335	1,450
<b>St. James</b>	179,657	6.8	180,350	6.8	181,728	6.8	183,142	6.8	183,722	4,333
<b>Hanover</b>	68,302	2.6	68,528	2.5	68,978	2.6	69,445	2.6	69,665	1,146
<b>Westmoreland</b>	141,666	5.4	142,127	5.4	143,042	5.4	143,990	5.4	144,446	776
<b>St. Elizabeth</b>	148,354	5.6	148,693	5.5	149,368	5.6	150,081	5.6	150,556	13,512
<b>Manchester</b>	187,875	7.1	188,215	7.3	188,885	7.1	189,605	7.1	190,205	16,001
<b>Clarendon</b>	241,792	9.2	242,389	9.1	243,575	9.2	244,820	9.2	245,595	50,425
<b>St. Catherine</b>	488,979	18.5	490,174	18.4	492,551	18.5	495,018	18.5	496,585	23,445

Source: Demographic Statistics 2006

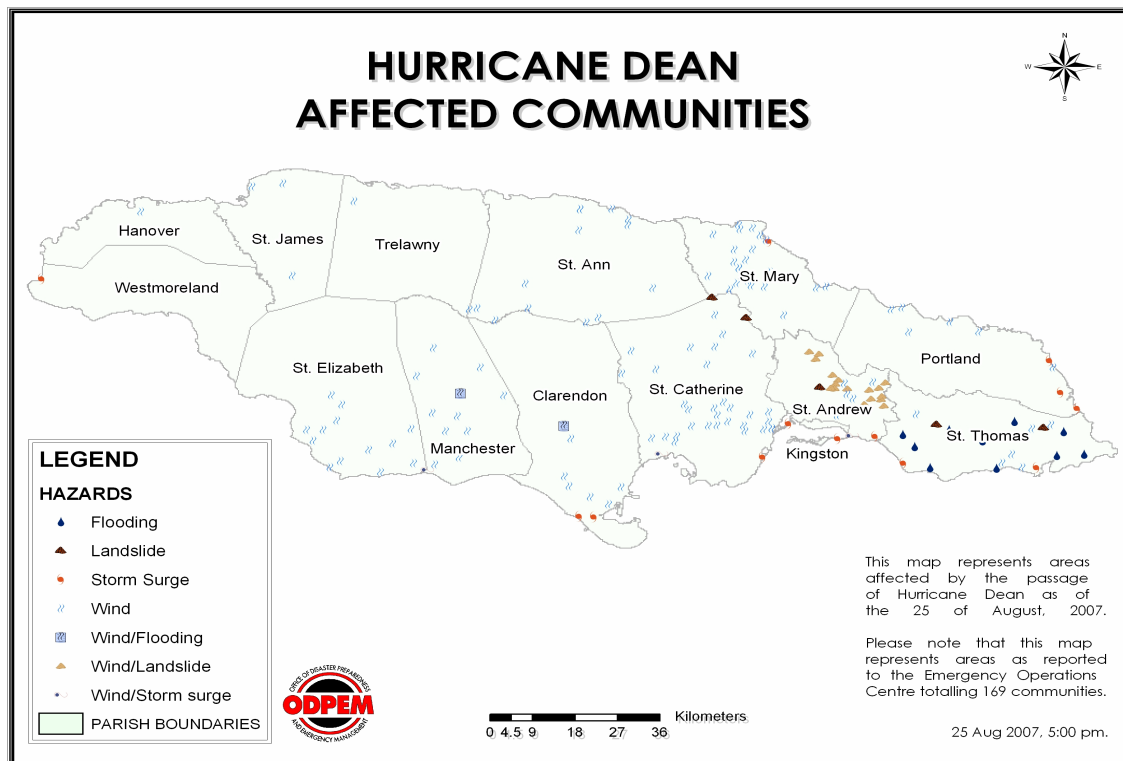
Note: Population Projection by the Social Policy, Planning and Research Division, PIOJ.

Estimated population affected during Hurricane Dean was calculated using the Mean Household Size by Parish, Jamaica Survey of Living Conditions, Parish Report 2002.

Up to seven days after the event 11 communities in the parishes of St. Thomas and Kingston and St. Andrew were still marooned. Figures 1.6 show the location of affected communities.



**Figure1.6:** Hurricane Dean Affected Communities



**Source:** ODPem

As at September 30, the cost of insurance claims for damage caused by Hurricane Dean was estimated at \$2215.98 million<sup>4</sup>. Of a total of 2733 claims, 1550 were related to housing and personal effects, 1002 to business properties and 181 to motor vehicles. (See Table 1.3)

**Table 1.3 :** Insurance Claims for Damage caused by Hurricane Dean

Type of Claim	Cost (\$ million)	Number of Claims
Personal Lines	837.78	1550
Commercial Lines	1,368.20	1002
Other Lines (Motor)	10.00	181
<b>Total</b>	<b>2,215.98</b>	<b>2733</b>

**Source:** Insurance Association of Jamaica

<sup>4</sup> Estimate based on responses from 11 general insurance companies.

## 5.0 Impact on livelihoods and women and children

The farming community was among the most severely affected by the hurricane given the geographical location of greatest impact as well as the overall impact on the agriculture sector. It is estimated that in the banana industry, the livelihoods of over 3 000 persons were directly affected while an additional 8 000 persons including shopkeepers, processors, truckers etc. had their income disrupted. A total of 810 growers who supply the domestic and export markets were also affected.

Overall, 56 537 food crop farmers and 7 170 livestock farmers were negatively affected by Hurricane Dean. The data suggest that many of these farmers had small holdings (Table 1.4). The impact on vegetable farmers, at about 20 per cent of the overall losses in domestic agriculture, was significant and was particularly noticeable in Clarendon, Manchester and St. Elizabeth. In these parishes some 20 000 vegetable farmers lost 850 hectares<sup>5</sup> of the 1314 hectares of vegetables and pulses damaged. Livestock farmers in these three parishes also suffered relatively heavy losses especially with respect to poultry where they accounted for some 60 percent of the number of birds lost.

**Table 1.4:** Number of Farmers Affected and Value of Losses by Parish

PARISH	Affected Farmers (Food Crop)	Value (\$M)	Affected Farmers (Livestock)	Value (\$M)
St. Catherine	5000	23.10	500	9.00
St. Andrew	3000	74.00	360	1.95
Portland	3358	99.60	125	2.15
St. Ann	4200	64.85	300	2.14
St. Mary	4850	71.63	300	0.77
St. Thomas	6000	46.00	670	7.36
Clarendon	8000	104.99	2000	18.13
St. Elizabeth	5179	60.50	1313	21.94
Manchester	6678	153.00	1295	5.00
Hanover	1100	46.60	80	2.09
Trelawny	4680	66.50	30	2.00
St. James	2820	71.60	37	0.60
Westmoreland	1672	22.00	160	1.38
<b>Total</b>	<b>56537</b>	<b>904.37</b>	<b>7170</b>	<b>74.50</b>

Source: RADA

In the fishing industry, approximately 3 500 marine fisher folk, mainly on the south coast, were directly impacted as they lost fishing equipment including nets and traps. Assuming that each fisher supplies an average of two vendors, the minimum indirect impact would be approximately 7 000 persons. The extent of the impact for these persons would have been worsened by the length of the recovery period which itself was extended by the severe erosion of some fishing beaches and destruction of fishing villages. The income flow of these persons would also have been disrupted by reduction in demand, as electricity supplies were not restored to approximately one-third of customers up to seven days following the event. It is anticipated that the worst affected persons would require some 2 - 6 weeks before returning to their fishing activities. Men constitute the largest proportion of fishers and would therefore bear the greatest over-all burden of damage and loss in this industry. The gender impact was nonetheless severe for women who make up the largest portion of fish vendors.

The main livelihood impact of the hurricane would have been on small farmers<sup>6</sup>, farm families and persons involved in related economic activities such as vending and shop keeping. The timing of the hurricane would have amplified the impact, particularly in farming communities as many families would have been preparing for back to school expenditure.

Approximately 1,237 children plus their respective care givers were affected by damage to nineteen (19) residential Child Care Facilities, six (6) of which are Government facilities.

## **6.0 Casualties**

The Ministry of Health has confirmed six (6) deaths due to Hurricane Dean, 4 males and 2 females. Table 1.5 outlines that there were four direct deaths resulting from falling concrete block, flying debris, wind effect and roof collapse and two indirect deaths from electrocution. Hospital and sentinel surveillance sites reported 628 injuries between August 19 and 25<sup>7</sup>.

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<sup>5</sup> Approximately two-thirds the total hectareage lost

<sup>6</sup> As in the case of fishing, most farmers are males but women are predominate with respect to the vending of farm produce

<sup>7</sup> A total of 213 injuries were reported for August 25, 2007. These may not be directly hurricane related but reflects injuries in the post hurricane period.

**Table 1.5:** Summary of Confirmed Deaths Related to Hurricane Dean

<b>Parish</b>	<b>Date of Death</b>	<b>Sex</b>	<b>Age</b>	<b>Cause</b>	<b>Remarks</b>
St. Thomas	8/19/2007	F	14	Head Injury	Head Crushed by rock
St. Elizabeth	8/19/2007	F	48	Abdominal Trauma	Flying Debris
Clarendon	8/19/2007	M	44	Crush Injury	Roof Collapsed
Manchester	8/19/2007	M	34	Motor Vehicle Accident	Wind effect
St. Andrew	8/18/2007	M	34	Electrocuted	Pruning a tree
St. Catherine	8/23/2007	M	ND	Electrocuted	Repairing JPS line

**Source:** Ministry of Health

**ND:** Not Determined

## II. SOCIAL SECTORS

### 1. Education

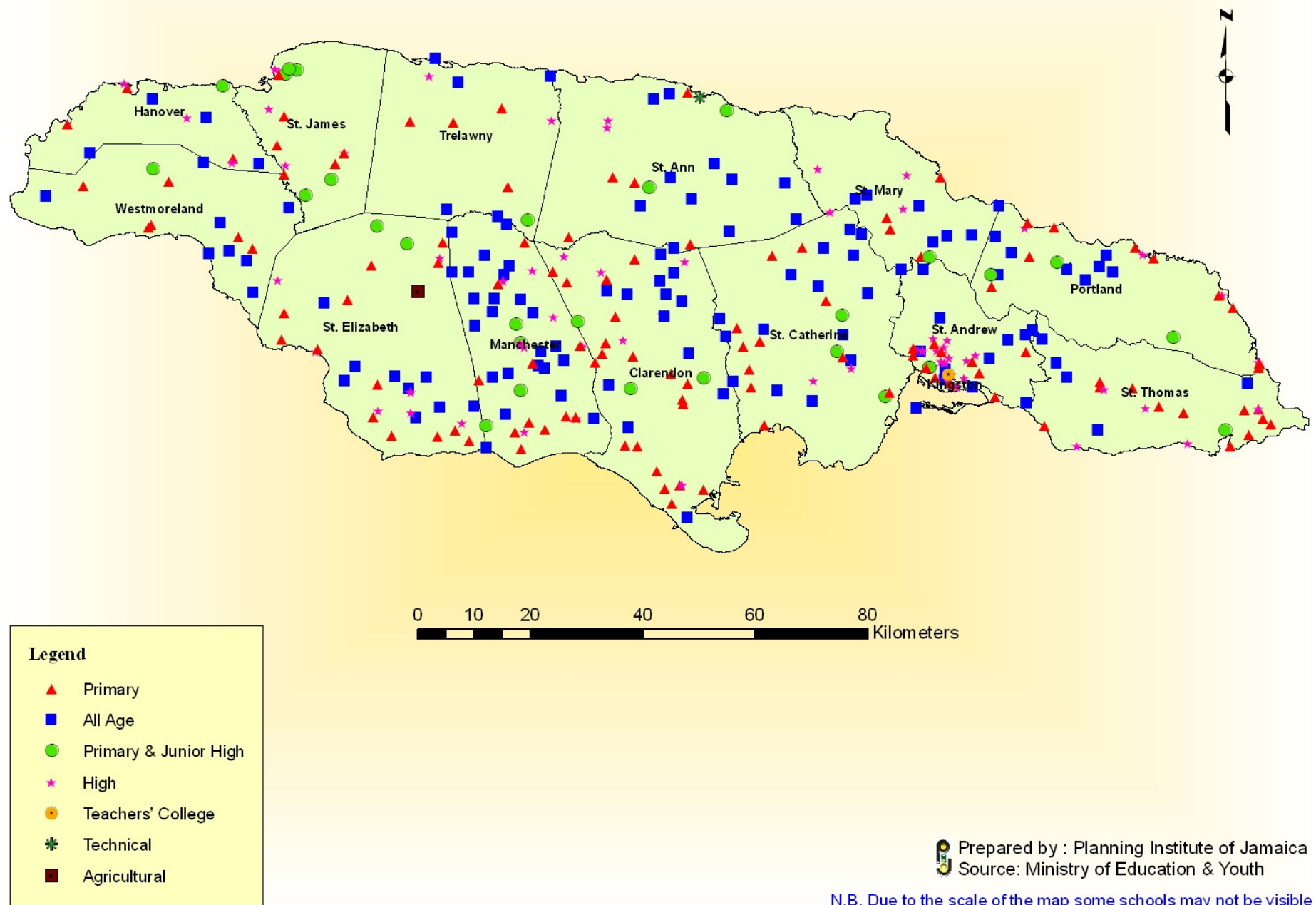
Damage to the education sector (public institutions) was significant. Preliminary reports from the Ministry of Education and Youth (MoEY) indicated that 518 primary and secondary schools and the Ministry's offices sustained damage estimated at \$727.86 million. The damage was mostly to roofs and structures. There was also damage to electrical equipment, sanitary facilities and fences. Numerically, the schools in southern parishes accounted for the majority of the damage with Kingston and St. Andrew (KSA) schools accounting for 14.7 per cent, St. Catherine 11.78, Manchester 11.20 percent, Clarendon 10.23 per cent, and St. Elizabeth 9.65 per cent (see Figure 2.1). Since the hurricane occurred during the summer holidays, classes were not disrupted. Despite the damage sustained and the fact that many schools were used as shelters, most schools reopened on schedule for the beginning of the Christmas term.

**Table 2.1:** Damage to Primary and Secondary Schools

Parish	No. of Schools	Total Estimated Cost (Million)
KSA	76	113.18
St. Thomas	25	38.13
Portland	26	11.97
St. Mary	25	26.57
St. Ann	51	48.07
Trelawny	19	19.94
St. James	32	53.81
Hanover	21	10.65
Westmoreland	21	13.25
St. Elizabeth	50	136.49
Manchester	58	166.98
Clarendon	53	43.47
St. Catherine	61	35.36
Schools Equipment & MoEY Offices		10.00
<b>Total</b>	<b>518</b>	<b>727.86</b>

Source: Ministry of Education and Youth

**Figure 2.1: Primary and Secondary Schools Affected by Hurricane Dean  
August 19, 2007**



The Early Childhood Commission (ECC) reported that a total of 179 basic schools were affected by Hurricane Dean. Thirteen (7%) were mildly damaged (e.g. leaking roof,), 84 (47%) were moderately damaged (e.g. part of roof damaged, bathroom or kitchen damaged) and 82 (46%) were severely damaged (roof completely damaged).

## 2. Housing

As at September 14, approximately 54 percent of the estimated number of houses reportedly damaged had been assessed by the Ministry of Labour and Social Security (MLSS). Table 2.2 shows the summary of the assessments and the cost of the damage by parish. Most of the assessments were done in the southern parishes, which were more severely affected by Hurricane Dean.

**Table 2.2:** Summary of Damages to the Housing Sector

PARISH	Assessment							
	# Assessed	Minor Damage	COST \$	Major Damage	COST \$	Totally Destroyed	COST \$	No Damage
KSA	5746	2643	49952700	2682	506898000	342	258552000	
St. Thomas	4479	2679	50633100	1429	270081000	371	280476000	
Portland	1505	764	14439600	641	121149000	100	75600000	
St. Mary	1486	664	12549600	758	143262000	74	55944000	17
St. Ann	532	276	5216400	215	40635000	41	30996000	
Trelawny	346	75	1417500	244	46116000	27	20412000	
St. James	1146	659	12455100	347	65583000	40	30240000	
Hanover	358	155	2929500	169	31941000	34	25704000	
Westmoreland	203	97	1833300	93	17577000	13	9828000	
St. Elizabeth	2338	1367	25836300	896	169344000	75	56700000	
Manchester	3515	1591	30069900	1708	322812000	216	163296000	
Clarendon	10713	4243	80192700	5161	975429000	1327	1003212000	
St. Catherine	5759	2840	53676000	2307	436023000	612	462672000	
<b>Total</b>	<b>38126</b>	<b>18053</b>	<b>341201700</b>	<b>16650</b>	<b>3146850000</b>	<b>3272</b>	<b>2473632000</b>	<b>17</b>
<b>TOTAL DAMAGE</b>							<b>5961683700</b>	

Source: MLSS

The total damage to the housing sector was estimated at \$5,961.7 million, of which 41.5% were for totally destroyed structures, 52.8% for major damage and 5.72% for minor damage<sup>8</sup>. Areas with totally destroyed houses included were vulnerable areas such as Rocky Point and Portland Cottage in Clarendon, Old Harbour Bay St. Catherine and Manchioneal, Portland.

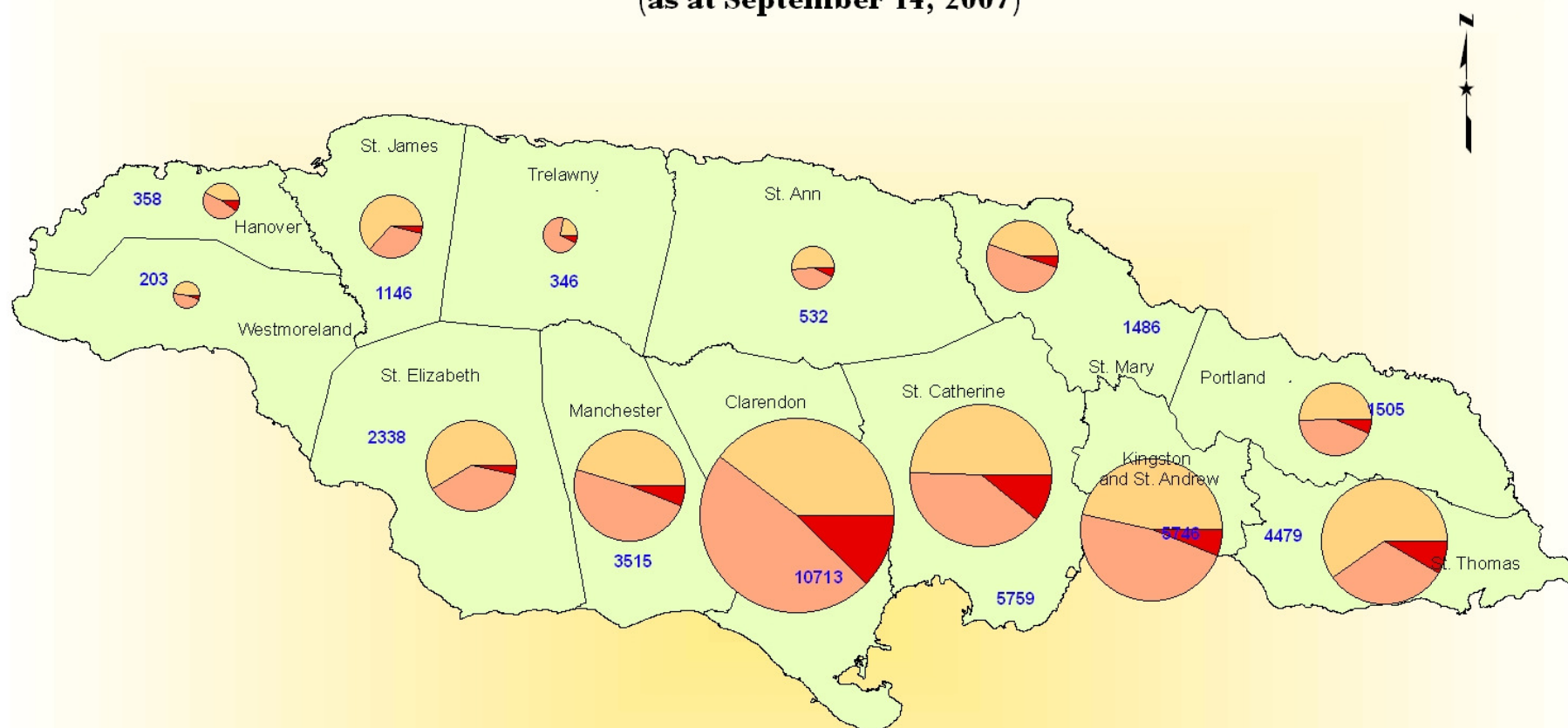
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<sup>8</sup> Based on the varying quality of housing, calculations were based on the following assumptions:

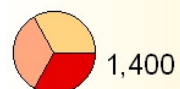
1. A 12x18 feet starter house (concrete) is \$3 500 per square foot totaling \$756 000
2. Repairing minor damage = 2.5% of the cost of the building
3. Repairing major damage (an entire roof) = 25% of the cost of the building



**Figure 2.2: Number of Households Suffering Damage Due to Hurricane Dean  
(as at September 14, 2007)**



Number of Households Assessed



### 3. Public Buildings

#### a) Correctional Facilities & Police Stations

Roof, window and other structural damage were reported by 47 police stations in 11 parishes affected by flooding and wind damage. Stations most affected are shown in Table 2.3.

**Table 2.3:** Stations Most affected by Hurricane Dean

PARISH	STATION	TYPE OF DAMAGE
St. Mary	Highgate	Extensively damaged
Clarendon	Exeter	Roof blown off
St. Elizabeth	Malvern	Major damage and flooding
St. Catherine	Shady Grove	Roof totally destroyed Major damage to building
St. Catherine	Old Harbour Bay	Roof totally destroyed
St. Thomas	Bath	Roof totally destroyed.

Source: Jamaica Constabulary Force

All the above stations had to be relocated. Damage was also sustained by some non-geographic sections of the Jamaica Constabulary Force (JCF) including the facilities of the Mounted Troop, Twickenham Park Training Estate, Community Relations and Traffic Headquarters which suffered flooding and major roof damage.

The Department of Correctional Services reported damage to 12 correctional institutions. Most facilities affected suffered damage to roofs, fencing and windows. Six dormitories at the Tamarind Farm Adult Correctional Facility sustained significant damage to roofs. Total damage to correctional facilities has been estimated at \$77.08 million.

## **b) Heritage Sites**

The National Heritage Trust reported damage to their headquarters and office in Roxborough, Kingston, as well as 12 of its heritage sites. The roof of the Auxiliary building of the historic Naval Hospital was blown off while 25 % of the brick wall of the historic Military Barracks in Spanish Town collapsed. Several windows of the historic Kings House in Spanish Town Square were also damaged. Damage to heritage sites and structures is estimated at \$9.28 million.

## **4. Health**

Damage and losses to the health sector totaled \$298.53 million (Table 2.3). Damage to infrastructure (roofs and structure) accounted for 62.23 per cent. However, 258 (84.9%) of the 304 health centres islandwide were operational within a week of the passage of Hurricane Dean. Only one of the 25 hospitals islandwide suffered damage to the extent that services were interrupted for up to five days after the event (Figure 2.3). As such, up to Sunday August 27, only partial services –in-patient and emergency services) were being offered at the Lionel Town Hospital.

Nineteen (19) residential Child Care Facilities were damaged with estimates of \$78.8M. Six (6) of these are Government facilities with estimates of \$47.1M. The majority have sustained roof loss or damage.

Direct damage, including hospitals and health centers, accounted for \$ 218.35 million, of which 85.08 per cent (\$ 185.77 million) relate to partial damage or total destruction of infrastructure. Over 14 per cent of the direct costs were for the replacement of latrine facilities while 0.5 per cent was for loss of equipment, furniture, pharmaceuticals, sundries and supplies.

The critical facilities for roof and structural repairs are:

1. National Public Health Laboratory – was undergoing work prior to the event
2. Shalimar Stores (Main MOH stores)
3. Ken Royes Rehabilitation Centre

**Figure 2.3: Hospitals and Health Centres Damaged by Hurricane Dean**



**Legend**

- Hospital
- Health Centre
- Parish

N.B. The following health centres are not shown on the map:  
 Mavis Bank, Bartons, Guys Hill, Kitson Town, St. Catherine,  
 Clarendon, St. Elizabeth & Smatt Road

4. St. Ann's Bay hospital – Main surgical ward
5. Lionel Town hospital – Doctor's quarters.
6. Falmouth hospital – kitchen, linen and store room
7. Savanna-la-Mar hospital – partial roof damage
8. Black River hospital – structural damage

**Table 2.3:** Summary of Damage to the Health Sector

	<b>Damage</b>		
	<b>Total (J\$)</b>	<b>Direct (J\$)</b>	<b>Indirect (J\$)</b>
Partial or total destruction of infrastructure	185,769,100.00	185,769,100.00	0.00
Loss of equipment and furniture	3,700,000.00	1,200,000.00	2,500,000.00
Loss of vaccines	0.00	0.00	0.00
Loss / replacement of pharmaceuticals, sundries and supplies	14,700,000.00	200,000.00	14,500,000.00
Vector Control	13,700,000.00	0.00	13,700,000.00
Water Quality Monitoring	1,500,000.00	0.00	1,500,000.00
Environmental Health Sanitation	645,000.00	0.00	645,000.00
Latrine Replacement	31,180,000.00	31,180,000.00	
Health Education Programme	11,583,733.00	0.00	11,583,733.00
Epidemiological/Shelter Surveillance	5,250,000.00	0.00	5,250,000.00
Vehicles	25,000,000.00	0.00	25,000,000.00
MOH Emergency Operations Centre	5,500,000.00	0.00	5,500,000.00
<b>Total</b>	<b>298,527,833.00</b>	<b>218,349,100.00</b>	<b>80,178,733.00</b>

**Source:** Emergency, Disaster Management and Special Services Branch, MOH September 14, 2007

Indirect losses to the health sector amounted to \$80.18 million (26.86% of total damage and losses), which could be attributable to the response of the health sector to the challenges brought on by the passing of Hurricane Dean. Special health education programmes had to be mounted in order to increase knowledge of water safety; proper personal hygiene; food safety; mosquito, fly and rodent control; and the prevention of disease outbreaks such as malaria and leptospirosis.

## **Environmental Health**

In the area of environmental health focus was placed on the priority areas of water quality control monitoring, food safety, vector control and environmental sanitation. Monitoring continued at water supply points, treatment plants and at distribution points with water quality improving as electricity returned to plants and turbidity improved. Up to ten days after the event food safety inspections led to 90,000 kg of meat, 8,300 kg of ice cream, 300 kg milk and 220kg of patties being seized and condemned islandwide.

Comprehensive programmes for mosquitoes, flies and rodents were implemented in all parishes, focusing on the worst affected areas. Source reduction, larvicidal work (oiling and placement of larvicidal agents and fish in pools of water) and fogging were the priorities.

**Environmental Sanitation:** A total of 328 latrines were destroyed and thirty one (31) damaged in five (5) parishes. All 359 will need to be replaced. In addition accumulation of solid waste islandwide required special interventions in collaboration with the NSWMA to prevent the breeding of vectors.

**Veterinary Public Health:** After the event, the Health Departments were required to dispose of/monitor the disposal of dead animals and over 50,000 birds in the parishes of Kingston, St. Andrew and St. Catherine.

**Special Service Delivery:** The delivery of special services such as blood transfusion and public health laboratory services were generally uninterrupted although only partial services were being offered at the Government Chemist facilities due to insufficient power supply.

### III. PRODUCTIVE SECTORS

Damage and losses to the agricultural sector was estimated at \$3.715 billion. Table 3.1 summarizes the damage.

**Table 3.1: Estimate of Direct Damage to the Agricultural Sector**

Activity	Estimate of Damage (\$ million)
Domestic Crop	904.37
Coffee	761.45
Sugar	802.00
Banana	525.00
Fisheries	310.00
Citrus	116.00
Cocoa	100.00
Livestock	74.50
Greenhouse/Protected Cultivation	52.47
Irrigation	17.20
<b>Total</b>	<b>\$3,715.99</b>

**Source:** Ministry of Agriculture and Lands (MOAL)

The major areas of devastation were domestic crop production, which suffered losses of just over \$900 million and coffee, sugar and banana with \$855, \$761.45 and \$525 million respectively. Approximately 80 per cent of the island's greenhouses were destroyed. The marine and aqua culture sub sector, experienced damage estimated at \$310 million with capture representing \$250 million while aqua culture accounted for \$60 million. The approximate number of fisher folk affected was 3,523 and estimated losses due to disruption of activities were \$75.6 million.

#### 1. Domestic Crop & Livestock Sub Sector

Preliminary figures from the Rural Agricultural Development Authority (RADA) revealed that domestic crops<sup>9</sup> and livestock<sup>10</sup> sustained considerable losses, totalling just over \$1.0 billion.

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<sup>9</sup> Domestic crop includes only those crops identified in Table 2, which would have been consumed locally and

Losses to the livestock sector amounted to \$73.45 million, while greenhouse cultivation and the domestic crop sub sector suffered losses of approximately \$52.47 million and \$904.37 million respectively.

The areas most impacted by the passage of the hurricane were concentrated mainly to the southern and easterly sections of the island. Damage sustained in these areas to crops and livestock were reportedly due to the effects of gusty winds in excess of one hundred miles per hour, rather than from flooding. The four most adversely affected parishes were Manchester, Clarendon, St. Elizabeth and Portland; where a significant portion of the country's agricultural activity takes place. In total, these parishes accounted for approximately, 50 percent or \$517.7 million of the total losses to the sector.

Manchester suffered the greatest estimated losses, amounting to \$203 million. In this parish, the domestic crop sub sector lost approximately \$153 million worth of production. The majority of the damage sustained to the island's greenhouses was concentrated in this parish, at an estimated cost of \$45 million.

A loss to the livestock sector while relatively low, in comparison to that of domestic crop production, was estimated at \$40 million. These losses are significant and should not be underestimated, as this industry contributes significantly to the livelihoods of many small farmers in these areas.

The cost of damage was greatest in Hanover and St. Thomas which in both cases accounted for approximately 5.0 per cent. Losses to these four parishes amounted to approximately \$160 million. The least affected parishes were Westmoreland and St. Catherine which accounted for 2.0 and 3.0 per cent of total losses respectively.

Table 3.2 and Figure 3.1 below give an empirical breakdown of the figures used to arrive at these preliminary estimates.

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excludes major exportable crops such as coffee, pimento, banana for export etc as collated by RADA.

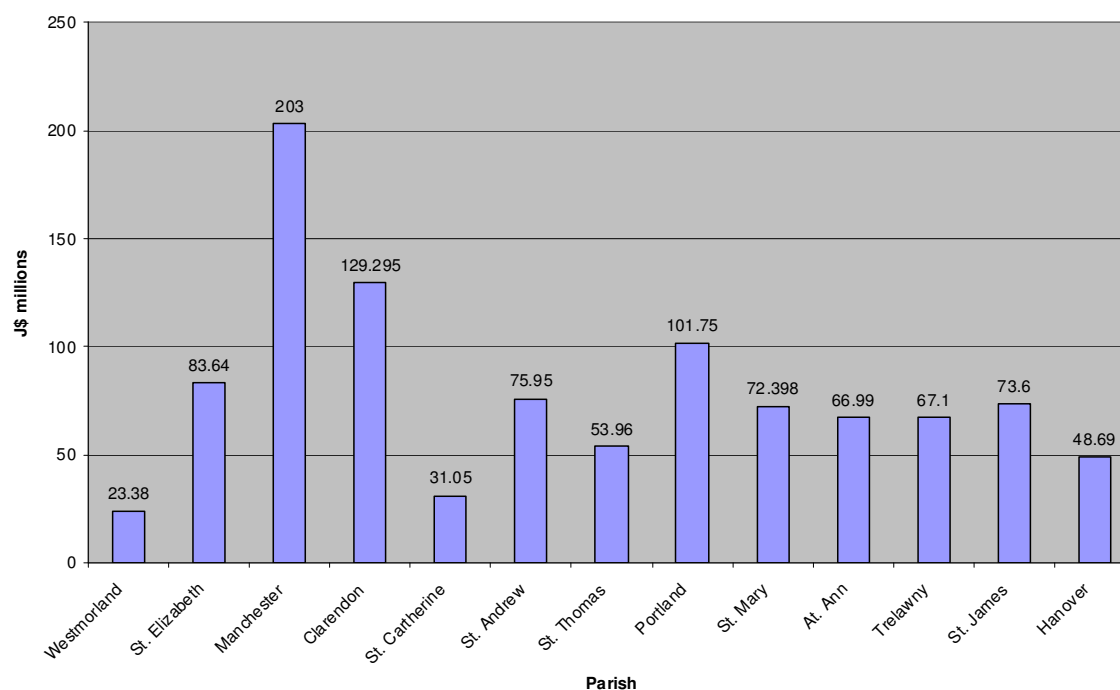
<sup>10</sup> Livestock here refers to poultry, pond fish, fingerlings, goats, sheep, beef cattle, dairy cows, pigs and other miscellaneous livestock as collated by RADA.



**Table 3.2:** Preliminary Estimates of Damage from Hurricane Dean by Parish

Parish	Livestock \$ million	Domestic Crops \$ million	Greenhouse \$ million	Total Damage \$ million
Manchester	5.0	153	45	203
Clarendon	18.125	104.9	6.27	129.295
Portland	2.15	99.6	-	101.75
St. Elizabeth	21.94	60.5	1.2	83.64
St. Andrew	1.95	74	-	75.95
St. James	2	71.6	-	73.6
St. Mary	0.765	71.633	-	72.398
Trelawny	0.6	66.5	-	67.1
At. Ann	2.14	64.85	-	66.99
St. Thomas	7.36	46.6	-	53.96
Hanover	2.09	46.6	-	48.69
St. Catherine	7.95	23.1	-	31.05
Westmorland	1.38	22	-	23.38
<b>Total</b>	<b>73.45</b>	<b>904.883</b>	<b>52.47</b>	<b>1030.803</b>

Source: RADA

**Figure 3.1:** Preliminary Estimate of Damage from Hurricane Dean to the Agriculture Sector by Parish (\$ million)

Source: RADA

Estimates reveal that approximately 5,354 hectares of arable produce have been lost. It is also evident that the impact of the hurricane will adversely affect the island's ability to produce roots and tubers in the short term. The estimates suggest that 1,514 hectares of roots and tubers have been destroyed representing approximately 28 percent of the total damage to the domestic crop production. The other sub groupings that were adversely affected include bananas (domestic market), vegetables and plantains. Together they account for less than 50 percent (2,596 hectares) of the damage suffered to domestic crop production.

Table 3.3 and Figure 3.2 below illustrate the damage to the sector based on hectare damage for various domestic crops in each parish. It is important to note here that increased damage per hectare does not necessarily equate to higher financial losses as this is a function of other variables, unique for each commodity produced in a particular area.

**Table 3.3: Preliminary Estimates of Hectare Damage by Parish**

Parish	Legumes	Cereal	Vegetables	Condiments	Fruits	FTC <sup>a</sup>	Banana (domestic market)	Plantain	Roots and Tubers	Total
Manchester	70		290	100	15				415	890
St. Elizabeth	130	45	200	125	110	2	4	6	110	732
Trelawny			30		25	25	50	50	490	670
St. James	25	15	30	45	20	16	300	120	40	611
Portland	10		20	15	20		250	120	125	560
St. Thomas	40	2	45	31	20		130	35	80	383
St. Mary	11		30	10	22		150	100	55	378
Clarendon	48	18	112	55	4		20	20	63	340
St. Andrew	15	7	20	10	2	80	20	140	30	324
Hanover	5	3	30	10	12	9	8	62	30	169
St. Ann	4	28	52	16	2				63	165
Westmorland	10	1	55	15	10	5	10	25		131
St. Catherine		10	32	14	1		15	15	13	100
<b>Total</b>	<b>368</b>	<b>129</b>	<b>946</b>	<b>446</b>	<b>263</b>	<b>137</b>	<b>957<sup>11</sup></b>	<b>693<sup>12</sup></b>	<b>1514</b>	<b>5453</b>

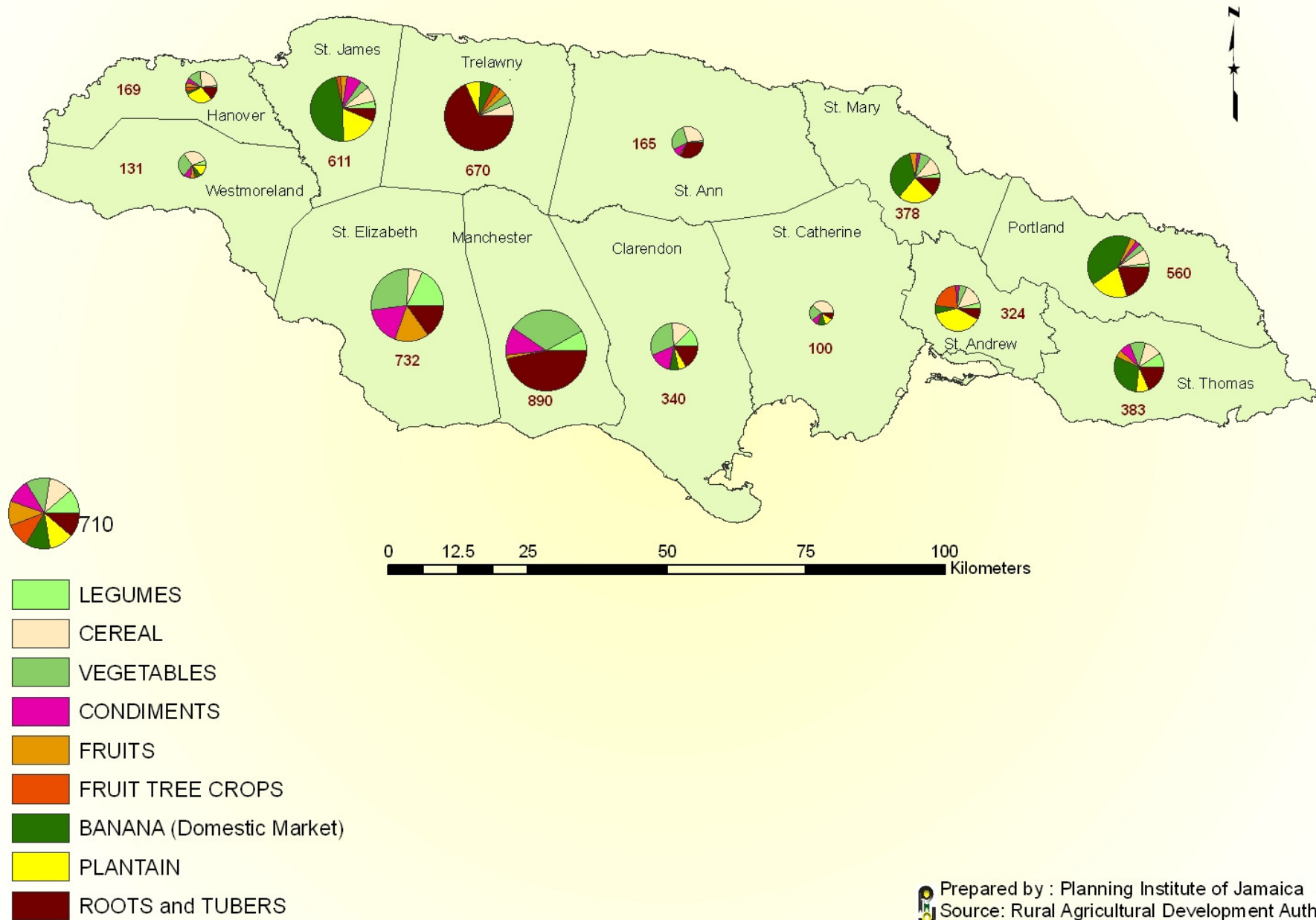
Source: RADA

Note a) FTC (Fruit Tree Crops)

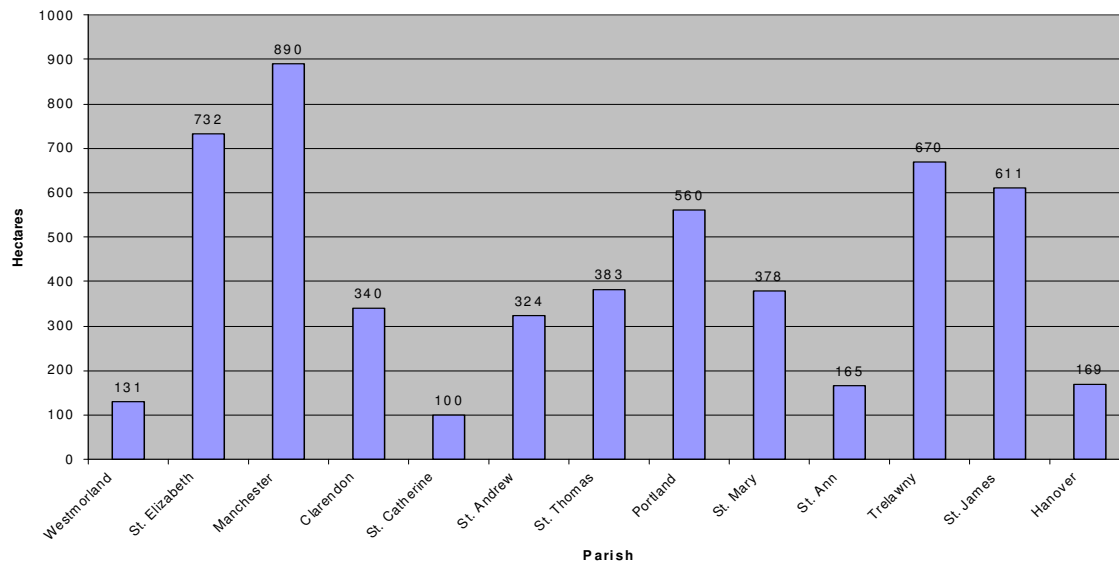
<sup>11</sup> These figures will vary from those of Banana Export Company (BECO) as the BECO figures include only those banana growers in the European Union Banana Support Programme (EUBSP) target parishes, whilst RADA's figures include all banana growing farmers.

<sup>12</sup> These figures will vary from those of BECO as the BECO figures include only those plantain growers in the EUBSP target parishes, whilst RADA's figures include all plantain growing farmers.

**Figure 3.2: Damage (hectares) for Selected Domestic Crops**



**Figure 3.3: Total Hectare Damage per Parish**



**Source:** RADA

## **2. The Cocoa Industry**

The cocoa sub-sector suffered severe damage particularly in Clarendon, St. Mary, St. Catherine and St. Thomas. The Cocoa Industry Board (CIB) revealed that approximately 9,000 hectares of cocoa was under production prior to the passage of the hurricane. The preliminary estimates indicate that approximately 50 percent of this total suffered damage. Projected output prior to the hurricane was 850-1000 tonnes (or 85,000-180,000 boxes). The revised projection is 425-500 tonnes. The fall crop, which runs from October to March and was valued at J \$90-\$100 million, has been totally wiped out.

## **3. The Citrus Industry**

In the Eastern Area Council (Portland, St. Mary) grapefruit and orange farmers sustained many losses. In Portland, 75 per cent of the grapefruit crop was destroyed while 70 per cent of the orange crop suffered a similar fate. In St. Mary grapefruit and orange crops suffered 30 per cent and 20 per cent damage respectively. See Table 3.4

**Table 3.4:** Preliminary Estimates of Impact on the Citrus Industry by Parish

Parish	Type of Citrus	% loss	Remarks
Portland	Grapefruit	75	
	Orange	70	
St. Mary	Grapefruit	50	In Portland and St. Mary major loss of fruit resulted from early maturing fruits falling off significantly
	Orange	25	
St. Catherine	Grapefruit	5	There was minimal fruit loss as a result of the hurricane
	Oranges	2 ½ - 3	
St. Ann	Grapefruit	5	No significant damage or fruit loss
	Orange	2	
Clarendon	Grapefruit	25 -30	Damage or fruit loss occurred mainly in the hilly terrains of Clarendon. There was minor damage in the low lying areas
	Oranges	4 – 6	
Westmoreland	Oranges	5	There was minimal loss of fruit in these parishes
Hanover	Oranges	1 -2	
St. James	Grapefruit	10	
	Oranges	5	
St. Elizabeth	Orange	10 -15	There was moderate fruit fall significant damage to trees throughout St. Elizabeth
	Grapefruit	20 – 25	Significant damage to fruit loss throughout St. Elizabeth
Manchester	Orange	15	There was severe damage and loss of fruit particularly to grapefruit in Manchester. However, trees were not toppled over.
	Grapefruit	60	

**Source:** RADA

The preliminary estimate of damage to the sector is \$116 million. Grapefruits suffered a 22% to 25% loss in national yields as result of damage to fruit trees. The loss in yields for oranges and ortaniques is between 7% and 10% of the national level. The Ugli fruit crop (which is largely concentrated in upper Clarendon and Trelawny) suffered minimal damage (Table 3.5).

**Table 3.5:** Fruit Loss as a Percentage of National Production

<b>Parish</b>	<b>Fruit loss/Parish as observed %</b>	<b>Parish to National Production %</b>	<b>National Production % – Remainder after Hurricane damage</b>
Portland	Grapefruit 75 Orange 70	Grapefruit - 4 Orange - 1	1 0.25
St. Mary	Grapefruit 50 - 60 Orange 25	Grapefruit - 5 Orange - 3	2.5 2.25
St. Catherine	Grapefruit 5 Orange 2 ½ - 3	Grapefruit - 20 Orange - 34	19 32.8
St. Ann	Grapefruit 5 Orange 2	Grapefruit - 15 Orange - 2	14.25 1.60
Clarendon	Grapefruit 25 - 30 Orange 4 - 6	Grapefruit - 45 Orange - 28	33.75 27.93
Westmoreland	Grapefruit 0 Orange 5	Grapefruit - 0 Orange - 1	0 0.95
Hanover	Grapefruit 0 Orange 1 – 2	Grapefruit - 0 Orange - 1	0 0.95
St. James	Grapefruit 10 Orange 5	Grapefruit - 6 Orange - 15	5.4 14.25
St. Elizabeth	Grapefruit 20 – 25 Oranges 10 – 15	Grapefruit - 2 Orange - 7	1.6 6.3
Manchester	Grapefruit 60 Orange 15	Grapefruit - 2 Orange - 5	0.8 4.25
Trelawny	Grapefruit Orange 5	Grapefruit - 0 Orange - 2	0 1.9

Source: RADA

#### 4. The Coffee Industry

The passage of the hurricane resulted in the following damage to coffee due to loss of berries, defoliation of coffee and shade trees, damage to coffee trees as a result of falling branches from shade trees; and uprooting and twisting of young 2-3 year old plants resulting in severe root damage.

It is projected that the 2007/2008 coffee crop would have yielded 510,000 boxes of Blue Mountain coffee and 90,000 boxes of non Blue Mountain coffee. However, with preliminary estimates indicating that approximately 45 percent of the total coffee crop sustained severe damage, losses are estimated at 240,000 and 30,000 boxes for Blue Mountain and non-Blue Mountain coffee at a value of \$855 million.

In addition to crop loss, infrastructure including parochial roads has been significantly damaged. However, processing plants have sustained minimal damage. Currently, there has been no determination of the total damage to coffee infrastructure.

## **5. The Banana Industry**

Direct damage to the banana industry was estimated at \$525 million. There was an 85 per cent loss of the standing crops and 95 percent loss of maiden suckers. The greatest number of hectares lost from the non-estate sector was in Portland, St. Mary and St. James.<sup>13</sup>

Total hectareage damaged was 2 358.7, with the export and domestic sector losing 1 552.51 and 806.19 hectares respectively. It is estimated that Hurricane Dean has directly caused a complete loss of income for up to 3 000 persons who depend solely on banana production for their livelihoods. There is also an indirect loss of income to another 8 000 persons (shopkeepers, truck operators, processors etc).

Indirect losses amounted to US\$40 million. This comprised of loss in export earnings of approximately US\$15 million and loss in domestic earnings of US\$25 million over the next six months. The banana sub-sector is extremely vulnerable to hurricanes, as over the last five years four major storms caused severe damage to the sector. Due to the risk associated with banana production, it is difficult to secure adequate insurance coverage for the sub sector. The frequency of these storms, poses severe financial burden on the farmers as the recovery process is very slow and costly. The cost to full recovery as a result of Hurricane Dean is estimated at US\$7.5 million dollars

Tables 3.6, 3.7 and 3.8 detail the damage to the sub-sector as result of passage of the hurricane.

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<sup>13</sup> The proportion of damage for these parishes was due to increased banana and plantain activities in these areas.

**Table 3.6:** Analysis and Distribution of damage sustained by Non Estate Banana Growers in EUBSP Target Parishes

	Export Growers			Domestic Growers			Total Damaged Hectares
	No. Affected	Hectares Established	Hectares Damaged	No. Affected	Hectares Established	Hectares Damaged	
St. Mary	36	260.02	256.77	134	178.98	178.98	435.75
St. Thomas	1	3.0	3.0	4	5.0	5.0	8.00
Portland	137	356.54	354.54	172	209	206.75	561.29
St. Catherine	1	88	91	3	6.0	6.0	85.20
St. James	0	0	0	209	320.85	320.85	320.85
Clarendon	0	0	0	3	6.62	6.62	6.62
St. Ann	0	0	0	17	19.93	19.93	19.93
<b>Total</b>	<b>175</b>	<b>707.56</b>	<b>693.51</b>	<b>542</b>	<b>746.38</b>	<b>744.13</b>	<b>1 437.64</b>

Source: BECO

**Table3.7:** Plantain Growers Affected by Hurricane Dean

Parishes	No. Of Growers	Hectares Established	Hectares Damaged
Portland	22	14.30	14.30
St. Mary	34	23.66	23.66
St. Thomas	21	8.6	8.6
St. James	14	15.5	15.50
<b>Total</b>	<b>91</b>	<b>62.06</b>	<b>62.06</b>

Source: BECO



**Table 3.8:** Summary of Damage by Hurricane Dean

<b>Growers</b>		<b># of Affected Growers</b>	<b>Hectares Established</b>	<b>Hectares Damaged</b>
Export	Non-Estate	175	707.56	693.51
	Estate (banana)	2	907	859
Domestic (banana)		542	746.38	744.13
Plantain		91	62.06	62.06
<b>GRAND TOTAL</b>		<b>810</b>	<b>2 423.0</b>	<b>2 358.7</b>

Source: BECO

## 6. The Poultry Industry

The passage of the hurricane resulted in moderate damage to the poultry sub-sector. Small poultry farmers, which account for approximately 30-35 percent of national production, experienced the worst damage. It is estimated that prior to the hurricane small farmers had about 2.5 million birds in production and would have lost approximately 20 percent (500 000 birds) of their birds as a result of the hurricane. On the other hand, large farmers suffered minimal damage as they only lost approximately 150 000 birds. However, other problems related to the health of the birds could result in further losses.

The extent of the damage to infrastructure was not ascertained but preliminary inspections suggest that infrastructure loss is moderate.

## 7. The Sugar Industry

Hurricane Dean caused damage to cane cultivation which varied by location, cane variety and age of cane at the time of the hurricane. The damage observed ranged from canes being blown down (extensive lodging) to severe stalk breakage, and minimum flooding.

The impact of the loss on production will depend on the condition of lodged cane and adequate drainage to prevent rotting. Canes with stalk breakage at the top will be affected by side shooting which impacts on growth and also contribute to poor quality canes.

## **7.1 Impact on Sugar Factories**

The Sugar Company of Jamaica (SCJ) factories incurred losses of approximately \$761m. These resulted from damage to sugarcane, buildings, irrigation equipment, and other infrastructure. Of the five divisions, Monymusk and Bernard Lodge realized the most significant impact. These two divisions account for \$467m (61%) of the total damage incurred. Due to the anticipated reduced cane volume and quality, it is estimated that total sugar production for the 2007/08 crop will likely be reduced by about 29 000 tonnes (21%), which represents lost revenue of about \$1.1 billion.

In the case of non SCJ factories, indications are that there was minimal infrastructural damage. However, information from the Sugar Industry Authority (SIA) indicate that the projected cane loss from Appleton and Worthy Park is 177 000 tonnes. At a ratio of 11.0 tonnes cane/tonnes sugar (tc/ts), the 177,000 tonnes cane converts to 16 090 tonnes sugar. At a price of \$38, 400 per tonne, the projected loss in revenue of sugar from these two factories amounts to approximately \$618 million.

## **7.2 Major Areas of Impact for SCJ Factories**

Table 3.9 shows total damage of approximately \$123.40m to physical structures, \$566m to agriculture which includes cane losses, and \$72m to irrigation facilities. The projected loss in revenue foregone from both SCJ and Non-SCJ factories is estimated at \$1, 732 million.

**Table 3.9** SCJ Damage to Physical Structures

<b>Main Losses (\$M)</b>	<b>Frome</b>	<b>M/musk</b>	<b>B. Lodge</b>	<b>STS</b>	<b>TSC</b>	<b>Total</b>
Buildings	-	55.00	31.12	3.00	-	89.12
Factory	-	12.40	3.88	18.00	-	34.28
<b>Sub-Total Structure</b>	-	<b>67.40</b>	<b>35.00</b>	<b>21.00</b>	-	<b>123.40</b>
Irrigation	-	52.00	20.00	-	-	72.00
Estate Sugarcane Losses	122.45	164.00	129.15	91.65	58.80	566.05
<b>Sub-Total Agriculture</b>	<b>122.45</b>	<b>216.00</b>	<b>149.15</b>	<b>91.65</b>	<b>58.80</b>	<b>638.05</b>
<b>Total</b>	<b>122.45</b>	<b>283.40</b>	<b>184.15</b>	<b>112.65</b>	<b>58.80</b>	<b>761.45</b>
<b>Losses-Tonnes Sugar</b>	9,266	8,826	5,846	3,542	1,528	<b>29,007</b>
<b>Loss revenue @ \$38,400/Tonne</b>	<b>355.81</b>	<b>338.92</b>	<b>224.47</b>	<b>136.03</b>	<b>58.66</b>	<b>1,113.88</b>

Source: RADA

\*Revenue losses on sugar manufactured at factories.

## 8. The Dairy Industry

Dairy farmers located in the southern parishes of Jamaica were the ones most adversely affected by the passage of Hurricane Dean. The widespread dislocation in electricity and water supplies, however, resulted in island-wide negative impacts on the sector, either directly or as a result of the suspension of milk purchases by the distributive trade.

The major sources of losses to the sector were loss of milk production and revenue through:

- Deliberate reduction in production by reducing feed to cattle to forestall dumping of milk
- Reduction in production by cows due to lack of draining water supply
- Absence of JPS electricity or standby generators thus once per day hand milking

- Structural damage to milking parlours at WINDALCO necessitating pooled once per day milking at common site
- Dumping of milk due to non-collection

### 8.1 Preliminary Estimates of Production Losses

The Dairy Board is at this time (September 10) unable to present an overall financial estimate of the impact of the hurricane on the sector as individual farms are still in the process of finalizing their estimate of damage. Indications are, however, that damage to buildings, fences and animals are minimal.

Based on information gleaned from contact with farmers, it is estimated that direct losses in milk production as at August 28 is approximately 25 percent of daily production. From the July production estimate of approximately 1.2 million litres, the estimated 25 percent loss of production translates to approximately 96,700 litres of milk or equivalently \$2.9 million during the 10 day period since the hurricane.

The experience from Hurricane Ivan in 2004 suggests that, assuming a similarly early resumption in electricity and water supply to affected areas, it may take up to three months to resume pre-hurricane levels of production. On this basis the residual effects on revenues to dairy farms is projected as follows:

**Table 3.10:** Estimated Losses in Production Revenue

Period	Estimated Loss In Production (Litres)	Estimated Loss In Revenue (\$ M)
TO 19/09	216,000 (18%)	6.48
20/09 – 14/10	144,000 (12%)	4.33
20/10 – 19/11	96,000 (8%)	2.88
<b>TOTAL</b>	<b>456,000</b>	<b>13.70</b>

Source: RADA

## **9. The Fisheries Sector**

Damage within the Fisheries Sector was estimated to be \$310 million of which the Aquaculture Sub-sector was \$60 million and the Marine Sub-sector was \$250 million. Much of the damage to the Fisheries Sector resulted from damage to the general coastline, infrastructure such as buildings, wharves, utility poles and fences, and fishing equipment such as gear, boats and engines. The impact was not restricted to the Capture Fisheries but the Culture Fisheries also underwent significant damage. The southern coast suffered most substantially as many beaches were inundated by copious amounts of sand and debris, changing the landscape, while some beaches have been totally eroded. In some areas on the south coast, fishing equipment has been severely or totally destroyed. Many traps and other fishing gear have been lost at sea and this can subsequently lead to “ghost-fishing” which poses a major threat to the viable existence of the fishery.

The income generating capacity of the fisher folk has been severely interrupted. In addition to losses within the sector some fishers have experienced personal losses such as houses, cars and furniture<sup>14</sup>. Many commercial entities on fishing beaches were also affected.

Damage was reported primarily for fishing beaches on the South Coast, particularly from Clarendon, St. Catherine, St. Thomas and Portland on the North East Coast (refer to Appendix 3A). Less severe damage was reported for the North Coast which may be attributed to the fact that Hurricane Dean veered south of the island causing more significant impacts on the south coast, the southern proximal banks and the Pedro Bank.

Fishing beaches have been severely affected in some areas. These include Rocky Point (St. Thomas), Rocky Point (Clarendon), Old Harbour Bay Beach, Port Henderson, Hellshire, Manchioneal, Yallahs, Morant Bay, Buff Bay and the Pedro Cays.

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<sup>14</sup> Fishers from St. Thomas, St. Catherine, Clarendon, Manchester and St. Elizabeth were directly affected. This translates to 3,500 fishers. For the south coast, from Westmoreland east to St. Catherine and other affected parishes such as Trelawny, St. Ann, St. Mary, Portland, St. Andrew and Kingston each fisher on average lost 15 traps or fishing gear unit. Each trap or gear unit is valued at \$4,000.00.

**Table 3.11:** Summary of damage to the Fisheries Sector Caused by Hurricane Dean

<b>Capture Fisheries</b>		<b>Aquaculture</b>	
Approximate number of fishers directly impacted	<b>3,500</b>	Approximate number of farmers directly impacted	<b>23</b>
Fishing gear damaged	<b>Value \$</b>	Estimate of damage to farms	<b>Value \$</b>
<ul style="list-style-type: none"> <li>• Traps, nets</li> <li>• Boats</li> <li>• Engines</li> <li>• Gear sheds</li> </ul>	210 million 30 million 4.9 million 580,000  <b><u>250 million</u></b>	<ul style="list-style-type: none"> <li>• Ornamental farms</li> <li>• Shrimp farms</li> <li>• Food fish farms</li> </ul>	27.23 million 2.5 million 30.37 million  <b><u>60 million</u></b>
Infrastructure damaged - access roads, beach damage etc.	Unquantified, but damage done in areas such as Rocky Point, Old Harbour and Pedro Cays	Infrastructure damaged - Included pond dykes, buildings, access roads	Unquantified, but significant.
Habitat or Fishing grounds damaged	Resource and Habitat assessment, and Rehabilitation needed		

**Source:** Fisheries Division

## 10. Irrigation

Preliminary assessment indicates no significant structural damage to the irrigation and drainage infrastructure. However, fallen trees and debris in all districts resulted in blockage of the irrigation canal network, access roads and drainage network. The systems mainly affected are those located in St. Elizabeth, Clarendon and St. Catherine. The National Irrigation Commission (NIC) has commenced some clean up work in these main districts. However, additional budgetary support is required to fully execute the recovery process in the shortest possible time. In the days following the event the pumping stations were without electricity supply. By September 3, 2007, two weeks after the event, electricity was restored to 25 per cent of stations in Clarendon and St. Catherine.

The preliminary estimate of the damage caused by Hurricane Dean is \$17.2 million (Table 3.12). Approximately 50 per cent of the sum is required immediately in order to return a reasonable level of service.

**Table 3.12:** Estimated Recovery Cost (\$ million) Resulting from Hurricane Dean

	<b>Head Office</b>	<b>St. Thomas</b>	<b>St. Catherine</b>	<b>Clarendon</b>	<b>St. Elizabeth</b>	<b>Trelawny</b>	<b>TOTAL</b>
<b>Irrigation Work</b>		0.15	2.2	1.8	0.25	0.15	4.55
<b>Drainage Structure</b>			0.3	0.4	2.8		3.50
<b>Access Roads</b>		0.1	1.2	1.1	1.6		4.00
<b>Pumps and Electrical Equipment</b>		0.1	1.5	1.8	0.3	0.15	3.85
<b>Offices and other Buildings</b>	0.25	0	0.6	0.15	0.3		1.30
<b>TOTAL</b>	<b>0.25</b>	<b>0.35</b>	<b>5.8</b>	<b>5.25</b>	<b>5.25</b>	<b>0.30</b>	<b>17.30</b>

Source: National Irrigation Commission (NIC)

## 11. Mining

The bauxite and alumina sector was directly and indirectly affected by Hurricane Dean. A Preliminary estimate of losses for the industry as a whole is set at a minimum of approximately US\$29 million. In terms of the direct impact, the JAMALCO refinery sustained severe damage to its port at Rocky Point. Due to the damage the plant will be unable to export from that port until repairs are carried out. The port will require significant repairs and temporary logistical support for shipping alumina while repair work is being undertaken. This work includes preparing storage for alumina which is currently limiting production to 50.0 percent of capacity, with full operation anticipated by early November. Taking into consideration insurance coverage, the total Jamalco impact from the hurricane – including lost production, business interruption and repairs is estimated to be US\$10.0 million after-tax.

The WINDALCO refinery sustained damage to a turbine at the Ewarton Plant. In terms of indirect impact, all refineries and the St. Ann Bauxite Company lost production time due to the

closure of plants in preparation for the hurricane and the consequential effect of power outage after the hurricane's passage. On average a total of 4-5 days of production time was lost. In the Quarrying sub-sector production time was lost due to power outage. There were also reports of roof damage, slippage and damage to road infrastructure.

## **12. Services**

### **Distributive Trade**

Preliminary investigations have revealed that distributors within the sector have suffered minimal damage due to Hurricane Dean. Most of the goods categories within the sector have reported damage associated with the hurricane. Damage which accrued to distributors included:

1. inventory losses
2. some major and minor structural damage; and
3. disruption of their production process.

Perishable items which were lost were attributed to the power outage after the hurricane, and in some cases, pilferage.

### **Tourism**

Damage to the tourist resort areas was estimated at \$43.7 Million. Of this amount, \$29.5 m occurred in the Accommodation Sub-sector while \$14.1m was accounted for by the Attractions Sub-sector (Tables 3.13 and 3.14). The damage was mainly caused by the strong winds and the associated storm surge. Extensive beach damage resulted from the action of the storm surge particularly in the eastern and southern parts of the island. Some cruise ships were diverted from Jamaican ports after the arrival of the hurricane.

In the South Coast Resort Area, a total of 13 entities reported extensive damage to their facilities; 12 reported moderate damage; and 23 were identified as having minor damage. Accommodation providers reported damage to roof, water tanks, generator, windows and some structural damage. Attractions report damage to landscaping.



In the North Coast Resort Areas, a total of 7 entities reported extensive damage to their facilities; 9 reported moderate damage; and 24 were identified as having minor damage. Initial estimates of damage to date stand at \$11.3 Million. Some accommodation in the Port Antonio Resort Area reported damage to landscaping, roofs, retaining wall and driveway; and electronic equipment

**Table 3.13:** Estimated Value of Damage to the Accommodation Sub-sector – Summary

<b>Parish</b>	<b>Estimated Value of Damages (\$)</b>
<b>Portland Resort Area</b>	
Portland Resort Areas	1,320,000
<b>Sub-total</b>	<b>1,320,000</b>
<b>Kingston Metropolitan Resort Area</b>	
Kingston & St. Andrew	
St. Thomas	4,000,000
<b>Sub-Total</b>	<b>4,000,000</b>
<b>South Coast Resort Area</b>	
Clarendon	4,316,000
Manchester	700,000
St. Elizabeth	4,070,000
Westmoreland (Scotts' Cove Ferris Crossing)	1,015,000
<b>Sub-Total</b>	<b>10,101,000</b>
<b>Montego Bay Resort Area</b>	
St. James	40,000
<b>Falmouth Resort Area</b>	
Trelawny	2,070,000
<b>Sub-Total</b>	<b>2,070,000</b>
<b>Negril Resort Area</b>	
Westmoreland (Savannah La Mar to Negril)	2,040,000
Hanover	
<b>Sub-Total</b>	<b>2,040,000</b>
<b>Ocho Rios Resort Area</b>	
St. Ann	3,224,213
St. Mary	1564,000
<b>Sub-Total</b>	<b>4,788,213</b>
<b>TOTAL</b>	<b>24,359,213</b>

Source: Hurricane Dean Damage Assessment Report, September 2007  
Tourism Product Development Company Ltd. (TPDCo)

In the Falmouth Resort Area the Starfish Resort Hotel reported the most extensive damage (thatch hut, vent, gazebo and two rooms) estimated at \$2 Million, but the facility is operational. Minor damage was reported at Glistening Waters. The Bamboo Craft market sustained severe damage to several shops and had to be closed.

**Table 3.14:** Estimated Value of Damage to the Attractions Sub-sector – Summary

<b>Resort Area</b>	<b>Estimated Value of Damage (\$)</b>
<b>Portland Resort Area</b>	
Portland Resort Areas	n/a
<b>Sub-total</b>	<b>n/a</b>
<b>Kingston Metropolitan Resort Area</b>	
Kingston	n/a
St. Thomas <sup>15</sup>	n/a
St. Catherine	0
<b>Sub-Total</b>	<b>n/a</b>
<b>South Coast Resort Area</b>	
Clarendon	0
Manchester	5,500,000
St. Elizabeth	3,300,000
Westmoreland (Scotts' Cove Ferris Crossing)	700,000
<b>Sub-Total</b>	<b>9,500,000</b>
<b>Montego Bay Resort Area</b>	
St. James	0
<b>Sub-Total</b>	<b>0</b>
<b>Falmouth Resort Area</b>	
Trelawny	0
<b>Sub-Total</b>	<b>0</b>
<b>Negril Resort Area</b>	
Westmoreland (Savannah La Mar to Negril)	0
Hanover	0
<b>Sub-Total</b>	<b>0</b>
<b>Ocho Rios Resort Area</b>	
St. Ann	2,380,000
St. Mary	0
<b>Sub-Total</b>	<b>2,380,000</b>
<b>TOTAL</b>	<b>11,880,000</b>

Source: Hurricane Dean Damage Assessment Report, September 2007  
Tourism Product Development Company Ltd. (TPDCo)

<sup>15</sup> Bath Botanical Gardens estimates remain outstanding

In St. Ann, some properties reported minor to moderate damage to roofing, landscaping and signage. Breezes Runaway Bay reported damage to their Wedding Chapel and huts on the beach. Seville Great House lost a hut, a number of trees and an entrance sign. Dunn's River Falls and Dolphin Cove, the country's two biggest attractions, were undamaged and are open for business. The Pineapple Craft Market, which was the most severely affected craft market in the parish, lost five shops as a result of hurricane; however, the facility is opened

## **IV. INFRASTRUCTURE**

The impact of the hurricane on infrastructure included damage to roads, water mains and utility poles. Direct damage was estimated at \$3.44 billion while indirect was estimated at \$150 million. It is important to note that information to evaluate damage and losses in the infrastructure sectors was not fully available at the time of the assessment. Some service providers were still executing restoration and recovery activities and were, therefore, unable to quantify the total cost of damage. The estimation of damage and losses in infrastructure presented is, therefore preliminary and is subject to change.

### **1. Public Utility Systems**

#### **a) Electricity**

The Jamaica Public Service Company Limited (JPS), the private entity entrusted with the provision of electricity in the island, stated that Hurricane Dean did not significantly affect the Company's generating units, although there was some infrastructural damage at some of the power stations.

The transmission system, however, sustained severe damage, particularly in the southern parishes. Indications are that the damage from Hurricane Dean on the transmission system was significantly greater than that caused by Hurricane Ivan in 2004. There was damage to about 60 of the Company's 72 transmission line segments, plus some damage at a number of substations.

On the power distribution system, all of the Company's 114 distribution feeder circuits suffered some level of damage. In addition, close to 3,000 pole locations show signs of damage, while approximately 150 kilometers of power lines were destroyed (See Figure 4.1).

In order to minimize long-term damage to key elements of the power system, JPS started the phased shutdown of the power system on August 19 by shutting down the electricity in eastern and southern parishes, where customers had been experiencing power outages earlier in the day as a result of broken power lines. An all-island system shutdown was effected in the afternoon as the island began to feel the full effects of Hurricane Dean.

The restoration of electricity was done according to the JPS restoration protocol with first priority given to damage assessment and repair of power plants and main transmission lines. On completion of that phase, electricity was first restored to the main lines that provide essential services such as hospitals, airports, communication systems and water supply facilities. Electricity was then restored to power lines serving the largest number of customers, smaller power lines serving smaller groups and finally to individual customers with isolated problems.

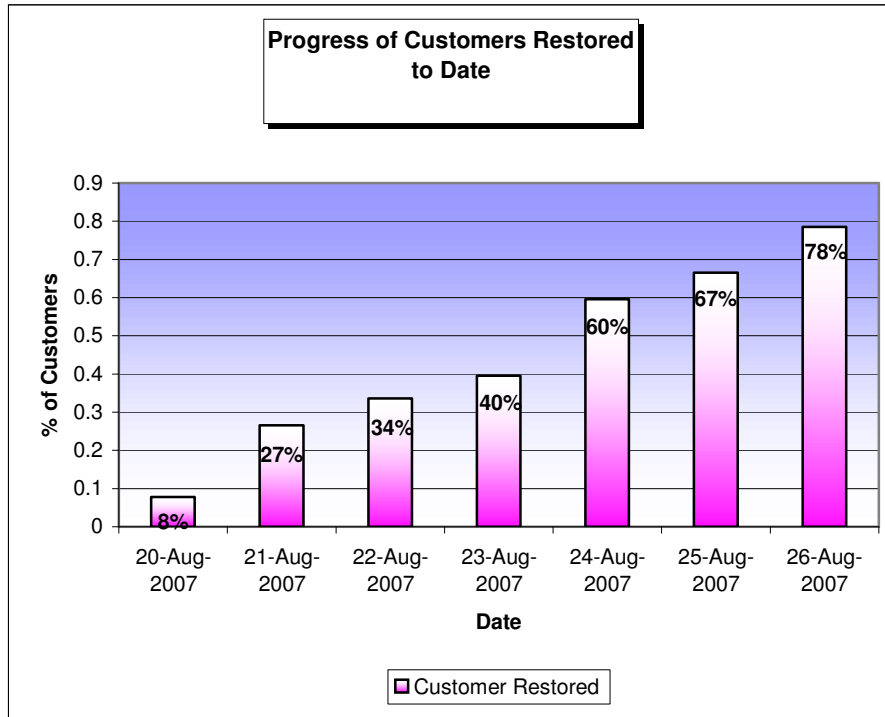
On August 26, 2007, one week after the event, power supply had been restored to approximately 78 per cent of JPS customers islandwide. Figure 4.2 and 4.4 shows recovery performance of electrical services after the hurricane. Figure 4.3 illustrates that the restoration timeline has significantly improved over that of Hurricane Ivan.

Challenges to the restoration process include severe damage to some areas of the power delivery system, difficult terrain, inclement weather, and lack of access to some areas. In addition, the theft of wires, transformers and other material from the power delivery system slowed down the process in some areas. The restoration process was also hampered by vandalism evident in the theft of 20,000 meters of wire.



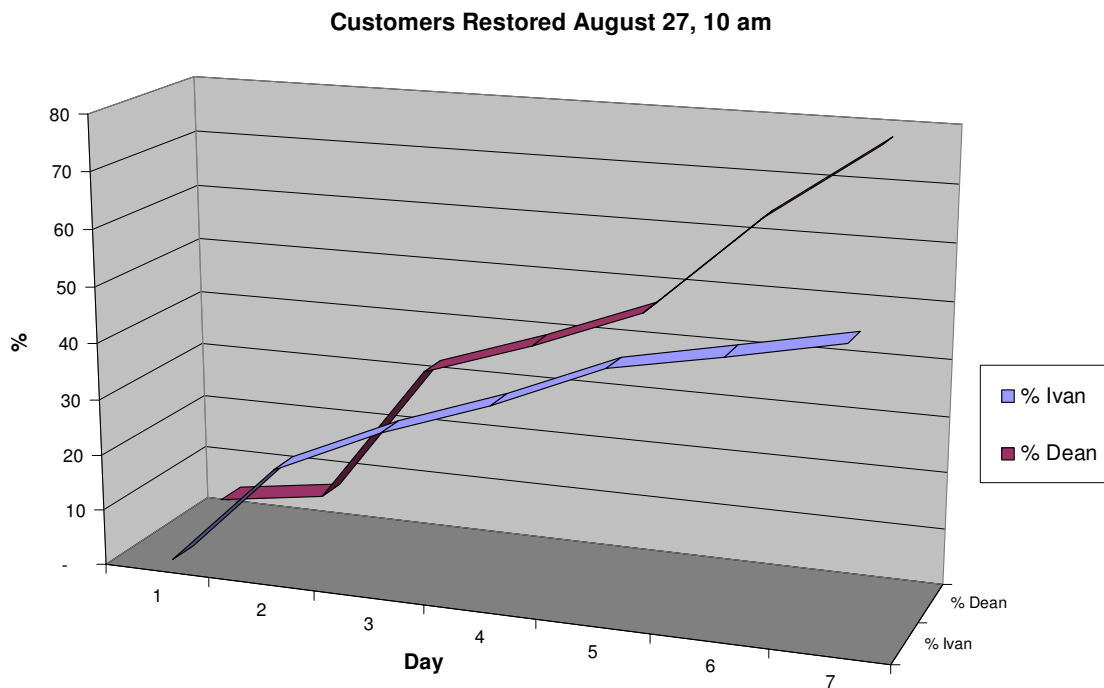
**Figure 4.1:** Fallen utility poles along the main road leading to Hellshire

**Figure 4.2: Progress of JPS Customers Restored to Date**



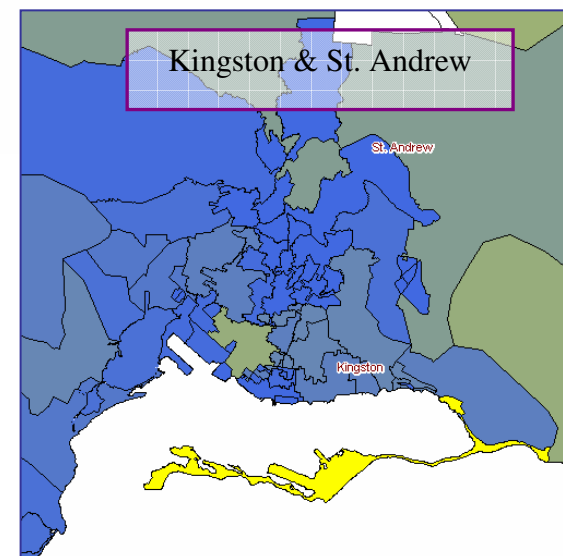
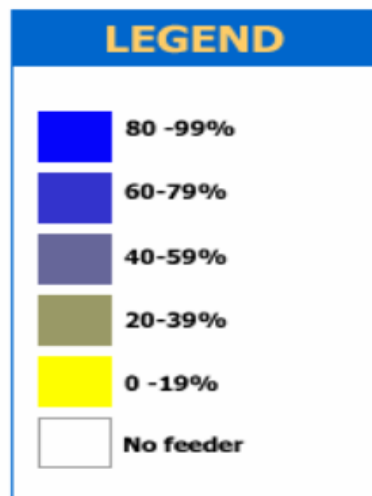
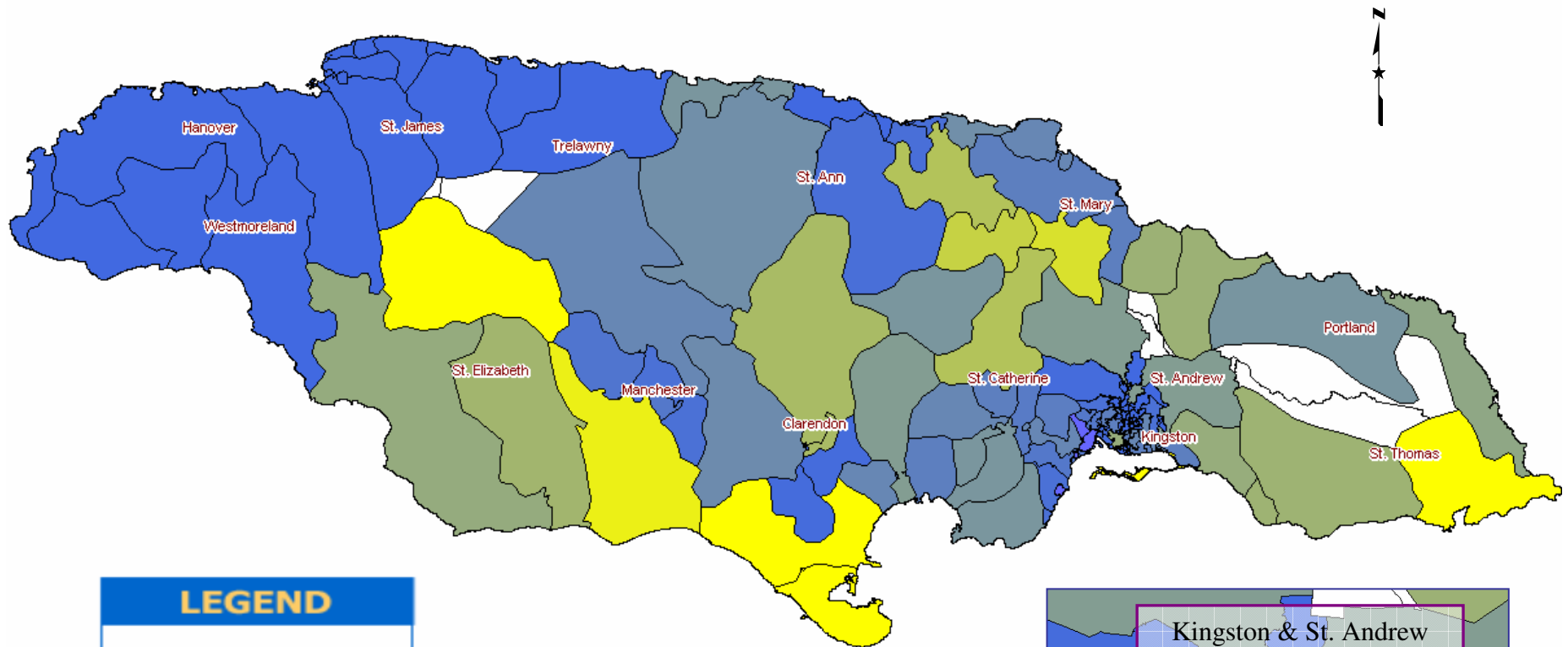
Source: Hurricane Dean Restoration Update August 27, 2007, JPS

**Figure 4.3: Comparison: Restoration Timelines – Ivan vs Dean**



Source: Hurricane Dean Restoration Update August 27, 2007, JPS

**FIGURE 4.4: PERCENTAGE OF FEEDERS ENERGIZED  
UP TO SUNDAY, AUGUST 26, 2007**



Preliminary estimates indicate that the electrical subsector sustained total damage and losses of some \$1,073.25 Million<sup>16</sup>, all or which are reportedly direct (see Table 6.1).

## **b) Water Supply and Sanitation**

The National Water Commission (NWC), the country's primary provider of essential water and wastewater services has estimated that damage to water systems amounted to approximately \$229.62 million, of which direct damage amounted to \$79.62 million and indirect losses were \$150.0 million (See Table 4.1 and Figure 4.5). More than four hundred and sixty (460) water supply systems and over six hundred (600) electricity-dependent facilities, including sewerage facilities, across the island were affected in one way or another by the passage of this hurricane<sup>17</sup>.

Prior to Hurricane Dean making land fall, the Commission carried out a number of pre-hurricane measures to protect and mitigate against possible damage of its facilities and assets. Some of these measures included the procurement of 23 portable Genset standby generator units, capping of the Yallah's Intake, including the diversion of the water source from the intake and the removal of pumps from Booster Stations that were susceptible to flooding. In addition, the NWC provided the JPSCo with a document with NWC "priority systems for restoration", which included maps showing the locations of each of these critical facilities<sup>18</sup>.

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<sup>16</sup> Calculated at approximately 75% of JPS claim to OUR for Hurricane Ivan (1.431 billion)

<sup>17</sup> In the event of extreme weather phenomenon such as Hurricane Dean, the island's water and wastewater systems are exposed to inherent risks. Many of the 460 water supply systems across the island, of necessity, have intakes in riverbeds and are susceptible to flood damage and blockages; wells are often located in low lying plains and susceptible to flooding; most systems are heavily dependent on National Power Grid for operations; more than 5,000 kilometres of undulating pipeline susceptible to land slippages, pipeline dislocation and breakages; water sources are at risk of contamination and muddy inflows (high turbidity) after heavy rainfall; and most water systems are at least partly situated in very remote areas that are difficult to access.

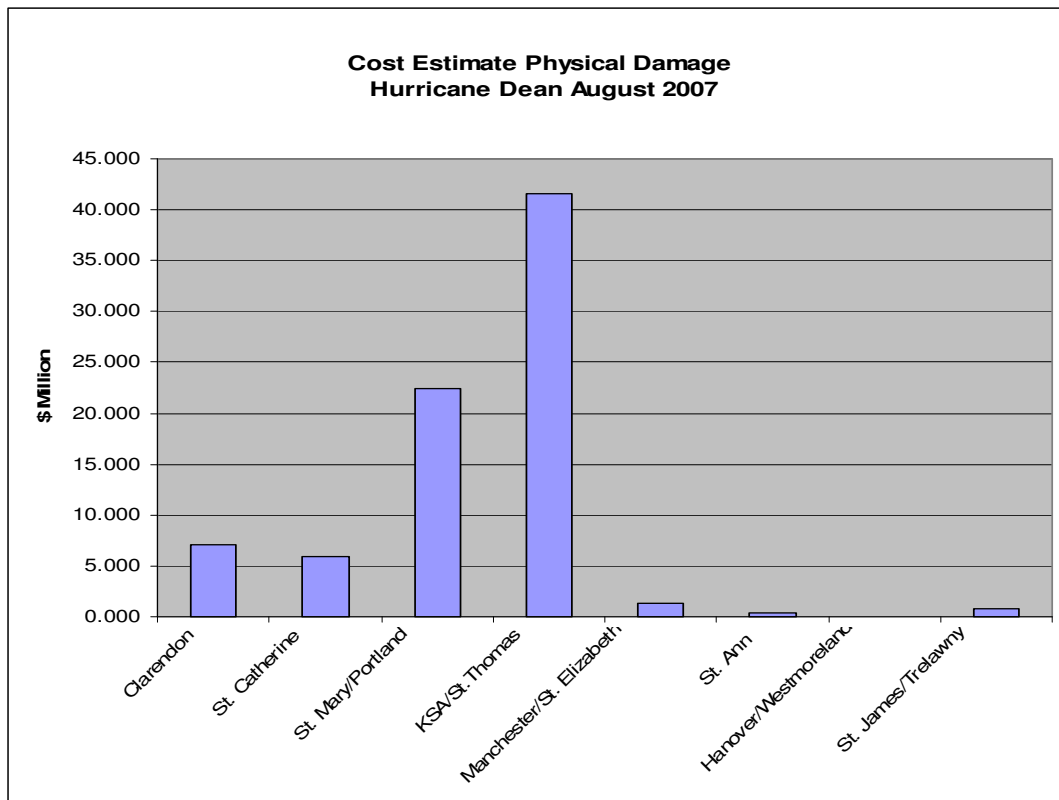
<sup>18</sup> Source: NWC Report on the Status of Water Supply Systems Due to Hurricane Dean, October 08, 2007



**Table 4.1:** Allocation of estimated cost incurred each Area due to Hurricane Dean

<b>A.</b>	<b>EASTERN DIVISION</b>	<b>COST/ESTIMATE \$</b>
1	Clarendon	7,117,800.00
2	St. Catherine	5,924,320.90
3	St. Mary/Portland	22,536,000.00
4	KSA/St.Thomas	41,537,078.00
	<b>Sub-total</b>	<b>77,115,198.90</b>
<b>B.</b>	<b>WESTERN DIVISION</b>	
1	Manchester/St. Elizabeth	1,337,536.00
2	St. Ann	360,000.00
3	Hanover/Westmoreland	50,000.00
4	St. James/Trelawny	760,000.00
	<b>Sub-total</b>	<b>2,507,536.00</b>
	<b>GRAND TOTAL</b>	<b>79,622,734.90</b>

Source: NWC Report on the Status of Water Supply Systems Due to Hurricane Dean, October 08, 2007

**Figure 4.5.:** Allocation of cost incurred by each Area

Source: NWC Report on the Status of Water Supply Systems Due to Hurricane Dean, October 08, 2007

Water supply systems were primarily affected by:-

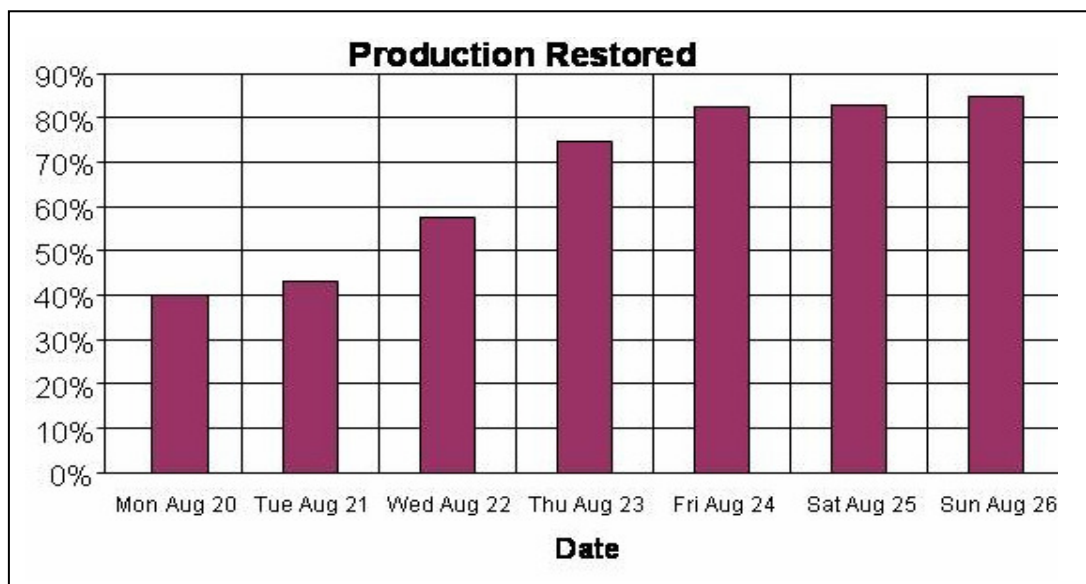
1. Extremely high turbidity levels especially at systems served by surface water sources (i.e. rivers and springs)
2. Absence of Electricity
3. Blocked and damaged intake structures
4. Dislocated and broken mains
5. Blocked access to critical facilities

Approximately 80% of water supply systems stopped operating during or immediately before the hurricane's passage, while some customers continued to receive piped water throughout the passing hurricane. Among the major systems that operated throughout passage of the Hurricane were the Bogue Water Treatment Plant (WTP) in St. Ann and the Roaring River WTP in Westmoreland.

Immediately following the passage of Hurricane Dean, NWC took steps to restore water supply systems that could be operated on available standby generators to areas that could be supplied by means of gravity flow. The Constant Spring WTP (18 mgd) and Mona WTP (15 mgd) in St. Andrew, the Great River WTP (15 mgd) in St. James and the Martha Brae (6 mgd) in Trelawny were re-activated to service and were fully operational by mid-morning on Sunday August 19, 2007. These plants were operated using stand-by generators. Others were restored over the last 7 days as intakes were cleared and the electricity grid was energized.

By the end of the day following the event, approximately 40% of production capacity was restored. Nearly all of the largest water supply systems were back in operation using available standby generators or by means of gravity flow distribution. In addition, most wastewater facilities were also back in operation. As a complement to the delivery of piped water supply, NWC initiated a comprehensive water trucking operation utilizing the services of the Rapid Response Unit of the Ministry of Water and Housing, private trucks and its own water trucks. Priority was placed on supplying water to hospitals, health facilities and shelters. As more and more piped water supply systems are brought back into operation, the focus of the trucking operations became more concentrated in those areas still without piped service.

**Figure 4.6: Progress of NWC Customers Restored**



**Source:** NWC Report on the Status of Water Supply Systems Due to Hurricane Dean, October 08, 2007

One week after the passing of Hurricane Dean (Sunday, August 26, 2007) the NWC reported that it had 84% of its production capacity in service. As at Saturday, September 01, 2007 production capacity was restored to 90.2 per cent. The progress of the restoration effort is graphically represented in Figure 4.6. Restoration of services to the remainder of facilities was hindered by difficulty in accessing communities located in hilly interior areas of the island. Three weeks after the event, a number of NWC customers and pockets within service areas were still experiencing low water pressure, intermittent water supply and no water as a result of fluctuations in pressure within the system. As at October 08, 2007, the National Water Commission had four (4) potable water supply facilities out of operation. This represents 99 % of the Commission's systems for which service has been restored.

The speed of restoration of NWC's production facilities was largely effected through the coordinated efforts of the JPSCo in providing energy and the National Works Agency (NWA) in assisting with access.

Table 4.2 provides a listing of the four facilities out of operation and the communities served at October 08, 2005. Most of the affected systems are of the smaller sources serving semi-rural and rural communities with challenging (hilly) terrains.

At some of these locations, access was still a challenge, heavy siltation occurred (Figure 4.7) and the restoration of JPS power supply was being awaited, at other facilities power has been restored however, voltage fluctuations and variation including low voltage is being experienced at these facilities.

**Figure 4.7:** Silted Catchment – Iterboreale, St. Mary



Source:NWC

The National Water Commission's facilities in the Parishes of Kingston, St. Andrew, Portland, St. Thomas, Clarendon, Manchester, St. Elizabeth and sections of St. Catherine were mostly affected by the hurricane.

The Commission did not sustain major structural damage to its facilities, however, damage/displacement of pipelines and damage/loss of roof to main and auxiliary buildings were reported for some areas.

**Table 4.2.:** List of Facilities out of operation due to the effects of Hurricane Dean

<b>No.</b>	<b>System</b>	<b>Source</b>	<b>Areas normally served</b>	<b>Remarks</b>
<b>KINGSTON &amp; ST. ANDREW</b>				
1	Mahoney	Spring	Mahoney, Rose Hall, Lawrence Tavern, Cassava River, Mount Olive, Assett Hill.	Electrical problem exists.
<b>ST CATHERINE</b>				
1	Cocoa Ridge / Goldmine T/P	Filter Plant	Bodose Hill, Bellas Gate, Cocoa Ridge, Sand Hole, Rhule Town. Planters, Sandy Ground, Bellfield, Marlie Hill, Joe Ground, Bamboo Ridge, Bartons, Wood Hall, Browns Hall, Blue Hole, Macca Tree	Roadway impassible. JPSCo. Low Voltage.
<b>PORTLAND</b>				
1	Seaman's Valley	Spring	Seamans Valley	System partially restored - 90%. 900 m of pipeline from source dislocated/damaged. Complete service is scheduled to be restored by October 2007.
2	Long Bay	Spring	Long Bay, Long Bay Pen, Rose Garden, Rural Hill, Elmwood	Restoration of service is at 95%. New pipelines along roadway have been laid.
			<b># of Systems out of operations</b>	<b>4</b>

Source: NWC Report on the Status of Water Supply Systems Due to Hurricane Dean, October 08, 2007

## **2. Telecommunications**

The telecommunications sub-sector<sup>19</sup> remained relatively operational throughout the event although damage to telecommunications network was sustained in the parishes of Portland, St. Mary, Clarendon and St. Thomas. Direct damage to the telecommunications sector was estimated at \$260 million.

### **a) Telecommunications Service Providers**

FLOW reported that while their backbone infrastructure remained operational throughout and after the hurricane, damage was sustained to approximately 10% of their distribution network. This was due to fallen trees and utility poles on cable lines. Approximately one-fourth of the cable plant in Port Royal will need replacement and there was loss of cable service to The Norman Manley Airport and Port Royal areas. FLOW reported that service was restored to 80% of affected customers within 24 hours of the event. Disruption of service during the event was due to fading due to extremely heavy cloud coverage and strong winds and flying debris which caused misalignment of some dishes.

Cable and Wireless reported that major damage sustained, was to their overhead transmission infrastructure, Cellular Sites and some of their administrative buildings. The parishes of St. Thomas, Clarendon, St. Elizabeth, and Manchester along with St. Andrew were most affected.

Damage was sustained to the microwave line connecting St. Thomas into the mobile network and to a fibre optic cable which affected service in Manchester, St. Elizabeth and Clarendon. Over 1 000 customers were without fixed line service because the Mandeville Exchange was flooded and equipment damaged; an antennae in Laughlands in St. Ann was blown out and another antennae at Huntley in St. Elizabeth was also blown out. This affected service in Whitehouse, Junction, Malvern, Thornton and Siloah. In Old Harbour Bay, St Catherine,

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<sup>19</sup> According to the World Telecommunication Indicators (ITU 2005), Jamaica has 18.7 main telephone lines per 100 inhabitants, 82.2 mobile cellular telephone subscribers per 100 inhabitants and 39.9 internet users per 100 inhabitants. Jamaica's telecommunications landscape also consists of some 146 telecommunications licenses, including 49 Internet Service Providers, 32 Internet Voice Service Providers, and 20 Data Service Providers, among others.

flooded equipment left the area without service; while a problem with a generator affected service in Tower Isle St. Ann area.

Digicel reported that disruptions in service were experienced in selected communities in eastern and central Jamaica, especially in the parishes of Manchester and St. Thomas. This was as a result of fading due to extremely heavy cloud coverage and strong winds and flying debris which caused misalignment of some dishes. Over 70% of their customers retained services during the peak hours of the hurricane and operations were almost regularized in less than 24 hours after the event. Restoration of service to badly affected areas like St. Thomas was challenging as roads to get to affected sites were impassable and the visibility from helicopter transporting repair teams was poor due to persistent heavy cloud coverage. Cable & Wireless and Digicel both used roving power trucks to facilitate customers who were unable to recharge their cellular instruments due to lack of electricity. These trucks visited key locations islandwide and consumers were able to recharge their phones free of cost.

#### **b) Post Offices and Postal Agencies**

Damage to post offices amounted to approximately \$5.68 million. See Table 4.3. The Post and Telecommunications Department reported major damage to 19 post offices in 8 parishes and three post offices have had to be relocated due to the extent of the damage. The relocations affected Old Harbour Bay Post Office in St. Catherine, and the Lottery and Ken Jones Post Offices in St. James. Most post offices sustained damage to roofs and windows. Services were also disrupted due to the lack of electricity and water at some locations.

In the aftermath of Hurricane Dean operations at the Central Sorting Office (CSO), the postal service headquarters, resumed on Tuesday, August 21 and the system was ready to facilitate airmail dispatch on August 22. Airmail processing was impacted by airline schedules having been changed, but this subsequently reduced as flights began to return to their accustomed times. Although roads blocked by debris caused delays in some of the more remote geographical locations, as at September 3, the Postmaster General reported that there was 95 per cent mail access across the island.

**Table 4.3:** List of Post Offices Damaged by Hurricane Dean on August 19, 2007

<b>Parish</b>	<b>Post Office</b>	<b>Nature of Damage</b>	<b>Estimated Cost of Repairs \$</b>
<b>Kingston/ St Andrew</b>	Hagley Park	Sections of roof	640,000
	Denham Town	Sections of roof	250,000
<b>St Catherine</b>	Ewarton	Sections of roof	120,000
	Old Harbour	Sections of roof	120,000
	Old Harbour Bay	Sections of roof	446,200
<b>St Ann</b>	Laughlands	Sections of roof	480,000
<b>Manchester</b>	Newport	Roof sheetings, window and flooring	520,000
<b>Clarendon</b>	Lionel Town	Roof sheeting ceiling	450,000
	May Pen	Roof sheeting	200,000
	Toll Gate	Section of roof ceiling	120,000
	Race Course	Roof/Ceiling	250,000
	Hayes	Perimeter Fence	100,000
<b>St James</b>	Montego Bay #2	Skylights blown off	100,000
	Ken Jones [Relocated]	Windows	130,000
	*Lottery (Rented)	Roof completely gone	[Relocated]
<b>Westmoreland</b>	Bethel Town	Sections of Roof	300,000
	Bluefields	Sections of Roof	700,000
	Whitehouse	Sections of Roof	150,000
	Ramble	Sections of Roof	600,000
<b>TOTAL</b>			<b>5,676,200</b>

**Source:** Post & Telecommunications Division

**Closed and Relocated Offices:**

- (1) Lottery relocated and operating at Sign P O in Montego Bay
- (2) Old Harbour Bay - closed and operations are now at the Old Harbour Post Office, St Catherine
- (3) Ken Jones - closed and operations are now at Hopewell Post Office, Hanover



### **3. Transport, Roads and Bridges**

Both main roads maintained by the National Works Agency (NWA) and by Parish Councils (PCs) suffered heavy damage due to the onslaught of Hurricane Dean. As in Hurricane Ivan, the road connecting Kingston and the Norman Manley International Airport was affected by storm surge causing flooding in the area of the Harbour View round-a-bout and piling sand approximately 1.5 meters high along the length of the road. Storm surge also caused heavy damage to the coastal roads in St. Thomas and Portland. Some of the major arterial roads that sustained damage and blockage included the following:

1. Goshen Main Road, St. Elizabeth
2. The Yallahs Ford, St. Thomas
3. Junction Main Road, St Mary

The National Works Agency (NWA) reported that a total of 446 roadways were blocked by fallen trees, debris, washed down silt and landslips due to the hurricane. Parishes hardest hit were Portland, St. Thomas and St. Catherine with the cost to reopen and restore amounting to a high of \$332.08 million in St. Thomas.

The total cost to reopen NWA and PC roads was estimated at \$545.97 million while the cost to restore NWA roads is set at \$566.38 million. The total effect of the disaster on the road transport sector was estimated as \$1.112 billion. Cost to re-open includes clearing of slips/blockages of roads, temporary repairs to roads and cleaning of critical drains. Balance to complete includes restoration of asphaltic and unasphaltic roads, cleaning of blocked drains, and repair of kerb/channel, relay culverts and construction/reconstruction of Retaining wall (see Table 4.4). NWA has estimated that there will be an additional cost of \$755.0 million for river training, gabion works and sea defence to correct damage in eight parishes. The cost to repair and replace retaining walls in four parishes is \$160.0 million while it is estimated to cost \$20.0 million to refurbish and/replace damaged traffic signals across the island.

Twelve days after the event there were still 47 affected intersections located in Kingston & St. Andrew, St. Catherine, Manchester, St. James, Clarendon and St. Elizabeth where traffic signals were non-operational. This was due to the lack of electrical supply at 30 of these intersections,

18 of which were located in Kingston & St. Andrew, three in Manchester, eight in St. Catherine and two in St. Elizabeth, while there was damage to cabinets, cable and signal heads at the other locations. There was also significant damage to the seawall along coastal roads in the Manchioneal, Portland and Roselle in St. Thomas.

**Table 4.4:** NWA Preliminary Cost Estimate – Hurricane Dean (August 18-20, 2007)

PARISH	COST TO REOPEN ( \$)		TOTAL COST TO REOPEN (\$ ) A	BALANCE TO COMPLETE NWA ROADS (\$ ) B	GRAND TOTAL REQUIRED (\$) (C=A+B)
	NWA ROADS	PC ROADS			
Kingston	16,339,559	21,769,999	38,109,558		38,109,558
St. Andrew	31,600,000	8,550,000	40,150,000	32,650,000	72,800,000
St. Catherine	29,698,000	34,843,000	64,541,000	23,210,000	87,751,000
Clarendon	22,665,000	8,140,000	30,805,000	55,015,000	85,820,000
Manchester	30,680,000	7,380,000	38,060,000	69,100,000	107,160,000
St. Elizabeth	12,800,000	800,000	13,600,000	21,700,000	35,300,000
Westmoreland	7,670,000	2,000,000	9,670,000	9,330,000	19,000,000
Hanover	13,961,960	2,673,880	16,635,840	13,711,760	30,347,600
St. James	5,671,060		5,671,060	10,750,000	16,421,060
Trelawny	7,000,000	500,000	7,500,000	10,800,000	18,300,000
St. Ann	31,750,000	450,000	32,200,000	5,250,000	37,450,000
St. Mary	26,610,000	4,675,000	31,285,000	50,410,000	81,695,000
Portland	91,916,000		91,916,000	68,200,000	160,116,000
St. Thomas	86,910,000	38,915,000	125,825,000	196,250,000	322,075,000
<b>TOTAL</b>	<b>415,271,579</b>	<b>130,696,879</b>	<b>545,968,458</b>	<b>566,376,760</b>	<b>1,112,345,218</b>

NB: Cost to re-open includes clearing of slips/blockages of roads, temporary repairs to roads and cleaning of critical drains

Balance to complete includes restoration of asphaltic and unasphaltic roads, cleaning of blocked drains, repair of kerb/channels, relay culverts and construction/reconstruction of Retaining walls

**Source:** National Works Agency

In the days following the event, the NWA with the assistance of private contractors sought to clear most roads blocked by fallen trees to ensure at least single lane traffic. Alternative routes were also assigned in cases where roads were impassable. By August 24, 2007, five days after the event, the NWA had restored access to over 95.0 per cent of the 446 roadways that were blocked. Of the 426 roads re-opened, full access were restored to 314 (70.0 percent) while 112 (25.0 percent) were cleared to single lane access. Twenty roads remain closed.

## **V. IMPACT ON THE ENVIRONMENT**

### **1. General**

#### **a) Overview**

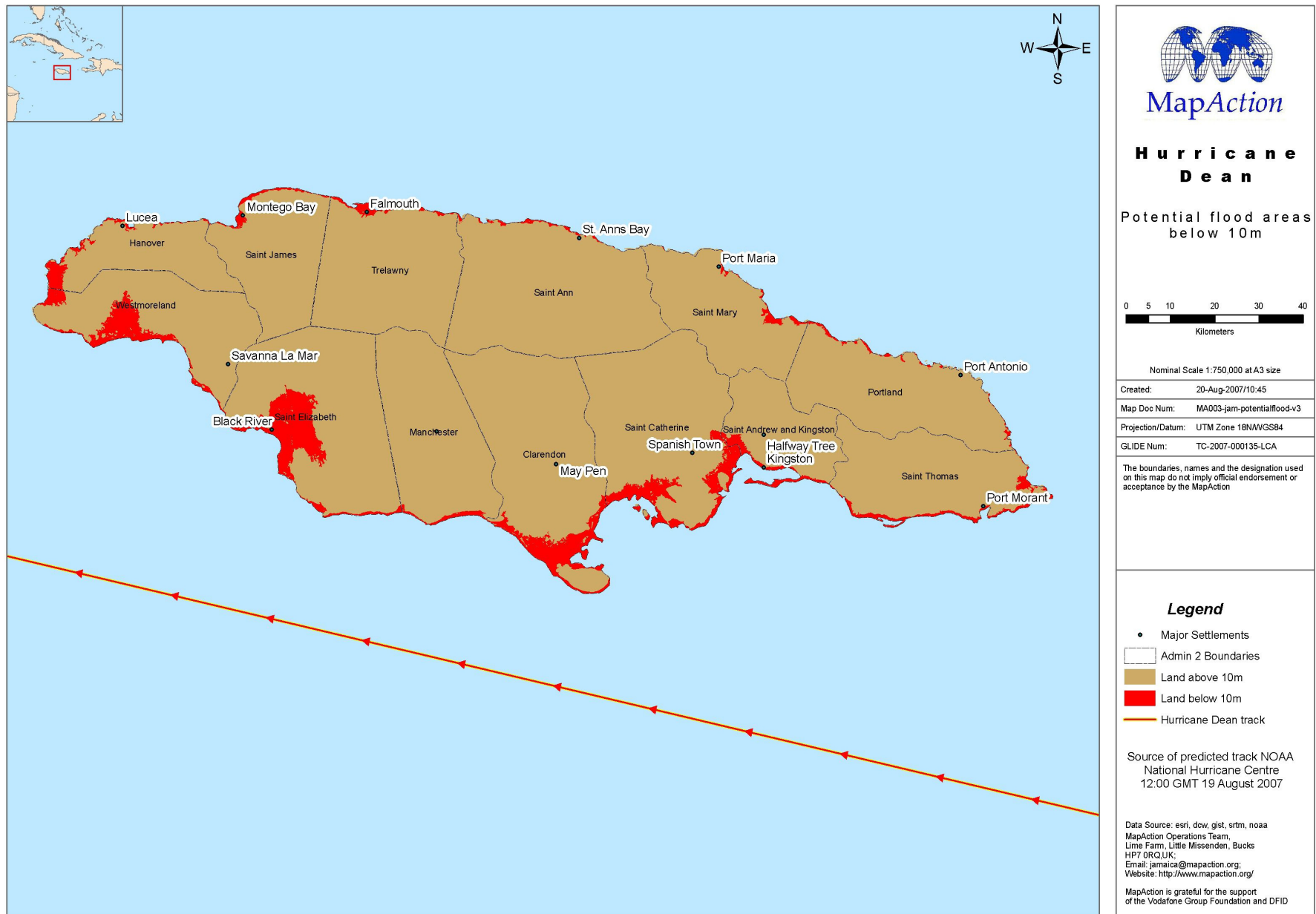
Natural hazards are an important feature of the natural environmental systems operating in Jamaica and the Caribbean. However, the occurrence of extreme events such as Hurricane Dean is often accompanied by disastrous impacts on social and economic well-being and extensive destruction to the natural environment. Changing climatic conditions are leading to more frequent and intense weather events. The impact of these events is often exacerbated by anthropogenic factors which increase the vulnerability of life and land. Extreme events can cause direct damage to critical coastal ecosystems such as, coral reefs, wetlands (mangroves) and seagrass beds which act as coastal buffers and are habitat, feeding and nursery areas for fish and other marine organisms. Strong currents caused by winds can also affect the sea floor. Additionally, beaches and coastal infrastructure are also eroded and damaged due to storm surges. Equally vulnerable to extreme storm events are forests and other terrestrial vegetation.

#### **b) Pre-Existing Environmental Conditions**

Pre-existing environmental conditions can limit or increase the potential impact of natural hazards such as hurricanes on the environment. Pre-existing conditions before the passage of Hurricane Dean included the following:

- The existence of formal and informal settlements in coastal areas which are highly vulnerable to flooding and storm surge (See Figure 5.1). This problem is often made worse by poor housing design in some of these areas;
- Coastal ecosystems were already being degraded due to marine and land-based pollution, habitat degradation, over-fishing and the effects of previous storm events (Hurricane Ivan, 2004). For example, the destruction of wetlands in critical areas (such as Portland Cottage, Clarendon and Old Harbour Bay, St. Catherine) served to increase the risk to storm surge.

**Figure 5.1: Potential Flood Areas Below 10m**



Source: MapAction

- Traditional agricultural crops such as bananas and sugar cane which are grown on low lying plains making them susceptible to coastal flooding and wind damage
- The denudation of hillsides and continued removal of vegetative cover can accelerate erosion due to rapid runoffs. This leads to increased sedimentation and turbidity in coastal areas which threatens marine resources.
- Vulnerability of beaches and critical coastal infrastructure (such as roads at Roselle, St. Thomas, and Palisadoes, Kingston) are located on the coast placing them at risk to wave action and storm surges.
- Accumulation of solid waste in water channels due to indiscriminate disposal increased the potential for flooding in some areas.
- Saturated ground conditions resulting from rainfall during the week prior to the hurricane

## **2. Impact of Hurricane**

The analysis of environmental impacts is limited by the lack of good quality data on the characteristics and conditions of the environment prior to the passage of Hurricane Dean. Thus, assessment of environmental damage and loss were mainly qualitative.

The wind strength, direction and forward speed of the hurricane; and the amount of rainfall associated with the event are major determinants the type of ecosystems impacts and the extent and location of the impacts. In the case of Hurricane Dean, flooding and wind damage were the major sources of impacts. Both terrestrial and marine environments were impacted by Hurricane Dean included. Some specific areas of damage included defoliation; destruction of wildlife habitats; landslides; and vegetation damage.

Due to the southerly path taken by Hurricane Dean, most of the impacts occurred in the southern part of the country. The parishes experiencing the worst environmental damage were Portland; Clarendon; Manchester; St. Elizabeth; Hanover and Westmoreland; St. Thomas; Kingston & St. Andrew and St. Catherine.

The environmental impact of the hurricane was categorized broadly to include Direct Damage and Indirect Loss. The assessment was based on field visits undertaken by NEPA, PIOJ, and the Fisheries Division.

## **Direct Damage**

### **a) Ecosystem and Habitat Damage**

**Coastal and Marine Ecosystems.** Seagrass beds and mangroves not only act as coastal buffers but they provide coastal stability and habitat and nursery for many fish species and other marine organisms. Hurricane Dean uprooted large mats of seagrass beds as seen in Figure 5.2. This is likely to lead to a reduction in fisheries catch in the ensuing months. It will also add to the clean up cost of beaches. Mangroves and seagrass act as sediment sinks and thus reduce turbidity in coastal waters.



**Figure 5.2:** Large mats of seagrass uprooted in Rocky Point, Clarendon

Several mangroves suffered crown damage by wind shear and storm surge especially in Clarendon, Manchester and St. Elizabeth (See Table 5.1). However, despite the eye of the hurricane passing closest to Clarendon, about 40% of the mangroves in the Portland Bight Area suffered very little or no damage. This is due mainly to the young state of these mangroves which are just recovering from Hurricane Ivan in 2004. Debris consisting of *Gorgonia* species

(e.g. Sea Fan) was washed ashore along sections of the Palisadoes strip. The impact on the coral reefs by the hurricane, although not yet assessed, is believed to be significant given the magnitude of the storm.

High turbidity affects the productivity of coastal ecosystems by lowering the amount of sunlight entering the water thus disrupting photosynthesis and reducing the amount of food available for marine organisms. Loss of coastal ecosystems such as coral reefs has a negative impact on marine fish catch since these ecosystems provide food and habitat for fish and the Jamaican fishery is mainly coralline. Additionally nutrient pollution from land through increase runoff can affect coral reefs leading to excessive growth of algae which stifles reef growth.

**Table 5.1:** Summary of Impacts on Ecosystems by Parish

HABITAT								
	Beaches		Marshlands		Mangroves		Forests	
IMPACT	Erosion		Lateral Compression		Crown Damage			
PARISH	Level	% Affected	Level	% Affected	Level	% Affected	Level	% Affected
Clarendon	High	100	Low	100	Low	40	Low	90
					Moderate	30	High	10
					High	30		
Manchester	Moderate	100	Moderate	100	Low	20	Low	95
					Moderate	50	Moderate	5
					High	30		
St. Ann							Low	100
St. Catherine	Moderate	40					Low	95
	High	60					Moderate	5
St. Elizabeth	Moderate	100	Low	100	Low	50	Low	95
					Moderate	30	Moderate	5
					High	20		
St. James							Low	100
St. Thomas	Moderate	20			Low	60	Low	95
	High	80			Moderate	40	Moderate	5
Portland	Moderate	40					Low	90
	High	60					Moderate	10
Trelawny							Low	100
Westmoreland							Low	100
St. Mary							Low	100

Source: National Environment and Planning Agency, 2007

Crown Damage: 0-25% - Low; 26-50% - Moderate; > than 50% - High

High water runoff from main drainage and land led to the deposition of a significant volume of solid waste into coastal waters threatening the lives of marine organisms. One of the likely impacts of this is that fish and turtles can become entangled in plastic bags resulting in suffocation.

The Fisheries Division has estimated that 52,500 fish traps were lost as result of Hurricane Dean. This implies that the potential 'ghost-fishing' catch of the traps is approximately 105<sup>20</sup> MT per week. A total of 3,500 fishers have been directly affected by the hurricane due to loss of fishing equipment and disruption in their fishing activities. Coastal and marine ecosystems usually take long time to recover naturally and even more so due to the added anthropogenic factors impacting them.

**Terrestrial Ecosystems:** Marshlands which are home to many freshwater species such as freshwater birds and crocodiles suffered low to moderate damage (lateral compression) within the parishes of Clarendon, Manchester and St. Elizabeth. Elevated water levels in marshlands such as in the Black River Morass could affect wildlife such as roosting and nesting birds through entrapment or drowning.

The National Environment and Planning Agency assessed both coastal and inland forests. Based on the southerly path of the hurricane, mangrove forests bore the brunt of the damage. While forest cover was impacted in all the affected parishes, crown damage was relatively low being less than 25% for most parishes (Table 5.1). Overall crown damage ranged from 0 percent (no effect) to more than 75% (severe). Moderate to heavy crown damage occurred in forests on the south coast such as Portland Ridge and Brazillito Mountains. Inland forests experienced moderate, little or no damage probably due to the reduction in wind speed outward and away from the eye-wall.

Coastal dry limestone forests in Clarendon showed moderate damage to tree crowns. Several tree species had broken branches and trunks. However, this was more pronounced in the Red Birch (*Bersera simaruba*) and Burnwood (*Metopium brownie*) which have little resistance to strong winds due to their brittleness.



**Habitat Loss.** Both terrestrial and coastal vegetation were damaged due to the force and wind speeds of the hurricane. This is likely to affect habitats that are important roosting, foraging and nesting sites for important bird species such as the White-crowned Pigeon (Bald Pate). In addition, under extreme hurricane conditions, the loss of foraging and roosting habitat can result in high juvenile and nestling mortality.

#### **b) Coastal Erosion and Sedimentation**

Storm surges of 7 to 9 feet (2 to 3 meters) battered sections of Jamaica's coastline. Some sections of the coastline, especially on the eastern and southern coast were badly eroded and damage done to sea defence structure. Some of the major impacts included:

- Damage to 200 metres of seawall and adjoining roadway in Manchioneal (Figure 5.3).
- Damage to houses at Old Harbour Bay and Rocky Point
- Road failure at Roselle (which was impacted in Hurricane Ivan) caused by extensive scouring and undercutting of the cliff face and shoreline;
- Destruction of housing and property in the Caribbean Terrace area immediately east of the mouth of the Hope River and south of the Harbour View housing estate;
- Removal of protective boulders and destruction of sand dunes and coastal vegetation along the Palisadoes peninsula which connects the Norman Manley International Airport and the settlement of Port Royal with the rest of the island;
- Damage to fishing settlements and beaches in Portland, St. Thomas, St. Catherine and Clarendon which includes extensive losses at Old Harbour Bay, Rocky Point and Portland Cottage.

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<sup>20</sup> This is based on the assumption that each trap catches an average of 2 kg of fish per week.



**Figure 5.3:** Eroded section of seawall along the main road in Manchioneal

Estimates of sediment deposits were not available during the assessment. However, sediment deposits were reported at several locations. The storm surge and wave action of Hurricane Dean inundated sections of the south coast with severe over-wash conditions that produced shoreline erosion, sand dune damage and sedimentation. The areas of greatest erosion produced by Hurricane Dean occurred along sections of the south coast and north eastern areas of Portland, St. Thomas and St. Andrew.

There was significant flooding and deposition of sand on the Palisadoes Road caused by wave action which made the road impassable for two days (Figure 5.4). The increased accretion of the beach on the harbour side caused by Hurricane Ivan in 2004 extended even further as a result of Hurricane Dean. This implies that the extent of the beach on the seaward side is reducing while the width of beach on the harbour side is increasing. Given the usually high currents experienced on the seaward side, the road is now more vulnerable. Also a pond approximately 20m from the shoreline (created by Hurricane Ivan) on the seaward side has increased even further by Hurricane Dean.

There was significant accretion of sand and debris on some beaches (up to 30m inland) such as Old Harbour Bay, Rocky Point and along the Manchester coastline while erosion or starvation of

sand on other beaches such as Rollings Bay, Clarendon and Treasure Beach, St. Elizabeth. At the Gunboat Beach, St. Andrew, there were several areas of accretion along the harbour side.

The hurricane also contributed to significant levels of sedimentation which flooded sea-grass beds and coral reefs along the south coast particularly in Old Harbour Bay and Rocky Point. Mangroves (Black and White) were also exposed to high levels of salinity in some areas which can eventually lead to stunted growth or death.



**Figure 5.4:** The Palisadoes Road in Kingston covered with sand after Hurricane Dean

### **c) Indirect Loss**

The reduction or loss of the protective effect of coastal ecosystems such as coral reefs, mangroves and seagrass can lead to significant erosion of coastline threatening coastal infrastructure and livelihoods. The loss of these ecosystems will also affect marine fish production and disrupt the livelihoods of fishers and other individuals and businesses that directly or indirectly benefit from fishing since these areas act as habitat and nursery areas for fish and other marine organisms. Although fish abundance may increase shortly after a hurricane, this is short-lived because the coastal and marine ecosystems have been damaged which may eventually lead to migration (fish look for better locations) or death of fish.

Other sectors such as tourism will be impacted from changes in beach morphology, beach erosion and loss of beach due to loss of coral reefs. The high turbidity of coastal waters and debris on beaches affect tourism by reducing aesthetic appeal. Runoff bearing diverse pollutants including sewage not only affects coastal ecosystems but also threatens the health of people living near the coast.

Changes in habitats resulting from natural hazards threaten the lives of organisms dependent on these habitats for survival. Wind damage to trees even if moderate can lead to loss of roosting, foraging and nesting areas for organisms. Also the wind can dislodge flowers and fruits, interrupting pollination and affect birds and bees and even honey production. Fruit eating birds such as the White-crowned Pigeon would be most threatened fruit loss. Loss of canopy may also trigger migration of birds and other organisms which can disrupt the ecosystem.

## VI. SUMMARY OF DAMAGE AND LOSSES AND MACROECONOMIC EFFECTS

Preliminary assessment the impact of Hurricane Dean on Jamaica amounted to **\$23,053.92** million. Of this total, **\$14,392.15** refers to direct damage while **\$8,661.78** million refers to indirect losses. (Table 6.1)

**Table 6.1: Preliminary Costs of Damage and Losses caused by Hurricane Dean (\$million)**

Sector and Sub-sector	\$million				
	Direct	Indirect	Total	Private	Public
<b>Total</b>	<b>14,392.15</b>	<b>8,661.78</b>	<b>23,053.92</b>	<b>18,753.69</b>	<b>4,300.24</b>
<b>Social</b>	<b>6,994.24</b>	<b>80.18</b>	<b>7,074.42</b>	<b>5,961.68</b>	<b>1,112.74</b>
Housing	5,961.68		5,961.68	5,961.68	
Education and Culture	727.86		727.86		727.86
Health	218.35	80.18	298.53		298.53
Correctional Facilities	77.08		77.08		77.08
Heritage Sites	9.27		9.27		9.27
<b>Productive</b>	<b>3,957.68</b>	<b>7,708.60</b>	<b>11,666.28</b>	<b>11,451.08</b>	<b>215.20</b>
Domestic Crop	904.37		904.37	904.37	
Livestock	74.50		74.50	74.50	
Greenhouse/Protected Cultivation	52.47		52.47	52.47	
Agricultural Crops*1	2,357.45	5,603.00	7,960.45	7,960.45	
Fisheries*2	310.00	75.60	385.60	385.60	
Irrigation	17.20	0.00	17.20	0.00	17.20
Mining		2,030.00	2,030.00	2,030.00	
Tourism	43.69	0.00	43.69	43.69	
Manufacturing		0.00	0.00	0.00	
Relief Assistance (Agriculture)*3	198.00	0.00	198.00	0.00	198.00
<b>Infrastructure</b>	<b>3,440.23</b>	<b>150.00</b>	<b>3,590.23</b>	<b>1,340.93</b>	<b>2,249.30</b>
Electricity*4	1,073.25		1,073.25	1,073.25	
Water Supply and Sanitation	52.00	150.00	202.00		202.00
Transport/Roads and Bridges	2,047.30		2,047.30		2,047.30
Telecommunications*5	267.68		267.68	267.68	
<b>Environment</b>	<b>0.00</b>	<b>120.00</b>	<b>120.00</b>		<b>120.00</b>
Forestry			0.00		0.00
Waste Management		120.00	120.00		120.00
<b>Emergency Operations</b>		<b>603.00</b>	<b>603.00</b>		<b>603.00</b>
Government Relief Assistance		580.00	580.00		580.00
ODPEM Recovery Activities		23.00	23.00		23.00

**Source:** Compiled by the PIOJ with data from various agencies

\*1 Agricultural crops include citrus, coffee, cocoa, banana and sugar

\*2 Calculations for Indirect cost based on 52,500 lost fish traps with an average catch 2kg of fish and harvested 3 times within a 2 week period at a cost of \$240/kg

\*3 Includes funds provided by the MOA to purchase and distribute fertilizer, assistance to farmers who lost greenhouses, rehabilitation of fruit trees, assistance to fishermen and banana farmers and a grant to the Sugar Industry

\*4 Calculated at approximately 75% of JPS claim to OUR for Hurricane Ivan (1.431 billion)

\*5 Includes preliminary estimates of damage to Cable & Wireless, Digicel and Post & Telecommunications infrastructure

## 1. The Macroeconomy

### Overview of Domestic Policies

The fiscal policy for 2007/08 was established within the context of the revised Medium Term Socio-Economic Framework 2006/07–2009/10 (Table 6.2). Some key macroeconomic targets that were established for FY 2007/08 included:

- inflation of 6.0–7.0 per cent;
- real GDP growth of 3.0 – 4.0 per cent;
- fiscal deficit of 4.5 per cent of GDP;
- debt to GDP ratio of 125.1 per cent; and
- Primary Surplus of 8.5 per cent of GDP.

**Table 6.2:** Medium Term Economic Indicators 2002/03 – 2009/10

INDICATORS	Actual					Targets		
	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Real GDP Growth Rate (%)	1.7	2.1	0.4	1.9	2.5	3-4	3-4	4-5
Inflation (%)	6.2	16.8	13.2	11.4	6.6	6-7	5-6	4-5
Fiscal Balance (% GDP)	-7.6	-5.6	-4.6	-3.3	-5.3	-4.5	-2—3	0.0
Primary Surplus (% GDP)	7.2	12.5	11.8	10.4	8.5	8.5	9-10	10-11
Debt/GDP (%)	143.9	142.5	136.6	131.5	130.4	125.12	119.91	110.89
NIR (US\$ million)	1,339.7	1,568.7	1,901.6	2,078.1	2,329.3	2,131.9	2,181.9	2,232.0

**Source:** Ministry of Finance & Planning

The fiscal targets were to be achieved through the Government's continued utilization of a combination of aggressive revenue enhancement measures and more efficient utilization of expenditure.

The Expenditure Budget for FY 2007/08 was set at \$380.4 billion, an increase of \$10.3 billion compared with the revised estimates for FY 2006/07. Debt Servicing at \$203.8 billion accounted for 53.6 per cent of the total FY 2007/08 budget compared with \$219.3 billion or 59.3 per cent

for FY 2006/07 budget. Central Government's operation for the FY 2007/08 budget was expected to be financed by the anticipated Revenue & Grants inflows of \$243,091.7 billion, 15.0 per cent higher than the actual out-turn for FY 2006/07.

The Debt Management Strategy for FY 2007/08 (a continuation of the policy initiated in FY 1998/99) places increased emphasis on liability management aimed at reducing long-term financing costs and maintaining a sustainable level of risk. Additionally, the debt strategy will continue to focus on:

- maintaining a mix of fixed and variable interest-rate debt to further diversify and minimize interest-rate risk;
- extending and smoothing the maturity profile of the debt to better manage refinancing risk;
- improving the transparency and predictability of primary market debt issuance; and
- promoting and building a liquid and efficient market for Government securities.

## **2. The Economy in the year of the Disaster: January – June 2007**

### **Fiscal Accounts**

Central Government operations for the first quarter of Fiscal Year 2007/08 generated a deficit of \$8 967.3 million, which was \$4 752.5 million lower than programmed. Inflows resulting from Revenue & Grants were \$200.2 million lower than expected. The intake from Revenue and Grants occurred against the background of lower than expected inflows from all subcategories with the exception of Bauxite Levy which was \$339.0 million higher than programmed. Total expenditure at \$64 661.9 million was \$4 952.7 million lower than budgeted. Capital Expenditure and Recurrent Expenditure were \$3 888.0 million and \$1 064.7 million lower than planned, respectively.

### **Gross Domestic Product**

For the first six months of 2007, real GDP increased by 1.8 per cent a deceleration in the growth rate compared with January - June 2006 when the economy grew by 2.4 per cent. The Goods Producing sector expanded by 1.6 per cent while the Services sector grew by 2.1 per cent ( see

Table 6.3). Growth was recorded for all Goods producing sectors. However, in the Services sector lower levels of activities were estimated for the Miscellaneous Services Sectors. The sectors which had the largest impact on the economy were the Construction & Installation, Transport Storage & Communication, Electricity & Water and Finance & Insurance sectors. The improved performance in the economy was influenced by: (i) increased alumina, bauxite and agricultural exports; (ii) normalization of activities in the Construction & Installation sector compared with the corresponding six months of 2006 when the sector was affected by a severe cement shortage; and (iii) increased electricity generation.

**Table 6.3: Change in GDP**

<b>YEAR ON YEAR CHANGE IN GROSS DOMESTIC PRODUCT IN PRODUCERS' VALUES, AT CONSTANT 1996 PRICES (PER CENT)</b>			
	<b>Jan-Mar</b>	<b>Apr –Jun</b>	<b>Jan-Jun</b>
	<b>2007</b>	<b>2007</b>	<b>2007</b>
	<i>Estimates</i>		
<b>GOODS PRODUCING SECTORS</b>	<b>1.4</b>	<b>1.8</b>	<b>1.6</b>
Agriculture, Forestry & Fishing	1.7	3.0	2.3
Mining & Quarrying	0.8	-0.7	0.0
Manufacturing	-0.9	1.2	0.2
<i>of which: Food, Beverages &amp; Tobacco</i>	-1.6	1.4	-0.1
<i>Other Manufacturing</i>	0.1	1.0	0.5
Construction & Installation	4.5	3.6	4.1
 <b>SERVICES SECTORS</b>	 <b>2.5</b>	 <b>1.7</b>	 <b>2.1</b>
Electricity & Water	4.5	3.9	4.2
Transport, Storage & Communication	3.8	2.2	3.0
Distributive Trade	2.8	2.8	2.8
Finance & Insurance Services	4.1	3.0	3.6
Real Estate & Business Services	2.5	2.5	2.5
Producers of Government Services	0.7	0.7	0.7
Miscellaneous Services (incl. Household & Private Non-Profit Institutions)	-0.3	-2.3	-1.3
<i>of which: Hotels, Restaurants &amp; Clubs</i>	-1.1	-3.5	-2.3
Less Imputed Bank Service Charge	8.5	1.5	5.0
<b>TOTAL GDP AT CONSTANT PRICES</b>	<b>1.7</b>	<b>1.8</b>	<b>1.8</b>

**Source:** Statistical Institute of Jamaica and Planning Institute of Jamaica



The performance of the economy during the first half of the year was constrained by the 1.3 per cent decline in the Miscellaneous Services sector<sup>21</sup>. This can be explained by the subcategory Hotels, Restaurants & Clubs, which captures a large share of tourism activity, declining by 2.3 per cent. The number of Stopover visitors that arrived during January-June 2007 declined by 3.4 per cent, due in part to the recovery of competing destinations, particularly Cancun.

## **Inflation**

Inflation for the first six months of calendar year 2007 was 2.9 per cent. This was 0.1 percentage points below the same period of 2006. The inflation indices for all eight major groups increased and was heavily concentrated in the groups Food & Drink and Housing & Other Housing Expenses which together accounted for approximately 55.8 per cent of overall price movement. Movements in the **Food & Drink** group were pushed by increases in the indices of the sub-groups, Meat, Poultry & Fish, Dairy Products, Oils & Fats and Baked Products, Cereals & Breakfast Drinks. These sub-groups were heavily influenced by:

- Rising grain prices<sup>22</sup> consequently leading to an increase in the prices of meat, dairy and baked products; and
- Supply constraints for the domestic cattle and fishing industry.

## **Balance of Payments**

For the period, January - April 2007, the Balance of Payments Current Account balance was negative US\$391.3 million, a deterioration of US\$108.0 million compared with the corresponding period of 2006. The Goods Balance deteriorated by US\$57.8 million to negative US\$1 006.7 million, and reflected the net result of an increase of US\$58.5 million in export revenue which was offset by an increase of US\$116.3 million in expenditure on imports. The growth in expenditure on imports primarily reflected net outflows for Machinery & Transport Equipment and Manufactured Goods.

The Services Balance, though positive, contracted to US\$269.6 million from US\$332.5 million.

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<sup>21</sup> This compares with the 11.6 per cent growth during January – June 2006.

<sup>22</sup> A strong demand for ethanol production resulted in corn prices reaching its highest level in ten years. Wheat prices were pushed upward by strong demand from major consuming countries and droughts in some wheat growing areas.

This reflected an expansion in the deficit on the Transportation sub-account with a simultaneous contraction in the surplus from Travel. Increased expenditure on shipping/freight and a reduction in stopover tourist arrivals over the period contributed to these changes.

### **External Trade**

For the January - April period Jamaica's external trade deficit widened by US\$93.2 million or 8.0 per cent to US\$1 264.9 million relative to the corresponding period of 2006. The value of Traditional Domestic Exports increased by US\$13.5 million (or 3.0 per cent) to US\$461.0 million, compared with January - April 2006. Non-Traditional Exports were valued at US\$223.2 million, approximately US\$41.3 million (or 22.7 percent), more than the corresponding period in 2006. Total Merchandise Imports for January - April 2007 increased by US\$150.8 million (8.3 per cent) to US\$1 965.6 million, compared with the corresponding period in 2006.

### **Exchange Rate**

At the end of June 2007, the monthly nominal exchange rate was \$68.42 per US\$1.00, compared with \$65.87 per US\$1.00 and \$67.70 per US\$1.00 at the end June 2006 and the end of March 2007, respectively.

### **The expected performance of the economy without the disaster**

For 2007, the economy was projected to grow by 2.1 per cent in the absence of Hurricane Dean (Table 6.4). All sectors were forecasted to grow with both the Goods - producing and Services sectors projected to increase by 2.2 per cent. The Construction & Installation, Electricity & Water, Transport, Storage & Communication and the Finance & Insurance sectors were expected to be the main drivers of growth for 2007.

Output during July-December was expected to expand at a faster pace (2.4 per cent) than in the January – June period when the economy grew by 1.8 per cent. This was partly based on an expected higher level of activity in the Mining & Quarrying and Miscellaneous Services sectors resulting in a projected growth of 5.2 per cent and 2.4 per cent, respectively for the final six months of the year<sup>23</sup>. Other sectors that were expected to contribute to the country's expansion

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<sup>23</sup> During January-June 2007, the Mining & Quarrying sector registered a flat performance while the Miscellaneous sector declined by 1.3 per cent.

during the final half of the year were the Construction & Installation, Electricity & Water and transport Storage & Communication.

**Table 6.4: Pre-Dean GDP Projections**

<b>YEAR ON YEAR CHANGE IN GROSS DOMESTIC PRODUCT IN PRODUCERS' VALUES AT CONSTANT 1996 PRICES (PER CENT)</b>				
	<b>Jul-Sept 2007</b>	<b>Oct-Dec 2007</b>	<b>Jul-Dec 2007</b>	<b>Jan-Dec 2007</b>
<b>GOODS PRODUCING SECTORS</b>	<b>2.6</b>	<b>2.9</b>	<b>2.8</b>	<b>2.2</b>
Agriculture, Forestry & Fishing	1.0	1.5	1.3	1.8
Mining & Quarrying	5.1	5.3	5.2	2.6
Manufacturing	1.7	2.2	2.0	1.0
<i>of which: Food, Beverages &amp; Tobacco</i>	2.0	2.5	2.2	0.9
<i>Other Manufacturing</i>	1.5	2.0	1.7	1.2
Construction & Installation	3.0	3.2	3.1	3.6
<b>SERVICES SECTORS</b>	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>
Electricity & Water	4.4	4.0	4.2	4.2
Transport, Storage & Communication	2.5	3.0	2.7	2.9
Distributive Trade	2.0	1.8	1.9	2.4
Finance & Insurance Services	2.4	2.5	2.5	3.0
Real Estate & Business Services	2.5	2.4	2.4	2.5
Producers of Government Services	0.5	0.5	0.5	0.6
Miscellaneous Services (incl. Household & Private Non-Profit Institutions)	2.4	2.3	2.4	0.4
of which: Hotels, Restaurants & Clubs	2.5	2.3	2.4	-0.1
Less Imputed Bank Service Charge	1.2	1.0	1.1	3.1
<b>TOTAL GDP AT CONSTANT PRICES</b>	<b>2.4</b>	<b>2.5</b>	<b>2.4</b>	<b>2.1</b>

**Source:** Planning Institute of Jamaica

### **The Evolution of the Economy with the Disaster**

Due to the impact of Hurricane Dean the economy is expected to grow by 1.1 per cent for 2007 instead of the 2.1 per cent forecasted prior to the passage of the hurricane. This will result from losses in output flows primarily in the Agriculture Forestry & Fishing, Mining & Quarrying and Electricity & Water sectors. However the Construction & Installation and Distributive Trade

sectors are estimated to be positively impacted by the effects of the hurricane. The Construction & Installation sector is expected to benefit from reconstruction activity. An expansion in activity in the Distributive Trade sector is predicated on projected higher gross sales associated with preparations prior to the hurricane and reconstructive work in the aftermath of the passage of the hurricane.

Prior to Hurricane Dean it was projected that inflation would be contained within the single digit range of 7.0 per cent – 9.0 per cent. Given the hurricane and the influence of other global events projections have been revised. It is now anticipated that inflation for calendar year 2007 will fall between 9.0 per cent – 10.0 per cent. For the remainder of year, inflation impulses are likely to be derived from:

- a shortage of domestic food crops, resulting from the impact of Hurricane Dean on the agricultural sector;
- higher prices for meat and poultry due to increased international grain prices and supply-side restrictions for beef. The marine sub-sector was also affected by the passage of Hurricane Dean;
- increased international crude oil prices, driven by tight supplies in the US given the closure of several refineries in the path of Hurricane Humberto. It is also expected that concerns about the effect of the Atlantic Hurricane season on the Gulf of Mexico could affect supplies and by extension, prices.

## **VII. GUIDELINES FOR A REHABILITATION AND RECONSTRUCTION PROGRAMME**

### **1. Rehabilitation Stage**

This initial phase is focused on normalizing the living conditions of victims, while also continuing to reactivate economic activity in the areas affected. Vital needs had to be met and basic services delivered. The victims' food, health care and employment needs should take priority and were met expeditiously through the following actions done both by the public sector and with private sector, international donors and NGOs:

- Provision of food
- Provision of potable water
- Medical attention to those at risk
- Control and prevention of diseases, especially contagious diseases
- Housing repair
- Establishment of improved sanitation services
- Generation of productive jobs
- Provisional repair of access roads to affected areas
- Supply of seeds and basic inputs into farming for small and medium-scale farmers, along with soft loans and other financial support
- Repair of affected infrastructure

The suggested rehabilitation programme met vital and basic needs, control and check the spread of diseases and epidemics in order to prevent hardships from becoming more acute. These actions will certainly overlap with the reconstruction stage.

## 2. Reconstruction Stage

This is the most crucial stage in economic and social terms, since it will lead to the full re-establishment of normal living conditions and the country's economic and social development momentum and increase the resilience reducing the vulnerability that Hurricane Ivan made evident.

This phase ought to bring about the implementation of specific projects that are matched to available resources and that can be assimilated by the different economic sectors and the country's government and financial sector. The main aim of the reconstruction stage and the projects thereof is to effectively overcome the direct and indirect losses stemming from the disasters, while increasing the mitigation against a recurrence of the event that took place. For example, the approaches to bridges have been exposed as being vulnerable to the type of water that descended on them.

Reduced vulnerability of housing, infrastructure reconstruction that improves on current exposure as evidenced by the damage suffered agricultural recovery and income-generating programmes are all part of this phase.

Most importantly, on designing the reconstruction programme it will be important to take into account macroeconomic principles so as to prevent the undesirable consequences of overly ambitious reconstruction programmes that impinge on the overall economic performance or absorptive capacity.

The impact of Hurricane Dean highlighted issues relating to land use and building practices and coastal roads. These issues are discussed below:

**Land Use.** A considerable portion of the impact of Hurricane Dean resulted from inappropriate location of settlements. In particular, communities such as Portland Cottage, and Rocky Point in Clarendon and Caribbean Terrace, St. Andrew, the areas affected in Clarendon, St. Catherine,

Kingston, St. Thomas St. Elizabeth are below the 10 metre threshold and are therefore prone to flooding.

**Building Practices and Standards.** Planning and design defects were contributory factors cited in the damage to housing in Rocky Point, Clarendon, Portland Cottage, Clarendon, Old Harbour, St. Catherine and White Horses, St. Thomas. In the past, building practices incorporated more mitigation measures to withstand wind and flood impact. Older buildings were likely to be built on stilts with a finish ground levels of >2ft above ground level compared with newer buildings with a finish of < 1 ft above ground level (Figure 1.7).

**Coastal Roads.** A common feature of coastal roads in Jamaica is that they are constructed in low lying areas and are therefore prone to flooding and subsequent damage. As a consequence, roads such as Roselle and Palisadoes have been subjected to frequent. Coastal roads should be engineered with adequate height (above sea level), drainage, central slope and protective structures to minimize effects from coastal hazards.

**Coastal Ecosystems.** Coastal ecosystems not only play an ecological role but they provide habitat for many commercial species and other marine organisms and acts as sediment traps and buffers to reduce storm surge. The coastal ecosystems are being frequently impacted by storm events. Within the last five years more than five storms have affected these ecosystems, two of which have been intense hurricanes. Hence, they have had little time to recover which makes them quite vulnerable. The continued loss of these ecosystems has increased the vulnerability of coastal areas and infrastructure and threatens one of the country's main industries, tourism. Rehabilitative and protective measures are therefore important to preserve these ecosystems.

### **3. Recommendations**

Based on the experience with Hurricane Dean and previous events, it is evident that steps are urgently needed to reduce vulnerability of housing, coastal infrastructure, the agriculture sector; and threats to livelihood.

Some of the measures required include:

- i. A review of standards to reduce the vulnerability of housing developments to hurricane. These stakeholders include ODPEM, NEPA, Water Resources Authority, National Housing Trust, National Housing Development Corporation, Construction Resource and Development Centre.
- ii. A review of coastal setback on an on-going basis. Developers must be made to conform to approved standards.
- iii. Improvements in enforcement of building regulations while taking into consideration the need for affordable housing and the capacity required for carrying out enforcement.
- iv. The provision of training in appropriate building techniques for the buildings
- v. Implementation of a programme of retrofitting for housing, incorporating hurricane resistant techniques.
- vi. Assessment of the impact of storm events on coastal ecosystems with a view to designing rehabilitation strategies.
- vii. Development of best management practices to address the vulnerability of specific coastal areas such as the Palisadoes Road, St. Andrew, Roselle, St. Thomas and Manchioneal, Portland; and
- viii. Development and implementation of a structured hazard mapping programme.
- ix. The development of affordable risk transfer mechanisms to reduce the burden on government at the answer of last resort.

Below is a list of suggested projects to address some of the issues highlighted by this recent event.



## **PROJECT TITLE: MAPPING OF COASTAL CHANGE HAZARDS**

### **The Problem**

Coastal damage resulting from storm surge that occur during hurricanes pose significant hazards to buildings and infrastructure that are close to vulnerable shorelines. The increased frequency and intensity of hurricanes has triggered significant storm surge activity Jamaica's coasts have resulted in loss of lives and damage to coastal infrastructure. The cost to the country has been in billions of dollars and lives and livelihoods are constantly under threat. Mitigating the risk from storm surges is important because approximately 1.8 million of Jamaica's 2.6 million inhabitants live in coastal areas. In addition, these areas have important economic assets including port facilities, and tourism infrastructure.

In order to manage coastal hazards adequate data are required for decision-making. National Hazard Maps and to some extent hazard management plans and policies exist at the national level. However, there is a need for these tools to be further developed, established, and utilized at parish/municipal levels. This will enable disaster managers to predict where and how much coastal change will occur in order to locate new construction landward of coastal hazards. Developing this predictive capability requires quantifying how coasts respond to extreme storm events.

### **Project Objective**

To determine possible storm surge inundation and run up levels which may occur in the passage of a hurricane in selected coastal towns. This information will serve to guide the decision making process as it relates to development planning, resource and land management, mitigation, emergency preparedness and evacuation planning.

### **Major Components**

1. Preparation of digitized and geo-reference existing bathymetric charts, topographic contours and satellite imagery.

2. Undertaking Oceanographic Survey to determine and document the condition and characteristics of coastal resources. This will include:
  - Bathymetric Survey from the nearshore to 30 metres water depths for the relevant towns.
  - Topographic survey of selected towns as follows and
  - Sand sampling to determine erosion potential
3. Identification and mapping of national resources/infrastructure/facilities including
  - i. Emergency Shelters
  - ii. Police stations; Hospitals (beds); Fire stations and other Critical Facilities
  - iii. Bridges and Coastal roads
  - iv. Properties and populations at risk
4. Site specific storm surge analysis to determine storm surge levels for 10, 25, 50 and 100 Year Return Period; and Category 4 and 5 hurricanes on worst-case track
5. Preparation of Hazard vulnerability maps in GIS format and report for all major coastal towns

### **Key Project Output(s)**

Storm Surge Vulnerability Maps

### **Duration**

3 months

## **PROJECT TITLE: COASTAL ECOSYSTEM STUDY**

### **The Problem**

The Jamaican coastal ecosystems are characterized by mangroves, seagrass beds and coral reefs. The ecosystems provide habitat, nursery and food for many commercial fish species and other marine organisms. They also act as sediment traps and buffers to reduce storm surge and also replenish sand on beaches. Besides the ecological role of these ecosystems, they provide social and economic benefits such as livelihood for many coastal dwellers (such as in Hellshire, Rocky Point and Old Harbour Bay) and is integral to our 'sun sea and sand' style of tourism.

However, the coastal ecosystems are not only being impacted by anthropogenic factors but by frequent storm events. Within the last five years (2002-2007), more than five storms have affected these ecosystems, two of which have been intense hurricanes, Hurricane Ivan (2004) and Hurricane Dean (2007). Due to the frequent impact from storms events, these ecosystems have had little time to recover which makes them even more vulnerable. Their continued loss has reduced marine biodiversity, increased the vulnerability of coastal areas and infrastructure and threatens tourism, one of the country's main economic sectors. Also fish traps and other fishing gears are usually lost at sea after a storm and continue to "ghost" fish which can contribute to significant over-fishing. So far, there has been inadequate assessment of the impact of storm events on the ecosystems due to inadequate financial and technical capacity. Additionally, the socio-economic value of coastal ecosystems is unknown but this information is pivotal to assessing the impact of natural hazards and encouraging protection. Information on the status of these ecosystems is sparse or absent.

The study is expected to provide a framework for the improved management and rehabilitation of coastal ecosystems. Better understanding of the social, economic and ecological value of these ecosystems will enable better assessment of the impact of storm events on the ecosystems themselves and on the country's economy. Information gained through this project will not only aid in creating an ecosystems database but will also assist in developing a natural hazards and risk management strategy for coastal ecosystems.

## **Project Objective**

To develop a framework for the rehabilitation and improved management of coastal ecosystems

## **Components**

The overall goal of the study is to preserve the coastal ecosystems' goods and services by providing valuable information for improved management and rehabilitation. Specific components are:

- 1) The valuation of coastal ecosystems: mangroves, seagrass beds and coral reefs
- 2) Determination of the pre-Hurricane Dean status of coastal ecosystems
- 3) Assessment of the impact of Hurricane Dean on the coastal ecosystem
- 4) Development of rehabilitative measures for the ecosystems

## **Key Project Outputs**

The key outputs expected are:

1. Data/Information on the pre-Hurricane Dean status of coastal ecosystems.
2. Value of coastal ecosystems to Jamaica.
3. Information on the Impact of Hurricane Dean on the coastal ecosystems.
4. Recommended measures to rehabilitate damaged ecosystems.
5. Removal of lost fishing gears.

## **Geographic Scope**

Port Royal and Port Royal Cays (Kingston), Port Antonio (Portland), Old Harbour Bay (St. Catherine), Rocky Point (Clarendon), Ocho Rios and Discovery Bay (St. Ann), Negril (Westmoreland & Hanover), Montego Bay (St. James).

**Duration:** 6 months

## **PROJECT TITLE: TO REHABILITATE DRAINAGE NETWORK**

### **Sector - Infrastructure**

Hurricane Dean caused extensive damage to road and drainage infrastructure in the parishes of St. Thomas, St. Andrew, St. Catherine, Clarendon, St. Mary, Portland, St. Ann and St. James. In addition to limiting access to some areas, there were threats to lives and property. The main objective of the project is to undertake river training and gabion works to protect drainage network in the affected parishes. Specific activities include: bunding, desilting, gabion works, sea defence, and road restoration.

## **PROJECT: HOUSING REHABILITATION**

### **Sector - Housing**

The considerable damage in the housing sector was mainly to houses where the roof was designed and built by tradesmen. In order to strengthen the building tradition of builders, training in hurricane resistant construction practices should be available to them. Efforts are underway to carry out training in the affected areas, but this needs strengthening and application across the country. An area of emphasis should be promoting the use of certified/qualified builders or tradesmen during construction.

### Objectives

1. To develop relevant courses for building tradesmen in disaster resistant construction methods and offer the courses at the local and national levels
2. To upgrade and reprint and disseminate training manual
3. To create a register of qualified construction workers

HEART Trust NTA will be integral to the designing; delivery and institutionalization of the courses.

**PROJECT TITLE:**

**REDUCING VULNERABILITY IN SELECTED COASTAL COMMUNITIES –  
TOWARDS INTEGRATED PLANNING FOR THE COASTAL FISHING  
COMMUNITIES**

**The Problem**

The coastal zone in Jamaica is rich in natural resources and they attract many Jamaicans who exploit them for a livelihood. As a result many settlements have developed within the coastal areas evolving into communities directly or indirectly dependent on the coastal resources.

Coastal areas are, in general, highly vulnerable to natural hazards such as hurricanes and storm surges. Further, exacerbating this vulnerability is the fact that many of these areas are characterised by high levels of poverty and indiscriminate land use practices.

Over the years, many of these coastal settlements have been frequently damaged by storm events, resulting in loss of lives, livelihood, and infrastructure. Among the communities that have been most affected are: Old Harbour Bay, St. Catherine; and Rocky Point/Portland Cottage, Clarendon. Over the last five years these areas have been impacted by two intense hurricanes, Hurricane Ivan (2004) and Hurricane Dean (2007). These communities which are dependent on fishing for economic survival have suffered significant disruptions to their livelihood. Other impacts included loss of lives, widespread damage to roofs and roads, damage to infrastructure and fishing equipment, and coastal ecosystem damage. Without appropriate interventions to improve the resilience of these communities, their sustainability (social, economic and environmental) will be threatened.

**Project Objective**

To improve the resilience of selected coastal communities through implementation of a multi-sector integrated project with measures to mitigate and adapt to hazard risks, improve socio-economic status

## **Major Components**

1. Evaluation of housing stock to determine resistance to multiple hazards.
2. Assessment of environmental conditions of Rocky Point and Old Harbour Bay Fishing Beaches.
3. Examination of livelihoods structure Rocky Point and Old Harbour Bay Fishers

## **Key Project Outputs**

1. Coastal residential construction manual
2. Environmental Management Plan
3. Livelihoods Improvement Strategy

**Duration:** 6 months

## **PROJECT TITLE: AGRICULTURAL CROP REHABILITATION**

Sector - Agriculture

The direct and indirect assessment of the agricultural sector revealed a loss to the sector of \$3.76 billion. Domestic crop production was the major area of devastation which suffered losses of just over \$900 million, and coffee, sugar and banana with \$855, \$802 and \$525 million respectively. Approximately 80 per cent of the island's greenhouses were destroyed. The main goal of the project is to allow farmers to recover from the damage and to build more resilience into their operations. The project will focus on a programme of resuscitation of domestic agriculture and tree crop rehabilitation, restoration of damaged greenhouses and introduction of some resistant greenhouse construction techniques.

## **PROJECT: SCHOOL REHABILITATION**

### **Sector - Education**

Damage to the education sector amounted to \$727.86 million. The impact of the Hurricane was extensive with 518 schools being affected across 13 parishes. Most of the impact to schools involved roof damage. The temporary measures put in place to address the problem have helped considerably to facilitate the reopening of schools. However, there needs to be a structured programme to facilitate more sustained repair to the schools.

These projects should include a component for the rehabilitation of recognized basic schools as a large number of these schools were damaged. Investment here would be consistent with the GOJ's emphasis on improving educational facilities, and especially early childhood facilities.