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**SOCIO-ECONOMIC ASSESSMENT OF THE DAMAGE AND LOSSES
CAUSED BY HURRICANE DEAN**

In collaboration with the Inter-American Institute for Cooperation on Agriculture (IICA).

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PREFACE

This report was prepared at the request of the Government of Dominica following the passage of Hurricane Dean on the 16 and 17 August 2007. The implications of the impact of Hurricane Dean posed a need, apart from the immediate humanitarian response, for a rapid assessment of the social and economic impact.

The assessment was conducted using the Economic Commission for Latin America and the Caribbean (ECLAC) Damage and Loss Assessment (DALA). A limited sustainable livelihood approach explored the vulnerability context of the affected groups and is situated within the wider macroeconomic framework of the country.

This assessment will complement and expand on the emergency and humanitarian needs identified previously by the Government of Dominica. The result of such an assessment provides a quantitative approximation of the overall damage to the economy and its impact on the affected population.

Mission components

The ECLAC mission was supported by the United Nations Development Programme (UNDP) Barbados SRO, the Inter American Institute for Cooperation on Agriculture (IICA) and the University of the West Indies (UWI), St Augustine, through the direct support of the Caribbean Disaster Emergency Response Agency (CDERA). The ECLAC mission followed a joint IICA/Ministry of Agriculture assessment of the agricultural sector using the ECLAC methodology and benefited from the findings. The mission was undertaken 17-24 September 2007.

Baseline data for the conduct of the Macro Socio Economic Assessment are drawn from among official government data sets including: the Population and Housing Census 2001, the Survey of Living Conditions 2002, Growth and Social Protection Strategy (2006), Commonwealth of Dominica Budget Address for Fiscal Year (2007/2008), and relevant data sets from the Government Central Statistical Offices, Ministry of Finance and Planning and the Eastern Caribbean Central Bank (ECCB).

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This report was made possible by the cooperation, coordination and support provided by the relevant government authorities. The national counterparts were coordinated by Ms Rosamund Edwards, Financial Secretary, and Mr. Alvin Bernard, Social Development Planner (Acting), and the UNDP National Focal Point, Ministry of Finance and Planning, Dominica.

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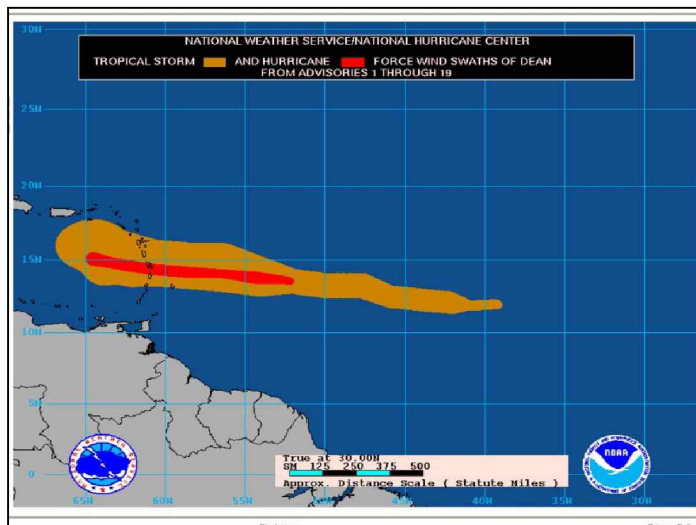
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I. BACKGROUND

A. Description of the event

On Monday 13 August the fourth depression of the 2007 hurricane season formed in the far eastern Atlantic Ocean. At 11:00AM EDT, the centre of this depression was located near latitude 12.0° north and longitude 31.6° west, or about 520 miles west-southwest of the Cape Verde Islands (2000 miles east of the Lesser Antilles). At this stage, the depression was moving in a westerly direction at a speed of 21 mph, a motion that was expected to continue for the next 24 hours. Maximum sustained winds were near 35 mph, with higher gusts being observed. Strengthening of the depression was forecast by the National Hurricane Center, with the expectation that it could become a tropical storm over the next 24 hours. The minimum central pressure was estimated at that time to be 1005 MB or 29.68 inches of mercury.

Map 1
Projected cone of tropical storm and hurricane
force winds from start of system

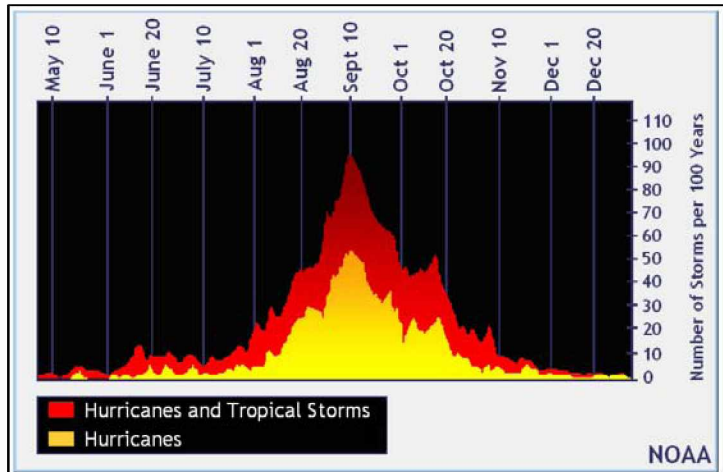


Source: NOAA

occurrence as a function of seasonality, as documented by the National Oceanic and Atmospheric Administration (NOAA), gives an indication of the historical occurrences of hurricanes in August, within the Caribbean basin. These historical records indicate that there is an expectation of one hurricane every three years in the middle of August. Generally, it now appears that the rate of occurrence of more intense hurricanes is on the increase.

By 5:00AM EDT on Thursday 16 August, the tropical depression had strengthened to a hurricane, with occasional glimpses of an eye in infrared satellite imagery. At this point, Dean was upgraded to the first hurricane of the 2007 hurricane season. Hurricane models called for Dean to become a major hurricane over the western Caribbean, although there was little change in strength predicted during the first 60 hours of the forecast. At that time, the centre of Dean was located near latitude 13.5° north, and longitude 53.3° west, or about 415 miles east of Barbados. It is interesting to note that a review of hurricane frequency of

Figure 1: Historical occurrences of tropical storms and hurricanes throughout the season

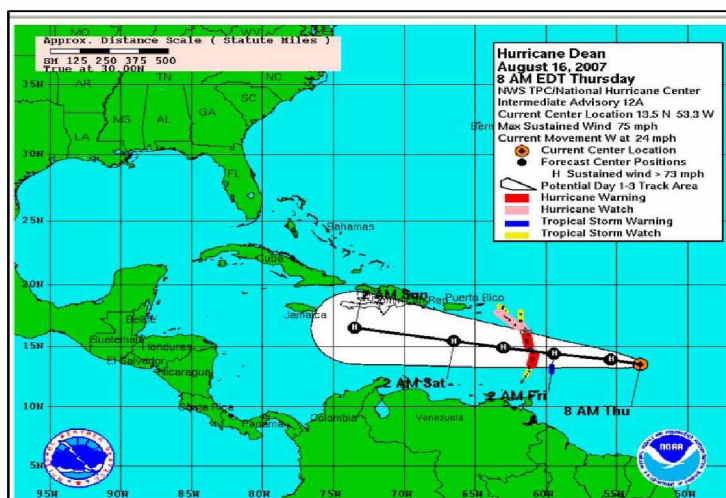


Source: NOAA

higher gusts being observed. This put Dean as a Category 1 hurricane on the Saffir Simpson scale, with additional strengthening forecasted over the next 24 hours. Hurricane force winds extended outward up to 25 miles, with tropical force winds extending outwards up to 70 miles. The estimated minimum central pressure by that time was 985 MB, or 29.09 inches. Storm surge predictions were of the order of 2-4 ft above normal tide levels, accompanied by large and dangerous waves.

Even as a less intense hurricane, Hurricane Dean caused some concern in the Lesser Antilles, because of its direct approach direction.

Map 2: Forecast track projections for Hurricane Dean as of 8:00 a.m. EDT on 16 August 2007



Source: NOAA

A hurricane warning continued in effect for the islands of Dominica and Saint Lucia, while a hurricane watch was posted for Martinique and Guadeloupe on 16 August. Dean continued to move quickly towards the west at a speed of nearly 24 mph, a motion that was expected to continue for the next 24 hour period. This motion was expected to bring the centre of Dean near the Lesser Antilles on Friday 17 August.

Maximum sustained winds had increased by that time to 80 mph, with

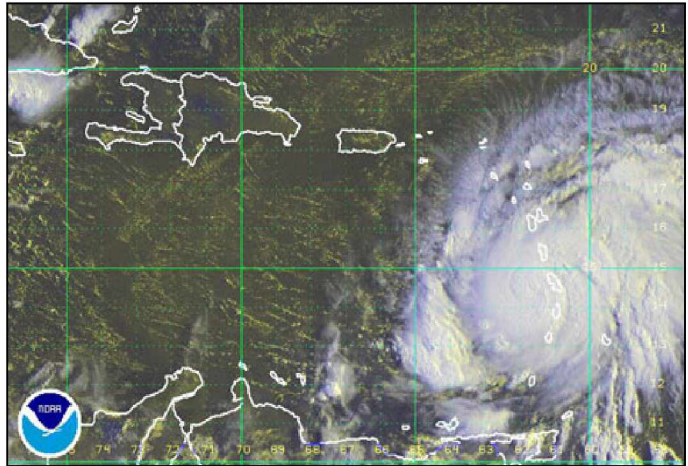
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By the morning of Friday 17 August, the centre of Hurricane Dean had crossed the Lesser Antilles between Saint Lucia and Martinique. The meteorological service of Martinique reported sustained winds of 76 mph, with gusts up to 104 mph. The minimum pressure in the eye was measured at 964MB. The latest imagery also showed a definite eye feature. The official forecast called for strengthening as Dean crossed the Caribbean Sea.

Map 3: Visible spectra satellite image taken just after the eye of Hurricane Dean passed between Saint Lucia and Martinique

B. Overall effects on Dominica

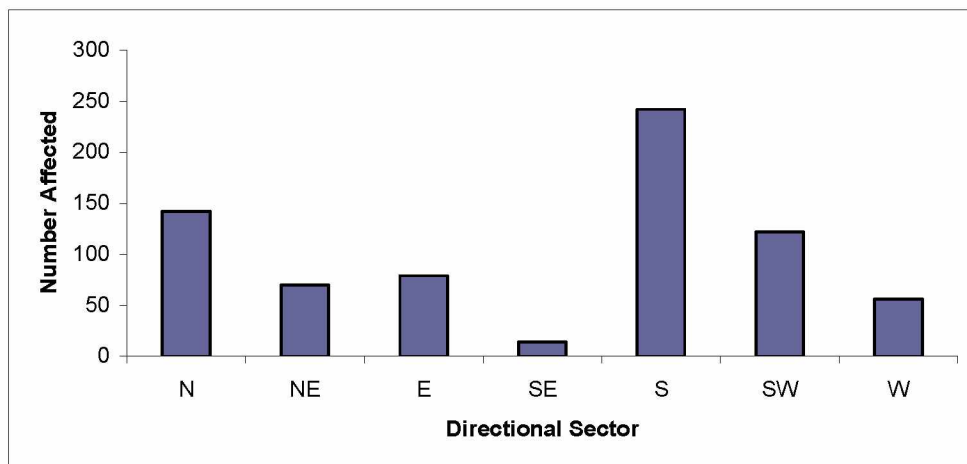
Because of the direction of approach of Hurricane Dean, the south-eastern, southern and south-western sections of Dominica's shoreline were exposed to the most damaging north-eastern quadrant of the hurricane. During the day, Dean continued to batter Martinique and Dominica, with lesser effects being felt in Saint Lucia. Air Force Hurricane Hunter aircraft located the hurricane near latitude 14.4° north and longitude 61.7° west, or 50 miles west-southwest of Martinique, and moving in a westerly direction at a speed of 23 mph. Maximum sustained winds increased to 100 mph, with higher gusts being observed. Hurricane force winds extended outwards up to 25 miles, and tropical force winds outwards to 140 miles. Fortunately for Dominica, the eye of the hurricane was sufficiently to the south that the full effect of hurricane force winds was not felt.



Source: NOAA

An indication of the spatial impact of Hurricane Dean can be inferred from National Emergency Management Organization (NEMO) records of damage to houses. In all, it is estimated that approximately 725 houses were affected, of which 33 were completely destroyed and 178 completely lost their roof. Categories tracked included: house completely destroyed; roof completely destroyed; house partially damaged; roof partially damaged; outdoor kitchen damaged; and other miscellaneous damages.

Figure 2: Matrix of affected households by geographical regions



Source: Meteorological Office of Dominica

What can be clearly seen is that the eastern, southern and southwestern sections of the island received impact, with little or no damage occurring in the northwest.

Significant damage was recorded to the infrastructure sector, notably in the form of damage to roads, landslides and river induced erosion. The photos below show two vivid examples of landslide and river erosion that occurred as a result of the hurricane. The first is at Laudat, which is the primary access road to several eco-tourism attractions, and the second shows the bank erosion induced by the Roseau River in the vicinity of the University of the West Indies (UWI) Campus.



eco-tourism attractions.



Roseau River induced erosion at UWI Campus

C. Rainfall records

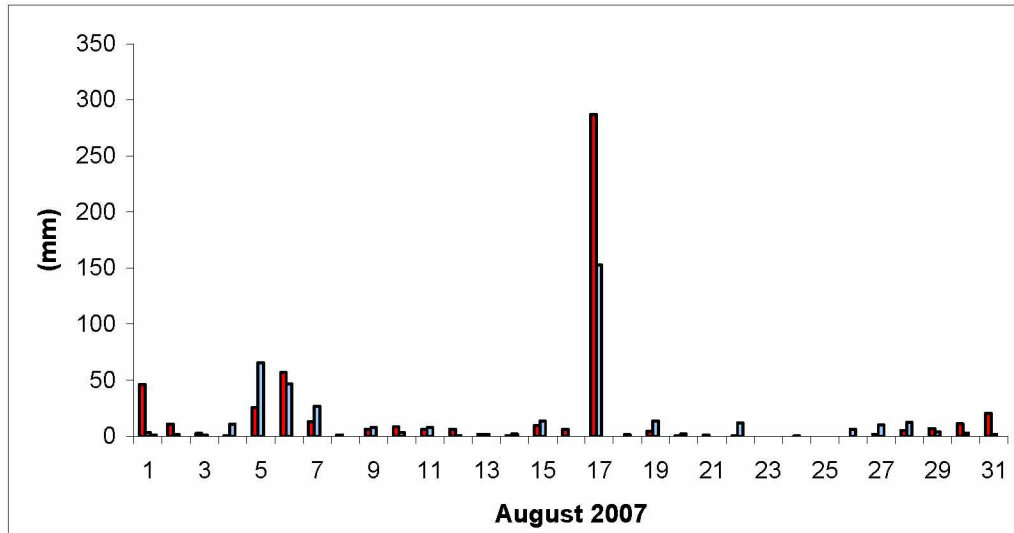
Rainfall records were collected from the gauge at the Canefield and Melville Hall Airports. These gauges reveal that on the 17 August, 287mm of rainfall fell at Canefield, and 152.7mm at Melville Hall. Prior to this, the only other rainfall event of note occurred on the 6 August, when a tropical wave resulted in relatively heavy rainfall at both stations (56.7 and 46.5 at Canefield and Melville Hall, respectively).

It is also of interest to compare the one-day rainfall during Hurricane Dean, with the long-term average rainfall for the entire month of August. Over a period of 26 years, the average monthly rainfall at Canefield (for August) is computed to be 250mm, with a high value of 446mm in 1995 and a low of 113 in 2005. At Melville Hall, the average for August over a period of 39 years was computed to be 257mm. It is therefore of interest to note that the one-day rainfall as a result of the hurricane exceeded the long-term average for the month at Canefield. Further, the total for the month of August 2007, which was recorded as 540mm, also provides a useful comparison with the long-term average. It shows that August 2007 had more than twice the amount of rainfall as compared

to the long-term average, and in fact was the wettest August on record since the start of record keeping at this station (Canefield) in 1982.

The following figure shows a plot of the rainfall for August for both stations.

Figure 3: Rainfall records – Canefield and Melville Hall



Note: Canefield Airport in **RED** and Melville Hall Airport in **BLUE**

Source: Meteorological Office of Dominica

D. Emergency actions

Prior to the passage of Hurricane Dean, the Caribbean Disaster Emergency Response Agency (CDERA) Coordinating Unit contacted the National Disaster Coordinator in Dominica to gauge the state of preparedness of the country.

Compared with the scale of the disaster, donor emergency relief and assistance was relatively modest. The Government of the United States provided 75 rolls of plastic sheeting for persons with damaged homes and US\$25,000 for procurement of emergency repair materials for the Office of Disaster Management. Also, CDERA sought access to the Emergency Relief Grant at the Caribbean Development Bank (CDB) for up to US\$100,000, a portion of which was to be earmarked for Dominica. Meanwhile, the Government of Venezuela provided 500 blankets, 500 sheets, three large tents, water, 120 units of tarpaulin and medical supplies.

II. VULNERABILITY AND HURRICANE DEAN

A. Sustainable Livelihoods Approach (SLA)

This assessment applied a limited Sustainable Livelihoods Approach (SLA)¹ to the process. The SLA is based on two concepts, sustainability and livelihoods. Livelihoods refer to the capabilities, assets and activities required for a means of living. It is understood that for livelihoods to be considered sustainable, they should demonstrate:

- (a) Resilience in the face of external shocks and stresses;
- (b) Capacity to maintain the long-term productivity of natural resources; and
- (c) Ability not to undermine the livelihoods of, or compromise the livelihood options open to others.

The goal of the SLA is to eradicate poverty through six objectives. These are:

- (a) Improved access and management to natural resources;
- (b) Improved access to high-quality education, technology, nutrition and health;
- (c) A more supportive and cohesive social environment;
- (d) Improved access to infrastructure;
- (e) Improved access to financial resources; and
- (f) A policy and institutional environment to promote multiple livelihood strategies and equitable access to competitive markets.

The disaster assessment using the SLA sought to ascertain:

- (a) Where were the affected communities located;
- (b) Which households were affected (how many and to what extent);
- (c) What were the damage and losses suffered by each household with regard to their assets;
- (d) How were their income-earning activities affected?
- (e) What would it take to get them back up and running;

¹ The Sustainable Livelihoods Approach (SLA) was developed by the Department for International Development (DFID), for further information see www.livelihoods.org.

- (f) What assistance was required to build resilience and reduce future risk; and
- (g) What would it take to make the livelihoods of the affected households sustainable.

The unit of analysis for the SLA is the household. To ensure a rigorous undertaking, sound household data disaggregated by the basic demographic characteristics of age, sex of the head of the household, family structure, education levels, health status, livelihoods/income streams and expenditures are required. The sources of baseline data are the country's most recent population and housing census, the Survey of Living Conditions (SLC), the Core Welfare Indicators Questionnaire (CWIQ) and the most recent agriculture survey. The livelihoods analysis seeks to gain an accurate and realistic understanding of the strengths (assets or capital endowments) of households and how these assets are converted into positive livelihood outcomes.

In undertaking a rapid assessment of livelihoods, as needs to be done following a natural disaster, the methodology involves key informant interviews and group interviews which seek to ascertain the processes of the primary, secondary and tertiary income-earning activities of the households in the affected areas; and the structures, contributors and beneficiaries of the household's current livelihoods. Such an assessment seeks also to understand how each activity has been affected by the recent disaster. Finally, a gender analysis is applied to understand the differential impact of the disaster on the livelihoods of men and women. From such a comprehensive analysis, recommendations that will support sustainable livelihoods follow.

B. The vulnerability context

1. General information

The Commonwealth of Dominica is situated in the Windward Islands between Martinique and Guadeloupe. The island has a land area of 790 km². It has eight active volcanoes, an abundance of rivers, and a rainforest covering 65 per cent of the land. The population is concentrated in coastal towns and villages. Dominica is divided into 10 parishes and the health services are organized into seven health districts. Dominica is centrally administered with a parliamentary type democracy. General elections are held every five years.

2. Vulnerability

The government's Medium-Term Growth and Social Protection Strategy (GSPS), April 2006, sets the course and direction for Dominica's economy over the period 2005-2009. The Prime Minister's budget address for fiscal year 2007/2008 "Furthering our development, responsibly", sets the goals and priorities for the current fiscal year.

The major challenge to the implementation of the GSPS has been identified as the vulnerability of Dominica to shocks of an internal or external nature, driven by two fundamental causes, one economic and the other environmental. The GSPS suggests that environmental shocks, particularly hurricanes or volcanic eruptions, can disrupt growth and exacerbate the poverty situation in Dominica for years to come. The Prime Minister in his budget address for

fiscal year 2007/2008, acknowledged the negative impacts which natural disasters can have on the people, economy and natural environment of Dominica. Like the GSPS, confidence is expressed, however, that Dominica has demonstrated good resilience.

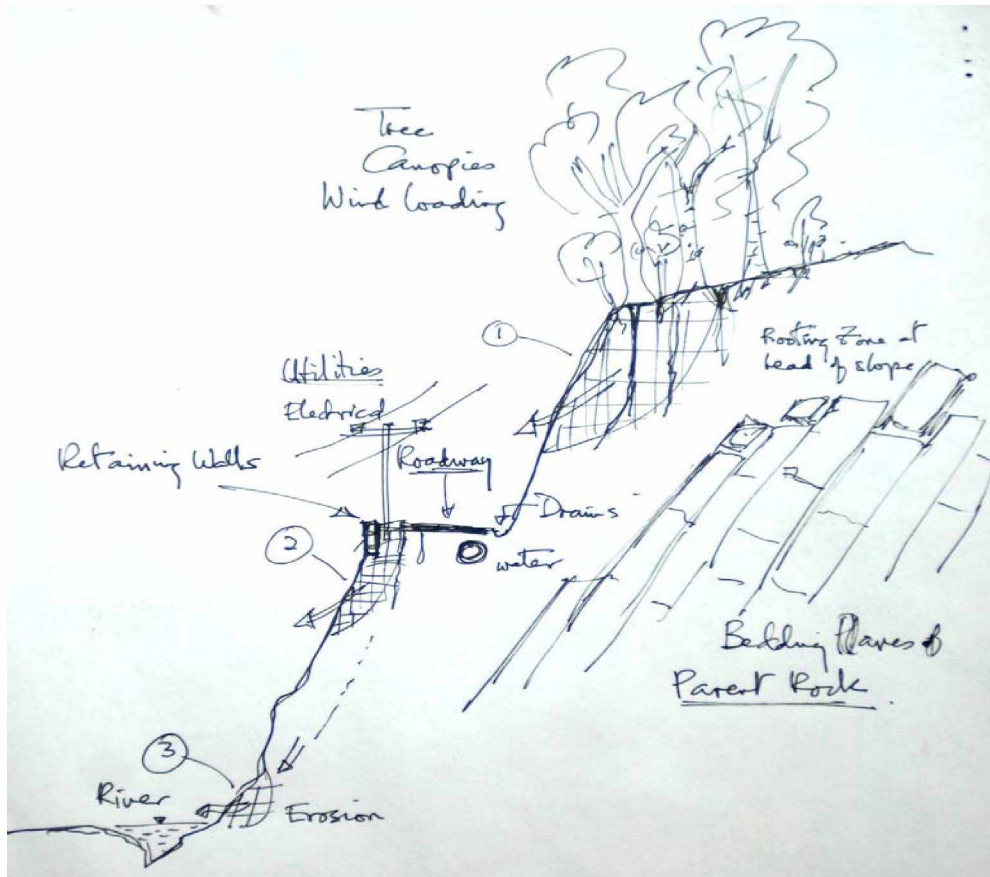
The extent of damage caused by Hurricane Dean suggests that, indeed, Dominica has developed over time some degree of resilience. Hurricane Dean, however, uncovered a number of areas of susceptibility which require attention.

Applying the sustainable livelihoods approach (as presented in figure 7) to the ECLAC methodology for the macro socio-economic assessment of Hurricane Dean to Dominica, allows the assessment team to highlight the areas of susceptibility which exist and to present strategic approaches to address the strengthening of resilience and strengthening the sustainable livelihoods of the population.

Table 1 presents issues of susceptibility that were highlighted by the passage of Hurricane Dean in the Commonwealth of Dominica based on that analysis. Central among them were the vulnerability of the physical infrastructure, poverty and its attendant ills on large segments of the population, and the high burden of care, of female heads of households with limited access to financial and other resources.

Table 1: Issues of susceptibility highlighted by the passage of Hurricane Dean in Dominica

- Poverty and its attendant ills;
- Roadways that are cut through soils that are unstable due to the steep mountainous terrain;
- Vulnerability of Physical Infrastructure (see illustrated in drawing hereunder);
 - Hazard caused by wind loading on trees at edge of steep slopes;
 - Inadequate retaining walls down slope of roadways;
 - Erosion of river banks and slopes;
 - Flooding caused by inadequately sized culverts and siltation during extreme events;



- High cost and ill suited location of critical infrastructure and other inputs due to mountainous terrain;
- Slow pace of adjustment out of agriculture in the wake of loss of preferences;
- Accumulation of assets overseas that could be utilized for local investment;
- Limited training and general education of the population dependent on agriculture;
- High burden of care, of female heads of households with limited access to financial and other resources;
- Inadequate management of construction of housing on slopes;
- Low levels of profitability and viability of the farming systems;
- Narrow economic base within which people make their livelihoods in the rural communities;
- Weak financial risk management mechanisms;
- Continuing loss of human resources through migration.

3. The affected population

Because of the structure of the economy and the supportive social structures, the full social impact of Hurricane Dean may become clearer over the next six months to a year.

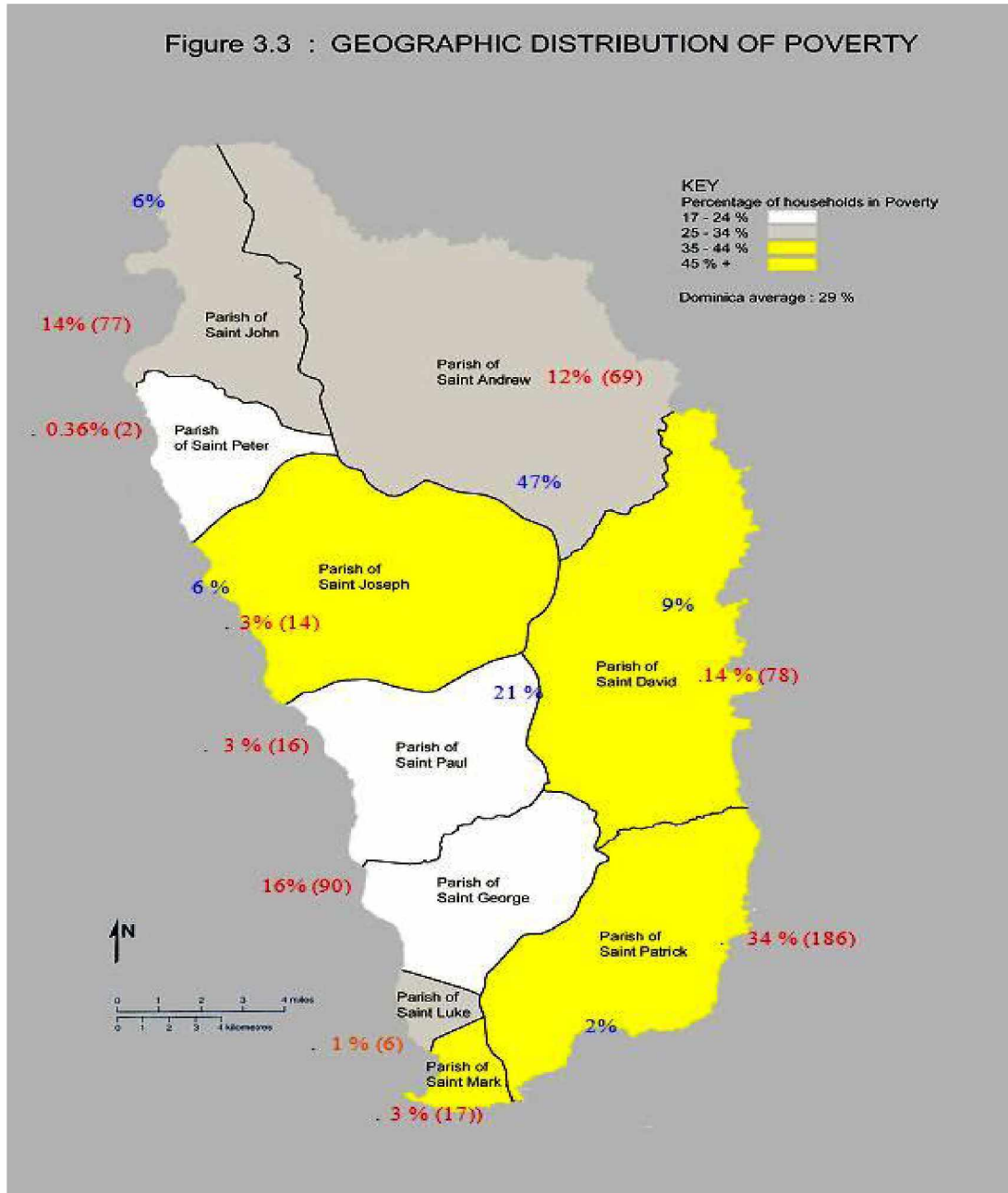
Hurricane Dean directly caused the death of two persons, a young mother and son. The circumstance of their death, caused by a landslide, demonstrates the combination of environmental and social susceptibilities which can be experienced in Dominica. There was another death due to a traffic accident caused by the resultant land slippage. Some 26 injuries were reported and they fit the characterization of injuries usually found in the aftermath of a hurricane.

The number of persons severely affected by Hurricane Dean is estimated to be 13, 283 persons, or 19 per cent of the population. These include persons who have lost homes or whose homes were damaged by the hurricane and those who have lost livelihoods. The characteristics of persons whose livelihoods were disrupted included banana farmers', farmers who produced crops such as oranges, coconuts, grapefruits, avocado, dasheen, plantain, yams and other crops; farmers who held livestock; and fisher folk. The severely affected population comprises approximately 47 per cent of the already poor and most vulnerable population.

The total affected population would include those dependent on the agricultural sector bringing the numbers to over 44,000 people or 62 per cent of the population.

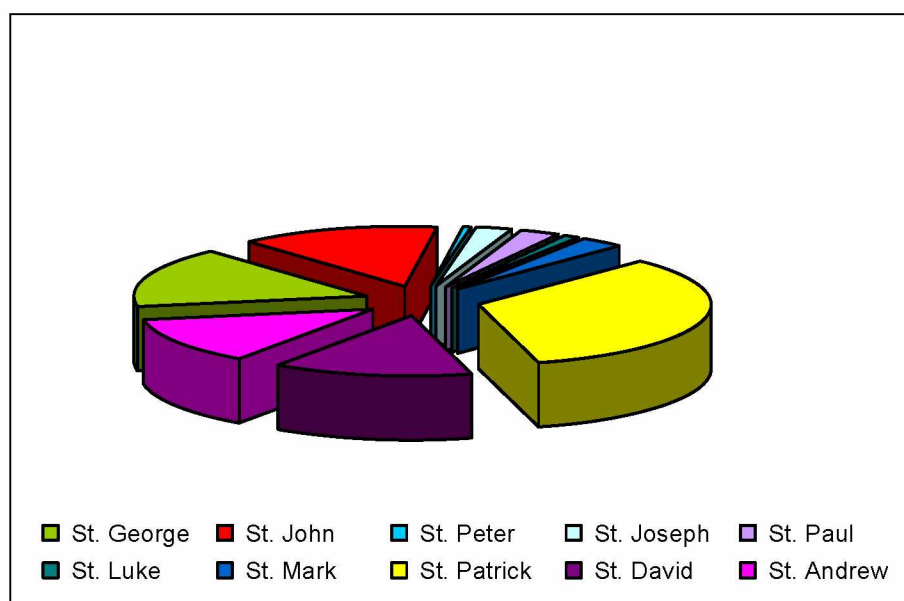
The impact of Hurricane Dean was felt throughout Dominica, although it inflicted most damage to populations resident in the northeast, central, southeast, and eastern agricultural districts of the country. The map presented in figure 4, illustrates the geographic distribution of poverty and is overlaid with damage to households and agriculture. The map also suggests that in those parts of the country where, as much as, and more than, 45 per cent of the population live below the poverty line, one would also find those persons who were severely impacted by the disaster.

Figure 4: Geographic Distribution of Poverty



Source: Survey of Living Condition (2002) and ECLAC estimates based on official Government of Dominica data.

The most severely affected population, as detailed in figure 5, could be found in the parishes of St. Patrick (34 per cent of damaged households), St. George (16 per cent), St. John (14 per cent), St. David (14 per cent) and St. Andrew (12 per cent), corresponding roughly to the agricultural regions of the northeast which accounted for 47 percent of the damage to agriculture, central 21 per cent, and the southeast 10 per cent. The west and north regions equally accounted for 6 per cent of the damage to agriculture.

Figure 5: Households affected by Hurricane Dean by Parish

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

Not all households found themselves equally susceptible to the effects of Hurricane Dean. An examination of table 2 suggests that the parish of St Patrick, which is ranked as the third poorest parish in Dominica also accounted for the most severely affected population. Some 34 per cent (186) households in that parish were reported to have suffered some degree of damage.

Table 2: Poverty Distribution of Population and Households by Parish

Parish	Population	No of Households*	% Indigent	% Poor	% All poor
St. George	20,365	5091	16	25	38
Roseau	15,853	3963	5	13	18
Rest of St. George	4,512	1128	11	12	24
St. John	4,990	1248	7	21	28
St. Peter	1,643	411	6	12	17
St. Joseph	6,183	1546	13	20	33
St. Paul	7,495	1874	12	11	23
St. Luke	1,552	388	4	28	32
St. Mark	1,943	486	13	31	44
St. Patrick	8,929	2232	9	32	41
St. David	6,977	1744	28	23	52
St. Andrew	11,106	2777	9	16	25
TOTAL	71,183	22887			

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

The latest Labour Force Survey (November 1997) puts the total labour force at 33,418 out of a population of 72,099. Of this labour force, 25,694 (14,560 males and 11,134 females) are employed. The largest portion of the labour force (23.4 percent) is employed in agriculture. Hurricane Dean has severely affected agricultural production, including fishing, and therefore, it can be expected, that the livelihoods of those persons and their families would also be severely affected.

The distribution of opportunities for employment within communities differs vastly, demonstrated by the fact that the people of the parish of St. Patrick have an unemployment rate of 45.9 per cent, almost twice the national rate.

In regard to households severely affected by Hurricane Dean, excluding agricultural households, table 3 suggests that approximately 3 per cent of households and 29 per cent of poor households were so affected.

Table 3: Characteristics of Households severely affected by Hurricane Deane

Characteristics	Number	Percentage	Measurement
Households suffering damage or destroyed houses	555	2.4%	As a percentage of all households in Dominica
Poor households in Dominica	6900	29%	As a percentage of all households in Dominica
Source: ECLAC estimates based on official Government of Dominica data.			

C. The elements of vulnerability present in the parishes most affected

1. Human and social capital

According to the Sustainable Livelihoods (SL) framework, human capital represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. It also includes the ability to command labour. The three cornerstones of human capital are education, health and knowledge. Health is measured by the key indicators of good health such as, life expectancy, infant mortality and maternal mortality, but also indicators such as child nourishment and availability and accessibility of quality health care. These issues will be addressed in the following sections under education and health.

Social capital in the context of the SL framework refers to the social resources such as networks and connectedness, membership in formalized groups such as Community-Based Organizations (CBOs) and Non-Governmental Organizations (NGOs), cooperative or professional organizations, and relationships of trust, reciprocity and exchanges that facilitate cooperation, reduce transaction costs and provide the basis for informal safety nets amongst the poor.

By and large there is an agreed notion that the social capital of Dominica is still very strong. The poverty assessment indicated that there were a number of high quality NGOs that

serve a wide range of vulnerable groups - children, youth, women, the elderly and physically and mentally challenged. NGOs and CBOs were also identified, that serve the community as a whole. Together they provide personal and community development programmes, safety nets, and preventative/remedial programmes. Many are faith based and some are linked to the international NGO community. Government partially funds a number of these NGOs and others have as their source of funding a mixture of local and international voluntary donors.

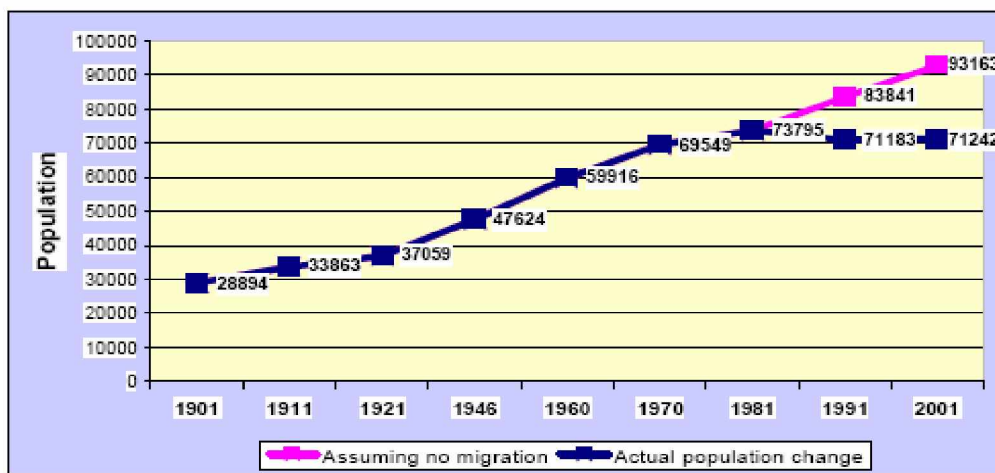
Significant about the social capital in Dominica is the large proportion of poor and not poor households that benefit from income received from family members resident in Dominica and overseas. The poverty assessment suggests that many also receive meals and other assistance from neighbors and friends. Non-income support for many needy families is also high – many elderly and single parents with children live in extended families. The report concludes that without such strong social fabric, demonstrated by the income and non-income support, the levels of poverty and, especially, indigence would be significantly greater. During Hurricane Dean, many reports were received of families who sheltered with neighbours reducing the otherwise negative impact of the disaster. Such reports confirm the notion of the strong social fabric in Dominica. However, because so many families already live on the margins (18 per cent of the population are indigent as indicated in table 4) unless care is taken to provide for quick resumption of livelihoods, there would be little resources to share among those most in need.

2. Migration

Data from the SLC suggested that the level of emigration over the last 10 years is similar to that derived from the intercensal change in population. Figure 6 below provides an illustration of the possible impact of migration, when the population projection is plotted against the actual population.

Figure 6: Population Growth in Dominica, 1901-2001

Figure 2.1. Population Growth in Dominica, 1901-2001



The SLC reported that 55 per cent of Dominican households had at least one close family member (spouse, child, parent or sibling) living overseas and over 30 per cent of households had 'lost' family members to migration in the last 10 years.

The SLC further reported that migrants are as likely, if not more likely, to be female than male and this may be a factor in the care of adolescents and their eroding sense of connectedness to family and community.

The Dominican population is predominantly (almost 80 per cent) of African extraction. Just over 4 per cent are Carib, the only concentration of indigenous peoples in the Antilles. Most of the remainder are mixed race.

The heavy toll on the livelihoods of those in the agricultural sector, particularly among the Carib community and a significant proportion of other Dominicans, if not swiftly remedied could become another factor which exacerbates the push of breadwinners to leave Dominica in search of improved livelihoods.

3. Poverty

Some 39 per cent of the population of Dominica lives below the poverty line. Of those some 18 per cent can be described as desperately poor or indigent.²

Table 4: Incidence of Poverty in Dominica

	Indigent	Poor	All poor	Non poor	Total
Households	(2,500) 11%	(4,400) 18%	(6,900) 29%	71%	100%
Population	18%	24%	39%	61%	100%
Source: Medium Term Growth and social protection Strategy (GSPS) April 2006					

As the map of poverty, presented in figure 6, suggests it was from among the poorest that those who were most severely affected by Hurricane Dean could be found.

4. Education and health

The government data suggest that the literacy rate in 1998 was 85 per cent (84 per cent in females, 86 per cent in males). Preschool education is provided to 3-4 year olds in 82 schools. In 1999-2000, primary school enrolment was 99 per cent and 88 per cent in secondary schools; 16 per cent of secondary school students attend the community college.

² The country poverty assessment report of June 2006 separated the poor into two groups. One on the basis of minimum food requirements referred to as indigent, and the other group on the basis of the minimum food requirements plus an element of non-food expenditure. This was derived according the CDB methodology. For Dominica the indigence line was set at EC\$ 2,000 (US\$740) per adult per year and the poverty line at EC\$3,400 (US\$1,260) per adult per year.

Despite these positive indicators, the educational level of heads of households is very low. The government's medium term GSPS reported that over three quarters of heads of household have not been educated above primary level. This is one of the factors which make shifting human resources into other sectors of the economy a challenge. Following the passage of Hurricane Dean and the disruption of livelihoods in the agricultural sector, alternative livelihood strategies have to be made available in the short run, but in the long run to reduce vulnerability and strengthen resilience more will have to be done to strengthen human resource capacity.

In regard to the health status of the population, health data for Dominica indicates that the population enjoys relatively good health. The Pan American Health Organization (PAHO) reports that more than 99 per cent of all births are assisted by a trained health care professional and in 1996-1999 infant mortality was 17.3 per 1,000 live births, 0.8 higher than 1992-1995. Life expectancy at birth, 1995-2000, was 68.7 years (72.8 in females; 64.8 in males). The Poverty Assessment Report indicated that health concerns which existed related to diet (high cholesterol/high sugar content) and societal issues (stress, drugs, violence) rather than lack of food or waterborne infections. In the area of environmental health, problems identified were those of contaminated water supply from inadequate sewage treatment and the shortage of waste disposal systems among poor households. The study concludes that past health programmes have been successful in improving the health and life expectancy of Dominicans. Hurricane Dean did not severely affect the health status of the population.

5. Vulnerability of women and children

Women comprise some 37 per cent of all heads of households in Dominica and women-headed households are larger on average than male headed households. Women heads of households are also older than their male counterparts. Data from the Poverty Assessment suggests that over 40 per cent of poor households are multi-generational (i.e. with members of three generations) or can be classified as extended households with mostly extended families including in-laws and/or brothers and sisters. The dependency ratio of poor households 3.4 is more than double that of non-poor households.

In regards to youth 15-19, there is a high incidence of teenage sexual activity with over 60 percent of adolescents aged 15-19 years having had sexual intercourse while only a quarter reported that they used contraceptives every time they had sex. STDs make up a large proportion of all medical consultations and the spread of HIV and AIDS is of concern.

In regard to children aged 0-14 years, almost half of the children in Dominica live in poor households and 22 per cent can be defined as indigent.

The incidence of 'no parent' households demonstrates the effect of migration on family patterns and has been cited as a causal factor for the changing behavior patterns witnessed in children and young adults. Should parents or main bread winners be forced to move elsewhere in search of a livelihood because of the devastation of Hurricane Dean on the agricultural sector, this could exacerbate an already difficult situation for children without parents in the household.

Box 1: Vulnerability of women

Identified needs relevant to women were:

(a) Income and maintenance

Household income reduction is felt most when the disaster impacts start manifesting particularly agricultural and fishery sectors. Households need income and those either headed by or having vulnerable individuals/members would feel the pinch the most. There is a need to urgently augment and/or replace income such as the government's plan for farmers and traders. Women's groups indicated that garden yard planting, livestock and poultry rearing as well as produce processing and trading could be instances of such schemes.

(b) Protection

Respondents confirmed that during hard times, men show more violent tendencies towards women, children and other vulnerable individuals in the households. On the response side, the Welfare Division capacities have been far too stretched. There is a need for two pronged approach, i.e. (a) Strengthening the Welfare Division and Women's Bureau with review of portfolios, urgent human resources augmentation, provision of resources and facilities, and capacity development; and (b) Development of community-based or community extension / outreach services to multiply the otherwise limited hands to reach the clientele. Ideally this would also be converging with the local governance reform leading to the integrated service delivery approach.

(c) Short and medium-term recovery interventions for children

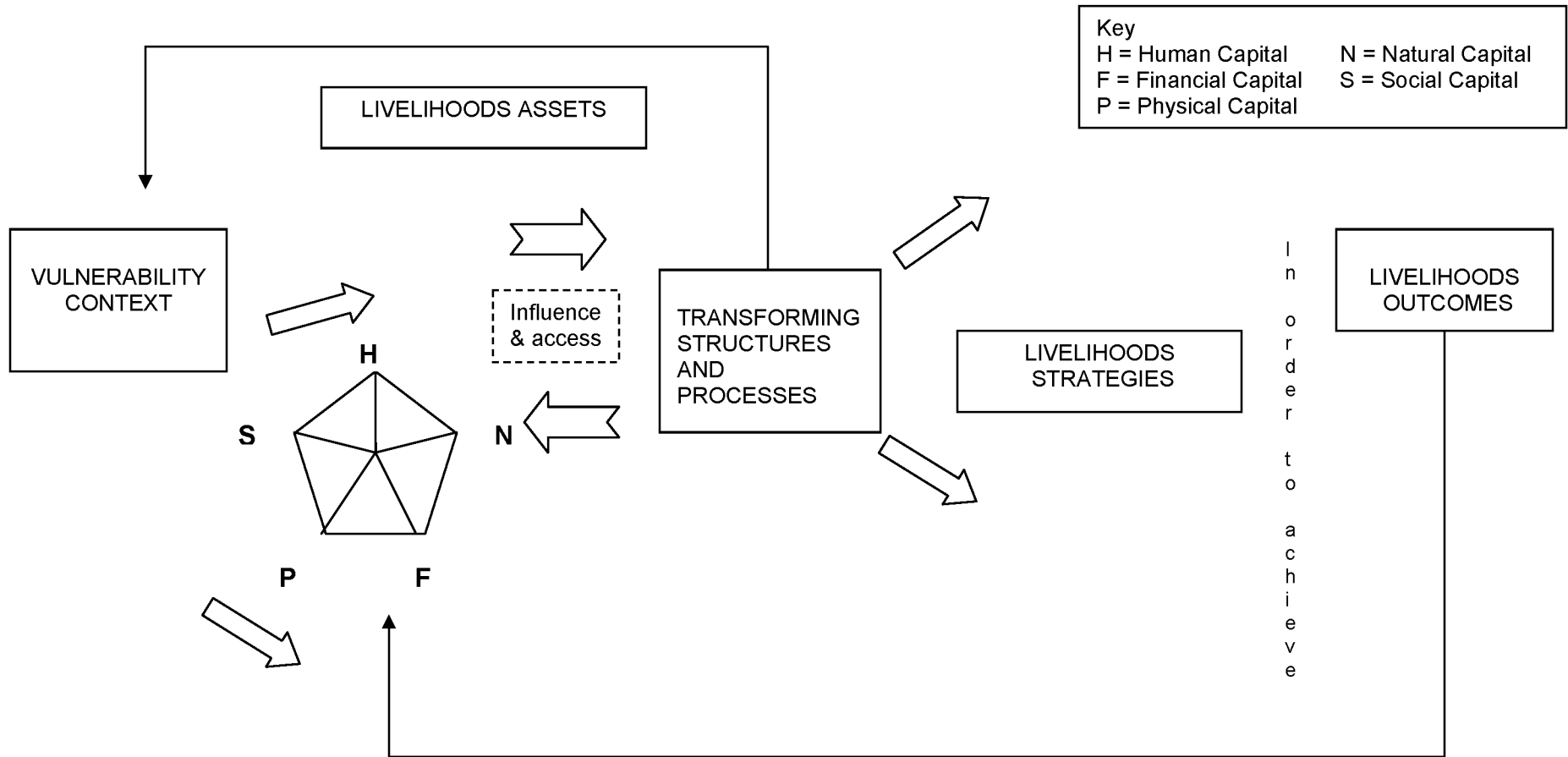
There is a need for short-term public awareness on child welfare and protection either independently or in conjunction with the community support outreach programmes. Service line would also need to be strengthened with helping professionals including social workers, psychologists and, as necessary, psychiatrists, or at least a referral network to access such professional services.

(d) Strengthening Participation and Women's Network

Women form a formidable and resilient force in the post-disaster recovery phase. There is a need to support the National Council of Women's dedication and voluntary spirit through possibly a quadripartite programme involving the Council itself, the Women's Bureau, Welfare Division, and the Local Government Department. This could improve capacities of women to participate in decision-making at their respective levels, enhanced referral network for advocacy and protection of the vulnerable groups, and improved public service delivery at the grassroots level.

Source: Assessment of Immediate to Medium Term Needs in Dominica Post Hurricane Dean, UNDP/BCPR

Figure 7: Sustainable Livelihoods Framework



III. ANALYSIS OF THE AGRICULTURE SECTOR

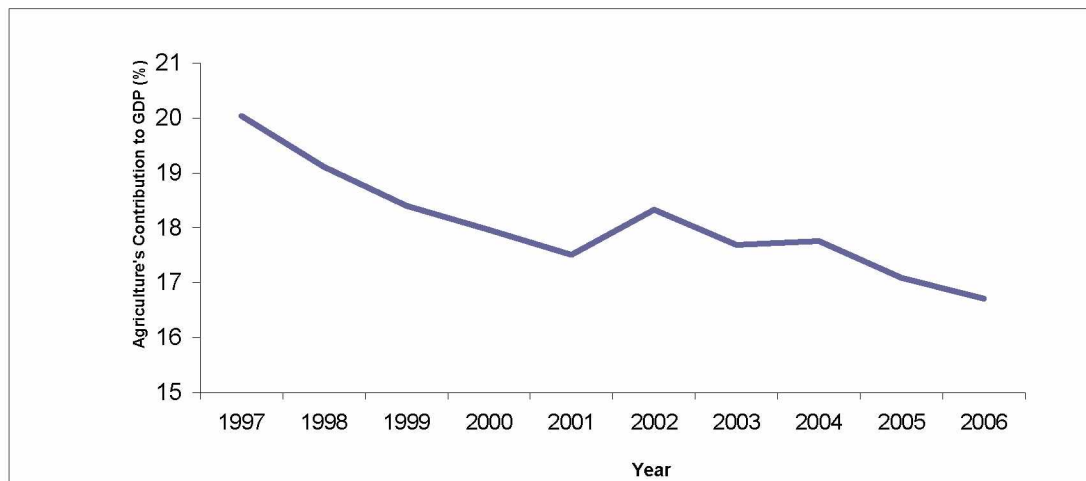
A. The agricultural sector

1. Overview

The agricultural sector is the dominant sector in the economy of Dominica, and although its contribution to GDP has been steadily declining over the last 10 years, it continues to play a significant role in the country's socio-economic development. The sector plays a multi-functional role in earning foreign exchange, generating employment and contributing towards economic growth and food security. This is in light of the fact that the rural communities in Dominica (estimated at 60 per cent of the total population) are largely agrarian in nature with a high dependence on agriculture for employment, income, food, energy (charcoal) and medicine.

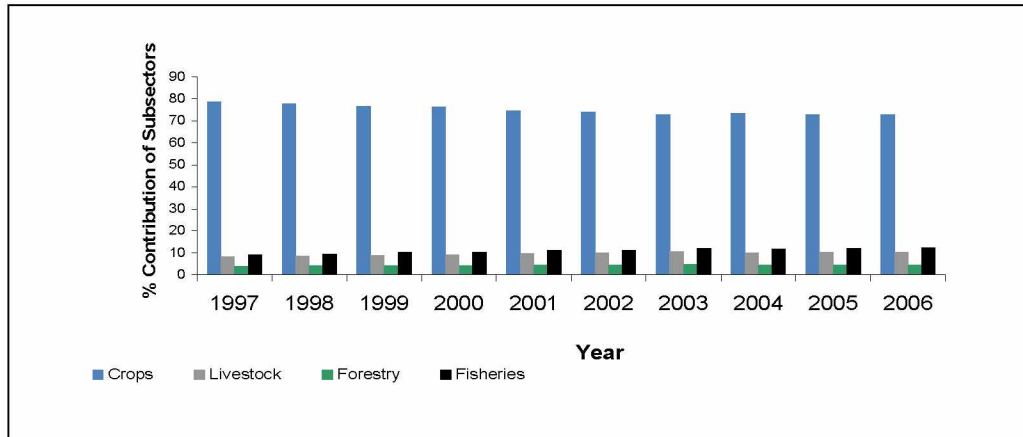
However, the performance of the sector has undergone considerable decline in the period of the 1990s to the present after experiencing impressive growth in the late 1980s. In 1997, for instance, the sector accounted for 20.04 per cent of total GDP, compared with 16.71 per cent in 2006. Agriculture's contribution to total GDP for the period 1997 to 2006 is presented in figure 8. This decline is attributed to declines in the crop subsector linked to natural disasters, erosion of the preferential treatment for banana in the European Market and inherent structural and institutional constraints affecting crop production in the country.

Figure 8: Agriculture's Contribution to GDP (1997-2006), 1990 Constant Prices



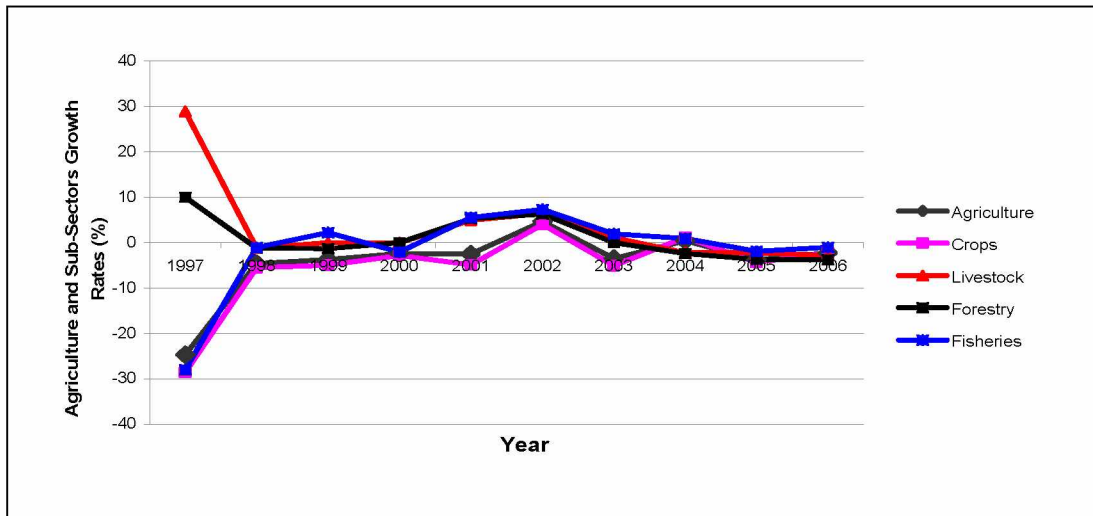
Source: ECLAC estimates based on official Government of Dominica data.

The contribution of the various subsectors to total agricultural GDP is presented in figure 9. The figure clearly demonstrates the importance of the crop subsector, which is dominated by the banana industry, to the agricultural sector in Dominica.

Figure 9: Contribution of Agricultural Sub-Sectors to Total Agricultural GDP (1997-2006)

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

For the period under review (1997-2006), figure 10 presents the growth rate of the agricultural sector as well as the growth rates of the various subsectors.

Figure 10: Agriculture and Sub-Sectoral Growth Rates, 1997-2006

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

The 16.6 per cent decline in the agricultural sector recorded for the period 1997 to 2006 was as a result of a substantial decline in the crop subsector, which declined by 22.5 per cent for the period under review. The banana industry accounted for most of the decline in the crop subsector, while the “other crops” which include roots and tubers, citrus fruits, coconuts, cut flowers, tree crops, plantain and vegetables recorded significant growth. In the “other crops” category, the performance recorded is still a long way off in bridging the gap created by the decline in the banana industry. In many ways, this category of crops represents a mix of

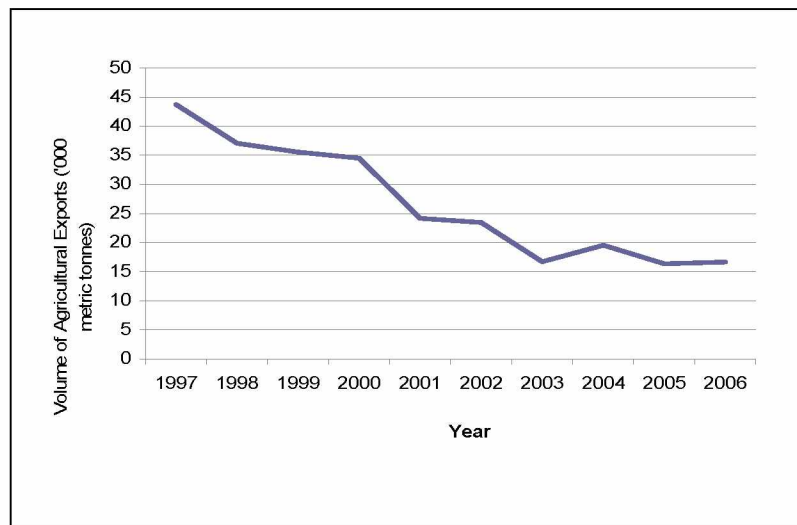
challenges and opportunities and remained an important agricultural development issue for Dominica.

The Government of Dominica has adopted the stance of other banana producing countries of the Windward Islands and reaffirmed its position that the banana industry was of extreme importance in the economy and the welfare of rural communities. As such, the industry continued to be seen as critical in the economic development process of Dominica. Accordingly, the Ministry of Agriculture, Fisheries and the Environment and the Banana Emergency Recovery Unit continued to implement measures to enhance the viability and sustainability of the industry.

The livestock subsector, which is dominated by the poultry industry and to a lesser degree the pork industry, grew marginally (3.7 per cent) over the period under review. However, the subsector has demonstrated a downward tendency over the last three years, with an overall decline of 7.1 per cent for those three years.

The forestry subsector declined marginally (1.2 per cent) over the period under review (1997-2006), while the fisheries subsector grew by 9.7 per cent for that same period. The export of agricultural commodities for the period 1997 through 2006 shows declining trends in both volume and value. The volume of agricultural exports over the period under review, as presented in figure 11, declined significantly from a high of approximately 43.72 thousand metric tonnes in 1997 to approximately 16.65 thousand metric tonnes in 2006, a 61.9 per cent decline. This decline in export volume is attributed in the main to a 65.7 per cent decrease in the level of banana exports. The “other crops” export levels have remained on the average fairly stable over the period under review albeit with a slight downward tendency.

Figure 11: Total Volume of Agricultural Exports ('000 metric tonnes)



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

This category of export was therefore not able to compensate for the substantial decline in banana exports. Details on the volume of agricultural exports by commodity group are presented in table 5.

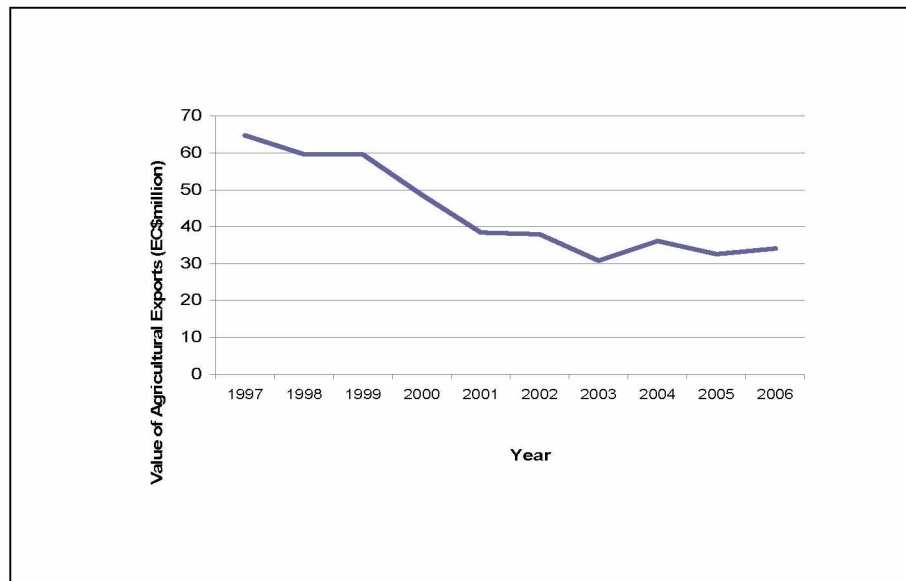
Table 5: Volume of Selected Agricultural Exports by Category (metric tonnes)

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Banana	37,366	30,679	29,519	28,768	10,061	18,379	11,956	14,484	11,953	12,827
Citrus	1,566	1673	1195	1235	1328	1256	1082	956	830	644
Cut Flowers	10	9	13	7	13	4	5	3	4.4	3.7
Fruit Crops	77	136	135	164	139	120	149	160	121	156
Plantain	2,006	2,056	2,104	1,824	1,490	1,461	1,443	1,569	1,383	1230
Root Crops	1,232	1,323	1,230	1,136	872	990	741	1,008	874	789
Tree Crops	1,040	878	1,046	965	889	935	962	1,054	937	731
Vegetables	420	305	308	370	339	278	355	307	239	270
Total	43,717	37,059	35,550	34,489	24,131	23,422	16,693	19,541	16,341.4	16,540.7

Notes: *Vegetables: Beans, cabbage, carrot, christophene, cucumber, lettuce, melongene, okra, sweet pepper, pumpkin, sweet corn, tomato, hot pepper and water melon.*
Citrus: Grapefruit, orange; lime; mandarins
Root crops: Cassava, ginger, Irish potato, sweet potato, dasheen, tannia, yam
Fruit crops: Pineapple, passion fruit, papaya, coffee
Tree crops: Avocado, breadfruit, coconut, golden apple, mango, nutmeg, soursop

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

Similar to the situation regarding the volume of agricultural exports, the value of crop exports over the period 1997 through 2006 registered a significant decrease of approximately EC\$30.63 million (47.3 per cent) with crop exports moving from EC\$64.74 million in 1997 to EC\$34.11 million in 2006 (figure 12).

Figure 12: Value of Agricultural Exports

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

Not surprisingly, the most significant contributor to this decline is the decline in banana earnings, which moved from EC\$46.33 million in 1997 to EC\$20.19 million in 2006, a 56.4 per cent decline. Significant declines were also recorded for a number of commodities in the “other crops” category including: citrus (51.4 per cent), cut flowers (60.5 per cent), plantain (29.9 per cent), vegetables (25.3 per cent) and root crops (19.7 per cent). See table 6 for details.

Table 6 - Value of Selected Agricultural Exports by Category (\$EC)

CATEGORY	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Banana	\$46,330,717	\$40,510,384	\$42,166,037	\$32,456,397	\$22,229,461	\$21,987,829	\$15,931,242	\$19,574,705	\$17,380,209	\$20,194,857
Citrus	\$3,914,232	\$3,892,021	\$2,837,581	\$3,221,328	\$3,564,254	\$3,559,242	\$3,009,791	\$2,651,528	\$2,392,582	\$1,902,930
Cut Flowers	\$74,845	\$67,172	\$106,949	\$57,807	\$546,119	\$37,322	\$45,991	\$25,207	\$33,888	\$29,528
Fruit Crops	\$247,802	\$438,847	\$455,563	\$431,669	\$357,936	\$368,833	\$515,821	\$633,232	\$521,143	\$610,400
Plantain	\$5,111,597	\$5,735,967	\$5,177,692	\$4,054,859	\$3,572,734	\$3,744,700	\$3,556,482	\$4,255,122	\$3,692,688	\$3,581,401
Root Crops	\$4,596,630	\$5,361,965	\$4,883,938	\$4,390,863	\$3,899,656	\$4,073,635	\$3,396,060	\$4,771,444	\$4,219,117	\$3,693,074
Tree Crops	\$3,015,054	\$2,555,656	\$2,834,275	\$2,498,399	\$2,879,000	\$2,961,939	\$2,806,911	\$2,917,144	\$3,290,512	\$3,013,609
Vegetables	\$1,446,892	\$1,085,540	\$1,104,616	\$1,484,268	\$1,364,919	\$1,193,995	\$1,536,965	\$1,282,942	\$1,045,034	\$1,080,638
TOTAL	\$64,737,769	\$59,647,552	\$59,566,651	\$48,595,590	\$38,414,079	\$37,927,495	\$30,799,263	\$36,111,324	\$32,575,173	\$34,106,437
<p>Notes: <i>Vegetables- beans; cabbage; carrot; christophene; cucumber; lettuce; melongene; okra; sweet pepper; pumpkin; sweet corn; tomato; hot pepper and water melon</i> <i>Citrus: grapefruit; orange; lime; mandarines</i> <i>Root crops: cassava; ginger; Irish potato; sweet potato; dasheen; tannia; yam; Fruit crops: pineapple; passion fruit; papaya; coffee;</i> <i>Tree crops: avocado; breadfruit; coconut; golden apple; mango; nutmeg; soursop</i></p>										
Source: ECLAC estimates based on official Government of Dominica data.										

B. Resource base

1. Overview

Dominica has a total land area of 750.6 km² (290 square miles) or approximately 185,000 acres. The topography of the island is characterized by very rugged and steep terrain, with the land rising steeply from the sea and reaching the highest peak of over 4,500 feet no more than four miles from the coast. These higher peaks are volcanic in origin and support a more or less radial drainage pattern.

The mountainous topography has made it difficult to clear lush vegetation and this has contributed considerably to the island's scenic beauty and the conservation of its national resources. About 2 per cent of the total surface area has a slope of less than 5 per cent, 13 per cent of the area is between 5 per cent and 39 per cent slope and the remainder is steeper than 30 per cent.

Flat areas for agricultural production are restricted primarily to the river valleys, the coastal areas of the northeast and an area in the center of the island known as Bells or Wet Area (D'leau Gommier). In this regard, 71.8 per cent of Dominica's land resources (132,744 acres) have been classified as unsuitable for agriculture because of erosion risks, water saturation due to heavy rainfall, or poor soils. Data obtained from the Dominica Agricultural Census of 1995 indicate that only 52,256 acres (28.2 per cent) of the total land area is in farms.

Dominica's climate is classified as humid tropical marine, with average temperatures of 27^oc. (80^oF). Because of the island's rugged topography, micro-climate variability exists within very short distances, influenced by the high moisture content of air masses that enter the region from the Atlantic Ocean. This makes Dominica a high rainfall country, with an average rainfall of 175 inches per year during the wet season. Rainfall increases from the Leeward (or Western) side eastward towards the central part of the island where it reaches approximately 450 inches annually.

Dominica has seven major watersheds found mainly in the central region of the island on both the Windward and Leeward sides. The northern area of Morne Trois Piton National Park is headwaters for four major watersheds (Belle Fille/Castle Bruce, Layou, Belfast and Rosalie). There are also three smaller watersheds located in the north of the island. Water is provided for domestic consumption, export to other Caribbean countries, generating hydro-electric power, agriculture and other activities.

Almost all of the 43 water catchments areas in Dominica are located on privately owned lands where there are no effective controls or land use activities. Most of these catchment areas are under cultivation, and in some cases inappropriate land use activities, such as deforestation and banana cultivation on steep slopes, have caused soil erosion and landslides. This has resulted in changes to the landscapes of the eco-systems (e.g. siltation of rivers and streams) but because of the fast growth of ground cover (vegetation), the impact has been considerably lessened.

2. Land use

The 1995 Agricultural Census indicates that 61.7 per cent (32,200 acres) of the total acreage in farms was classified as cultivated (2,300 acres under temporary crops, 29,300 acres with permanent crops and 600 acres under fallow of one year and less). Twenty-three percent (23 per cent) (14,800 acres) was forest belonging to the farms; and the remaining 10 per cent (5,200 acres) was classified as others, which included fallow more than one year to three years (2,500 acres), pastures (1,700 acres) and 1,000 acres of non-agricultural areas under farms (waste land, construction, etc). See table 7 for details.

Table 7: Land Use in 1961 and 1995

Land Use	1961		1995	
	Acre ('000)	%	Acre ('000)	%
Temporary	8.8	12.2	2.3	4.4
Permanent	24.9	34.5	29.3	56.1
Fallow <1 year	-	-	0.6	1.1
Fallow > 1 year	-	-	2.5	4.8
Pastures	4.3	6.0	1.7	3.3
Forest	37.1	51.4	14.8	28.4
Others	1.1	1.5	1.0	1.9
Total	72.2	100.0	52.2	100.0

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

Comparative analysis between the Agricultural Census of 1961 and 1995 shows considerable change in the structure of the land use pattern in Dominica. The acreage under cultivated land decreased by 4.5 per cent, however, the area under permanent crops increased by 17.7 per cent from 24,900 acres in 1961 to 29,300 acres in 1995, but the land under temporary crops decreased almost four-fold, from 8,800 in 1961 to 2,300 in 1995. This is a substantial decrease in the area under forest for the comparative period, from 37,100 acres in 1961 to 14,800 acres in 1995, a 60.1 per cent decline. The area under pasture also declined from 4,300 acres in 1961 to 1,700 acres in 1995.

3. Farm and parcel size

Table 8: Comparative analysis of results obtained from the 1961 and 1995 agricultural consensus.

Farm Size	Number of Farms		Land Use Farms ('000 acres)	
	1961	1995	1961	1995
Landless	442	737	0	0
0.01-4.9	6405	6130	10.1	12.3
5.0-49.9	2087	2187	20.3	21.6
50.0-99.9	78	53	5.1	3.6
100 and over	97	63	40.8	14.6
Total	9109	9170	71.4	52.1

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

Table 8 presents a comparative analysis of the results obtained from the 1961 and 1995 agricultural census. The following conclusions are drawn from the analysis:

- (a) There has been a slight increase in the number of farmers and a substantial decrease in the acreage under farmers in 1995 when compared to 1961;
- (b) The number of “landless” farmers has increased by more than 66.7 per cent from 1961 to 1995;
- (c) The number of farms having from 0.01 to less than five acres decreased by 4.3 per cent from 1961 to 1995. However, the acreage under farms in 1995 (12,300 acres) is 21.8 per cent higher than 1961;
- (d) The number of farms having from five to less than 50 acres and the land under these farms increased by 4.8 per cent and 6.4 per cent, respectively, in the period of three and a half decades;
- (e) The number of farms having 50 acres and over of total farm land has decreased by 34.1 per cent and the land has been reduced by 60.3 per cent (27,700 acres) during the period 1961 to 1995; and
- (f) In 1995, 73.8 per cent of the farms had only 23.6 per cent of the land with farm sizes of less than five acres. On the other hand, 1.3 per cent of the farms had 50 acres or more and occupies 34.9 per cent of the land under farms. This situation of land distribution may be characterized as poor.

4. Land tenure

The main land tenures according to the 1995 Agricultural Census were ownership with 34,000 acres (65.1 per cent) and family land with 5,700 acres (10.9 per cent) of total land under farms. Rented and communal land had similar relative importance regarding land tenure (5.6 per cent with 2,900 acres for each tenure). Farmers squatting on the land represented 1.7 per cent (900 acres) to total acreage under farm.

There has been substantial structural change in the land tenure system in Dominica during the period 1961 to 1995 based on the Agricultural Census of those two years. There were only three land tenure classes in the 1961 Census; they were ownership representing 95.5 per cent (72,800 acres) of the total land under farms, land rented for money with 4.2 per cent (3,200 acres) and the remaining 0.3 per cent (200 acres) of the land was rented for free. See table 9 for details.

Table 9: Land Tenure for 1961 and 1995

Land Tenure	1961		1996	
	Acreage	%	Acreage	%
	(*000 acres)		(*000 acres)	
Owned	72.8	95.5	34.0	65.1
Family Land	-	-	5.7	10.9
Rented	2.2	4.2	2.9	5.6
Squatted	-	-	0.9	1.7
Communal Land	-	-	2.9	5.6
Other Tenures	0.2*	0.3	0.7	1.3
Not Stated			5.1	9.8
Total	76.2	100	52.2	100.0
*Land rented for free				
Source: Dominica Agricultural Censuses, 1961 and 1995				

5. Human resources

One of the main human resource issues affecting the agricultural sector in Dominica is the decline in the number of young persons involved in agricultural and related activities. This is reflected in data from the 1995 Agricultural Census, which indicated that only 4 per cent of all farmers at that time were under the age of 25 years, while 36 per cent were over the age of 55 years. The data also indicate that the majority of farmers have not gone beyond primary education.

It is widely believed that there is a shortage of locally “available” farm labour for servicing the needs of the agricultural sector. To this end, immigrant workers from Haiti are employed on Dominican farms in both crop and livestock production. The issue of productivity of the local farm labour, its reliability and cost continues to plague the industry.

C. Infrastructure

1. Roads and transportation

Dominica has a well developed road network consisting of approximately 336km of primary roads, 126 km of secondary roads and 350km of tertiary roads, traversing the entire country. Most of the primary roads are in fairly good condition. However, the secondary and tertiary roads are in relatively poor condition with unpaved surfaces, broken pavements, poor drainage and structural failures. This has resulted in increased travel time for vehicles, increased vehicle maintenance costs, increased fuel use and increased levels of mechanical damage to produce impacting the quality of the produce.

Given that a good road network is essential to the enhancement of agricultural production and productivity and engendering international competitiveness, the Government of Dominica with donor funding from the European Union (SFA 1999, 2001) complemented by local funds is currently implementing a farm access road rehabilitation programme across the island. The

programme is targeting the rehabilitation of key farm access roads in the most productive agricultural regions of the country.

The absence of an international airport in Dominica has seriously constrained the country's ability to access the external markets (regional and international) via air transport. The air service provided by LIAT airline, the regional carrier, is inadequate in terms of space and facilities and the freight rates offered are prohibitive.

Ocean shipping to Europe is available weekly through the Geest Lines, but this service is very much underutilized. Shipping to the regional market is done through open hull, un-refrigerated schooners, with produce packed in bags, overweight crates, or in the case of bananas and plantains shipped on the bunch. This unsatisfactory means of transport accounts for almost all of Dominica's produce exported to the regional market.

The provision of upgraded, refrigerated shipping/transport for the regional trade is critical to the maintenance and expansion of output of the agricultural sector.

2. Irrigation

Historically, water has not been a scarce resource for agricultural production in Dominica. However, the issue of water was related to its availability in the right quantity at the right time and in the right place. This problem has impacted negatively on the expansion of the acreage under irrigation in the country.

Presently, there are three main areas under irrigation in Dominica. These are the Grand Savanne, Castle Bruce and Melvin Hall.

(a) Grande Savanne

This area of approximately 250 acres (100 hectares) is located on the west coast close to the town of Salisbury in the drier region of the country. Part of the area is cultivated by farmers using sprinkler and drip irrigation in open fields and more recently under plastic tunnels, growing a range of vegetables, including tomatoes, cabbage, lettuce, sweet pepper and cucumber.

(b) Castle Bruce

This area of 550 acres (220 hectares) is located in the eastern side of the island. This area is comparatively very flat, which is not typical of other areas on the island. The irrigation scheme covers some 230 acres of land.

(c) Melvin Hall

This is an area of approximately 100 acres (40 hectares) of undulating lands, most of which are under irrigation.

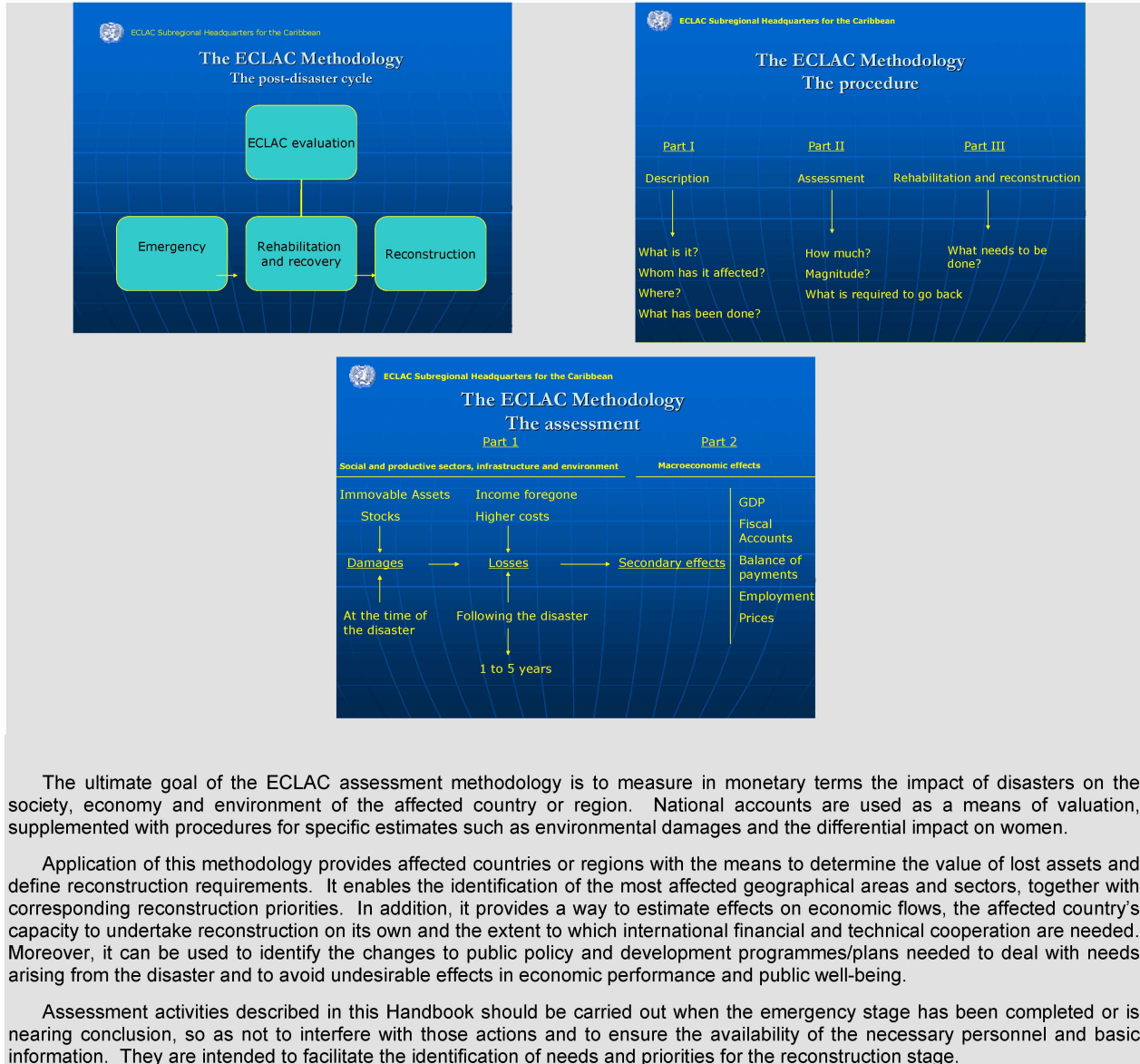
There are several major areas targeted for irrigation in Dominica. These areas and the targeted acreage for irrigation are presented in table 10.

Table 10: Areas and Acreage Targeted for Irrigation

Major Areas	Target Acreage (acres)
Caye En Boucs	50
Londonerry	60
Melvin Hall/Marigot/Calibishie	360
Woodford Hill	150
Milton	70
TOTAL	690
Source: Situation Analysis of the Agricultural Sector – Dominica, March 2007	

IV. DESCRIPTION OF DAMAGE AND LOSSES BY SECTOR

Box 2: Damage assessment: The ECLAC Methodology (DaLA)



The ultimate goal of the ECLAC assessment methodology is to measure in monetary terms the impact of disasters on the society, economy and environment of the affected country or region. National accounts are used as a means of valuation, supplemented with procedures for specific estimates such as environmental damages and the differential impact on women.

Application of this methodology provides affected countries or regions with the means to determine the value of lost assets and define reconstruction requirements. It enables the identification of the most affected geographical areas and sectors, together with corresponding reconstruction priorities. In addition, it provides a way to estimate effects on economic flows, the affected country's capacity to undertake reconstruction on its own and the extent to which international financial and technical cooperation are needed. Moreover, it can be used to identify the changes to public policy and development programmes/plans needed to deal with needs arising from the disaster and to avoid undesirable effects in economic performance and public well-being.

Assessment activities described in this Handbook should be carried out when the emergency stage has been completed or is nearing conclusion, so as not to interfere with those actions and to ensure the availability of the necessary personnel and basic information. They are intended to facilitate the identification of needs and priorities for the reconstruction stage.

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

A. Infrastructure

1. Critical elements of physical vulnerability

A review of the physical infrastructure of Dominica reveals that the most critical aspects relate to the need to provide safe roadways for Dominicans and visitors alike. This requirement is challenging, given the natural terrain that prevails throughout the island. The principal failures in infrastructure observed were primarily to roadways and bridge infrastructure. In many cases, utilities were also damaged where these were associated with, or linked to, roadways.

In this report five principal modes/mechanisms of failure have been identified. All have associated vulnerability as a result of steep topography and/or soil type. The modes of failure for roads and bridges are summarized as follows:

(a) Roads

(i) Failure of the upslope (slope above the roadway), from water, wind, debris and tree mechanisms originating from above the roadway;

(ii) Failure of the down-slope (slope section below the roadway), from waters and debris;

(iii) Failure of slopes/banks of a river channel due primarily to river erosion.

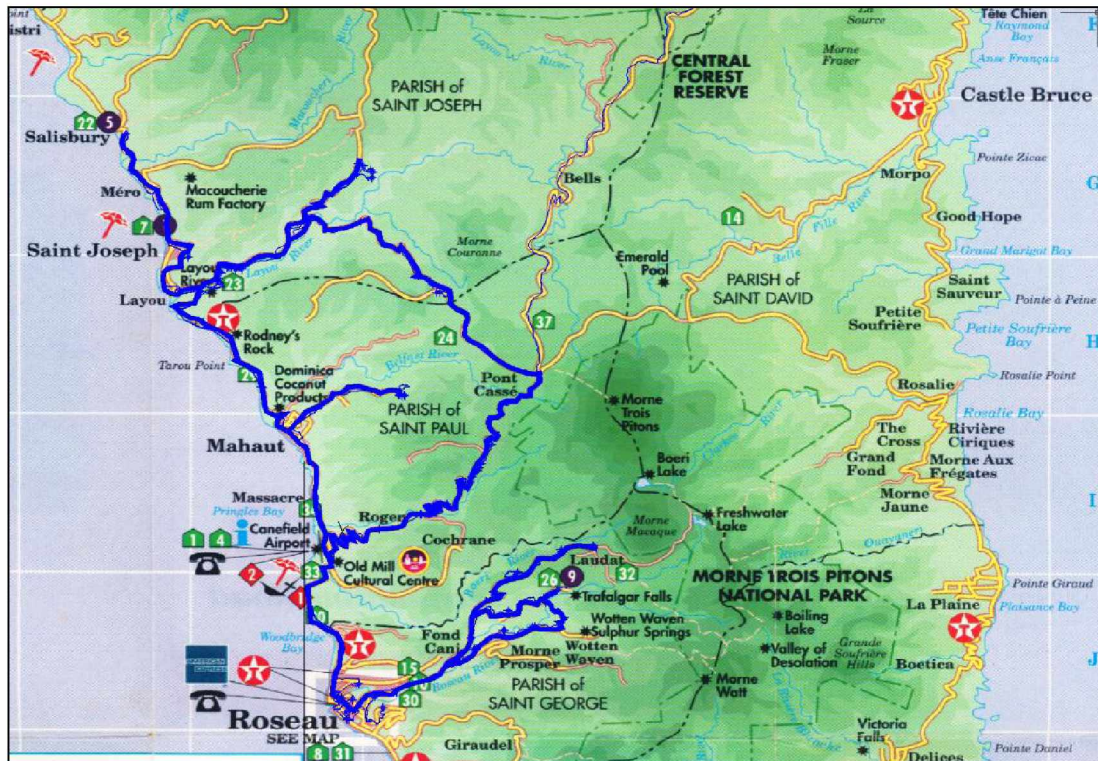
Figure 13 presents a picture of the Map of Dominica with the roadways severely impacted by Hurricane Dean and the accompanying system, outlined in dark ink. These roadways were identified by GPS hand held system.

(b) Bridges

(i) Failure of foundations of bridge abutments and piers within a river channel due primarily to water-based erosion;

(ii) Failure of the waterway area capacity due to blockage of the discharge path by debris (boulders, trees, soil, and man made refuse such as motor vehicle chassis and other household refuse, etc.). This failure leads to flooding of adjacent areas.

Figure 13: Roadways impacted by Hurricane Dean and accompanying suestem



Source: ECLAC assessment

(c) Soil type

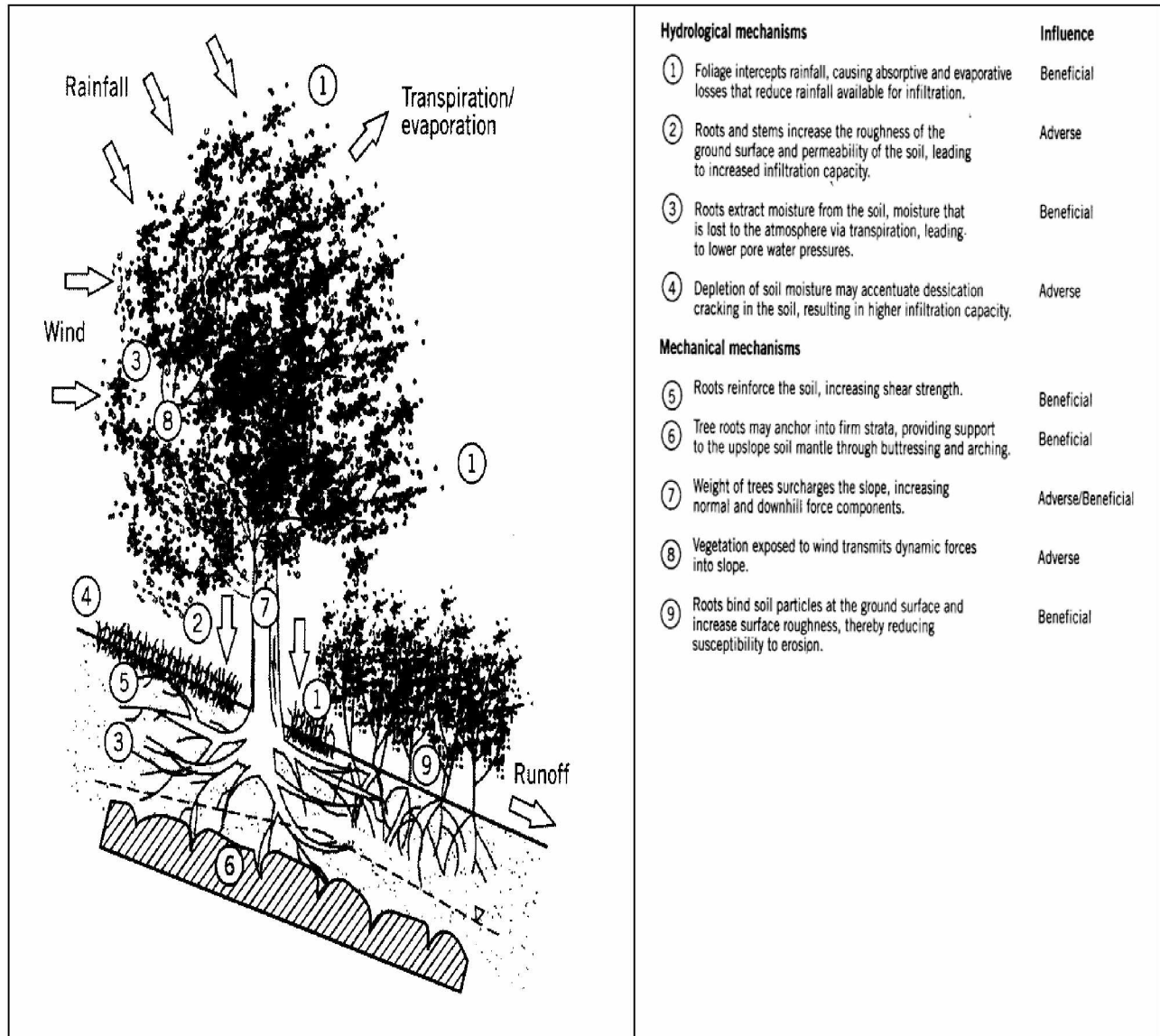
Slopes were affected by soil type, geology, slope angle, slope drainage and vegetation. Slopes were influenced by river erosion. See figure 15 which details the metamorphic residual soil.

The topography of Dominica, in a word, can be described as mountainous. The natural terrain in which many of the main arterial roads are founded are indeed steep ($>$ than 60° to the horizontal) and in many cases even vertical.

In many cases the failures occurred in areas that were heavily vegetated with mature trees at the edges of the slopes.

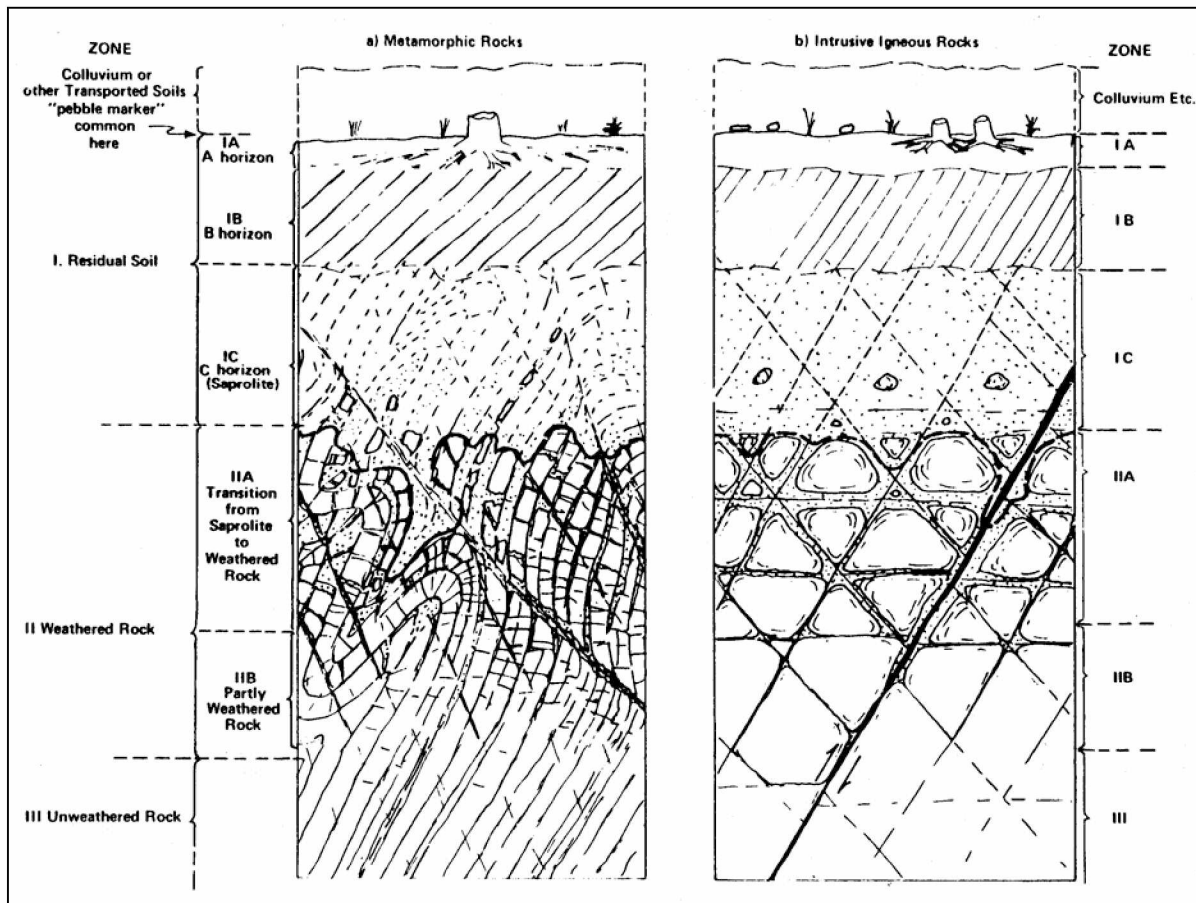
The rooting systems of large trees appeared to have contributed to soil loosening, cracking and increased infiltration. The effect of vegetation on slopes has been documented by Greenway (1987) as illustrated in figure 14, however, the oscillation and loosening of soils at the edges of slopes needs to be emphasized as this mechanism appears to be the far most significant in the Caribbean rainforests. These mechanisms have been observed in Trinidad in metamorphic residual soils and in Tobago, Dominica, Grenada and Saint Lucia in volcanic residual terrains (see residual formations in figure 15).

Figure 14: Effect of vegetation on slopes



Source: Effect of Vegetation on slopes (Greenway 1987)

Figure 15: Metamorphic residual soils



Source: Development of Residual Soil profiles in metamorphic and volcanic terrains (Deere and Patton 1971)

(d) Walls

Walls appeared to be constructed without footings, Domestic and Public Works (Terrain too steep). In many instances, walls functioned as erosion protection as opposed to retaining structure.

(e) Vegetation on slopes and landslides

The effect of trees and other vegetation on landslide occurrences is very complex and site-specific to the geology, soils, vegetation, climate, topography (slope angle), etc. Greenway (1987) lists the effects of trees on slope stability, as shown on figure 14. Some factors have a greater effect than others, depending on the relationships between the physical attributes indicated.

For example, tree roots can anchor a thin mantle of soil overlying bedrock on a steep slope but the thickness of the soil and the type of root system are critical elements. However, if that soil contributed to increased porosity of the soils resulting in the buildup of pore-water

pressure through a perched water table at the rock face, the increased water pressure can give rise to a catastrophic event as in the case of the Campbell landslide.

Conventional wisdom suggests that roots on a slope have a mechanical reinforcing or restraining influence on soils within the rooting zone of up to about 2m depth. Increase in Mass of tree due to size [of branches, trunk, etc.] Mass during storm due to water storage on leaves. Hence, component of weight surcharge down the slope increases over time.

Oscillation of trunk transmitted to root anchoring system during storms due to wind loads on the canopy. This rocking and pulling within the root zone would result in loosening of the soil thereby reducing its anchoring capacity. An increase in porosity at the near surface would also result in commensurate increase in infiltration, further softening and build up of pore water pressures.

Increase in soil and rock porosity due to expansion and penetration of roots resulting in increased infiltration. In some cases plant roots may cause the direct physical breakdown of rock by the pressures exerted during growth. Small root hair cells enter bedrock cracks and increase in length and width, gradually prising the cracks apart. Pressures have been measured as high as 1.45 MPa sufficient to break up rock (Cornforth 2005). Roots and stems increase the roughness of the ground surface and the infiltration capacity of the soil.

In an unsaturated state, the roots of vegetation can invoke increases in soil strength by the generation of high soil suction pore-water pressures (negative pore-water pressures). This would initially yield a beneficial effect until soil moisture adsorption results in desiccation cracking within the soil matrix resulting in higher infiltration capacity and the development of positive pore-water pressures.

On steep slopes with rock close to the surface, the reinforcement of the soil provided by the roots is probably the key element.

2. Water

The passage of Hurricane Dean resulted in damage to some of the production and distribution facilities. In general the impacts were not overly severe on an island-wide basis, as many systems were able to be restored to normal within two to 14 days, and most being restored within a one-week timeframe.

Damages were experienced in the Springfield water catchment system, where landslides in the Red Gully area resulted in excessive siltation. This catchment delivers water to the capital Roseau and to the west coast (Mero to Loubiere), with over 20,000 people served. This event has served to highlight the urgent need for relocation of the water intake for the Springfield catchment. It is of interest to note that the general maintenance of the catchment is carried out by the Forestry Department, whose responsibility it is to ensure the overall integrity of these catchments.

The cost of remedial works (direct damages) was estimated by the Dominica Water and Sewerage Company (DOWASCO) personnel, and is as follows:

- The total estimated all-island cost of remedial works (damages) was EC\$3,780,000.

The breakdown for these numbers is provided in table 11.

Table 11: Breakdown of all-island cost of remedial works

Item	Rehabilitation Cost (ECS)
Reconstruction of damaged intakes (including Springfield)	950,000
Repairs to water storage tanks	70,000
Replacement of broken/washed away pipes	600,000
Reconstruction of access roads to intakes	500,000
Replacement of damaged sewer lines	60,000
Roof damages – Bay Town plant	25,000
Roof replacement – Main office	75,000
Rehabilitation of river banks where needed	1,500,000
TOTAL	3,780,000
Source: ECLAC estimates based on official DAWASCO data.	

An estimate may be made for a computation of down time, assuming a total shut down time of seven days, affecting a population of 20,000. At an estimated average billing rate of EC\$30 per month (anecdotal information), this gives a total indirect loss for this utility of EC\$140,000.

3. Electricity generation

Dominica Electricity Services (DOMLEC) infrastructure began experiencing the impact of Hurricane Dean from the evening of Thursday 16 August, as strong winds brought down trees onto the transmission and distribution infrastructure. Inspection carried out after the hurricane also revealed that several poles had been damaged by landslides. The most badly affected areas were in the south and the east.

Power was shut down from the evening of 16 August, and remained off for several days. In some areas, power was off for up to a week, whereas in the main urban area of Roseau, it was restored quickly.

In general, all systems were back in working order within 10 days, with the exception of the Padu generating facility, which is a hydroelectric facility that supplies up to 12 per cent – 15 per cent of the national grid (between 2-3 MW of a total peak of up to 22MW). Examination of this facility has revealed that it will likely be out of operation for one year, while repairs are being effected. DOMLEC has made up for this shortfall by increasing the output of other diesel and hydroelectric stations. This action will likely result in some increased costs to consumers,

given the high cost of petroleum products. It is of interest to note that hydroelectric generation accounts for up to 40 per cent of the national requirement.

It must be noted that while the shortfall caused by the absence of the Padu generating facility may be made up from other hydroelectric plants and from diesel stations, this situation may change for the worse in the dry season (traditionally between February and April) when there is no excess water capacity. It is therefore considered essential that in the national interest, this station be brought back on line as soon as possible, and before January 2008.

Annual revenues for DOMLEC for the year 2006 were reported as being EC\$74m. This translates to an average per day revenue rate of EC\$202,700. Based on discussions with members of the general public, it appears that the down time varied from two days to 10 days, with an average of five days across the island. Using this figure, an indirect loss estimate, accounting for income loss, may be made. This figure amounts to EC\$1,014,000.

4. Communications

(i) Cable and Wireless

High winds started on the evening of 16 August 2007, and continued through the night and into the morning of the 17 August. Because of the planned shutdown of DOMLEC prior to the main passage of the hurricane, Cable and Wireless relied on generator power from the night of 16 August until Monday 20 August 2007.

In general, there was little damage to transmission towers and to satellite dishes. Damage however, was recorded as:

- (a) Downed or broken cables that had to be replaced;
- (b) Poles downed or broken as a result of landslides;
- (c) Poles slanting that required straightening;
- (d) Inundation of underground cables and equipment; and
- (e) Trees that had fallen on cables and which required trimming.

In many instances, the damage to overhead cables was as a result of flying debris. Damage was observed all over the island, but was most severe in the southwest. In the case of Layou, cables laid along roads were exposed and damaged when the Layou River broke its banks and damaged these roads. Along the Pointe Michelle to Soufriere road, damage was as a result of flying debris and landslides. In general, however, service was restored the day after the passage of the hurricane.

An estimate of the total cost of repairs was given by Cable and Wireless, and is presented below.

- Cost of materials, equipment and labour for implementing repairs (direct damage) was estimated at EC\$13,500,000.

The indirect losses related to Hurricane Dean for this provider are considered to be primarily attributable to costs related to the cost of diesel used to run standby generators, and were estimated to be EC\$550,000. (Costs were estimated for five days of generator operation, using a total of 1,000 gallons of diesel at a cost of EC\$11 per gallon).

(ii) **Orange**

A total direct damage estimate for this sector is set at EC\$14,000,000 which includes allowances for Cable and Wireless, Digicel and Orange, accounting for the fact that no data was available from these latter two providers.

The total indirect damages for this sector were estimated by taking the Cable and Wireless figure, and applying an 80 per cent factor to account for Digicel and a 60 per cent factor to account for Orange. This gave a total indirect loss estimate for this subsector of EC\$1,320,000.

5. **Ports**

Any damage that was sustained by the sea port facilities were as a result of high seas, flash flooding and wind. A summary of the noted damage is provided:

(i) **Woodbridge Bay Port**

- (a) No significant damage from high seas and winds;
- (b) Flooding occurred at the port facility itself;
- (c) There was need for a major clean up operation by port staff; and
- (d) A barge that had been obtained previously under a World Bank project was lost at sea.

It should be noted that the damages obtained at this terminal did not appear to affect the operation of the port once the clean-up activities were completed within two days of the passage of the hurricane.

The total estimate for damages at the main sea port was approximately EC\$750,000 which includes the items listed above.

(ii) Roseau cruise ship berth

Damage to the cruise ship berth was minimal, and was limited to damage sustained to wooden decking planks. An estimate of repair time of three weeks was made initially for the completion of repairs. Notwithstanding the minor nature of these damages, however, they have prevented the use of this berthing area by visiting cruise ships.

Damage estimates for this facility amount to EC\$50,000.

Other minor damage was experienced at the Longhouse Port, where loss of galvanized sheeting was observed.

Some damage was also documented at the Canefield Airport (damaged fencing; flooded runway; etc.) and at Melville Hall Airport (flooding of terminal due to inadequately sized drains at cargo shed). Subject to final damage assessment numbers being tendered by CEP Dominica, a figure of EC\$100,000 is assumed for these miscellaneous damages.

Total estimate of direct damages for the air and sea ports subsector, is EC\$900,000.

Some indirect losses are to be expected in this sector, mainly resulting from the loss of business at the Craft Market. This is as a direct result of the Roseau Cruise Ship Berth being unusable since the passage of the hurricane. This indirect loss, however, is to be accounted for in another sector of the analysis.

6. Roads (main, secondary and feeder)

The network of main roads were extensively damaged, and in particular the road to Laudat, the Canefield to Pond Casse road (Imperial Highway), and the Layou road. In all cases, the damages that occurred were as a result of three direct phenomena: landslides, which were triggered by a combination of saturated soils; wind loading on the canopy of large trees (which weakened the soil matrix); and improper drainage collection and outlet works. See figure 13.



Major landslide on Imperial Highway



Road damage caused by the Layou River. Note broken culvert in image to the right

In many cases, the landslides that occurred along the Imperial Highway were in areas that were characterized by very steep slopes, with large trees on the slopes. The theory proposed by the Geotechnical Engineer on the team is that the rain in the hurricane saturated the soil, while at the same time the wind would have shaken the tree canopy, causing the root system to loosen the soil. This combination of events was apparently sufficient to result in the triggering of several landslides along this stretch of highway, making it very hazardous for travel. A second source of slope failure occurred where culverts conveyed water under the road and the water was discharged directly unto steep slopes without any dissipation of energy taking place. This

mechanism would, in many cases, have exacerbated down slope failure such as is shown in the photograph on the previous page.

Estimates of damage costs for roads and road related infrastructure were carried out by the Ministry of Public Works and Public Utilities and are summarized in table 12. These locations were in many cases visited by the Geotechnical Engineer on the ECLAC team, and the magnitude of works verified.

Table 12: Estimates of damage costs for roads and road related infrastructure

Category	Problems Observed	Solutions Proposed	Estimated Cost (EC\$)
Main Roads	Flooding; broken road edges; slope failures; poor road conditions; overtopping by rivers	New bridge and/or alignment; widening of road sections; culvert and drain improvements; construction of retaining walls; improvement to roadways	8,255,000
Secondary Roads	Mass debris; road edge failures; blocked drains; damage to road surface; roadway subsidence	Clearing and disposal; retaining structures; roadway restoration	4,950,000
Feeder Roads	Mass debris; tree blockages; road edge failures; blocked drains; damaged road surfaces	Clearing and disposal; retaining structures; cleared drains; restored roadways	5,800,000
Bridges	Wingwall collapse; abutment undermined; damage to guard rail; damage to bridge decking and fittings; flooding	New wingwall; underpinning abutment; new guard rails; rehabilitation of decking; construction of box culvert bridge; improvement of approaches to and from culvert bridge	950,000
Sea Walls	Roadway badly eroded; undermining by the sea	Seawall and roadway reconstruction	5,500,000
River Walls	Existing wall collapse; threat of flooding; building infrastructure threatened; community under threat; roadway under threat; gorge undermined	Wall reconstruction; new wall construction; river training works	15,000,000
Ravine and Other Walls	Flooding of homes; community under threat	Ravine re-channeling and concreting; ravine wall construction; retaining wall construction	770,000
TOTAL			41,225,000
Source: ECLAC estimates based on official data from Ministry of Public Works and Public Utilities			

This total does not include the initial cost of carrying out clean-up and disposal activities, which totaled EC\$9,350,000. The estimate for total direct damages for road and road-related infrastructure is therefore estimated to be EC\$50,575,000.

The table preceding includes information on the network of feeder roads that service the agricultural sector. These roads provide access routes for the many farmers in the countryside from their inland farms to the main urban areas. These roads were severely damaged by the

rainfall that accompanied the hurricane. Assessment of this road network indicates that approximately 18 miles (30km) of feeder roads were in need of repair.

In most cases, these roads are covered with a 6" layer of crusher run material, with or without the addition of a weak mix of cement to act as a stabilizing agent. In other cases, the surface dressing for these roads consists of a sprayed mixture of bitumen and gravel. In both cases, the combination of heavy rainfall and poor drainage results in roadways that are very susceptible to wash out and extensive pitting of the surface layer. Deterioration of this road network affects the ability of the farmers to transport their goods to their main markets.

Indirect costs for this subsector relate primarily to two areas. First, at Laudat, the major landslide that occurred resulted in the need to create a diversion road. This road had to be cut and was surfaced using a concrete pavement. In all, approximately one-half mile of new road was created for this purpose (0.8 km). The cost of constructing this new diversion road is estimated at EC\$360,000 (including clearing and disposal; chainsaw cutting; road creation; and drains). The second component of indirect losses in this subsector relates to the fact that the travel distance between Roseau and Melville Hall was almost doubled by virtue of the fact that taxi operators were forced initially to travel via Portsmouth. This would have caused the operating cost per trip, namely increased diesel usage, to increase commensurately. For the 27 taxi operators plying this route, an additional 20 miles per trip was incurred, in each direction. Assuming that drivers still made three trips per day on average, this would amount to 120 extra miles per day per carrier, or a total of 3240 miles per day for all carriers. At a consumption rate of 20 miles per gallon, this would translate to a per day additional diesel usage of 162 gallons, or EC\$1782 per day. Over a seven day period, this would have added approximately EC\$12,000 in indirect losses. The total indirect loss for this subsector was therefore estimated to be EC\$372,000.



Breakdown of pavement on feeder road after Hurricane Dean

7. Summary Costs

A summary of all costs developed under the infrastructure heading is presented in table 13.

Table 13: Summary costs - Infrastructure

Total Damage Infrastructure(ECS '000's)	72,101
Total Direct Impacts (ECS'000's)	69,255
Water – Damage to distribution equipment; intake lines	3,780
Electricity Generation – Damage to distribution equipment	
Communications – Damage to equipment	14,000
Sea and Air Ports	900
Roads	50,575
Total Indirect Losses (ECS'000's)	2,846
Water – Loss of Income	140
Electricity Generation – Loss of income	1,014
Communications – Use of standby generators	1,320
Roads – Construction of alternative roads	372
Source: ECLAC estimates based on official Government of Dominica data	

Within the infrastructure sector, it can be seen that the roads subsector occupied over 74 per cent of the estimated damages and losses. The second ranked subsector was the communications and the third was water, from the perspective of damages and losses.

8. Vulnerability reduction and recovery – In infrastructure

Within the infrastructure sector, a number of vulnerability issues become immediately apparent. First, for the main roads, and in particular the Imperial Highway and also the road to Laudat, which provides access to a large number of eco-tourism attractions, the primary area of vulnerability pertains to the inherent geotechnical instability of the mountain slopes through which these roads have been cut. The first of these two roads is the main access for all arrivals to Dominica travelling between the Melville Hall Airport and Roseau. It is therefore of the utmost importance that this road be repaired and to a more secure standard than before. In order to do this, it will be necessary to carry out the following interventions:

- (a) Regrade unstable slopes, so as to make them more stable from a geotechnical perspective;
- (b) Cover the most unstable slopes along the highway with a geomesh netting fabric;
- (c) Install grass vegetation on the slope in the voids of the geomesh, to promote the natural stabilizing effects of this type of vegetation;
- (d) Provide a 6m wide verge (exclusion zone) along the top of the slope, which is to be cleared of any tall trees. This verge will need to be maintained on an ongoing basis;

(e) Provide more well constructed culverts to convey water under the road, and implement at the discharge side, a lined channel (lined with small stones), which will serve to dissipate the energy of the discharging jet of water;

(e) Where retaining walls are to be constructed, the commonly accepted design should be modified to incorporate a proper toe or pad foundation, which will serve to resist rotation of these walls; and

(f) On the down-slope side of the road, consideration should be given to either regrading to a gentler slope, or to installing geomesh for approximately 20 ft linearly down the slope.

The cost for implementing these works along the Imperial Highway is estimated to be EC\$15,000,000.

For the majority of the Laudat road, safer conditions may be obtained by simply regrading the cliff side of the road, by constructing retaining walls in locations where the road has slid, and by implementing larger drains. These interventions will go a long way towards providing a safer experience for visitors to the associated attractions (Middleham Falls, Titou Gorge, Trafalgar Falls, etc.). For the section where the main landslide occurred, this approach will need to be modified by virtue of the sheer steepness of the precipice side of the road in this location. In particular, there does not appear to be much that can be done here, to make this short section of road significantly safer. One solution may be to grade back the slope significantly, thus reducing its exposure to future landslides. This approach would, however, most likely require the removal of the house at the top of the cliff. It would also require a significant amount of earth moving, but is expected to provide a safer section of roadway along this immediate stretch. A detailed description of the mechanisms of slope failure active in these areas, and of the suggested improvements described briefly here, are given in the subsequent section on mitigation.

The cost for implementing these works along the Laudat road is estimated to be EC\$5,000,000.

From the perspective of institutional strengthening, it is recommended that mapping and GIS capability be developed. This could include the mapping of physical characteristics as an integral part of the mitigation of natural hazards.

In this activity we refer to the ability to rapidly identify the following:

- (a) Aerial photography: surface characteristics,
- (b) Topography: position, xyz, digital elevation model (DEM),
- (c) Topography: buildings and utilities
- (d) Meteorology,

- (e) Hydrology,
- (f) Drainage,
- (g) Geology,
- (h) Soils,
- (i) Seismology: earthquakes,
- (j) Seismology: volcanic activity.

B. Productive Sector - Agriculture, Fisheries and Forestry

1. Overview

The impact of Hurricane Dean on the agricultural sector of Dominica was widespread and significant. Hurricane force winds, torrential rain and high sea swells resulting from the hurricane severely affected all subsectors including crops, livestock, forestry, fisheries and farm infrastructure. The high level of precipitation in excess of eight inches over 18 hours and wind gusts of up to 170 km per hour resulted in flash floods, swollen rivers, soil erosion and landslides and extensive damage to livestock, vegetation, infrastructure and wildlife. Widespread damage was reported in the entire productive sector, with the worst affected areas being the northwest, central, east and southeast. Three thousand two hundred (3,200) farmers reported some level of damage to their productive enterprises and over 3,100 fishers and related fish vendors were impacted. The damage was most severe in the crops subsector and in particular with bananas, root crops, fruit trees and plantains.

The analysis of the impact of Hurricane Dean on the agricultural sector was conducted by utilizing the ECLAC macroeconomic Methodology for Estimating Socio-Economic and Environmental Effects of Disasters in general and in particular the methodological framework related to “Estimating the Effects of Disasters on the Agricultural Sector.” Within this context, the damage to the sector was categorized under two broad headings, direct damage and indirect damage/loss.

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

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

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

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

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

Table 14 provides a summary of the direct damage, indirect damage/losses and total impact of Hurricane Dean to the crops, livestock, fisheries and forestry subsectors as well as farm infrastructure. On-farm infrastructural damages to the livestock industry are included in the livestock subsector damage. Damages to farm roads as well as extensive damage to farm lands (landslides, etc) are not included in the estimates for the agricultural sector as they will be addressed under damage to infrastructure.

Table 14: Summary of Direct Damage and Indirect Losses of Hurricane Dean (EC\$)

Subsector	Direct Damage	Indirect Loss	Total Damage	%
1. Crops				
1.1 Bananas	7,544,200	4,573,170	12,177,370	
1.2 Plantains	1,638,270	3,445,470	5,083,740	
1.3 Citrus	972,250	3,282,400	4,254,650	X
1.4 Fruit Trees	1,056,940	4,429,725	546,665	
1.5 Root Crops	2,482,910	5,552,000	8,034,910	
1.6 Hot Peppers	51,270	209,840	261,110	
1.7 Vegetables	329,300	932,000	1,261,300	
Sub-Total Crops	14,075,140	22,424,605	36,499,745	
2. Livestock	1,029,160	149,070	1,178,230	
3. Fisheries	919,405	265,890	1,185,295	
4. Forestry	2,301,020	286,100	2,587,120	
5. Farm Infrastructure	1,312,500	2,036,940	3,349,440	
TOTAL	19,637,225	25,162,605	44,799,830	100.0
Source: ECLAC estimates based on official Government of Dominica data.				

Total damage to the agricultural sector, as presented in Table 14, is estimated at EC\$44.8 million, of which direct damage is estimated at EC\$19.64 million and indirect losses put at EC\$25.16 million. The crop subsector was severely impacted accounting for 81.5 per cent of total damage, followed by farm infrastructure (7.5 per cent), forestry (5.8 per cent), fisheries (26 per cent) and livestock (2.6 per cent) subsectors in that order in terms of level of impact. With respect to the crop subsector, the banana industry was severely impacted (95 per cent) accounting for 27.0 per cent of total damage to the agricultural sector, followed by root crops

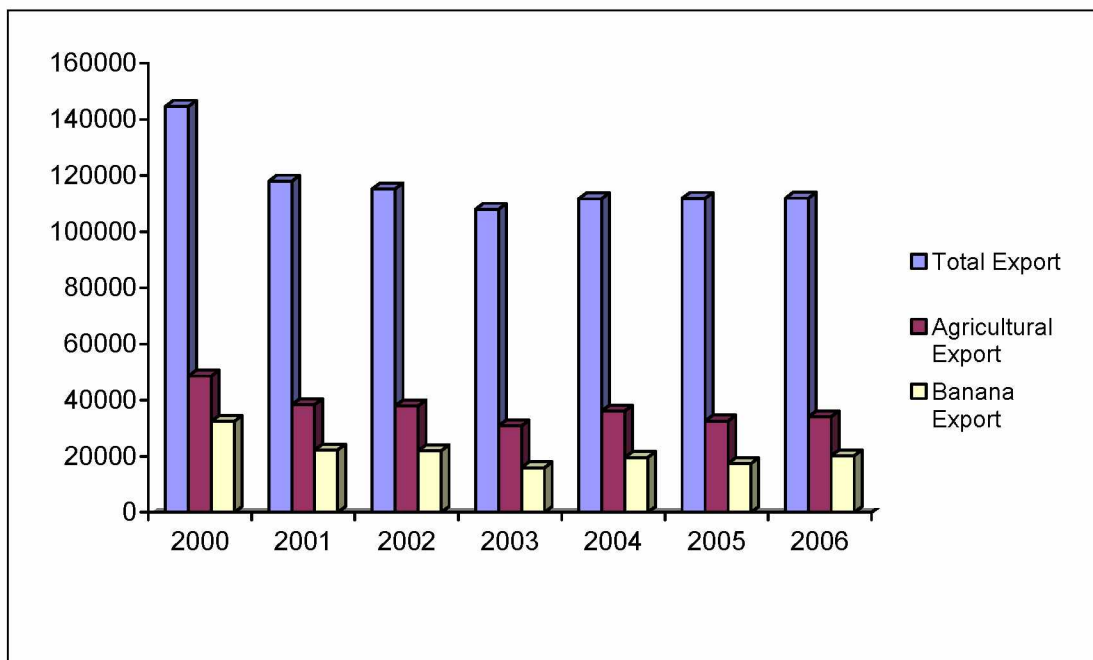
(17.9 per cent), fruit trees (12.2 per cent), plantains (11.39 per cent) and citrus (9.5 per cent) in terms of severity of damage.

2. Banana industry

The banana industry has played an important and critical role in the economy of Dominica contributing significantly to GDP, foreign exchange earnings and employment.

Figure 16 demonstrates that the banana industry is a major contributor to export earnings in Dominica.

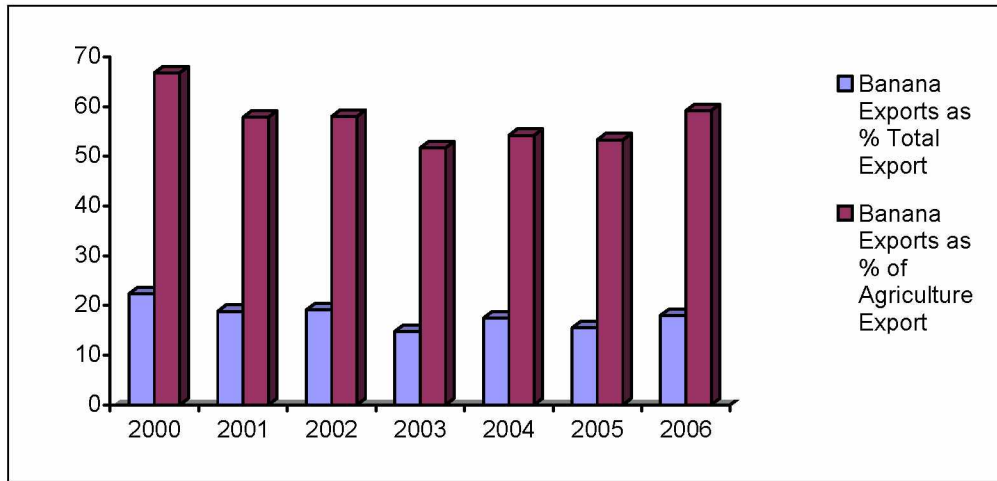
Figure 16: Comparative Analysis of Banana, Total and Agricultural Expenses



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

Figure 17 shows that the contribution of the banana industry to total domestic exports ranged from a low of 14.8 per cent in 2003 to a high of 22.4 per cent in 2000. As a percentage of total agricultural exports, banana contribution ranged from a low of 51.7 per cent in 2003 to a high of 66.8 per cent in 2000.

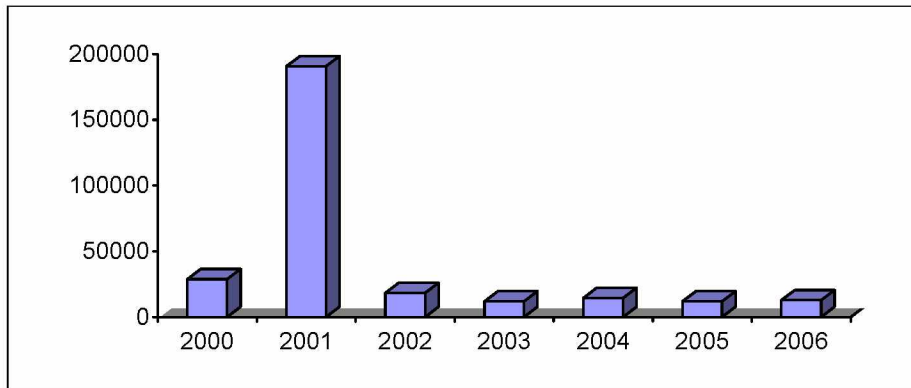
Figure 17: Percentage Contribution of Bananas to Total and Agricultural Exports



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

The export of bananas in terms of volume is presented in Figure 18.

Figure 18: Volume of Banana Exported (metric tonnes) 2000-2006



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

The banana industry is also a significant contributor to employment in Dominica. It is estimated that there are approximately 1,113 banana farmers operating on about 2,694 acres of land and employing approximately 3,300 workers directly (Table 15).

Table 15: Pre Hurricane Dean Banana Subsector Situation

Agricultural Region	Number of Farmers	Acreage (Acre) under Production	Estimated Production (lbs) (2007)	Extent of Damage (%)
North	103	223	1,438,562	85
Northeast	524	1,185	11,966,921	96
East	146	282	2,426,565	99
South East	92	216	2,483,398	92
Central	147	560	5,293,166	98
West	40	133	1,424,643	93
South	61	95	548,046	98
Total	1,113	2,694	25,581,301	95.6

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

The banana industry was heavily impacted by Hurricane Dean, with total damage estimated at EC\$12,117,370. The direct damage was estimated at EC\$7,544,200 and the indirect damage/loss put at EC\$4,573,170. The extent of the damage to the industry was estimated at 95.6 per cent, with the nature of the damage observed included the snapping and toppling of the banana plants.

The impact of the disaster was more pronounced in the north-east and central agricultural region with reported total impact of EC\$5,668,500 (467.4 per cent) and EC\$2,507,270 (20.7 per cent) of total banana damage, respectively. Approximately 1,185 acres in the north-east region and 560 acres in the central region were impacted.

Details of the total damage to the banana industry are presented in tables 15 and 16.

Table 16: Total Damage to the Banana Industry (EC\$)

Agricultural Region	Direct Damage	Indirect Losses	Total Damage
North	424,250	257,170	681,420
Northeast	3,529,170	2,139,330	5,668,500
East	715,620	433,800	1,149,420
South East	732,380	443,960	1,176,340
Central	1,561,010	946,260	2,507,270
West	420,140	254,680	674,820
South	161,630	97,970	259,600
Total	7,544,200	4,573,170	12,117,370

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

The impact of Hurricane Dean on the banana industry obviously will have serious effects and implications for future banana production as well as for farmers and export income. These implications are presented in table 17.

The country is expected to have a shortfall in banana export of EC\$7.97 million in value up to March 2008. Farmers loss in income is estimated at EC\$4.44 million.

Table 17: Implications of Hurricane Dean on Production and Farmers and Export Incomes

Year	Pre-Dean Expected Production (tones)	Post-Dean Projected Production (tones)	Production Losses (tones)	Projected Farmers Income Losses (ECS)	Projected Export Losses (ECS)
2007	25,582,000	17,218,900	83,631,000	3,679,764	6,606,849
Jan-March 2008	5,765,000	40,358,500	1,729,500	760,980	1,366,305
TOTAL	31,347,000	21,254,400	10,092,600	4,440,744	7,973,154

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

Some critical assumptions utilized in arriving at the projections are:

- Farm gate price of banana (less carton cost) is EC\$0.46; and
- Export value per lb banana is EC\$0.79

3. Other crops

The category, “other crops”, which included plantains, citrus, fruit trees, root crops, hot pepper and vegetables suffered substantial damage from Hurricane Dean, with total impact of the hurricane on this category estimated at EC\$24,382,375. The direct damage is estimated at EC\$6,530,940 and the indirect losses put at EC\$17,851,435. Details are provided in tables 18 and 19.

Table 18: Summary of “Other Crops” Damage

Crop	Reported Acreage (Acres) Damaged	Number of Farmers Affected	Extent of Damage
Avocado	239	1,087	50
Grapefruits	580	287	50
Oranges	1,084	473	50
Limes	101	231	50
Coconuts	1,200	457	65
Mango	83	192	70
Coffee	36	106	65
Cocoa	39	383	65
Tannia	280	206	70
Dasheen	720	539	60
Yams	770	562	70
Plantain	883	1,420	95
Passionfruits	80	122	75
Pepper	26	139	100
Vegetables	210	372	100
TOTAL	6,331	6,576	

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

Table 19: Total Damage to “Other Crops” (EC\$)

Crop	Direct Damage	Indirect Losses	Total Damage
Avocado	312,800	3,011,400	3,324,200
Grapefruits	269,570	1,334,000	1,603,570
Oranges	652,630	1,718,400	2,371,030
Limes	50,050	230,000	280,050
Coconuts	480,000	560,000	1,040,000
Mango	79,310	396,330	475,640
Coffee	34,400	171,900	206,300
Cocoa	35,490	186,225	221,715
Tannia	388,040	616,000	1,004,040
Dasheen	671,730	2,102,400	2,774,130
Yams	1,423,140	2,833,600	4,256,740
Plantain	1,638,270	3,445,470	5,083,740
Passionfruits	114,940	103,870	218,810
Pepper	51,270	209,840	261,110
Vegetables	329,300	932,000	1,261,300
TOTAL	6,530,940	17,851,435	24,382,375
Source: ECLAC estimates based on official Government of Dominica data.			

Approximately 883 acres of plantains, involving 1,420 farmers were impacted to the extent of 95 per cent. Total damage for this industry was estimated at EC\$5,083,740 with direct damage estimated at EC\$1,638,270 and indirect losses put at EC\$3,445,470. It should be noted that the export of plantains generated EC\$3,581,401 in 2006.

The citrus industry which includes oranges, grapefruits and limes were also heavily impacted. Reported acreages damaged for oranges (473 farmers), grapefruits (287 farmers) and limes (287 farmers) were 1,084, 580 and 101 acres, respectively. The reported level of damages to the citrus industry was estimated at EC\$4,254,650 with direct damage estimated at EC\$972,250 and indirect losses put at EC\$3,282,400. The main citrus trees affected were oranges (EC\$2,371,030) and grapefruit (EC\$1,718,400).

The other major fruit trees including avocado, mango, coffee, cocoa and passion fruits also suffered significantly through high loss of fruits, uprooted trees, broken branches and defoliation. In addition, coconuts suffered extensive damage to their “tops” as a result of the high wind velocity. These fruit tree crops are also significant earners of foreign exchange and are exported primarily by huskers to the nearby islands of the Eastern Caribbean. In 2006, exports of fruit tree crops earned a total of EC\$5,526,939 crops with citrus and the “other fruit tree crops” generating EC\$1,902,930 and EC\$3,624, 009 in foreign exchange earnings, respectively.

Dominica is a major producer of root crops and these occupy an estimated 2,700 acres and generated EC\$3,693,074 in foreign exchange in 2006. The main root crops cultivated on the island are dasheen, yams, tannia, sweet potato, ginger and irish potato. Damage has been reported for 1,700 acres of root crops, representing a level of damage of 65.6 per cent of the total acreage under production. Damage to the root crops resulted mainly from the high winds, heavy rainfall, soil erosions and landslides. The total damage to the root crop industry was estimated at EC\$803,491 million, with direct damage estimated at EC\$2,482,910 and indirect losses at EC\$5,552,000.

Approximately 210 acres of vegetables, in open field, produced by 372 farmers suffered losses to the extent of an estimated 100 per cent. The total damage to vegetable production is estimated at EC\$1,261,300 with direct damage and indirect losses estimated at EC\$329,300 and EC\$932,000, respectively. Also of importance is vegetable production under plastic or shade cloth covered tunnel, often referred to as greenhouse production. As estimated, 198 greenhouses were on the ground prior to Hurricane Dean, with a total of 60 reported to have suffered damages. Thirty-three of these houses suffered structural damages due mainly to the fact that the covers were not removed prior to the passage of the hurricane.

Other crops of importance that suffered less damage were coffee, cocoa and hot peppers, with total estimated damage of EC\$206,300, EC\$221,715 and EC\$261,110, respectively.

4. Livestock

The livestock industry in Dominica, is relatively small contributing only 1.7 per cent to GDP. The subsector suffered moderate to serious losses as a result of the hurricane, with serious losses reported for the poultry, pig and sheep industry.

The overall estimate of the damage to the industry is put at EC\$1,178,230. Of this total, EC\$1,029,160 represents direct damage and EC\$149,070 indirect losses. Livestock infrastructure including farm buildings, livestock housing, and pastures including fencing, with estimated damage attributed to this area put at EC\$703,850 or 59.7 per cent of total livestock damage. While some animals were lost (mainly poultry) feeding regimes were impacted, overall damages in the two areas were not substantial.

Details of the damage incurred by the livestock subsector by industry are presented in table 20.

Table 20: Total Damage to Livestock Subsector (EC\$)

Livestock Specie	Number of Affected Farmers	Number of dead/ injured animals	Direct Damage				Indirect Loss	Total Damage
			Animals	Infra-structure	Others	Total Direct		
Poultry	44	4,475	90,820	327,150	8,050	426,020	34,080	460,100
Pigs	41	132	66,010	132,600	3,900	202,510	22,270	224,780
Sheep	13	33	4,500	18,500	450	23,450	8,810	32,260
Goats	142	376	75,200	187,900	6,100	269,200	49,800	319,000
Cattle	18	33	66,000	33,200	2,100	101,300	33,260	134,560
Others	16	132	1,980	4,500	200	6,680	850	7,530
Total	274	5,181	304,510	703,850	20,800	1,029,160	149,070	1,178,230

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

The poultry industry forms a significant part of the livestock subsector, with local production meeting the domestic demands for eggs. Approximately 4,475 birds were lost and this has impacted negatively on the egg production in the country. The poultry industry infrastructure, mainly housing, was severely impacted; the estimated damage in this area was put at EC\$327,150. Total damages to the poultry industry was estimated at EC\$460,100.

The pig industry provides significant income to many small producers and 41 pig farmers impacted by the hurricane. Significant damages were also caused to pig housing mainly as a result of the inadequate investment and poor quality of the materials utilized in construction. The estimated damage of the hurricane to the pig industry is put at EC\$224,780. A total of 376 goat and 33 sheep farmers reported losses on their farm. Total damage to the small ruminant industry is put at EC\$351,260.

The cattle industry in Dominica, with revenues derived from the sale of products, is utilized to supplement family income. In general, damages to the cattle industry was minimal (EC\$134,560) with the damage mainly limited to lost of animals (18) and structural damage to fences.

5. Fisheries

The fisheries subsector is extremely import to the socio-economic development of Dominica in general and in particular those rural communities located along the coastal areas. The subsector employs approximately 3,100 fishers and fish vendors and in 2006, contributed 2.03 per cent of total GDP. The value of fish landings is estimated at about EC\$5.9 million annually and most of the fish landed is consumed locally, thereby making a significant contribution to national food security.

Traditionally both fresh water and marine fisheries exploitation takes place. The industry is characterized by small part-time fishermen operating with small non-commercial fishing vessels. The emphasis is on coastal pelagic including ballyhoo, sardines, jacks, sprats and tuna which are heavily exploited for local use. Other migratory pelagics, including dolphins, skipjack,

wahoo, flying fish and yellow fin tuna, are increasingly exploited with the use of improved techniques such as long line and fish aggregating services (FAD). Presently, the development efforts of the fishery industry focus on the commercialization of the industry, the training of fishers and the provision of improved physical and economic infrastructure to facilitate the production of value-added products.

The damage to the fisheries subsector may be characterized as moderate, with total damage estimated at EC\$1,185,295. Of this total damage, direct damage accounted for EC\$919,405 while indirect damage loss was put at EC\$265, 890 (Table 21).

Table 21: Total Damage of the Fisheries Sub-Sector (EC\$)

Landing Sites	Direct Damage	Indirect Losses	Total Damage
Anse de Mai/Anse Soldat	43,200	17,280	60,480
Batalie	34,200	10,650	44,850
Bioche	51,400	11,920	63,320
Capuchin	65,560	5,460	71,020
Colihaut	48,000	7,780	55,780
Dublanc	39,960	3,380	43,340
Fond St. Jean	151,300	73,360	224,660
Mahaut	90,865	3,060	93,745
Prawn Farm	65,000	10,500	75,500
San Sauveur	25,000	10,400	35,400
Scotts Head	50,000	32,840	83,440
Soufriere	24,100	7,500	31,600
Stowe	94,300	27,120	121,420
Others	136,100	44,640	180,740
TOTAL	919,405	265,890	1,185,295
Source: ECLAC estimates based on official Government of Dominica data.			

The damage to the fisheries subsector varied according to the location of the landing sites as well as the structural integrity of the related economic and physical infrastructure. A high level of direct damage resulted from storm surges and high winds that ravaged jetties, land and mooring areas, boat sheds and destroyed or damaged fishing boats and equipment. A number of landing sites were made inaccessible to fishers.

The south eastern coast was the most severely affected area, with the passage of Hurricane Dean leaving much damage to coastal habitats and landing sites at Scotts Head, Stowe, Fond St. Jean and San Sauveux. At Fond St. Jean, the landing site became inaccessible to fishers from both land and sea and a result of the deposition of large boulders in the area. At Scotts Head, the main isthmus was cut off causing flushing of the water from the Atlantic Ocean into the Caribbean Sea. The Stowe and San Sauveux landing sites were also severely affected and required the clearing of boulders and debris in the aftermath of Hurricane Dean. It was reported that only eight of the 32 landing sites on the island had sand and consequently, the productivity

of most fishers was affected after the passage of the hurricane in as much as they were unable to safely launch their boats.

Highest damages were reported for fishing gear, mainly fish pots and FADs. Fishers reported losing 1,224 fish pots and three FADs while one FAD equipment was damaged. It is anticipated that more than half the pots would remain lost at sea resulting in ghost fishing and reduction of the fishery. Fishers with pots suffered heavy losses as a result of the remoteness of the gear and their inability to respond quickly and safely to the hurricane warnings. Fishers also reported losing 16 outboard motors while 23 fishing boats were damaged, of which 21 boats were damaged beyond repair. Damage was also reported for 29 boat sheds, 11 buildings and seven lockers rooms. Four jetties and one landing and mooring area were also reported damaged. Summary of the direct damage to the fisheries subsector is presented in Table 22.

In addition, considerable coastal degradation occurred as a result of high seas and the large amount of silt, mud and debris that was brought down by the rivers and other surface runoff. It has been observed that the current operation system for land-based quarrying activities is adversely affecting fishing activities on the west coast due to high levels of runoff into the sea. The high rainfall level of Dominica also increases the runoff of agro-chemicals from agricultural areas into the sea and this has resulted in algal bloom, with the corresponding growth of algae that kills fish life.

The passage of Hurricane Dean has resulted in decreased fish landings due to the loss of fishing gear and damage to landing sites. This has had and will continue to have an adverse impact on the earnings of over 3,000 fishers and vendors along with their families. It is also impacting on the availability of fish as an important source of food. Several fishers have been servicing loans and will now find it very difficult to maintain their payment commitments in the immediate to short term due to reduction of income. In addition, the third quarter of the year is the main period for pot fishing and the high loss of pots resulting from the hurricane is expected to result in a marked reduction in fish landings. Fishers have begun the rebuilding of pots but previous experience has shown a tendency to use smaller size mesh wire after a hurricane, resulting in the catching of smaller fishes and the depletion of the fishery.

Table 22: Direct Damage of the Fisheries Subsector

Landing Sites	Fish Pots		Outboard Motor		Jetty/Landing Moor		Boat Shed		Building		Fishing Boats		FAD/FAD Equipment		Metal Dump		Dam		Others		Total	
	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs	No.	Costs
Anse de Mai/ Anse Soldat	216	43,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	43,200
Batalie	121	24,200	1	9,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	1,000	3,122	34,200
Bioche	149	31,400	-	-	1	20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	51,400
Capuchin	37	7,400	1	16,160	1	30,000	-	-	1	12,000	-	-	-	-	-	-	-	-	-	-	40	65,560
Colihaut	66	13,200	1	10,000	-	-	8	24,800	-	-	-	-	-	-	-	-	-	-	-	-	75	48,000
Dublanc	11	2,200	1	16,160	-	-	5	11,200	1	10,400	-	-	-	-	-	-	-	-	-	-	18	39,960
Fond St. Jean	42	8,400	4	32,100	1	40,000	1	3,000	1	4,000	8	54,600	2	6,000	-	-	-	-	3	3,200	62	151,300
Mahaut	7	1,400	1	9,285	1	20,000	-	-	-	-	-	-	-	-	1	60,000	-	-	-	-	10	90,685
Prawn Farm	-	-	-	-	-	-	-	-	1	20,000	-	-	-	-	-	-	1	45,000	-	-	2	65,000
San Sauveur	30	6,000	-	-	-	-	-	-	1	30,000	1	8,000	1	4,000	-	-	-	-	1	4,000	34	25,000
Scotts Head	223	42,600	-	-	-	-	-	-	-	-	2	8,000	-	-	-	-	-	-	-	-	225	50,600
Soufriere	-	-	-	-	-	-	-	-	-	-	4	24,100	-	-	-	-	-	-	-	-	4	24,100
Stowe	14	2,800	4	29,900	-	-	1	6,000	1	6,000	6	46,100	-	-	-	-	-	-	1	3,500	27	94,300
Others	308	59,400	3	2,500	1	1,200	14	39,200	5	21,000	2	3,800	1	4,000	-	-	-	-	1,503	5,000	1,837	136,100
TOTAL	1,224	242,200	16	125,105	5	84,200	29	84,200	11	76,400	23	144,600	4	14,000	1	60,000	1	45,000	4,508	16,700	5,822	919,405

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

6. Forestry

Dominica's natural vegetation covers an estimated 51,770 hectares or 65.7 per cent of the total area of the country. The sustainable utilization and maintenance of the island's forest, wildlife and national park resources is critical for Dominica so that it can maintain its image as the "Nature Isle" of the Caribbean.

The impact of Hurricane Dean on the forest resource base is characterized as moderate, affecting the forest lands, seven watersheds and 43 catchment areas which support an ecosystem where much flora and fauna benefited directly or indirectly. The five forest ranges were impacted differently, with the extent of the damage varying from a low of about 20 per cent in the central forest range to a high of 90 per cent in the northern range.

Hurricane Dean impacted both the forest and the eco-tourism sites and facilities located in the forest reserve. The impact on the forest and the eco-tourism sites and facilities included the destruction of forest covers, tree degradation, broken branches, uprooted trees, soil erosion, landslides, blocked drains, accumulation of debris, damage to streams, siltation, damaged pipelines, damaged buildings, damaged wooden steps and rope railings along trails, erosion of boundary demarcation lines and natural habitat loss. The reduction in canopy cover as a result of the stripping of the forest vegetation has exposed the forest and watersheds to a more direct impact of precipitation. This can result in accelerated erosion on the top soil and road ways, increased runoff and flash flooding, with adverse impact on lives and property downstream as well as on the marine environment.

As indicated earlier, the forest resource base in Dominica plays an important role in the preservation of wildlife and water resources. The wildlife of the forest depends on the forest flora and fauna to survive as well as on the forest cover for protection and opportunities for nesting. The damage to the forest will obviously place the wildlife under significant pressure for survival and resulting in depredation of agricultural crops.

The forest resource base is also an important area for eco-tourism related activities including national parks, natural falls, national trails, rivers and streams, sulphur springs and boiling water. Some of these eco-tourism sites and facilities were impacted with damage including uprooted trees, broken branches, destruction of forest cover, tree defoliation, water erosion, damaged streams, siltation, damaged building, wooden steps and rope trails, blocked drains and accumulated debris. This can impact on revenue generation from eco-tourism related activities which is an important selling point for tourism promotion on the island.

The assessment also examined the landslides occurring along rivers, riverbanks, water intakes and other watershed related activities. However, this analysis and assessment will be addressed under the section on infrastructure.

Total damage to the forest resource base is estimated at EC\$2,587,120 with direct damage estimated at EC\$2,301,020 and indirect loss at EC\$286,100 (Table 23).

Table 23: Assessment of Total Damage to Forestry Subsector

Forest Range	Direct Damage			Total Damage	Indirect Loss	Total Damage
	Forest	Eco-Tourism	Others			
Eastern	325,000	45,230	-	370,230	58,500	428,730
Central	150,000	129,650	-	279,650	27,550	307,200
Northern	350,000	51,640	-	401,640	105,600	507,240
Roseau	250,000	299,500	-	549,500	64,350	613,850
Other	-	-	700,000	700,000	30,100	730,100
TOTAL	1,075,000	526,020	700,000	2,301,020	286,100	2,587,120

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

Direct damage for forest (natural and plantation) is estimated at EC\$1,075,000 (Table 24) and that for eco-tourism related activities put at EC\$1,226,020 (table 25).

Table 24: Assessment of Direct Damage Caused to Forestry

Forest Range	Site Description	Type of Damage						Extent of Damage (%)	Total Damage ECS
		Destruction of Forest Cover	Tree Defoliation	Broken Branches	Uprooted /Fallen Trees	Erosion	Landslides		
Eastern	Forest	x						35%	250,000
	Forest					x			75,000
Central	Natural Forest		x		x			20%	75,000
	Plantation Forest		x	x	x			20%	75,000
Northern	Woodford Hill Swamp		x	x	x			90%	100,000
	Bleinheim		x	x	x			90%	50,000
	Salisbury		x	x	x			90%	50,000
	Others	x	x	x	x	x	x	30%	150,000
Roseau	Forest: Petite Savanne Area	x	x	x		x	x	40%	75,000
	Forest: Moune Trois Piton National Park	x	x	x		x	x	30%	75,000
	Forest: Others	x	x	x		x	x	20%	100,000
TOTAL									1,075,000
Source: ECLAC estimates based on official Government of Dominica data.									

Table 25: Assessment of Direct Damage Caused to Eco-Tourism Sites and Facilities

Forest Range	Site Description	Type of Damage							Total Damage ECS
		Tree Defoliation	Broken Branches	Uprooted Trees	Erosion/Landslides	Buildings/Steps	Blocked Drains	Others	
Eastern	Emerald Pool	x	x					x	1,430
	Emerald Pool Trail	x	x	x				x	17,250
	Sari Sari Falls			x	x				3,850
	Victoria Falls		x	x				x	3,850
	Chemin Letang Trail		x	x		x			3,850
	Delices Forest Station					x		x	15,000
Central	D'leau Gommier Lumber Shed					x		x	33,000
	D'Leau Gommier Trail	x	x	x				x	1,650
	Pond Case Nursey							x	10,000
	Pond Case Station					x		x	85,000
Northern	Cabrits National Park Trail		x	x				x	2,090
	Cabrits Visitor Centre					x			500
	Indian River		x	x				x	4,450
	Syndicated Nature Trail		x	x				x	42,950
	Cold Soufriere		x	x					1,650
Roseau	Soufriere Sulphur Spring							x	54,220
	Middleham Falls/Trail		x	x	x	x		x	13,850
	Trafalgar Falls		x	x	x			x	5,670
	Boiling Lake Trail					x		x	64,210
	Boeri Lake Trail					x		x	12,200
	Botanical Garden	x	x	x				x	149,350
General	Natural Habit Loss							x	500,000
	Boundary Demarcation Lines			x					200,000
TOTAL									1,226,020
Source: ECLAC estimates based on official Government of Dominica data.									

Indirect loss, estimated at EC\$286,100 includes activities related to the pruning, clearing and removal of uprooted trees and broken branches and debris, dredging of sedimentation basins and bathing rivers and pools, implementation of conservation agricultural and agro-forestry production systems on steep slopes and revenue loss from eco-tourism during the period of recovery. The cost of mitigation work related to the stabilization of slopes and riverbanks is included under the section on infrastructure.

7. Farm infrastructure

Hurricane Dean impacted farm infrastructure in six main areas as follows:

- (a) Farm roads;
- (b) Greenhouses and horticulture structures;
- (c) Other buildings including agro-processing facilities;
- (d) Irrigation systems; and
- (e) Farm structures for animals.

The impact of the hurricane on farm roads will be discussed and presented under the general section entitled “Infrastructure”, while that for animals is presented under livestock.

As indicated earlier, several greenhouses were impacted as well as several horticulture structures. The total estimated damage under this area is put at EC\$444,500.

Most of the island-wide agricultural stations were severely affected because of the pre-Dean dilapidated state of the buildings and as a result of inadequate investment and poor maintenance. The total damage estimated for agricultural station is put at EC\$2,500,000 and included mitigation costs for rebuilding better (improvements).

There is a significant level of agro-processing in Dominica, which utilizes local raw materials, including green papaya, passion fruits, hot pepper and citrus in the production process. The passage of Hurricane Dean has not only disrupted the main source of raw materials for these facilities, but has resulted in structural damage to some of the facilities. Total damage to other buildings, mainly agro-processing facilities was estimated at EC\$302,500.

The total farm infrastructure damage is estimated at EC\$3,349,440 with direct damage put at EC\$1,312,500 and indirect damage at EC\$2,036,940 (see table 26).

Table 26: Summary Impact to Agriculture

Subsector	Damage	Loss	Total Impact
Crops			
1.1 Bananas	7,544,200	4,573,170	12,177,370
1.2 Plantains	1,638,270	3,445,470	5,083,740
1.3 Citrus	972,250	3,282,400	4,254,650
1.4 Fruit Trees	1,056,940	4,429,725	546,665
1.5 Root Crops	2,482,910	5,552,000	8,034,910
1.6 Hot Peppers	51,270	209,840	261,110
1.7 Vegetables	329,300	932,000	1,261,300
Sub-Total Crops	14,075,140	22,424,605	36,499,745
Livestock	1,029,160	149,070	1,178,230
Fisheries	919,405	265,890	1,185,295
Forestry	2,301,020	286,100	2,587,120
Farm Infrastructure	1,312,500	2,036,940	3,349,440
TOTAL	19,637,225	25,162,605	44,799,830
Source: ECLAC estimates based on official Government of Dominica data.			

C. Productive sector - tourism, commerce and other services

An examination of the damage done by Hurricane Dean to the above-captioned sectors was made on the basis of documentation received and, at times, descriptive accounts of damage, many unquantified in money terms.

1. Tourism

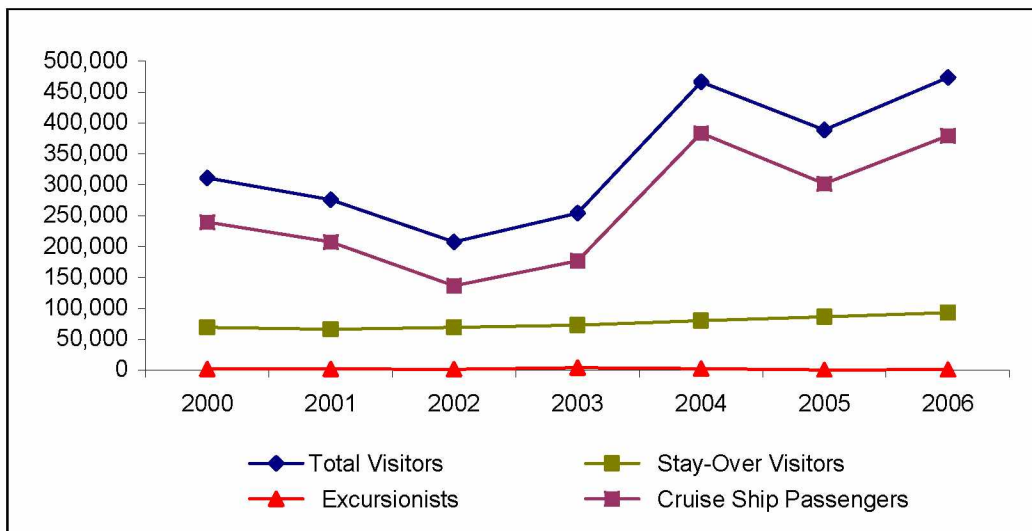
Tourism comprises activities that cut across a number of sectors. Those activities may be grouped to derive what we call the tourism sector. Tourism contributes on average about 3.1 per cent of GDP and includes hotels, restaurants, water sports, natural sites and other elements of nature in Dominica that are of interest to visitors. It is reported to be the major earner of foreign exchange in Dominica. The industry is still in its infancy and is to some extent constrained by poor airlift conditions for tourists wishing to come to the country. Tourist accommodation is provided by at least 20 hotels and guest houses of varying quality and capacity, with an estimated 900 rooms available.

Vulnerability considerations in tourist activities: Among the main drivers of tourism is the country's infrastructure, for example, roads and telecommunications facilities. The dive sites and other natural phenomena contribute to the attractiveness of the country as a tourist destination and have the potential of earning much foreign exchange, depending on their development and the improvement of tourist on-site amenities. The damage to the country's

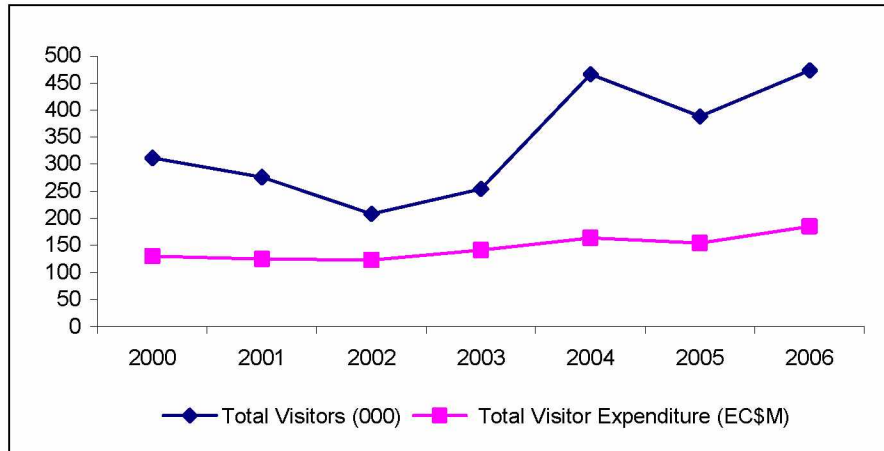
infrastructure has been extensive as landslides have posed a threat to the safe access to a number of inland tourist sites. Some bypass roads are in place to circumvent sections of the roads rendered dangerous by landslides, but the gradient on these roads militates against the use of medium-sized buses to transport the tourists. A decision will have to be made by the tourism authorities as to whether some sites will be closed to tourist access in the interest of their safety pending the completion of road works to remediate the damage.

Tourist arrivals are a major indicator of tourism activity. Figures 19 and 20 illustrate selected visitor characteristics. Stay-over tourism comprises hotel guests, nationals returning home on holiday and business visitors. In 2006, the total number of tourist arrivals rose to 473,553 from 388,480, an increase of 21.9 percent. Of this amount, 92,983 were stay-over visitors, indicating the preponderance of cruise ship visitors (see table 27). Part year statistics for 2007 were not available at the time of writing, but indications are that the total for 2007 would be much the same as in 2006, owing to cancellations of ship visits in the wake of hurricane Dean. Total visitor expenditure was of the order of EC\$185 million in 2006. This figure is expected to be slightly less in 2007 as the prospect of recession in the United States of America is likely to result in a reduction in the tourist earnings in 2007 and 2008. In addition, damage to the country's infrastructure, especially its road network and tourist sites, will affect negatively the earnings from tourism in the 2007-2008 tourism season.

Figure 19: Selected tourism indicators



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

Figure 20: Total visitors and total visitor expenditure

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

Table 27: Dominica Tourism

	2000	2001	2002	2003	2004	2005	2006
Total Visitors	311,264	275,999	207,726	254,162	466,278	388,480	473,553
Stay-Over Visitors	69,578	66,393	69,193	73,190	80,087	86,319	92,983
USA	15,077	14,493	15,464	15,717	17,515	18,492	23,537
Canada	2,173	1,870	2,039	1,954	1,633	1,977	2,837
UK	6,107	5,967	5,652	6,034	6,015	6,117	7,219
Caribbean	39,898	37,851	40,289	43,408	48,540	47,126	51,531
Other Countries	6,323	6,212	5,749	6,077	6,384	12,607	7,859
Excursionists	1,890	1,979	1,674	3,928	2,577	650	927
Cruise Ship Passengers	239,796	207,627	136,859	177,044	383,614	301,511	379,643
Number of Cruise Ship Calls	285	231	187	206	287	234	314
Total Visitor Expenditure (EC\$M)	130	125	123	141	164	154	185

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

The Government's medium term GSPS document estimates tourist arrivals for 2007 to be 387,592, with cruise ship arrivals in the vicinity of 300,000. It estimates tourism expenditure for 2007 to be EC\$193,000,000. Figures for 2007 were not available at the time of the mission. Damage to the tourism sector will be affected by damage to the infrastructure and to other facilities used by both residents of Dominica and tourists. Such facilities include the beaches and dive areas and the natural phenomena such as the sulphur springs and other geophysical attractions. Damage to these sites, although, they impact heavily on tourism, will not be included in the estimate of damage to tourism plant more narrowly defined as damage to hotels

and guest houses. The table below represents an estimate of damage to tourism plant (hotels and loss of hotel/guest house business) resulting from the hurricane and subsequent rains. The estimate has been made difficult by the lack of organized data on which to base an estimate. Informal probing has facilitated the data presented below. The extent of loss of income is mollified by the fact that the natural events took place outside the tourist “high season”. The loss of income was therefore minimized. Some loss of earning and damage to livelihoods is expected as some hotels will not be able to open in time for the upcoming tourist high season beginning in November 2007. The estimate arrived at in the table below is thought to be a conservative estimate as it does not seem to have taken into account the cost of restoration of the damaged properties to a working condition. It was guided by reports that there was no major damage to hotel plant, and supported to some extent by damage reports coming from a number of hotels and guest houses in response to a data request from the relevant representative association. The estimate for loss of business to the sector was arrived at by considering the expected traffic to the tourism sites of 2000 visitors per week for 12 weeks until the end of 2007. The estimated loss of business would be some EC\$ 1.2 million. The total damage impact on the sector would be of the order of EC\$ 2.7 million. The balance of payments implication of the reconstruction is estimated to be some 50 per cent of the damage estimate to physical tourism plant.

Table 28: Summary of Impact on Tourism to Year End 2007

Description of Damage	Remarks	Estimate in ECS
Total Impact (narrow impact on tourism plant)		2,700,000
Damage to hotels, guest houses and sites	Includes damage to beachfront property	1,200,000
Loss of income to hotels and guest houses		300,000
Loss of business/income to tour operators	*Mainly cruise ship visitors	1,200,000
Source: Data provided and ECLAC mission estimates. Data facilitated by the Dominica Hotels and Tourism Association.		

2. Commerce

Commerce is a major contributor to GDP and is reflective of the configuration of the economy which is not strong in terms of manufacturing. The sector can be described as the link between manufacturers and consumers. An agricultural economy at base, the economy of Dominica is dependent on international trade to feed itself and to earn foreign exchange. The distribution sector can be described as labour-intensive and comprises a number of small and medium-sized establishments. An essential component of the distributive trade is the activity of the hucksters, a group of at least 200 active traders³ who supply the local as well as other Caribbean economies with a significant amount of root crop and vegetable supplies. Other elements of the distributive trades include bakeries, handicrafts, shops, fuel depots, saw mills and other small operations that may be considered manufacturing but whose prime purpose is to sell to the final consumer.

³ The estimate of the number of hucksters varies. There may be as many as 500 hucksters, but the Hucksters' Association has identified 200 as being active.

Damage sustained by the commerce sector, as defined above, comprises damage to buildings, stocks and machinery from winds and rain. This would include real estate and banking. The following table presents an estimate of direct and indirect damage to the commerce sector. The data collection focused on buildings. A number of actors within the commerce sector suffered indirect damage as the loss of crops affected their livelihoods. The group of hucksters saw their business fall by 75 per cent as a result of the natural events. Their livelihoods are expected to be adversely affected for some six months as it would take that time for bananas to be harvested once more. The hucksters are expected to be out of pocket until December by which time some of their traded items would have re-entered the market. A request has been made for the sum of EC\$1 million to be lodged at the NDFD to give credit of \$10,000 to each huckster pending the resumption of their regular work volumes. Some 75 per cent of the hucksters do both exports and imports, while the remaining 25 per cent import exclusively. Estimates of the value of goods traded by the hucksters were divergent. The mission estimate is that for the period August to December 2007 the loss of value of goods traded will be some EC\$3 million. If one applies an average mark up of 30 per cent on the goods traded and subtracts the operating expenses of the hucksters, the loss of income for the period would appear to be of the order of EC\$2 million. A check for the acceptability of the estimate was made by dividing the loss of business over the number of hucksters. This yielded a per capita loss of EC\$10,000 in income over the period from the hurricane to the end of the year. Taking into consideration that the huckster trade is usually two-way, there is return trade to Dominica as the hucksters purchase merchandise and goods from the countries to which they export. Assuming that the volume and value of the return purchases will be less than before the hurricane because of less operating capital, the per capita loss of earnings on the return trade could be some EC\$5,000. Calculating per capita loss of EC\$15,000, the total loss of income to hucksters should be approximately EC\$3,000,000 (see table 29). The figure appears to be reasonable when compared to the request made by the Hucksters Association to have a credit of EC\$10,000 to be made to the hucksters, bearing in mind that the amount of credit requested would be a fraction of the income of the hucksters. Indications of loss of income of other workers in the commerce sector were not forthcoming. If one looks at the loss of income to hucksters for a period of six to eight months into April 2008, the estimated income loss would be some EC\$5,000,000.

Table 29: Damage to commercial sector

Description of Damage	Remarks	Estimate in ECS
Total Impact		8,307,500
Damage to buildings (direct damage)		5,307,500
Damage to stocks (direct damage)		Negligible
Loss of business (indirect damage)	Loss of income to hucksters	3,000,000
Source: Situation report of Office of Disaster Management		

Vulnerability issues concerning the commerce sector: The commerce sector was not significantly affected by the natural events of 2007. This is so partly because of location of operations generally and relatively low risk of operations. The volume of the trade in agricultural products is vulnerable to the vagaries of the weather and to cultural practices. This vulnerability is external to the industry itself. Vulnerability issues in commerce would address situations of insufficient inventories. The mistakes of the past have apparently been corrected.

One official disclosed that losses in the distributive trades (hardware, to be more specific) did not arise as the purchasing policy of his company, and by extension much of the sector, took into consideration the time of the year and the probability that there could be a sudden steep increase in demand for building materials. Vulnerability among the hucksters continues to be closely related to natural events as their commodity is not susceptible to warehousing. Loss of business can be mitigated by including other neighbouring countries in the supply chain of the hucksters in the event of a failure domestically.

3. Manufacturing

Agro-industries provide opportunities for employment generation and foreign exchange earnings from the exports of domestically produced fruits and vegetables. This activity is an important factor in the reduction of post-harvest losses. Agro-processing can be undertaken at the cottage level while adhering to international standards. Challenges to the activity include the difficulty in sourcing agricultural raw materials locally, the obtaining of capital for development, transportation and marketing.

The micro credit enterprise has been well served by NDFD, the Credit Union and specialized programmes of the European Union (EU) and other donors. The focus of the inquiry on damage in this sector is directed to the NDFD and the Windward Islands Crop Insurance (WINCROP).

The NDFD provides loans, technical support and training to small businesses. Loans to the agro-processing sector comprising a relatively few entrepreneurs are few. The entrepreneurs in this sector are challenged by packaging materials. Bottles, for example, are in short supply and retard growth of the product. In some cases, such as in the case of sea moss, raw material has been scarce since the hurricane as a result of damage to the sea bed. Coconuts have been in short supply. These shortages have impacted the distributive trades with resulting product discontinuities or increased prices. Fruit and vegetables are the prime examples of shortages. This has impacted on the continuing ability of restaurants to supply these items. The handicraft subsector is small and production is dependent on the availability of raw material. The precarious nature of income and cash flow to entrepreneurs in this activity has resulted in the NDFD having 47 per cent of its loans non-performing. The effects of damage to these activities have put the livelihoods of the entrepreneurs at risk. The NDFD has therefore requested grant funding to help farmers who suffered loss for a period not exceeding six months. A crude estimate of the value of losses accruing to the small craftsmen and other small businesses serviced by NDFD would be in the vicinity of EC\$2,700,000 (see table 30). Some EC\$1,827,200 represented losses by small agro-processors and craftsmen.

Table 30: Damage to Agro-processing and Craft industries

Description of Damage	Remarks	Estimate in ECS
Total Impact		2,700,000
Damage to buildings (direct damage)		900,000
Damage to stocks (direct damage)		1,200,000
Loss of business (indirect damage)		600,000
Source: ECLAC estimates based on official Government of Dominica data.		

Vulnerability considerations in agro-processing and craft industries: Vulnerability in the small manufacturing and craft subsector is heightened by the relatively high cost of production that accompanies low-volume production. The vulnerability here is to competition posed by similar products that may go on the market, or cheaper substitutes. The challenge is even greater when in order to emerge from the informal nature of production, technical assistance in the production of cottage products and crafts is necessary. The solution would be to gain market share while procuring reliable supplies of raw material and intermediate inputs such as packaging, at favourable costs. Vulnerability to stringent quality standards could destabilize the effective demand for agro-processing outputs, especially to third countries.

4. Other services

The other services⁴ sector is described as the set of establishments that market and sell intangible products rather than physical goods. Government provides services but these are accounted for in the sector accounts, such as health and education. The implications of effects of the hurricane and rains on the government sector will be reflected in considerations of fiscal outturn. Other services include the financial services which include the following:

- (a) Ministry of Finance (regulatory and borrower)
- (b) Central Bank (regulatory) - ECCB
- (c) Chartered commercial bank – foreign branches (4) and indigenous (1)
- (d) Development banks (1)
- (e) Finance companies (1)
- (f) Unit Trust (Mutual Funds) – Dominica Unit Trust Cooperation
- (g) Hire purchase firms (Courts D/ca Ltd, J. Astaphans & Co. Ltd, Cimplex)
- (h) Pension Fund (Dominica Social Security)
- (i) Insurance companies (life, general, agents, brokers)
- (j) Credit unions
- (k) Micro business lenders (National Development Foundation of Dominica)
- (l) Eastern Caribbean Stock Exchange

WINCROP, established around 1987, was set up to take care of lost banana plantations. Dominicans adapted the original design of WINCROP to something indigenous to Dominica. WINCROP quantifies banana losses but does not compensate the farmers to the full extent of

⁴ Excludes the Government Sector which is covered in other parts of the report

their reported losses. It compensates up to 25 per cent of income loss to the banana farmers. There are strict measures for estimating banana losses. Three measures of damage are used. These are based on snaps, toppled trees and defoliation. The WINCROP estimates may have a margin of error of 5 to 10 per cent.

Farmers with 80 per cent or more loss are compensated 100 per cent of their loss, especially if the holding was damaged significantly by topples. Only 50 banana farmers are not covered by WINCROP insurance. These sell to hucksters on their own account. Not all farmers suffered total loss of crops. For a period of eight months total production will not be at the accustomed levels as the recovery in bananas takes place. Some 60 to 70 per cent of banana farmers lost their sheds which were not insured. Most of the part-time farmers have left the industry and lands are being re-allocated as farmers seek to purchase idle banana lands.

The evaluation of damage indicates that no loss was suffered by the large finance and credit houses. The conservative estimate is corroborated by the opinion expressed by several persons interviewed. Insurance coverage of houses and commercial property is low. No reasonable estimate could be obtained from this source. No estimate apart from the figure quoted in the table below could be obtained. This is in part due to the large numbers of associations that do not appear to get together on data issues. The thinking is that no significant damage involving insurance claims occurred to the commercial sector.

Table 31: Estimate of direct and indirect damage to Other Services Sector

Description of Damage	Remarks	Estimate in ECS
Total Impact		1,800,000
Damage to buildings (direct damage)		1,000,000
Damage to stocks (direct damage)		400,000
Loss of business (indirect damage)		400,000
Source: ECLAC estimates based on official Government of Dominica data.		

Vulnerability issues pertaining to other services: The major vulnerability that is associated with this sector is quality of service. Especially in the case of intangibles, it would be erroneous to argue that quality service can be relaxed because of an apparent captive domestic market. The globalized world has opened up many options to individuals, especially those demanding services. The quality of service offered by local establishments should be world class in order to compete against aggression from the rest of the world.

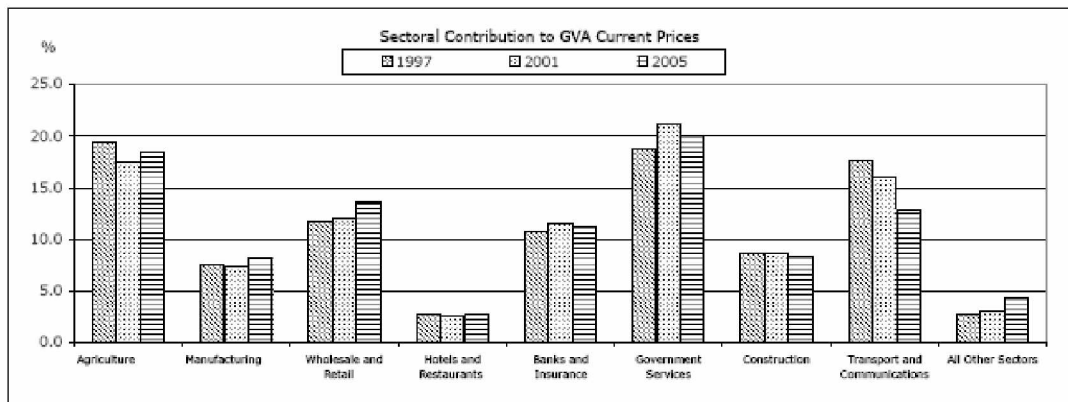
Table 32: Percentage contribution of GVA by economic activity, in current prices

Table 4.3
Dominica
 PERCENTAGE CONTRIBUTION OF GVA BY ECONOMIC ACTIVITY
 IN CURRENT PRICES

	1997	1998	1999	2000	2001	2002	2003	2004 ^R	2005 ^P
Agriculture	19.39	18.85	18.72	18.10	17.51	17.74	18.28	18.72	18.64
Crops	15.64	15.10	15.03	14.49	13.77	13.75	14.25	14.82	14.76
Livestock	1.43	1.38	1.34	1.33	1.37	1.47	1.47	1.41	1.35
Forestry	0.64	0.61	0.59	0.58	0.60	0.64	0.64	0.61	0.58
Fishing	1.69	1.76	1.75	1.70	1.78	1.89	1.93	1.89	1.85
Mining & Quarrying	0.92	0.79	0.80	0.84	0.88	0.88	0.79	0.85	0.85
Manufacturing	7.62	8.68	8.09	8.76	7.43	7.74	8.00	8.31	8.14
Electricity & Water	4.73	6.00	5.49	5.46	5.93	6.42	6.35	6.43	6.39
Construction	8.59	7.91	8.03	8.40	8.63	6.81	7.92	8.29	8.40
Wholesale & Retail Trade	11.79	11.59	11.51	11.68	12.08	12.12	12.60	12.68	13.59
Hotels & Restaurants	2.74	2.65	2.85	2.73	2.63	2.69	2.59	2.89	2.77
Transportation	9.62	9.49	9.44	9.29	8.72	7.87	8.40	8.98	8.67
Road Transport	5.16	4.85	4.65	4.79	4.58	3.94	4.47	4.80	4.53
Sea Transport	3.60	3.87	3.95	3.71	3.41	3.24	3.18	3.36	3.18
Air Transport	0.85	0.78	0.84	0.79	0.75	0.70	0.75	0.82	0.85
Communications	8.03	8.45	8.55	7.70	7.30	6.89	4.48	4.41	4.30
Banks & Insurance	10.78	11.23	11.27	11.28	11.54	11.27	11.29	11.30	11.28
Real Estate & Housing	3.45	3.40	3.32	3.36	3.51	3.79	3.83	3.71	3.68
Government Services	18.72	19.29	19.11	18.58	21.13	23.13	21.99	20.22	20.11
Other Services	1.53	1.55	1.55	1.53	1.63	1.81	1.78	1.78	1.75
Less: FISIM	7.91	8.88	8.55	8.68	8.90	8.95	8.31	8.57	8.38
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SOURCE: CSO, ECCB

Chart 4.3

**Figure 21: Sectoral contribution to GVA current prices**

D. Social sector

1. Housing

Damage to the housing sector accounted for 68 per cent of the value of overall damage to the social sector caused by Hurricane Dean, which amounted to EC\$ 32.1 million. The housing stock in Dominica is fairly sturdy and the low level of damage to the housing sector may be attributed to the low category level of Hurricane Dean, at the time when it struck Dominica, and its relatively sturdy stock of housing. The Government of Dominica views housing as “an essential component of quality of life” and as such had embarked on what it describes as a ‘housing revolution’. Among the elements of this programme is the provision of serviced lots for the purpose of housing construction. None of these sites under development by the government was reported to have suffered any damage due to Hurricane Dean. Such damage, as occurred, amounted to EC\$ 2.4 million, which represents estimates of damage to 2.42 per cent of the housing stock, as presented in table 33.

Data found in table 33 suggests that when reports from all districts were taken into consideration, some 35 houses were totally destroyed, and 520 suffered roof and window damage. There were fewer than 200 other structures many related to micro enterprises attached to homes, which were also destroyed. The housing destruction occurred predominantly in the eastern parishes of St. Patrick, St. David and St. Andrew. This was followed by the western parishes of St. George and St. John.

Table 33: Description of damage to Housing Sector by parish

Parish	Number of Households*	Damaged	destroyed	As a percentage of HH
St. George	5091	82	8	16%
St. John	1248	77	0	14%
St. Peter	411	2	0	0%
St. Joseph	1546	14	0	3%
St. Paul	1874	15	1	3%
St. Luke	388	6	0	1%
St. Mark	486	13	4	3%
St. Patrick	2232	173	13	34%
St. David	1744	72	6	14%
St. Andrew	2777	66	3	12%
TOTAL	22887	520	35	2.42%
Note: Number of households base on average household size of 4				
Source: ECLAC estimates based on official Government of Dominica data.				

Houses which were totally destroyed were in the main houses built with walls of plywood materials. This is not unusual, as it is usually the poorly constructed homes which can least withstand the advances of hurricane winds. Data in table 34 which presents housing indicators by poverty status in Dominica suggests that 60 per cent of the poor as against 28 per cent of the non

poor live in houses which are constructed with wood or ply wood walls. As can be noted the majority of the population either poor or non poor own their own homes. However, what has been ascertained is that very few home owners are covered by insurance and this condition would be more prevalent among the poor.

The government has embarked on a national housing rehabilitation and sanitation programme to the cost of some EC\$3.6 million which targeted about 400 homes in 28 communities.⁵ The damage caused by Hurricane Dean may act as a setback to this programme unless additional resources become available.

Table 34: Housing Indicators by Poverty Status

Indicator	% Poor	% non Poor
Tenure		
House owned	77	74
land squatted	4	3
Overcrowding		
up to 1 person per room	34	71
from 1-2 persons per room	37	24
Over two persons per room	29	5
Defective housing		
House with wood/plywood walls	60	28
no safe water	16	7
no electricity	23	8
no toilet or latrine	29	11
no bathing facilities	35	14
no kitchen facilities in house	41	18
does not use gas for cooking	38	15
Uses wood	23	8
Source: Commonwealth of Dominica Medium Term Growth and protection Strategy, April 2006.		

The value of the damage as presented in table 35 suggests that the value of damage to housing, stands at EC\$11.6 million. This damage accounted for approximately 53 per cent of the overall impact to the housing subsector which stands at EC\$21.9 million.

⁵ Commonwealth of Dominica, Budget Address for fiscal year 2007/2008

Table 35: Summary of Damage and Loss to the Housing Sector

Total Impact	21,990,024.69
Damage	21,784,584.69
Damage to housing	11,676,359.11
Damage to public institutions and Churches	771,975.00
imported component	9,336,250.58
Losses	205,440.00
Clearing debris/cleaning	205,440.00
Source: ECLAC estimates based on official Government of Dominica data.	

2. Education

Damage to the education sector amounted to EC\$1.2 million. This reflects the minor damage which Hurricane Dean had on the education sector. There was little or no disruption of the school system as Hurricane Dean occurred during the school vacation period. The description of damage incurred, by school, appears in table 36. The government had recently embarked on the installation of two hundred computers in 10 schools across the island. Damage to school roofs could jeopardize what is the beginning of a programme to provide access and training in Information and Communications Technology (ICT) to “every student in every school in Dominica by the year 2010”⁶. This became evident in the case of Goodwill Secondary School which had the roof of its computer lab damaged resulting in the loss of computer equipment.

⁶ Commonwealth of Dominica Budget Address for fiscal year 2007/2008

Table 36: Damage to Education Sector

School	Description of Damage	Estimate
Salisbury Primary School	Office (Lower Building) – 1 Sheet galvanize removed, guttering broken; Upper building entire roof and ceiling removed	\$88,622.23
Mahaut Primary School	One landslide at the back of the southern end and rocks inside one classroom. Galvanize shed at the front partly broken off. Guttering also broken.	20,000.00
Goodwill Secondary School	Roof of computer lab affected. One classroom affected, 3 computers waterlogged and damaged	25,000.00
Wesley Primary School	All the guttering around the school removed and damaged	6,801.88
Pierre Charles Secondary School	Ceiling of the auditorium damaged	60,000.00
North East Comprehensive School	Counseling room ceiling cave in; Library door is broken; Windows in staff room is broken	51,250.00
Marigot Junior School	Small section of roof affected	45,324.15
Vieille Case Primary School	Roof of lunch shed removed	17,257.40
Willstrathmore Stevens School	One window broken off and window damaged	3,000.00
Soufriere Primary School	Roof affected, about three galvanize sheet removed. Debris in yard and tree fell in the block section, two classrooms may be affected.	5,000.00
Isaiah Thomas Secondary School	Eastern core house galvanize lifted Vehicular access road to the school almost impassible Few fallen trees Seriously damaged fowl house used for agriculture classes About three damaged doors.	5,153.65
Woodford Hill Primary School	Broken windows at the school library and in two classrooms. A number of ceiling plies got water logged and are currently suspended, taking some of the lighting fixtures with them.	10,500.00
Grand Bay Primary School	Destruction of Doors and Windows	23,000.00
Total		360,909.31
Source: ECLAC estimates based on official Government of Dominica data.		

Some 92 per cent of value of the impact to the sector, EC\$1.1 million, arises from the damage, as detailed in table 37, to facilities and furnishings. The remaining 8 per cent or EC\$0.09 million can be attributed to losses suffered through cleaning of schools and the use of schools as shelters. The value also includes replacement of the doors and roof of the Soufriere Primary School.

Table 37: Summary of damage to the education sector

Total Impact	1,214,911.29
Damage	1,122,991.29
Damage to education facilities	360,909.31
Damage to furnishings	491,400.00
Imported component	270,681.98
Losses	91,920.00
Cleaning of Schools	8,160.00
Losses due to use as shelters	3,760.00
Replacement of roof and doors for one school	80,000.00
Source: ECLAC estimates based on official Government of Dominica data.	

3. Health

Total damage to the health sector accounted for 28 per cent or EC\$7.6 million of the value of damage to the social sector. See table 38 for details of the description of damage to the health facilities which in the main represents roof damage to the major hospital on the island, the Princess Margaret Hospital and water damage caused by leaking roofs and seepage through windows and floors of a number of health centres.

At first glance, it may be said that the health sector suffered minor damage. Damage to the Princess Margaret Hospital (PMH), however has to be regarded as significant due to the importance of the institution to the life of Dominica. It may be defined as the most important complex of buildings in the Commonwealth of Dominica. The significance of the PMH is derived from its pivotal roles as the referral, secondary-care hospital in Dominica. Its 228 bed capacity facility is required to operate during and immediately after natural disasters. The complex comprises buildings built during various periods. In a report to the Pan American Health Organization/World Health Organization (PAHO/WHO)⁷ the complex was described as comprising buildings which predate the great Hurricane David of August 1979, and others which were designed and constructed relatively recently in the post-David era.

The government has sought to strengthen its primary health care, to reduce the burden on its main secondary and tertiary institution (PMH) through the construction of a modern type-3 centre at Castle Bruce at the cost of some EC\$1.2 million. This facility will offer services in

⁷ Princess Margaret Hospital, Dominica – Post Dean Assessment by Tony Gibbs for PAHO/WHO

child health, reproductive health, nutrition, health education, dental health and environmental health to the people of Castle Bruce health district which includes: Castle Bruce, Petit Soufriere, San Sauveur, Good Hope and the Carib Territory. The facility is situated on a rise to avoid threats to flooding and has been constructed to withstand a level two hurricane. The resilience of the centre was tested by Hurricane Dean

Table 38: Damage Health Sector

Facilities	Description of Damage	DAMAGE	Losses
Princess Margaret Hospital Medical Wards	Roof replacement including ceiling and electricals	165,000.00	
	Floor replacement	80,000.00	
	The building is old and dilapidated and will have to be reconstructed		1,500,000.00
Louis Pasteur Polyclinic	Replacement of waterproofing, wall,	100,000.00	
	roof and other roof repairs	100,000.00	
Francisca Dorival Complex	Roof - maternity Ward;	200,000.00	
	external wall repair	200,000.00	
	Replacement of waterproofing (wall component);	125,000.00	
Paediatric Ward	Roof ;	1,000,000.00	
	Replacement of waterproofing (wall component)	35,000.00	
	external wall renovations	60,000.00	
Psychiatric Unit	Demolition and reconstruction of the Acute Ward is required due to excessive flooding	2,400,000.00	50,000.00
	Relocation of patients		100,000.00
Health Centres	Water damage caused by leaking roofs, seepage through windows; and floors	200,000.00	
Total		4,265,000.00	1,650,000.00
Source: ECLAC estimates based on official Government of Dominica data.			

Table 39 presents the summary of damage and losses. Of significance within the losses is the cost of demolition of one of the buildings in the PMH and the relocation of its patients. Roof damage at the PMH has been exacerbated by the hazard, which the asbestos in the roof poses.

Table 39: Summary table of Impact to the Health Sector

Total Impact	7,614,518.38
Total Damage	\$5,088,750.00
i. Damage to facilities	2,265,000.00
imported component*	\$2,823,750.00
Total Losses	2,525,768.38
i. cleaning and sanitizing	5,120.00
ii. relocation of patients	100,000.00
iii. demolition	30,000.00
iv. reconstruction	1,650,000.00
v. Provision of Public health services	\$740,648.38
Imported component at 75%	
Source: ECLAC estimates based on official Government of Dominica data.	

V. MACROECONOMIC IMPACT OF HURRICANE DEAN

A. Summary damage and losses

The total impact of Hurricane Dean on Dominica amounts to EC\$162 million, the equivalent of US\$60.0 million.⁸ This figure is somewhat conservative given the lack of complete data on the full extent of impacts in the infrastructure sectors and also tourism and commerce. Nevertheless, the amount noted gives a relatively fair estimate of the total impact in terms of damage and losses on the country.

Contrary to the conventional patterns, where hydrometrical events tend to result in greater losses relative to damage because of their tendency to disrupt income flows and to necessitate higher spending⁹, especially in the productive sectors; the damage stemming from Dean in Dominica was over three times the amount of the losses. The damage (impact on physical assets, including stocks) amounted to EC\$126.3 million, the equivalent of 78 per cent of the total impact, while losses (both of loss of income and higher contingent spending) that will take place in 2007 and 2008, amounted to EC\$36.7 million or 22 per cent of the total impact (see table 40).

Although not nearly as devastating as Hurricane Ivan in Grenada in 2004, Dean has resulted in substantial economic fall-out in Dominica. In terms of economic aggregates, the total impact of the disaster is equivalent to 23.9 per cent of the country's GDP, 139.7 per cent of exports of goods and services, 21 per cent of consumption and 24.1 per cent of public external debt. These parameters indicate that the disaster adversely affect the ability of the country to achieve its macroeconomic targets in the short-term at least. Indeed, the high cost of damage to infrastructure and other assets means that government will be burdened with significant reconstruction and rehabilitation costs in the current and following year. In addition, losses will result in an important fall-out in GDP at the time when the economy was on a welcomed recovery path.

Table 40: Summary breakdown of total impact by type

	ECS million	Per cent
Destruction and damage to assets	126.3	78
Production losses, increased operational expenses and revenue losses	36.7	22
Total	162	100
Source: ECLAC estimates based on official Government of Dominica data.		

⁸ A uniform median exchange rate of EC\$2.70 per United States Dollar has been used throughout this assessment.

⁹ The disruption of power supplies, telecommunications systems and other contingent spending as a result of these types of events tend to be relatively high.

Total impact in relation to main macroeconomic variables:

- 23.9 per cent of GDP
- 135.7 per cent of agricultural GDP
- 139.7 per cent of exports of goods
- 42.7 per cent of exports of goods and services
- 65.5 per cent of gross domestic investment (GDI)
- 21 per cent of consumption
- 24.1 per cent of public external debt

Another important consideration from the standpoint of economic welfare and livelihoods was the relatively greater impact of the disaster on some of the poorer agricultural and fishing communities.

Table 41: Summary Damage and Losses

Sector and subsector	Damage and losses			
	Total Impact (US\$ thousands)	Total Impact (ECS thousands)	Damage	Losses
Total	59996846.06	161991484.36	126296050.98	36709433.38
FX rate		2.7		
Productive sectors	21087048.15	56935030.00	26144725.00	30790305.00
Agriculture	17010196.30	45927530.00	19637225.00	26290305.00
Bananas	4487914.81	12117370	7544200	4573170
Other Crops	9448175.93	25510075	6530940	18979135
Farm infrastructure	1240533.33	3349440	1312500	2036940
Livestock	436381.48	1178230	1029160	149070
Fishing	438998.15	1185295	919405	265890
Forestry	958192.59	2587120	2301020	286100
Tourism	1000000.00	2700000	1200000	1500000
Commerce	3076851.85	8307500	5307500	3000000
Social Sectors	12581279.39	33969454.36	30896325.98	3073128.38
Housing	8144453.59	21990024.69	21784584.69	205440
Education and culture	449967.14	1214911.29	1122991.29	91920
Health	3320191.99	8964518.38	6588750	2375768.38
Other services	666666.67	1800000	1400000	400000
Infrastructure	26328518.52	71087000.00	69255000.00	2846000.00
Road transport	18869259.26	50947000	50575000	372000
Water supply and water disposal	1451851.85	3920000	3780000	140000
Electricity generation			...	1014000
Communications	5674074.07	15320000	14000000	1320000
Sea and air ports	333333.33	900000	900000	

Source: ECLAC, on the basis of information provided by the authorities in Dominica

The sectoral distribution of the impact of the disaster provides some indication of the fall-out on GDP and the allocation of reconstruction costs between the private and public sectors (see table 41). The infrastructure sector and productive sectors suffered the bulk of the damage. The infrastructure sector was most badly affected, suffering total impact of EC\$71.1 million.

Damage to the sector was substantial and amounted to EC\$69.3 million, reflecting destruction of parts of major highways and roads and communications and water supply and disposal system and also the air and sea ports. Meanwhile, losses amounted to 28.5 million, comprising loss in electricity generation and telecommunications losses.

The productive sectors suffered damage and losses amounting to EC\$56.9 million. Damage totaled \$26.1 million, while losses amounted to \$30.8 million, which would constrain GDP growth. Within the productive sectors, agriculture bore the brunt of the damage with total impact value of \$45.9 million. The banana subsector was buffeted by the hurricane, incurring an impact amounting to \$12.1 million, of this amount; damage was valued at \$7.5 million and losses at \$4.6 million. It is anticipated that the subsector would not reach previous levels of production until around the end of the first quarter of 2008.

The 'other crops' subsector, which includes fruit trees, root tubers and vegetables was impacted to the tune of \$25.5 million, or 55.5 per cent of the total damage and losses in the agricultural sector. Given the importance of this subsector both for supplement food supplies and as a source of cash earnings, the social consequences of the damage to it could be severe. The livestock and fishing subsectors were not too badly affected and both suffered damage and losses of around \$1.2 million. Meanwhile, the impact on forestry was valued at \$2.6 million. Thankfully, the tourism sector was spared the worst impacts, with the fall-out amounting to only \$2.7 million. On the other hand, commerce was more badly affected with total damage and losses of about \$8.3million.

1. The pre-disaster macroeconomic performance

Following an average decline in real growth of 3.1 per cent between 2001 and 2003, the economy rebounded to post decent average growth of around 3.5 per cent in the last three years. In the last decade, Dominica has been adjusting to the economic shocks posed by trade liberalization and the loss of preferential access for its bananas on the EU market, which was compounded by the events of 11 September 2001 and its impact in the following years. Moreover, with sluggish private sector activity, the government has had to take the lead in stimulating activity to maintain growth and employment. As a result of this undertaking, government borrowing has led to a significant accumulation of debt, which now poses some risks to growth and stability.

The economy continued on its upward trajectory in 2006, growing by almost 4 per cent, the highest rate for almost a decade, following growth of 3.3 per cent in 2005. Growth was propelled by a 15 per cent increase in value added in the tourism sector, boosted by strengthened activity in both the stay-over and cruise subsectors. Stay-over visitor arrivals rose by 7.7 per cent to 92,983 in line with increased air lift capacity following the operations of Take Air and Air Taxi. Also, cruise passenger arrivals expanded sharply by 25.9 per cent reversing an almost similar scale of decline in 2005. Cruise arrivals were bolstered by the relatively less active hurricane season and improved marketing.

Construction and mining and quarrying posted strong growth of around 8.5 per cent following more sluggish growth of 3.5 per cent in 2005, reflecting robust residential construction,

tourism facilities and public sector projects, including the Windsor Park Stadium, the Melville Hall Airport and upgrading of road networks.

Agricultural output recovered to grow by 3.4 per cent, after the contraction of 0.4 per cent in 2005. Value added was bolstered by a 7.6 per cent increase in banana production to 11,408 tonnes, associated with improved weather conditions and higher prices. Output in the fishing subsector was up sharply by 12 per cent due to the use of new and improved technology.

Inflation moderated in 2006 moving down to 1.6 per cent from 2.7 per cent in 2005. This was mainly attributed to a fall in the sub-indices for fuel and light and transport and communications by 3.6 per cent and 1.9 per cent, respectively. Fuel and light costs declined in the last quarter due to a fall in the surcharge on electricity consumption consistent with the moderation of international fuel prices in the latter part of the year. Meanwhile, the heavily weighted food sub-index was up by 3.9 per cent on account of higher costs of vegetables, meat and restaurant meals. Meanwhile, reflecting strong demand, housing prices rose by 9.5 per cent.

Wages were expected to remain flat in 2006, as the public sector wage freeze helped to contain wage costs as government continues to streamline the public sector workforce under the Poverty Reduction and Growth Facility (PRGF). Employment outcomes were mixed in 2006, as reduction in public sector employment existed side by side with increased private sector employment in construction, tourism and other activities.

2. Fiscal performance

The fiscal stance improved during 2006, with the overall surplus rising from 2.6 per cent to 6.3 per cent of GDP. This outturn was mainly associated with an increase in grant receipts, which more than doubled to \$106.3 million. Grants reflected outlays by the Government of Trinidad and Tobago under the oil relief fund, the Government of Venezuela for housing construction and the Republic of China for the construction of the Windsor Park Stadium.

Buoyed by grants and tax receipts, total revenue expanded by 20 per cent to \$376 million. Tax proceeds were up by 8.1 per cent to \$248 million, reflecting stronger performance of taxes on domestic goods and services, personal income tax and property tax. These were only partly offset by reduced intakes from taxes on international trade and transactions and consumption tax. At the same time, VAT, which was introduced in March 2006, turned in proceeds of about \$70 million. On the other hand, non-tax revenue fell by 17.8 per cent to \$21 million.

Total expenditure grew by just over half the rate of total revenue at 10.2 per cent. Growth in spending was led by the capital budget, which expanded significantly by 42.8 per cent to \$78 million associated with a number of infrastructure and other projects.

3. Monetary developments

Driven by the growth stimulus, broad money increased by over 9 per cent to \$687.2 million in 2006. Growth in the money supply was mainly associated with an over 14 per cent rise in savings deposits.

On the assets side, domestic credit declined by 9.6 per cent due mainly to reduced credit to the central government and an increase in its net deposits with the banking system. A favourable development with respect to the distribution of credit was a more than 65 per cent increase in credit to the tourism sector, linked to renovations and construction of new properties. Indeed, for tourism to realize its potential, room capacity would have to be increased and the quality of the room stock upgraded.

The net foreign assets of the banking system increased by 19.9 per cent to \$427.2 million, relative to a small decline in 2005. Net foreign assets benefited from the surge in official grant receipts and higher tourism receipts. Consistent with economic dynamism, liquidity in the banking system increased in 2006. The ratio of liquid assets plus liquid liabilities moved up from 49.8 per cent in 2005 to 52.5 per cent in 2006. Also, the spread between commercial bank loan and deposit rates declined by 1.1 percentage points to 5.8 per cent in 2006.

4. Balance of payments

The balance of payments worsened somewhat in 2006, with the overall surplus falling to \$36.4 million or 4.3 per cent of GDP from \$38.14 million or 4.7 per cent of GDP in 2005. The overall position was affected by reduced net capital and financial inflows, largely reflecting foreign investments of commercial banks. This outflow, the opportunity costs of which might be high in a relatively capital scarce economy, is probably indicative of insufficient high return bankable projects and general low rates of return in the domestic economy.

By contrast, the current account deficit narrowed by 28.6 per cent to \$148 million or 17.3 per cent of GDP. Improvement in the current account was built on a welcomed recovery in services, particularly tourism receipts. It is hoped that this would become part of a structural trend of tourism contributing more to domestic value added and export receipts and thereby providing a dynamic pillar for diversifying the economy. The structural merchandise deficit increased by 0.8 per cent to \$277 million, linked to a 0.6 per cent growth in imports and a 0.1 per cent growth in exports. Overall growth in exports was constrained by a decline in re-exports, as domestic exports rose by 3.3 per cent, associated with a 12.7 per cent increase in banana export earnings, which was propelled by higher prices for the Fair Trade Label bananas.

B. Expected macroeconomic performance in 2007 without Hurricane Dean

Before Hurricane Dean, growth in activity in Dominica was projected to slow in 2007, as the previous year was an above growth year. Real output was projected to grow by 3.3 per cent following growth of around 4 per cent in the previous year. The performance of the productive sectors is expected to be mixed. Agriculture was expected to strengthen somewhat, with growth rising to 3.8 per cent compared with 3.4 per cent in 2006. Output in the crops subsector is expected to improve driven by higher banana and cash crop production. Value added in the livestock and forestry subsectors were also expected to increase, while output in fishing was projected to decline by 4 per cent after the bumper catches in 2006. Importantly, tourism is projected to grow by 5.2 per cent, which is fairly dynamic, although much lower than the rate for last year. Stay-over arrivals have been boosted by the filming of a reality show and improved marketing overseas, especially in the diving subsector. Nevertheless, problems with airlift and

competitiveness in terms of value for money need to be addressed for the sector to realize its full potential.

Inflation is expected to remain moderate in 2007, with upside risks coming from any hike in fuel prices and the cost of imported capital goods. Also, with government's commitment to fiscal prudence and the containment of wage costs, public sector wage levels were expected to remain relatively stable during the year. Private sector wages should respond to domestic demand conditions, particularly in the construction and tourism sectors.

1. Fiscal performance

The fiscal performance of central government was expected to weaken in 2007. The overall surplus was projected to contract from \$54 million to \$4 million. Growth in expenditure is the major driver behind the deteriorating fiscal position, as capital spending is expected to expand by 50 per cent. Capital outlays will be allocated to a number of projects, including the 'Housing revolution' aimed at providing low income housing to a number of citizens. A major road improvement and maintenance programme is also planned along with other outlays on education and health.

Current spending will rise only marginally by 1.2 per cent, as higher outlays on wages and salaries and goods and services will be offset by lower interest payments on the debt. Wages and salaries will rise by over 9 per cent on account of higher payments to public officers, while goods and services will rise by 15 per cent, reflecting improved provisioning geared towards improving productivity and efficiency in the public service. On the other hand, interest payments will contract by 39 per cent in line with debt restructuring.

2. Monetary developments

Monetary developments were expected to remain relatively stable in 2007. Broad money was expected to post somewhat slower growth in line with slower growth in activity. Credit to the private sector was projected to remain dynamic, particularly for tourism and other services, including distribution. Liquidity in the banking system was expected to remain fairly high as aggregate loan demand would be well within trend levels. Meanwhile, the banks were expected to continue increasing their net foreign assets in an effort to capture better investment returns overseas.

3. Balance of payments

The balance of payments current account was projected to worsen in 2007, with the deficit expanding by over 7.7 per cent to \$159.5 million. Merchandise exports were projected to rise by over 5 per cent to \$117.6 million, reflecting higher exports of bananas and other crops. Merchandise imports were forecasted to increase by 4 per cent to 412.0 million. The surplus on the services account was expected to fall by 1.2 per cent to \$120.5 million, associated with sluggish growth in tourism receipts and weakness in other services. Meanwhile, the income balance was expected to worsen on account of a fall in investment income. Current transfers are expected to decline by 5.8 per cent in line with reduced transfers to the government and weak

growth in workers remittances. Meanwhile, the financial account is forecasted to deteriorate after a bumper year in 2006. Foreign direct investment is expected to contract sharply by over 33.9 per cent to \$47.8 million, compared with \$72.3 million in 2006.

C. Macroeconomic performance as at the first half of 2007

1. Output and inflation

Real output was estimated to have increased by 2.8 per cent for the first half of 2007, compared with the same period in 2006. Activity was buoyed by higher growth in agriculture and manufacturing. Agricultural activity was estimated to have increased by 4.1 per cent, somewhat stronger than the same period last year. Although banana output fell by 3 per cent, this was offset by growth in production of other crops. Meanwhile the pace of growth in activity in fishing and forestry was estimated to have increased in the first half of 2007, relative to the same period last year.

Manufacturing activity picked up strongly (12.5 per cent) as the sector recovered from small contraction during the similar period in the previous year. Output was buoyed by increased production of soap and dental cream, among other products. Nevertheless, the sector continues to face competitiveness challenges relating to productivity and modernization, which are exacerbated by the high costs of production due to high fuel, transport and other input prices.

With the winding down of projects such as the Windsor Park Stadium and some road works, the pace of construction slowed to 3 per cent from over 8 per cent in 2006.

Consumer prices were estimated to have increased by 1.3 per cent during the first quarter of 2007, relative to the same period last year, driven mainly by higher food, transportation and electricity prices. Average prices for fuel and light increased by 12.2 per cent, while transportation prices rose by 1.5 per cent. Meanwhile, food prices increased by 0.4 per cent, linked to higher international prices.

2. Fiscal performance

Central government finances deteriorated in the first half of 2007, compared with the same period last year. During the current period, the overall fiscal surplus contracted by over 7 per cent to \$6.99 million, after increasing in 2006. Total expenditure grew by 4.2 per cent to 173.9 million, surpassing growth of 3.7 per cent in revenue to \$180.8 million. On the expenditure side, outlays on wages and salaries rose by 7.8 per cent, while spending on goods and services expanded by 23.6 per cent to 27.6 million. By contrast, interest payments declined by 36 per cent in keeping with debt restructuring.

Tax revenue increased by 11.2 per cent to 139.5 million bolstered by receipts from the newly introduced VAT and taxes on domestic goods and services, while non-tax proceeds increased by 15 per cent.

3. Monetary developments

For the period end of July 2007, relative to the same period in 2006, monetary conditions were marked by a relatively strong (13 per cent) expansion in the money supply and a rapid accumulation of foreign assets. Growth in the money supply was propelled by a 14 per cent increase in saving deposits and a 17 per cent rise in demand deposits, as foreign currency deposits fell modestly by 4 per cent.

Of interest was the 50 per cent expansion in net foreign assets, reflecting sharp growth in commercial banks' foreign assets and also the imputed reserves of the Central Bank. This accumulation of foreign assets raises the concern as to the opportunity cost of these funds in the domestic economy and also the issue of the extent of bankable projects in the domestic economy that could provide an effective demand for commercial bank funds. Underscoring this was the sharp (24 per cent) contraction in domestic credit. Of note was the 15 per cent decline in business credit in an environment where entrepreneurship is weak and businesses often complain of facing a credit crunch.

Meanwhile, in an unwelcome development, domestic credit contracted by 24 per cent associated with reduced business credit (-15 per cent) and anemic credit growth to the private sector. With the decline in credit in the domestic economy, banks accumulated assets investments abroad and the net foreign assets of the banking system expanded by a substantial 50 per cent to \$533.4 million.

4. Balance of payments position

External payments were expected to have worsened somewhat in the first half of 2007, relative to the same period in 2006. The volume of bananas exported declined by 3 per cent to 5548 tonnes and the value of exports contracted by 1.2 per cent to 7.92 million.

D. The post-disaster macroeconomic performance

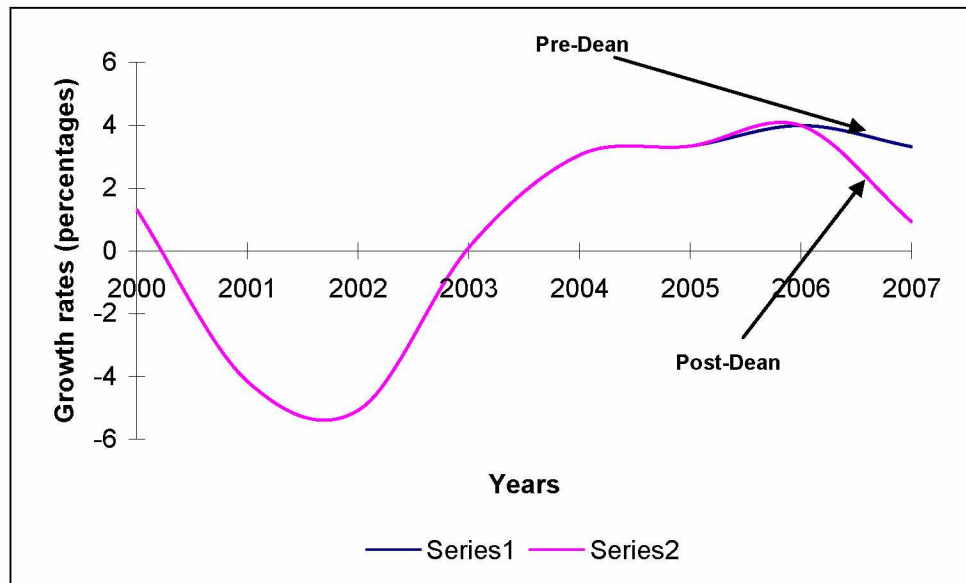
Hurricane Dean is expected to have a substantial impact on economic performance in Dominica in 2007 and also for part of 2008. The agriculture sector was badly damaged which will result in a significant loss in banana production and also output of other crops. Moreover, the road and transport links have been badly affected and this is likely to have an adverse contagion on tourism, commerce and other sectors. Given the nature of the tourism product that is eco-tourism-based, road networks connecting major sites in more remote areas are critical to value added in the sector. However, tourism and commerce themselves did not suffer major damage as a result of the disaster.

1. Impact on GDP

Hurricane Dean and the tropical rains after it are expected to lead to a 2.4 per cent decline in the growth rate for Dominica, resulting in a realised growth of about 0.91 per cent, rather than the 3.31 per cent that was forecasted before the disaster (see figure 22). The agricultural sector is projected to decline by over 16 per cent, as the crop subsector suffered a devastating impact. In

the main banana subsector, an estimated 95.6 per cent of the crop was damaged or destroyed, leading to a projected total damage of EC\$12.12 million of which, loss of income amounted to EC\$4.57 million. The other crops subsector, which includes subsistence crops and cash crops was also heavily impacted by the hurricane, with losses that impinge directly on GDP amounting to EC\$17.85 million. As a result, real output in the crop subsector is projected to decline by 19.62 per cent, reversing the previously expected growth of 3.4 per cent. The fall-out in other agriculture is forecasted to be much more moderate, as real value added in forestry is estimated to decline by 5 per cent, as forest resources were affected by the toppling and uprooting of trees, the accumulation of debris and other impacts. Meanwhile, fisheries are projected to suffer a 1.42 per cent loss in real output in 2007, negating the previously forecasted dynamic growth of 8 per cent. The most significant impacts will result from the loss of fish pots and FADs and also reef degradation, including siltation. Moreover, given the importance of the sector to nutritional balance and food security, the social consequences for directly affected communities could be severe.

Figure 22: Real GDP Growth rates pre-Dean and post-Dean



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

The impact of the hurricane on the other sectors ranged from marginal to moderate. In the manufacturing sector, real output was expected to decline by 2.35 per cent, only marginally greater than the previous decline of 2 per cent. For the most part, the sector was not badly affected by the hurricane, as the brunt of the impact fell on small agro-processors, which implies that the social consequences would tend to outweigh the impact on GDP. Although some construction activity might have slowed in the immediate aftermath of the disaster, construction activity is expected to pick up to facilitate reconstruction and recovery. Widespread damage to roads, ports and other infrastructure means that a significant programme of road rehabilitation, re-engineering and reconstruction is required to facilitate adequate internal transport, especially for agricultural producers and the tourism sector.

Fortunately, the tourism plant was spared from heavy direct damage as a result of the disaster, unlike the case of Hurricane Ivan in Grenada in 2004. Indeed, there was no major damage to the hotel plant and given the fact that the disaster occurred outside of the main tourist season, loss of income was contained. The total damage to the sector was estimated at around EC\$2.7 million, with loss of business amounting to EC\$1.5 million. With these developments, growth in tourism is expected to turn from positive 5.2 per cent to a decline of 1.6 per cent in 2007. Moreover, this is a conservative estimate since the negative multiplier effects of the reduced access to eco-tourism sites and general internal transport problems have not been factored into the estimate.

The commerce sector, an important contributor to GDP, was spared the worst effects of the disaster. Growth in real value added in the sector was estimated to decline from 3.3 per cent to 1.9 per cent. The impact stemmed from damage to buildings and machinery and loss of stocks. However, the impact was varied across groups with the hucksters and small traders bearing the brunt of the impact. The mission estimated a per capita income loss for the hucksters of around EC\$10,000 from the time of the hurricane to the end of year. This is significant and portends hardships and fall-out in livelihoods for this group

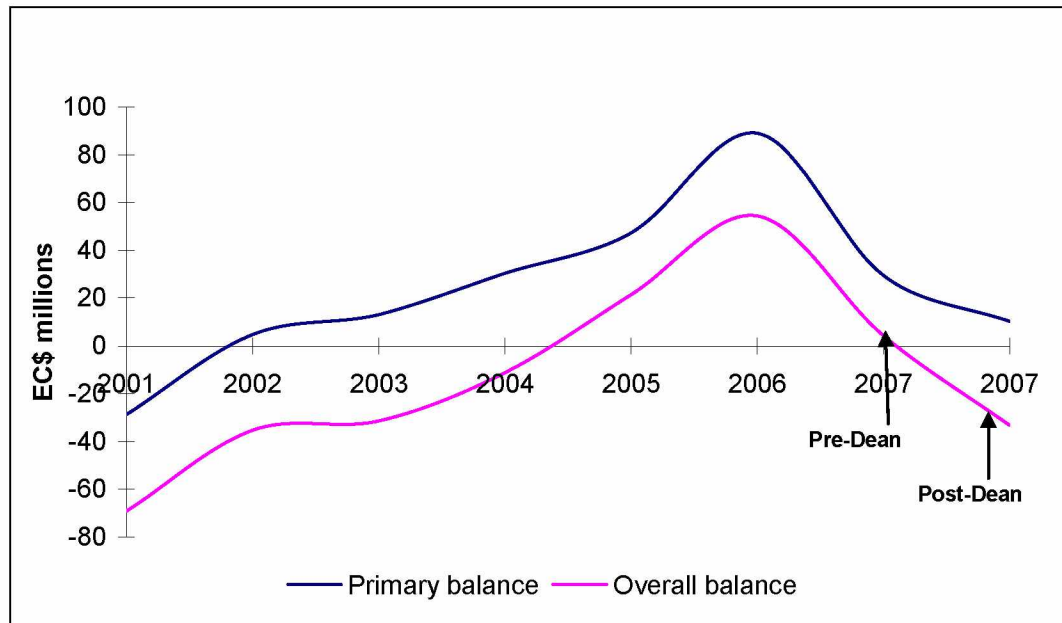
2. Prices, wages and employment

Propelled by shortages in the domestic food sector, inflation is expected to pick up to around 3 per cent in 2007, up from 1.6 per cent in 2006. Meanwhile, wages are expected to be contained as dampened activity should soften wage demands. Moreover, employment growth is projected to slacken with reduced overall activity. Nevertheless job growth in construction is expected to pick up in line with reconstruction and rehabilitation works, but would be insufficient to offset sluggish job growth in the other sectors.

3. Fiscal operations of central government

In the last few years, Dominica has been on the road to fiscal consolidation, achieving both primary and overall surplus on central government's fiscal operations. Nevertheless, the significant debt overhang leaves the country with limited degrees of freedom in acquiring new debt or in relaxing expenditure management. Therefore, Hurricane Dean is a rather inopportune event for the country as it will lead to some slippage in fiscal targets at least in the short term.

Central government's primary surplus, which excludes volatile grants receipts, is expected to contract by over 65 per cent to \$10.2 million (see figure 23). Total revenue is projected to fall by around 4 per cent on account of reduced tax intake and non-tax proceeds, as the down-turn in activity impacts on average proceeds and the ability to pay. With reduced buoyancy of the tax take, tax revenue will fall by over 9 per cent associated with lower receipts from income tax, taxes on domestic goods and services, including the VAT. Although proceeds from taxes on international trade are expected to fall by some 14 per cent, import duties, a major component, will increase due to growth in imports for recovery and reconstruction. Meanwhile non-tax receipts will fall by around 8 per cent as intake from fees and charges for services decline in response to reduced demand for services.

Figure 23: Primary balance and overall fiscal balance, 2001-2007

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

On the other hand, total expenditure is expected to increase by 6 per cent catapulted mainly by a 25 per cent rise in capital spending to \$146.25 million (see table 42). Substantial capital outlays would be required for road rehabilitation, repair of the cruise ship port and the reinforcement of slopes above roadways, that are prone to landslides. Nevertheless, it is anticipated that the bulk of the work of rehabilitating and re-engineering road networks to cope with disasters will be a longer-term project spanning a number of years. Therefore, the allocation for the current year and even for next year would only be part of a systemic upgrade of the road infrastructure. Current expenditure is anticipated to grow by 6 per cent, pushed by higher spending on goods and services. Goods outlays include the purchase of relief and rehabilitation supplies and also reconstruction materials and equipment. Moreover, the openness of the economy means that the bulk of these goods will be imported, adversely affecting the balance of payments current account.

Transfers and subsidies are projected to increase by 10 per cent in the current year as government moves to provide relief and assistance in the form of cash grants and supplies to farmers, small businesses and other affected groups. Interest payments, however, are expected to remain contained as government receives relief from creditors. Meanwhile wages and salaries are projected to post only marginal growth of around 2 per cent as these outlays would not be much affected by the disaster. Indeed, higher outlays on wages and salaries would largely reflect the contracting of workers for clean-up operations and extra work on road repairs and overtime work.

Table 42: Central Government Fiscal Operations (ECS millions)

			Pre-Dean	Post-Dean
	2005	2006	2007	2007
Total revenue	313	376	390	375.00
Current revenue	255	269	274	248.00
Tax revenue	229	248	249	224.00
Taxes on income and profit	51	51	49	45.26
of which: b/				
Personal	30	33	30	28.02
Corporate	21	18	18	17.25
Stabilization levy	0	1
Taxes on property	7	8	6	5.60
Taxes on domestic goods and services	59	123	144	126.00
of which:				
Sales tax	38	11
Consumption tax	5	1
Hotel occupancy	1	0
VAT		70	87	80.00
Taxes on international trade and transactions	113	67	57	49.00
of which:				
Consumption duty (imports)	58	10	...	
Import duty	28	28	29	33.00
Service charge (imports)	13	13	14	16.00
Non-tax revenue	26	21	26	24.00
Capital revenue	17	1	3	3.00
Grants	41	106	95	124.00
of which: capital grants	41	106	95	124.00
Total expenditure	292	322	386	408.27
Current expenditure	237	244	247	262.02
Staff costs	109	110	120	122.87
Goods and services	50	47	54	61.02
Interest payments	26	35	21	21.24
External	8	14	11	11.21
Domestic	18	20	10	10.03
Transfers and subsidies	53	53	52	56.89
of which: pensions	13	13	20	22.00
Capital Expenditure and Net Lending	55	78	117	146.25
Of which: Capital expenditure	58	81	117	146.25
Primary balance	47	89	30	10.22
Overall balance	21	54	4	-33.27
Source: ECLAC, based on data provided by the Authorities				

4. Monetary and exchange rate conditions

Dampened activity will constrain growth in the money supply and credit. The money supply is expected to grow at a slower rate pinned back by the slowdown in activity. Term deposits growth should be particularly affected as households hold more liquid deposits to cushion needed spending.

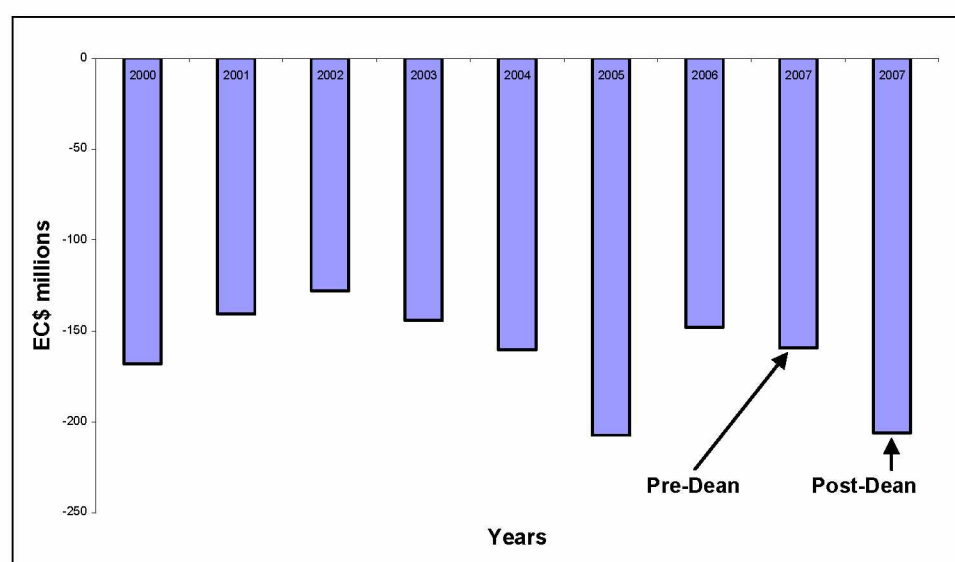
With less optimistic expectations, credit growth is also expected to decrease. Nevertheless, the relative distribution of credit by sector would reflect the varying impacts of the disaster. Credit to the banana sector is expected to increase as farmers supplement insurance receipts with bank credit to get their operations back up and running as quickly as possible.

Net foreign assets are expected to decline in the aftermath of the hurricane, as banks draw down funds invested abroad to finance the recovery and rehabilitation.

5. Balance of payments

The current account deficit will expand by 29 per cent to \$206.2 million, largely reflecting reduced exports and an upsurge in imports (see figure 24 and table 43). The deficit on goods and services is projected to increase on account of both reduced banana and other crop exports and also lower travel receipts associated with reduced tourism demand. Consistent with the decline in banana production by around 33 per cent, banana exports are expected to fall by some \$6.6 million in 2007 and \$1.4 million in 2008. Meanwhile, exports of other crops and products, which are destined primarily for the regional market, are expected to decline by \$3 million in 2007.

Figure 24: Current account balance of Dominica, 2000-2007



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

The disaster necessitated an upsurge in imports of relief and recovery supplies and reconstruction materials and equipment. Consequently, imports are projected to grow by 6 per

cent to 436.75 million. Similarly, the surplus on the services account will decline by over 12 per cent to \$105.12 million as tourism receipts decline by around 5 per cent due to damage to hotels and reduced business at eco-tourism resorts. However, the performance of the eco-sites could benefit on the upside from a speedier repair of connecting road networks and the rehabilitation of sites that were damaged. Insurance receipts are projected to increase by 41 per cent in line with inflows to banana farmers and other affected sectors, but this represents a relatively small nominal amount. Farmers, for instance, only receive about 25 per cent of their direct loss in terms of banana sales and the insurance estimates do not cover losses such as defoliation and plant movements that reduce yields.

Meanwhile, the income account deficit will decline marginally by over 2 per cent, mainly on a projected small reduction in debt service costs. On the other hand, current transfers will increase by around 2 per cent mainly due to an 8 per cent increase in workers' remittances, as relatives abroad increase their support to affected families.

The surplus on the capital and financial account is expected to increase by 10 per cent to \$136.06 million. Capital grants are projected to increase by around 15 per cent as friendly governments and regional and international donors provide project funds for road and other infrastructure repair and rehabilitation. Similarly, the financial account surplus will improve by 5 per cent in keeping with higher direct investment in the economy. Direct investment is expected to increase in response to reconstruction in the tourism sector.

Table 43: Balance of Payments: Detailed Format (ECS millions)

	2006	Pre-Dean 2007	Post-Dean 2007
CURRENT ACCOUNT	-148.02	-159.45	-206.18
GOODS AND SERVICES	-155.16	-166.11	-214.86
A. GOODS	-277.04	-286.59	-320.60
MERCHANDISE (f.o.b.)	-284.57	-294.49	-327.92
Domestic	-287.28	-297.31	-330.53
Re-exports	2.71	2.82	2.61
REPAIR ON GOODS	0.00	0.00	0.00
GOODS PROCURED IN PORTS BY CARRIERS	7.52	7.90	7.31
B. SERVICES	121.88	120.48	105.75
TRANSPORTATION	-57.19	-59.57	-61.66
Sea Transport	-37.00	-38.56	-39.97
Air Transport	-20.19	-21.00	-21.69
Other Transport	0.00	0.00	0.00
TRAVEL	158.91	159.60	152.41
INSURANCE SERVICES	-12.77	-13.27	-18.71
Freight Insurance	-8.95	-9.30	-13.11
Life Insurance	-2.06	-2.14	-3.02
General Insurance	-2.73	-2.83	-3.99
Re-Insurance	-4.23	-4.39	-6.19
Insurance Agents Commissions	5.20	5.40	7.61
OTHER BUSINESS SERVICES	33.13	33.95	33.95
Communications	16.28	16.56	16.56
Construction Services	-1.13	-1.32	-1.32
Legal and Accountancy Services	0.25	0.26	0.26
Management and Consultancy Fees	-2.15	-2.23	-2.23
Computer and Information Services	-0.05	-0.05	-0.05
Royalties, Licence and Fees	-0.64	-0.64	-0.64
Other Business Services	20.56	21.37	21.37
GOVERNMENT SERVICES	-0.20	-0.24	-0.24
Resident Government	0.53	0.52	0.52
Foreign Government	1.97	2.01	2.01
Other	-2.70	-2.77	-2.77
C. INCOME	-45.72	-43.15	-42.12
COMPENSATION OF EMPLOYEES	2.95	2.95	2.95
INVESTMENT INCOME	-48.66	-46.09	-45.07
Direct Investment	-24.74	-25.68	-25.68
Income on Equity	-24.27	-25.21	-25.21
Distributed Branch Profits	-5.99	-6.23	-6.23
Reinvested Earnings	-18.27	-18.99	-18.99
Income on Debt (interest)	-0.47	-0.47	-0.47
Portfolio Investment (a + b)	-7.35	0.57	0.57
(a) ECCB Investment Income	1.31	1.34	1.34
(b) Other Profits and Dividends (i + ii)	-8.66	-0.78	-0.78
(i) Central Government	-8.84	-0.99	-0.99
Regional Government Securities Market	0.00	0.00	0.00
ECCU	0.00	0.00	0.00
Other	0.00	0.00	0.00
Other bonds (including stabilisation, TnT USA)	-0.99	-0.99	-0.99
ECCU	-0.27	-0.27	-0.27
Other	-0.72	-0.72	-0.72
Arrears	-7.86	0.00	0.00
(ii) Rest of Public Sector	0.18	0.00	0.00
ECCU	0.18	0.00	0.00
Other	0.00	0.00	0.00
Arrears	0.00	0.00	0.00
(iii) Private Sector	0.00	0.21	0.21
Regional Government Securities Market	0.00	0.21	0.21
ECSE	0.00	0.00	0.00
Other (Comm banks and insurance co. trans)	0.00	0.00	0.00
Other Investment	-16.58	-20.97	-19.95
Interest on Government Transactions	-16.71	-21.11	-20.09
Central Government	-11.36	-16.96	-16.96
Government Guaranteed	-4.19	-4.14	-4.14
Arrears	-1.15	0.00	0.00
Other	0.13	0.13	0.13
D. CURRENT TRANSFERS	52.85	49.80	50.80
GENERAL GOVERNMENT	0.76	-3.82	-2.82
OTHER SECTORS	52.09	53.62	53.62
Workers' Remittances	56.64	58.05	62.70
Other Transfers	-4.55	-4.43	-4.33

Source: ECLAC, based on data provided by the Authorities

6. Economic challenges going forward

Hurricane Dean will present some important challenges to the socio-economic adjustment process in Dominica at least in the short to medium term. Prior to the disaster, the economy was grappling with the high debt burden and had made commendable progress in debt consolidation and in reducing the downside risks of debt to growth and public investment. The adjustment programme has been successful in restoring macroeconomic stability including a manageable fiscal stance, stable monetary conditions and some restructuring of the banana subsector with the introduction of the Fair Trade Label bananas. Nevertheless, the country has benefited from generous grants in recent years, and these might not be sustainable over time. This points to the need to continue the prudent management of spending and raising revenue capacity to bridge any fiscal gap from own resources as much as possible.

An important consideration for Dominica is maintaining a tight fiscal stance that generates a current surplus that could be used for some capital projects. Although it is difficult to measure the accumulation of capital assets such as roads, education facilities (building up human capital base), ports and other infrastructure that are important drivers of productive activity, this would be a worthy exercise. In fledgling economies, such as Dominica and others in the region, it is important to cost capital assets as well as liabilities, so as to arrive at an estimate of net capital. A capital budgeting framework that allows government to account for changes in net capital by offsetting movements in capital assets against liabilities might be useful for countries such as Dominica, especially given its need for major infrastructure works because of its terrain.

A capital budgeting framework would allow the government to deduct expenditure on capital assets from its total accumulation of debt. This could provide the government with important breathing space to engage in counter-recessionary spending in the aftermath of a major economic shock such as a disaster. Given the development challenges of the country and the urgent need to accumulate productive capital, the speedy rehabilitation of infrastructure including roads, the cruise ship port and telecommunications networks, could provide some degree of freedom for a one-time increase in the deficit to facilitate reconstruction. Budgeting for the rehabilitation, upgrade and addition of new capital assets after Hurricane Dean should be seen as an improvement to or as additional capital stock. This would be an effective 'public good' that would provide the economy with some breathing space to recover and achieve growth rates that are closer to its potential.

Indeed, such degree of freedom is in keeping with the principle of providing an economic stimulus in the wake of a negative shock to the economy. This is especially so in the case of Dominica where the roads to the nascent eco and heritage tourism sites have been badly damaged and would require urgent repair to ensure that sites can be opened for business at least for a part of the high season. Although the rehabilitation works required could be significant and might require the contracting of additional debt, this debt should be partly offset by the potential increase in the rate of growth that could result from re-engineering and reconstruction of the major road network.

Dominica needs to improve the competitiveness of all areas of production and trade. The Fair Trade Label bananas are a welcome move in this direction in agriculture. However, the tourism sector holds good potential, especially eco-tourism and heritage tourism, but there is a need for product development, improved service delivery and branding of different components of the market so that visitors can be assured of what to expect in a package. The marketing systems also need to be strengthened with improved information flow and coordination between foreign tour-operators and domestic service providers.

VI. CONCLUSION

Although different emphasis is required in each country depending on the type of damage and the vulnerability existing prior to the disaster, the consequences of Hurricane Dean in Dominica call for the adoption of new rehabilitation and reconstruction criteria to reduce the country's vulnerability. Dean was a reminder of Dominica's fragile eco systems and geographical characteristics. Moreover since the present development growth is predicated on activities that rely heavily on the environment, as are tourism and agriculture, the sustainability and preservation and access through mountainous roads form the basis for future growth. The adoption of a rational management of risk, therefore, will be essential.

An occasion such as Dean, fortunately without the major loss of lives as has recently occurred in other countries, provides an opportunity for a change of policy to strengthen resilience and manage risk.

ECLAC presents in the following box a list of possible approaches that could advance sustainable livelihoods and development. Such approaches can be explored and should lead to the development of full-fledged priorities for action and accompanying programmes and projects.

Box 3: Strategic Mitigation approaches to advance sustainable livelihoods and development

- Improve fiscal consolidation and debt management;
- Use modern and appropriate technology in the production processes;
- Strengthen disaster management capacity at the micro, meso and macro levels;
- Provide special incentives to increase the participation of youth and female producers, particularly those who are heads of households, in the economic development process;
- Strengthen economic diversification efforts (within and outside of agriculture) to generate alternative employment opportunities and as a risk reduction strategy;
- Improve quality of services and ensure value for money;
- Embark on a programme of river defenses for the most vulnerable roads near river courses;
- Implement soil conservation practices on the slopes;
- Undertake scientific assessment on the post disaster situation of the fishing environment including siltation and depleting/displacement of fish stocks, in order to build resources to future hazards;
- Address the relocation of communities and critical infrastructure located in the hazard zones;
- Establish affordable micro credit facilities (rural development investment funds);
- Strengthen baseline information systems especially national statistical systems producing timely and periodic data;
- Explore the benefits of biodiversity and strengthen eco-tourism;
- Explore the potential of the introduction of a National Agricultural Insurance Scheme;
- Evaluate drainage requirements of feeder road networks followed by the design of drains and implementation of landslide control measures; and
- Undertake effective measures to address high risk infrastructure.

Annex I

A. Project ideas to address issues of vulnerability and recovery in Dominica following Hurricane Dean on 16 August and tropical wave on 10 September 2007

1. Information communication technology (ICT) for local community capacity development to support community-based disaster management

Given the demonstrated value of ICTs in enabling community-based action including disaster management, it is proposed to build on existing initiatives to realize improved community-based disaster management. Specifically, the use of international United Nations Volunteers and expanding the UNDP-supported Community Resource Internet Centres (CoRICs) in the Commonwealth of Dominica will provide the foundation for a community-based approach to building ICT literacy and enable training and tools for disaster management including vulnerability assessment and effective response. This should be extended to coastal and mountains community groups.

2. Community-based disaster risk reduction and disaster response

Dominica is prone to a number of hazards including landslides, earthquakes, tropical storms and storm surges. Many of the damages and casualties realized from these events are based on inadequate knowledge and action at the community level. There are a number of examples of community-based initiatives to support improved resilience and reduce vulnerability to natural events. These initiatives, which can be adapted, include community-led vulnerability assessments; community-based disaster preparation and response including the initial disaster assessment; improved communication and data management. The referred ICT initiative will be the vehicle to deliver and facilitate the elements identified. This activity will build on existing experiences such as the International Federation of Red Cross and Red Crescent Societies (IFRC), the Regional Bureau for Latin America and the Caribbean (RBLAC) of the UNDP and CDERA vulnerability and capacity assessments; the United States Agency for International Development/Office of US Foreign Disaster Assistance (USAID/OFDA) and CDERA natural hazard training and disaster assessment initiatives.

3. Improvement of national capacity in disaster risk reduction and response

The assessment of post-Dean impacts has illustrated the need for support to the Commonwealth of Dominica in the areas of disaster assessment and analysis; coordination of national preparedness and response; integration of hazard mapping and vulnerability assessment into the planning and infrastructural development activities and the application of ICT for disaster recovery and rehabilitation activities. A national assessment of the disaster management structure in Dominica within the context of the Comprehensive Disaster Management (CDM) framework currently in preparation in addition to the ECLAC-led assessment will provide the basis for this capacity-building programme.

4. Coastal assessment to support sustainable fisheries

The coastal fisheries provide approximately 30 per cent of the fish landings, but serve the majority of fishers (n=3100). Following Hurricane Dean and the tropical wave of 10 September, the coastal fisheries have been subject to the impacts of waves and currents motion caused by the winds, the heavy runoff of terrestrial debris/sediments including sand from mining sites and other forms of pollution. The Fisheries Division requires early support in assessing the state of the near shore fisheries, including communities highly dependent on fisheries and advising on the impact on habitat of the marine species, appropriate management of the marine environment and regulatory measures to inform the season that commences in October. This will be a two-phased approach: (a) a two-week assessment of the marine environment post-Hurricane Dean and forecast of the recovery time; and (b) an in-depth assessment to quantify the hurricane impact, the establishment of various baselines for habitats and stocks in relationship to various hazards operating in Dominica's environment. The results should be made available in the appropriate dissemination form to the fisheries communities.

Annex II
Illustrated Damage to Infrastructure



Roseau Valley - UWI



Roseau Valley - Elmshall



Roseau Valley - Fond Cani: Debris slides up-slope and edge failures and washouts down slope of roadway on blind curve. Slope to be cut and roadway realigned to regain roadway width.



Roseau Valley Fond Cani



Roseau Valley: River erosion affecting residential communities on south bank.



Laudat



Laudat landslide at highest upslope tree to be removed.



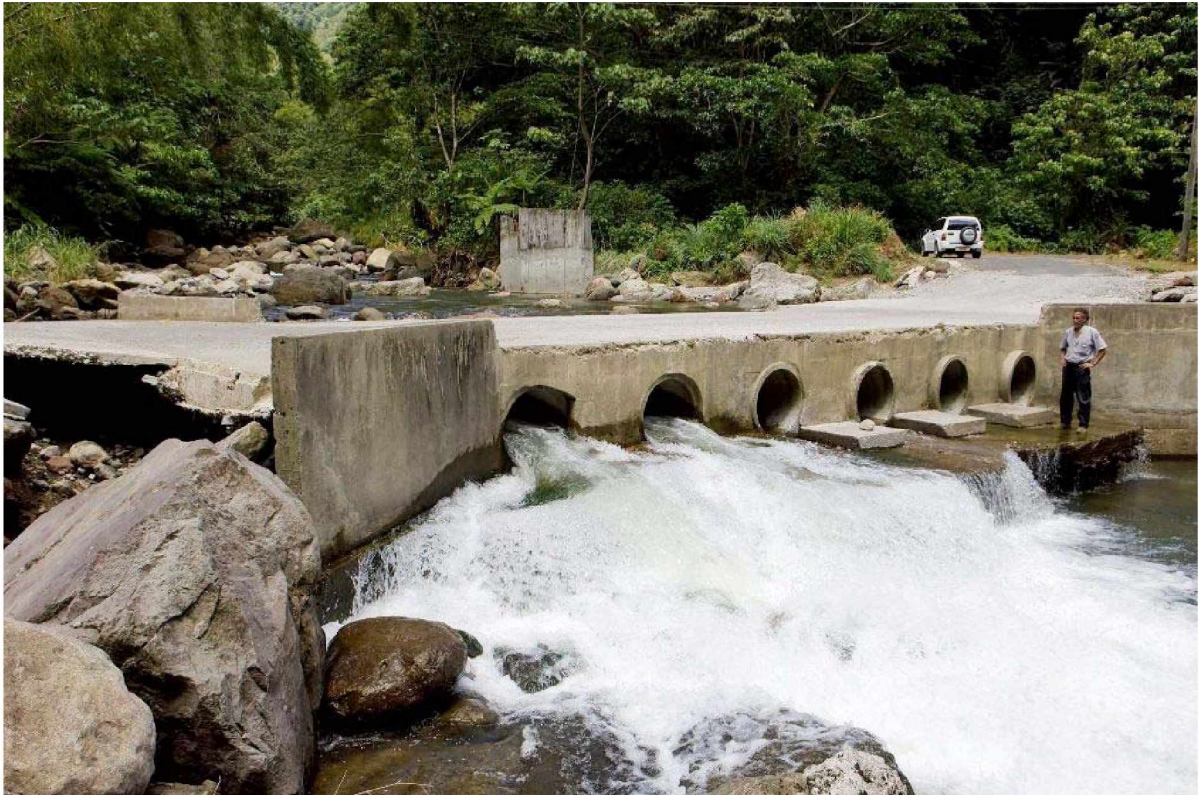
Laudat downslope 60° to bottom of valley 150 m below.



Middleham Falls Road



Middleham Falls – Trafalgar Road junction



Trafalgar-Wotten Raven Road. Four upstream culverts blocked by sediment load.



Wotten Waven – Coptal Road: Back of residential property along road



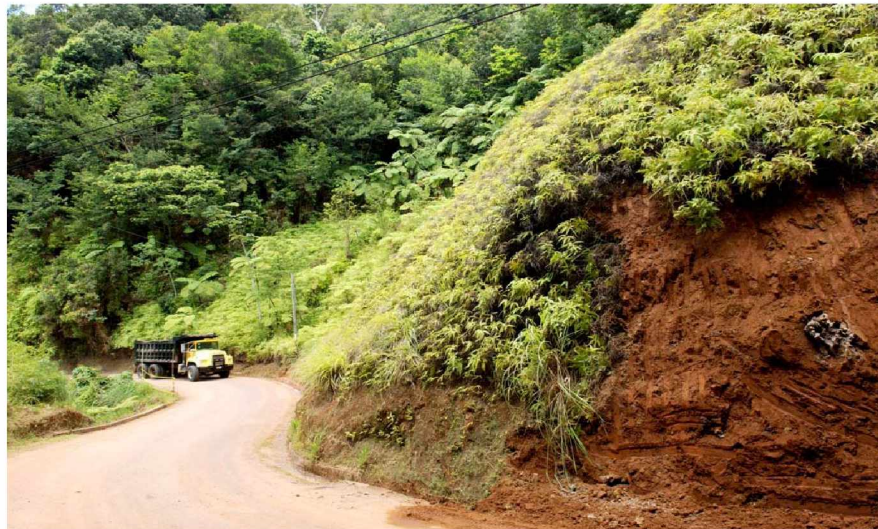
Imperial Road washouts exposing water supply lines



Imperial Road Springfield



Imperial Road near vertical cut in residual soil (Miranda's Bar)



Imperial Road 50° slope in residual soil



**Imperial Road ~55° slope in residual soil
Mature trees at head of slope, indications
of block desiccation/stress relief cracking**











Pont Cassé – Layou Road: Grand Ravine Bridge Foundations undermined.



Campbell landslide initiated on slope angle 25°-30°



Campbell landslide: scarp at head of slope, note mature trees with fully canopies



Campbell landslide: Basement Rock cleavage planes parallel to topographic slope at slip surface and perched water table basement strata (Top: left hand side top of scarp, Bottom: right hand side top of scarp).



Campbell landslide: Basement Rock slabs/boulders from bedding/sliding surface of landslide reaching river 150 m below



West Coast Road St Joseph Village on grassed hillside slopes, away from shallow debris flows.



West Coast Road: Tarou cliffs looking north

Note: absence of large trees present at top of slope



West Coast Road: Tarou cliffs looking south



