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REPORT ON THE WORKSHOP ON DAMAGE AND LOSS ASSESSMENT AND THE IMPACT OF DISASTERS IN BELIZE

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INTRODUCTION

In collaboration with the National Emergency Management Organization (NEMO), ECLAC conducted a three-day damage assessment workshop on the ECLAC methodology to assess sectoral, social, environmental and macro economic effects of natural disasters. [1] The workshop was held at the NEMO Headquarters in Belmopan from 10 to 12 January. The training was funded by the Inter American Development Bank (IDB).

In 2000, ECLAC in collaboration with the IDB, the Inter American Institute for Cooperation on Agriculture (IICA), the United Nations Development Programme (UNDP), the Pan American Health Organization (PAHO) and the United Nations Children's Fund (UNICEF) conducted an assessment on the macroeconomic, social and environmental consequences following the impact of hurricane Keith. [2]

Background

To increase capacity in Belize, ECLAC conducted an initial damage assessment training course in 2001 and a refresher course in 2004. However because of staff changes in NEMO and in the damage assessment teams, a request was made to conduct a full assessment course before the 2006 hurricane season. In response to this request NEMO and ECLAC organized and conducted a three-day training seminar on the application of the ECLAC methodology for the assessment of the impact of disasters. Part of the training will be an exercise for participants to conduct an assessment in a specific context. The sectors selected are ecotourism and the agricultural sector.

Inauguration

In his opening remarks, the Co-ordinator of NEMO stated that the Government of Belize was committed to undertake a Damage Assessment and Needs Analysis (DANA) immediately following the impact of the disaster and to increase the DANA Committee's capacity with trained and competent assessors. The Co-ordinator indicated that the ECLAC methodology would provide Belize with a useful tool in preparing disaster and risk management reports. The opening remarks are appended in Annex 1.

The main objective of the workshop was to expose the DANA teams to the ECLAC damage assessment methodology, the fundamental concepts that underlay the ECLAC approach, sectoral applications of the methodology and estimating the impact of a disaster on the main macroeconomic parameters.

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[1] ECLAC (2003), *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters* (LC/MEX/G.5) or (LC/L.1874).

[2] ECLAC (2002), *Belize: Assessment of the Damage Caused by Hurricane Keith, 2000* (LC/CAR/G.627) or (LC/MEX/G.4).

Attendants and trainers

The workshop was conducted by a joint mission of the ECLAC Mexico and Port of Spain offices and included the ECLAC disaster focal point, Ricardo Zapata, Asha Kambon, Esteban Perez and Erik Blommestein.

Thirty-one people attended the workshop. However some of the participants only attended part of the workshop, in particularly those sessions that were of immediate relevance to their day-to-day work. As a result 15 people participated in the case study and completed the questionnaire. The list of participants is appended in Annex 2.

Agenda and programme

The agreed agenda for the training covered the following topics: the vulnerability conditions in Belize and, to set the stage for the training, a detailed presentation of the ECLAC methodology and the application of the exercises prepared especially for this training.

The programme is detailed as follows:

Tuesday 10 January

OPENING (NEMO DIRECTOR)

9.00 –9.15

Welcome remarks
Introduction of trainers and participants – R. Zapata / NEMO

SESSION 1: VULNERABILITY - SETTING THE STAGE

9.15 – 10.30

The concept of vulnerability – R. Zapata
Profile of the Caribbean and its vulnerability – E. Blommestein
The coastal zone – Summary of hazards and vulnerabilities

10:30-11:30

Introduction to the ECLAC Methodology – R. Zapata
Key concepts and definitions

Coffee

SESSION 2: THE ECLAC METHODOLOGY

11.30 – 12.30

The human dimension: Affected population: gender differentiation, loss of life, displaced population, homelessness, migration, employment effects, – A. Kambon

Lunch

SESSION 3: APPLYING THE METHODOLOGY

14.00 – 16.00

Basic services and Infrastructure:
Transport, Communications, Energy, Water supply – R. Zapata

16:00 – 17:00

Economic Sectors
Tourism – E. Blommestein
Agriculture and fisheries– R. Zapata

WEDNESDAY 11 JANUARY

SESSION 3: APPLYING THE METHODOLOGY , CONTINUED

9.00 – 10.30
Economic Sectors: Continued – E. Pérez / O. Paddison
Manufacturing/ Commercial sector – E. Pérez

Coffee

11.00 – 12:30
Social Sectors: Housing, education, health – A. Kambon
Restoring livelihoods

Lunch

14.00 – 15.00
Environment and cultural heritage – E. Blommestein / R. Zapata

SESSION 4: PUTTING IT ALL TOGETHER – SUMMARY OF EFFECTS

15.00 –17.00
Overall effects of damages on the economy: macro economic impacts– O. Paddison
Overall effects of damages: macro economic impacts continued
Planning for vulnerability reduction – R. Zapata

THURSDAY 12 JANUARY

SESSION 5: CASE STUDY

9.00 – 10.30
Presentation of case study – R. Jovel (R. Zapata)
Description of case study
Organization of working groups

Coffee

11.00 – 16:00
Breakdown sessions for group work and preparation of case study solution by groups. Work is encourage to continue over lunch, for presentation in the afternoon

16:00 – 17:00
Presentation of case study results by each group
Comments on results and solution to the case by case-study monitor – R. Zapata / E. Blommestein

17:00 – 17.30

Closing of the training (including distribution of certificates of attendance) – NEMO Director or designate

Evaluation of the course

A questionnaire was disseminated to all participants. Of those who completed the questionnaire, 13 participants felt that the course had met their expectations, one indicated that the course exceeded and another one that it partially met expectations. No person indicated that the workshop had not met expectations.

With respect to the usefulness of the workshop to their current work, nine people indicated that attending was very useful, five indicated that the course was useful and one indicated that the workshop was somewhat useful.

This assessment changed marginally with respect to the anticipated usefulness for future work. Eight people thought that the course was very useful, four indicated it was useful, two believed it to be somewhat useful and one person indicated that the course was not very useful.

Most participants believed that there was just enough material presented (12 responses). One person did not respond to the question and the response of the two others was equally divided between too much and not enough.

More practical exercises and the practical collection of data were areas identified by eight participants for future training. Other future training aspects included social sector assessment.

Annex 1

Opening remarks from the Director of NEMO

Good morning:

Chief Executive Officer to the Ministry of Natural Resources, Mr. Ismael Fabro, Mr. Ricardo Zapata and other ECLAC facilitators, various governmental and non-governmental representatives, my colleague from NEMO Secretariat, all;

Please allow me to express our deepest appreciation for your presence here today to participate in this very important workshop.

Damage Assessment is an important emergency response function. It can be described as the process by which the extent of damage, following a major hazard impact, is established through the collection and analysis of damage information. This is used to determine the need for victims and the strategies to provide appropriate assistance to restore the affected area to normality in the shortest possible time.

The Government of Belize is committed to undertake, a Damage Assessment and Needs Analysis for the country, immediately following the impact of any hazard.

The overall policy of the Government is to maintain adequate capability to execute rapid assessments of hazard impacts on the country. This is carried out through the National Disaster Management programme coordinated by NEMO Secretariat. The lead agency in our DANA effort is the Ministry of Natural Resources.

At the national level, we are seeking to improve consistency and standardization in assessment methodologies and procedures.

New and improved data collection questionnaires has been developed and recently tested after the impact of Hurricane Wilma and Tropical Storm Gamma to Belize.

The DANA Committee is working on:

- Improving effective coordination, communication and collaboration amongst the various agencies.

- Increasing the Committee's capacity with trained and competent assessors and base line data for effective assessment.

The ECLAC methodology focuses a great deal on the economic impact of a hazard on a country. While some of our participants, especially the disaster managers, may wish to see a stronger emphasis on a cross-cutting theme of disaster and risk management, the three basic and recurring concept of damage + losses = impact, that will be discussed during the next two days, will provide us with a useful tool in preparing disaster and risk management reports.

Our participants from the business, health and social sectors will note that the methodology affords for the economic, social and environmental systems to be naturally integrated.

It is hoped that the knowledge, experiences and best practices that will be shared, will yield to sound environmental planning and management, improvement of standards and codes as a long term focus to reduce vulnerability to our country and its people from the various hazards that threatened the nation.

I want to ask the facilitators to make the sessions as informal and interactive as they can possible make it; and, if they allow me I want to invite you the participants to put aside your inhibitions and indulged in open and frank discussion, use the experiences that have been assembled here for this workshop to gain maximum value from it.

Many thanks once again for your presence.

Annex 2

Participants at damage assessment workshop
10-12 January 2006

Ser.	Name	Organization
1	Elida Brown	Local Government
2	Lee Van Chan	Works
3	Esmond Segura	Works
4	Ricardo Thompson	Agriculture
5	Capt. Lawrence Lorenzo	Defence force
6	Lt. Robert Guerra	Defence force
7	A. Bautista	Agriculture
8	Eugene Palacio	Natural Resources
9	Francis Martinez	Environment
10	Glenroy Ferguson	Natural Resources
11	Dirk Francisco	Belize Audubon Society
12	Netty Johnson	District Coordinator
13	Mario Hoare	Agriculture
14	Kurk Hyde	Coast Guard
15	James Janmohamed	Special Coordinator
16	Linsford Coleman	Central Bank
17	Elsa Vasquez	District Coordinator
18	Mary Ann Sutherland	Natural Resources
19	Noreen Fairweather	Natural Resources
20	Rudolf Williams Jr.	Meteorology Services
21	Jeromey Timrose Augustine	District Coordinator
22	Cpl. Eloy Cacho	Defence force
23	Omar Vasquez	Natural Resources
24	Santiago Acosta Sr	Asst. Training Officer
25	Col. George Lovell	National Coordinator
26	Cecilia Velasquez	NEMO Support Staff
27	Brain Flowers	Warehouse Manager
28	John Suazo	District Coordinator
29	Yadira Lotiff	NEMO Support Staff
30	Delvorine August	NEMO Support Staff
31	Steve Solis	Agriculture

Annex 3

Case study: Exercise applied in the training course

I. BACKGROUND

Since 1972, the Economic Commission for Latin America and the Caribbean (ECLAC) has carried out numerous assessments of the social, economic and environmental impact of disasters in the region, and has developed a well-known methodology for such undertakings. [3] Due to the usefulness of this methodology, and in cooperation with the World Bank, it is being applied in other regions of the world, especially in Asia.

The National Emergency Management Organization of Belize (NEMO) has requested assistance from ECLAC to carry out a training seminar for Belize Government officials on the subject of disaster damage assessment, with special reference to the subject of drought. Similar training courses – with special reference to the case of hurricanes – were provided by ECLAC in 2001 after the assessment of the impact of hurricane Keith,[4] and in 2004.

Since 2003 – and in some locations since 2001 – rainfall has been below average and, in some cases, has been insufficient to meet the water requirements of crops. At the end of 2001, an assessment was carried out by ECLAC on the impact of a drought in the Central American Isthmus that affected Belize only marginally. [5] However, the deficit has been very clear in Belize since the beginning of the 2004 rainy season.

In view of the above, NEMO authorities requested that the training seminar have a special emphasis in the methodologies and procedures for the assessment of droughts, and further requested that real data from the recent drought in said country be used for exercises to be carried out as part of the training seminar.

To comply with this request, ECLAC engaged the services of Roberto Jovel, an international consultant on damage and loss assessment following disasters who led the development and updating of the ECLAC methodology. From 22 to 30 June 2005, Mr. Jovel undertook a field mission to Belize in order to collect relevant information for the estimation of drought impact on the economy. Since not sufficient data was available during Mr. Jovel´s mission, extensive use was made of electronic communications to gather the missing information. NEMO and other Government officials provided support to Mr. Jovel in his data collection efforts.

This report summarizes Mr. Jovel´s findings and provides the background data for the assessment of the economic impact of the 2004-2005 droughts in Belize. Furthermore, the

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[3] See ECLAC, *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters,* 2003.

[4] See ECLAC, *Assessment of the damage caused by Hurricane Keith in Belize: Implications for economic, social and environmental development*, Mexico City, November 2000.

[5] See ECLAC and Comisión Centroamericana de Ambiente y Desarrollo (CCAD), *El impacto socioeconómico y ambiental de la sequía de 2001 en Centroamérica*, January, 2002.

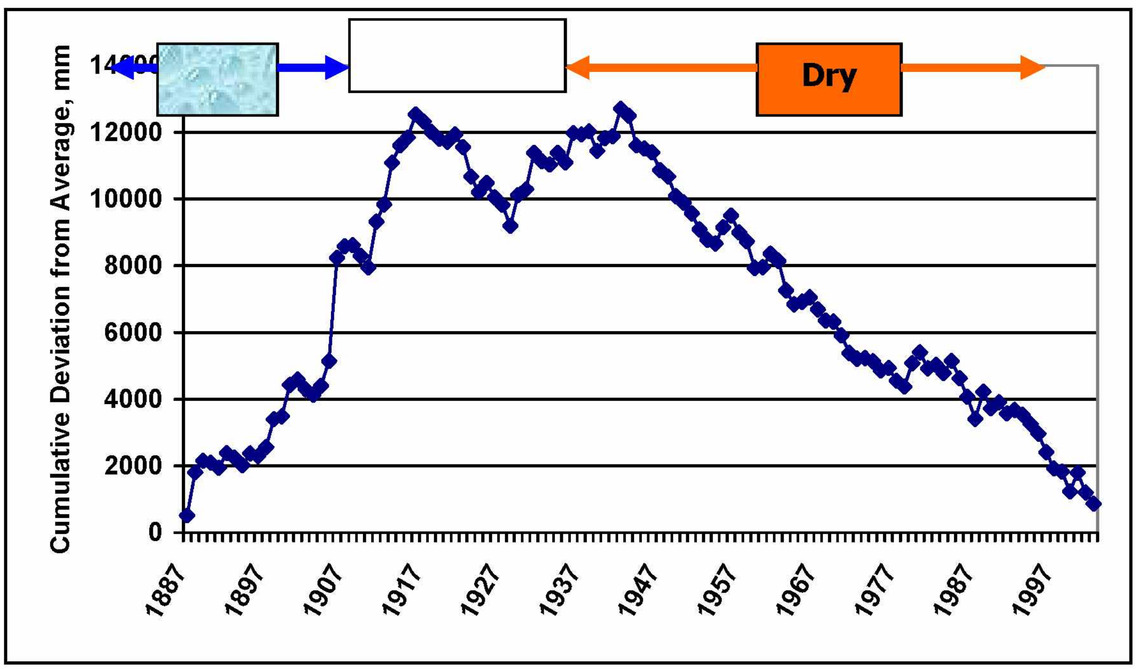
procedure for the assessment is described in the last chapter, together with the basic assumptions to be adopted, which are to be used during the training seminar.

II. THE DROUGHT IN 2004-2005

Long-term records available for the Capital City of Belize indicate that **annual rainfall** seems to have entered an extended period of below-average rainfall since the early 1940s. On the other hand, the period from 1887 to the end of the 1920s, can be recognized as a wet one; and a transition seems to have occurred in between. An analysis of the cumulative departure of annual rainfall from its long-term mean value is shown in the graph below.

Figure 2-1

CUMULATIVE DEPARTURE OF ANNUAL RAINFALL FROM THE LONG-TERM MEAN IN BELIZE CITY (1887 THROUGH 2004) [6]



Monthly rainfall data for several rain-gauging stations located throughout the country (See table 2-1 and figure 2-2 below) was analyzed for the years 2003 to mid-2005, to determine the extent and location of the drought.

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[6] Rainfall data provided by Meteorological Department of Belize; the analysis of information was made by the Consultant.

Figure 2-2

MAP OF BELIZE SHOWING LOCATION OF SELECTED RAIN STATIONS

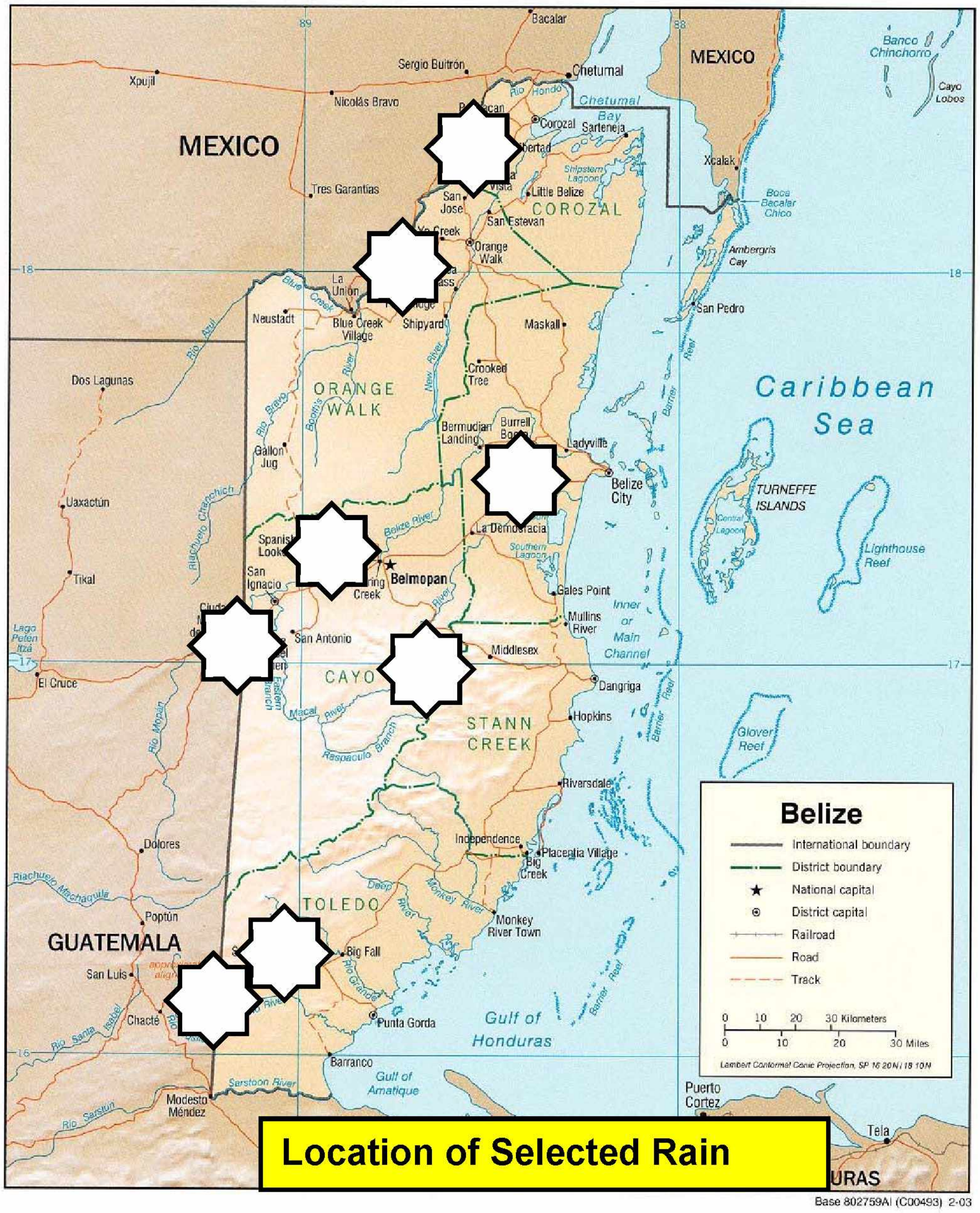


Table 2-1

ANNUAL PRECIPITATION IN SELECTED RAINFALL STATIONS IN BELIZE

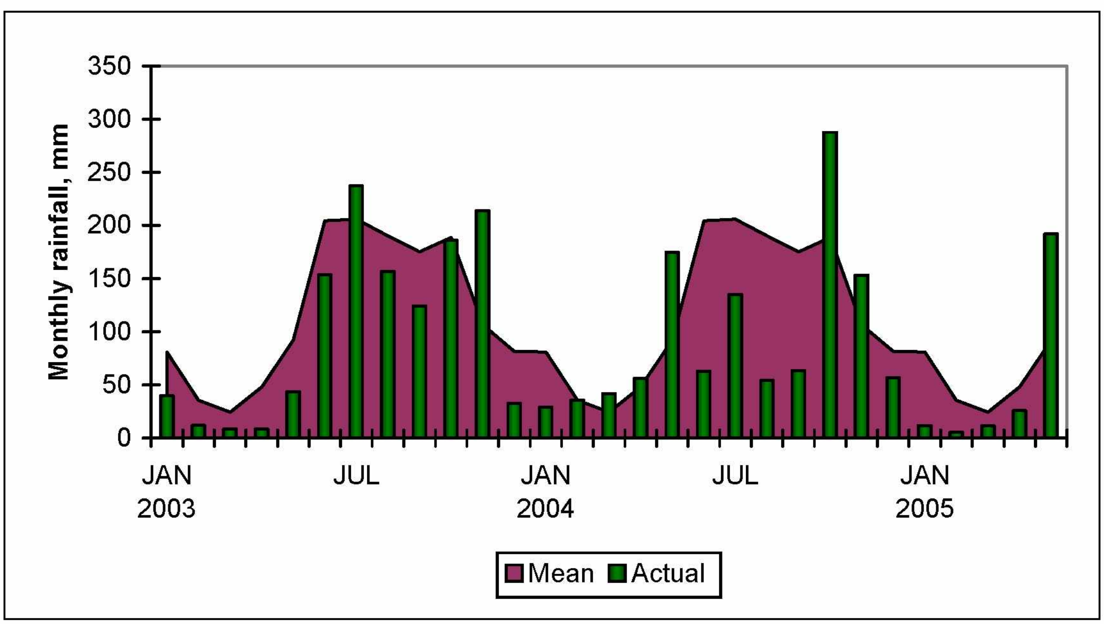
	Station	Location		Annual rainfall		
		Latitude North	Longitude West	Average (mm)	2004 (mm)	Per cent over average
1	Central Farm	17° 11	89 ° 00	1,580	1,338	84.6
2	Libertad	18 ° 17	88 ° 28	1,333	945	70.9
3	Big Falls	16 ° 16	88 ° 47	2,520	2,692	106.9
4	Belmopan	17 ° 15	88 ° 46	1,880	1,374	73.0
5	Middlesex	17 ° 01	88 ° 31	2,382	2,267	95.0
6	Airport	17 ° 32	88 ° 18	1,948	1,452	74.5
7	P.G. AgStat	16 ° 08	88 ° 51	3,683	3,443	93.5
8	Spanish Lookout	17 ° 13	88 ° 59	1,529	1,293	84.6
9	Towerhill	18 ° 02	88 ° 34	1,247	1,152	92.8

Data Source: Meteorological Department of Belize.

The analysis of existing rainfall information – presented in the previous table – shows that precipitation was from 20 to 30% below average for at least the Northernmost half of the country, above parallel 17° N (See table 2-1 and figure 2-2 combined). This area coincides with the one devoted to the main agricultural activities of the country. Additional, although as yet unconfirmed, information indicates that the rain-deficit area extends further North and covers the Yucatan peninsula and parts of Cuba.

Figure 2-3

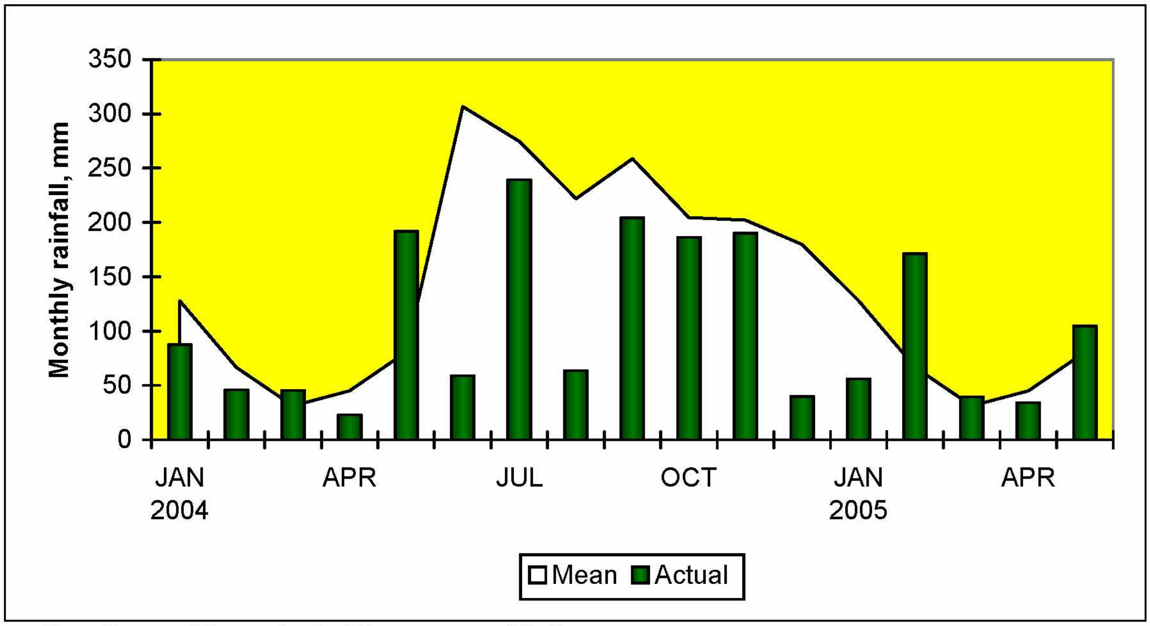
ACTUAL VERSUS MEAN MONTHLY RAINFALL AT BELIZE AIRPORT, 2003 TO May 2005



Data Source: Meteorological Department of Belize.

Figure 2-4

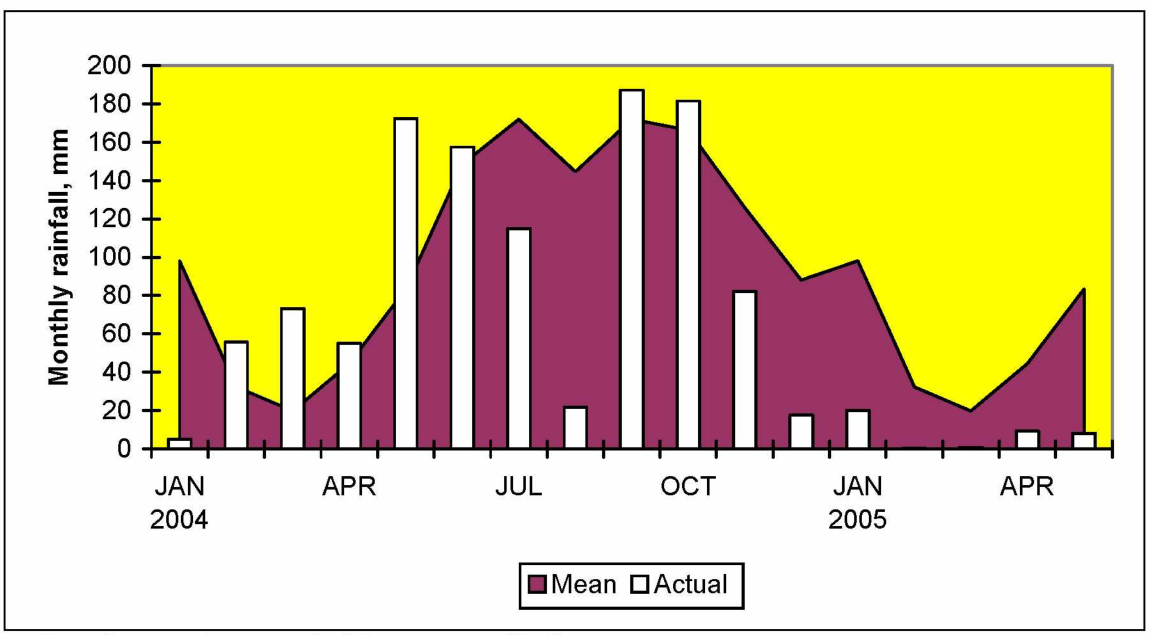
ACTUAL VERSUS MEAN MONTHLY RAINFALL AT CENTRAL FARM RAIN STATION



Data Source: Meteorological Department of Belize.

Figure 2-5

ACTUAL VERSUS MEAN MONTHLY RAINFALL AT TOWER HILLS RAIN STATION



Data Source: Meteorological Department of Belize.

The data for the station located at Belize International Airport indicates that **monthly rainfall** rates since early 2003 have been – with few exceptions – below average. In 2003, except for the months of July, November and December, the entire dry and rainy seasons had below-average precipitation. The situation continued in 2004, where from June to September rainfall was well below average; October and November were wet months, and from December 2004 through April 2005, rainfall was very scarce (See figure 2-3).

Data for the Central Farm rainfall station show that for the entire period between January 2004 and May 2005 rainfall has been below average, except for two months (May 2004 and February 2005). This is probably typical of the Central-Western part of the country, where this station is located (Figure 2-4).

Data for Tower Hills (shown in Figure 2-5) indicate that, since July 2004, monthly rainfall has consistently been below average, with the exception of September and October 2004. This is considered typical of conditions in the northernmost portion of the country.

The fact that rainfall has been below average throughout the period under consideration has resulted in water deficits for many economic activities. In fact, the months from June to November are the ones where agricultural crops require more water for their growth; during the first half of each year, availability of water for hydropower generation is critical. Therefore, it is no surprise to note that production losses occurred in these and other sectors of the economy, as will be described later on in this report.

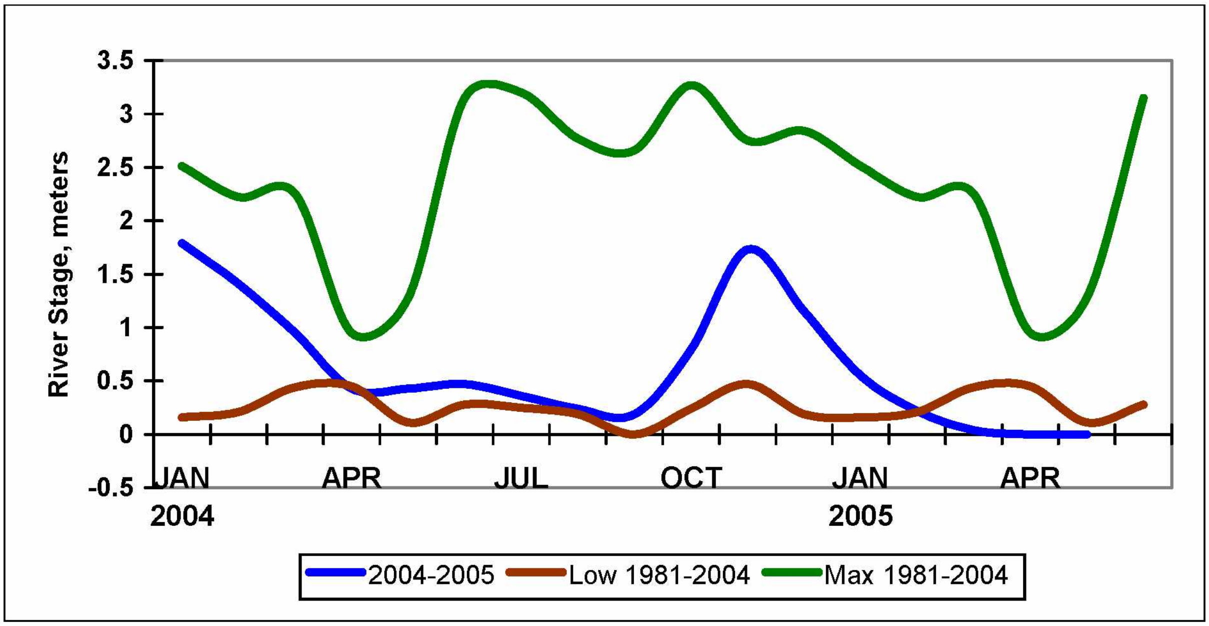
Limited information on **surface water** features indicate that water availability has followed a decreasing pattern that resembles the trends in rainfall. Water level records for a station located at Crooked Tree Lagoon, show that water levels in 2004-2005 have closely followed the 25-year minimum values, as indicated in Figure 2-6 below. This graph shows that in April 2004, the actual water stage coincided with the 25-year minimum, and that until October of same year both values were very closely related. Then the actual level rose in response to heavy rainfall, but began decreasing at a high rate from November 2004 onwards, until in February 2005 it dropped below the recorded lows and dried up the following month.

It is reported that **groundwater** levels have steadily declined for the same time period of the analysis, and that pumping costs have risen accordingly, although no hard data is available at the time this report is being written.

It is reported that **air temperature** increased significantly during the drought period (See figure 2-7), inducing higher water requirements from people and crops. Forest fires were more common during the drought period due to the increased air temperatures as well as higher radiation rates.

Figure 2-6

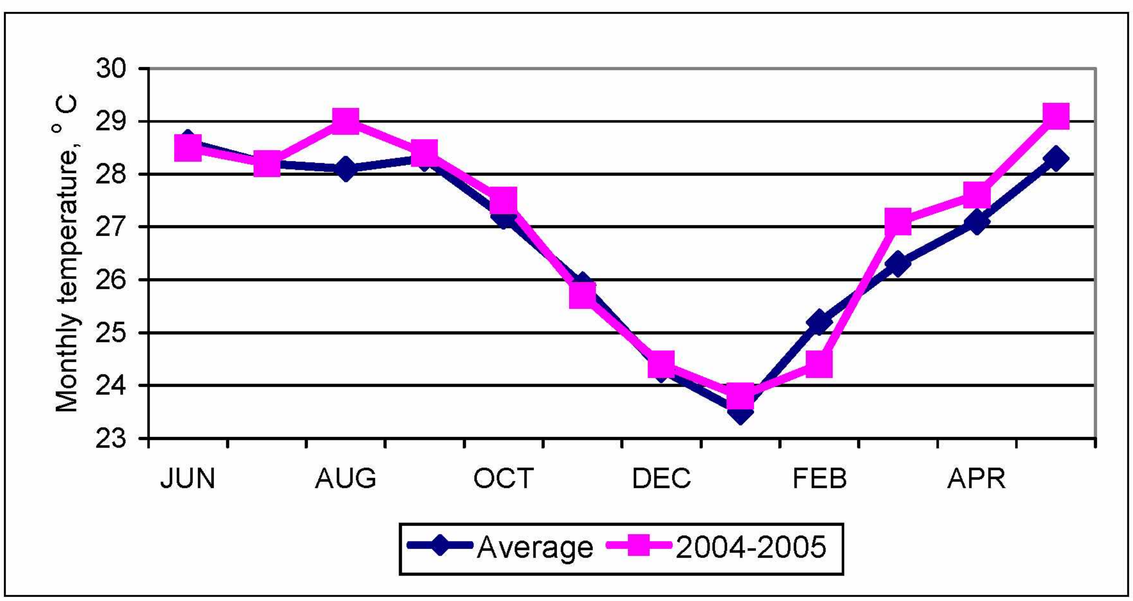
MONTHLY WATER LEVEL AT CROOKED TREE LAGOON



Data Source: Meteorological Department of Belize.

Figure 2-7

MONTHLY AIR TEMPERATURE IN 2004-2005 VERSUS AVERAGE MONTHLY VALUES



III. IMPACT ON SELECTED SECTORS

Drought affects different sectors, generating losses to the economy that may last beyond the actual recovery of rainfall rates. Most affected are usually the sectors of agriculture and livestock, as well as agro-industry as the second link in the food production chain. In addition, other sectors and activities than depend on normal water availability suffer from the lack of sufficient water: the water supply and sanitation and the electricity generation sectors.

No sufficient information was available to attempt an estimation of the damage to environmental assets and the loss of environmental services caused by the limited water availability and by the forest fires that occurred during the study period 2004-2005.

1. Agriculture

In order to appreciate more clearly the impact of the drought on the agriculture sector, the following table shows the agricultural calendar for Belize.

Table 3-1

CALENDAR OF AGRICULTURAL PRACTICES IN BELIZE

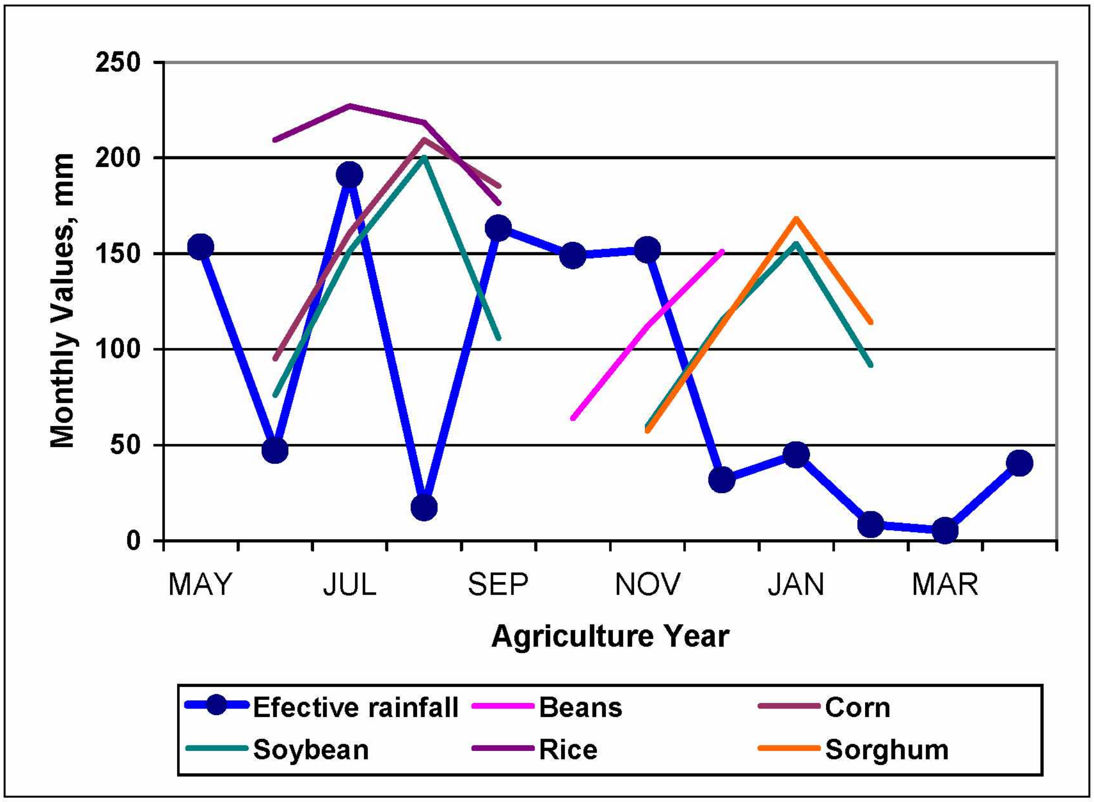
Product	Agriculture season					
	1st calendar year				2nd calendar year	
	J F M	A M J	J A S	O N D	J F M	A M J
Seasonal crops						
Corn		X X	X X X			
Rice		X X	X XX			
Soybeans		X	X X X	X X X	X X X	
Red kidney beans				X X	X	
Black beans				X X X		
Plantations						
Banana	X XX	X X X	X XX	X X X	X XX	X X X
Sugarcane		X X	X XX	X X X	X XX	X X
Citrus	X XX	X X X	X XX	X X X	X XX	X X X
Agro-processing						
Sugar milling					X X X	X X X

Source: Agriculture Department of Belize.

Based on the above calendar of production and making use of the modified Blaney-Criddle formulae, [7] estimates were made of the water requirements of selected agricultural products for the case of Belize. These were compared to the value of effective precipitation that occurred during the period 2004-2005, to ascertain possible water deficits as shown below.

Figure 3-1

COMPARISON OF ESTIMATED WATER REQUIREMENTS FOR GRAIN CROPS AND EFFECTIVE RAINFALL IN BELIZE, 2004-2005 AGRICULTURAL SEASON



Similar comparisons were made for the case of vegetables and of plantations such as banana and sugarcane. In all cases, the comparison indicates that during the 2004-2005 agricultural season rainfall was not sufficient to meet crop water needs at all times, especially during the most critical periods for some of the crops. The result was either wilting of some crops and/or lower unit yield of other crops and plantations. The most notable example is that of soybean.

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[7] A description of the methodology used for the estimation of water requirements of agricultural products can be found in: Jovel, R. and Martinez, H., *El cálculo del uso consuntivo*, Ministry of Agriculture and Livestock, El Salvador, 1964; Jovel, Roberto, *El cálculo de los requerimientos de agua para la irrigación en Costa Rica*, Proyecto Hidrometeorológico Centroamericano, San Jose, Costa Rica, 1968; and in FAO, *Irrigation Water Management, Irrigation Water Needs*, Rome, 1986.

The banana plantations were spared from that problem since most are under irrigation.

a) Impact on grains and vegetables

As a result of the water deficit, production of most seasonal crops dropped due to lower unit yields. Information on the production, acreage planted and average unit yield for grains and selected vegetables are given in the following tables.

Table 3-2

PRODUCTION AND ACREAGE OF GRAIN CROPS IN BELIZE, 2000-2004

Product	Year				
	2000	2001	2002	2003	2004
Corn					
Production, thousand pounds	69,933	80,987	73,611	78,474	67,150
Planted area, acres	35,019	30,168	35,335	31,567	31,416
Avg. Yield, pounds per acre	1,997	2,684	2,083	2,486	2,137
Rice					
Production, thousand pounds	21,710	26,722	24,139	28,114	23,018
Planted area, acres	8,953	9,935	11,793	11,200	7,746
Avg. Yield, pounds per acre	2,425	2,690	2,047	2,510	2,972
Black beans					
Production, thousand pounds	2,018	1,241	3,284	2,582	2,180
Planted area, acres	2,413	1,337	4,475	3,476	2,548
Avg. Yield, pounds per acre	836	928	734	743	855
Red kidney beans					
Production, thousand pounds	10,908	12,796	4,939	9,668	6,630
Planted area, acres	13,467	17,056	11,582	11,790	11,429
Avg. Yield, pounds per acre	810	750	426	820	580
Soybeans					
Production, thousand pounds	1,092	1,160	2,058	3,516	700
Planted area, acres	609	730	3,047	2,602	600
Avg. Yield, pounds per acre	1,794	1,588	675	1,351	1,167
Sorghum					
Production, thousand pounds	13,901	18,542	26,651	20,180	17,954
Planted area, acres	4,928	5,525	9,785	5,977	9,016
Avg. Yield, pounds per acre	2,821	3,356	2,723	3,376	1,991

Source: Policy Analysis and Economics Unit, MAFC.

It is to be noted here that the data on acreage planted, especially referred to the 2004 calendar year, may not always reflect the actual area that was planted at the beginning of the agricultural season; rather, it may reflect the area that was subject to harvest, after the drought.

Table 3-3

PRODUCTION AND ACREAGE OF SELECTED VEGETABLES IN BELIZE, 2000-2004

Product	Year				
	2000	2001	2002	2003	2004
Cabbage					
Production, thousand pounds	4,068	3,855	4,222	2,470	3,387
Planted area, acres	184	161	170	154	143
Yield, thousand pounds per acre	22.1	23.9	24.8	16.0	23.7
Cucumber					
Production, thousand pounds	241	432	417	547	222
Planted area, acres	39	33	38	63	36
Yield, thousand pounds per acre	6.2	13.1	11.0	8.7	6.2
Hot pepper					
Production, thousand pounds	732	818	446	580	408
Planted area, acres	..	195	81	72	58
Yield, thousand pounds per acre	..	4.2	5.5	8.1	7.0
Sweet pepper					
Production, thousand pounds	1,121	884	1,183	930	695
Planted area, acres	148	97	126	131	97
Yield, thousand pounds per acre	7.6	9.1	9.4	7.1	7.2
Tomatoes					
Production, thousand pounds	4,923	3,113	3,155	2,767	1,301
Planted area, acres	246	235	155	147	84
Yield, thousand pounds per acre	20.0	13.2	20.4	18.8	15.5
Onion					
Production, thousand pounds	280	746	1,181	1,798	1,304
Planted area, acres	30	155	103	112	89
Yield, thousand pounds per acre	9.3	4.8	11.5	16.0	14.7
Irish Potato					
Production, thousand pounds	2,726	2,384	1,387	1,055	1,599
Planted area, acres	285	255	209	195	132
Yield, thousand pounds per acre	9.6	9.3	6.6	5.4	12.1
Carrots					
Production, thousand pounds	348	294	232	503	569
Planted area, acres	46	35	32	52	59
Yield, thousand pounds per acre	2.1	8.4	7.2	9.7	9.6

Source: Policy Analysis and Economics Unit, MAFC.

As in the case of grains, the area planted indicated for 2004 may not reflect the area initially planted but, rather, the area where harvest was collected.

In any case, it can be easily seen that many of these products (grains and vegetables) were affected significantly by the drought, since both their total production and the average yield show considerable decline in 2004. According to the available information, some vegetables (notably cabbage, Irish potato and carrots) were not affected by the drought, as they are probably grown in areas where rainfall was adequate for the crops.

b) Impact on sugarcane production

Since the area devoted to the production of sugarcane is located within the zones most affected by the drought, the impact on its production was significant, as indicated in the table below.

It is to be noted here that the data on sugarcane and sugar production must be given by agricultural season, which goes through the next calendar year. Statistics on the production of these two items, as shown in the publications of the Policy Analysis and Economics Unit of the MAFC, indicate figures for the calendar year only. Thus, the Consultant resorted to information given by the Sugar Industry Control Board – which provides monthly data on cane reception at the mills and on sugar production – to revise the data on this issue, as shown in the table below.

Table 3-4

PRODUCTION OF SUCARCANE IN BELIZE, 2000-2004

	Agriculture season				
	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Production, thousand long tons	1,011	1,151	1,073	1,149	929
Planted area, acres	57,322	57,322	59,500	61,300	59,000
Average yield, long tons per acre	17.64	20.07	18.04	18.75	15.75

Source: Sugar Industry Control Board.

The above information shows that the drought had a significant impact on the production of sugarcane in the 2004-2005 season equivalent to a decline of 20 per cent. If the information on planted area is correct, then the decline in sugarcane yield was of 15% only.

c) Impact on other products

There is only partial information on the possible impact of the drought on other products. However, they have a lower economic value in the overall picture, and will not be included in the analysis.

2. Livestock

The cattle and poultry producer associations reported that due to the lack of water and of pasture, many cattle heads perished and many more lost weight; a significant number of broiler chicken and layers also perished. As a result, the stock of these species was diminished and the production of meat, milk and eggs dropped during part of 2004.

The following is a summary of damage and losses submitted by the respective associations. [8]

Table 3-5

DAMAGE AND LOSSES IN THE LIVESTOCK SECTOR DUE TO THE DROUGHT IN 2004

	Monetary impact (BZ$)		
	Damage	Losses	Total
Cattle	4,878,000	…	4,878,000
800-lb heads (98)	78,400		78,400
1200-lb heads (40,000)	4,800,000		4,800,000
Poultry	461,450	26,641	488,091
5-6 week broilers (65,000)	333,450		333.450
Layers (8,000)	128,000		128,000
Egg production (April-August)		26,641	26,641
Totals	**5,339,450**	**26,641**	**5,366,091**

Source: Cattle and poultry associations.

Not sufficient data was available in order to estimate milk production loss or to visualize the relative damage to total animal stock in the country.

3. Agro-industry

In correspondence to the negative impact on primary production (agriculture and livestock), agro-industry sustained similar reductions in its output.

a) Sugar production

Information is available on the impact on sugar production, derived from sugarcane, as indicated in the table below that utilizes information obtained directly from the Sugar Industry Control Board, and which was used to adjust data from the Policy Analysis and Economic Unit of MAFC, as indicated in the section on agriculture.

[8] Direct electronic communication to the Consultant, by Orlando Habet, 30 June 2005.

Table 3-6

PRODUCTION OF SUGAR IN BELIZE, 2000-2004

	Agriculture season				
	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Production (thousand tons)	103.86	111.31	103.58	116.58	100.4
Sugarcane to sugar ratio	9.74	10.34	10.36	9.86	9.26

Source: Sugar Industry Control Board.

Data from the above table shows that after the good production obtained during the 2003-2004 season, a significant decline of 14% occurred in the 2004-2005 season. The decline in sugar production at the mills was due to the combined effect of lower sugarcane volumes processed (by about 20%) due to the drought, and of higher sugar content in the cane. The latter was probably due to the higher air temperatures that prevailed during the maturation of the sugarcane crop.

b) Other agro-industries

No direct information was made available concerning the production declines that other agro-industries may have sustained. However, unless timely substitution of food products through imports from abroad was accomplished, these industries will surely have sustained significant financial losses.

4. Drinking water supply

Drinking water supply and waste-water disposal is carried out by Belize Water Services (BWS), a privately owned enterprise. In 1994, BWS had a total of 39,500 connections; the individual water systems had different sources of water supply, as shown in the table below.

In recent years, BWS has been making significant efforts to reduce conveyance and distribution losses, as well as illegal water tapping. Total losses accounted for 53% of total production in 2002-03, 44% in 2003-04 and 36% in the most recent year. Together with other measures, loss reductions have enabled BWS to show a net operating surplus in 2003-04 for the first time. [9]

[9] See *Annual Report, 2003-2004*, Belize Water Services, Belize City.

Table 3-7

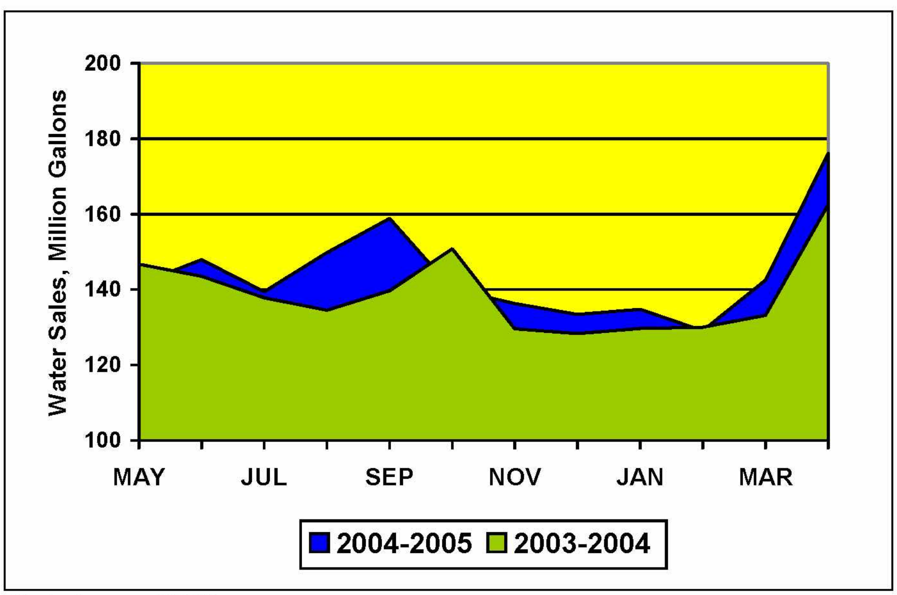
CONNECTIONS AND WATER SOURCE IN THE MAIN CITIES OF BELIZE, 2004 [10]

Water system	Number of connections	Water source
Belize City	15,760	Surface River Water
Hattieville	515	Ground Water Wells
Corozal	3,515	Ground Water Wells
Progresso	200	Ground Water Wells
Orange Walk	3,595	Ground Water Wells
Belmopan	4,070	Surface River Water
San Ignacio	4,190	Ground Water Wells
Benque Viejo	1,660	Springs, and Wells
Dangriga	2,490	Surface River Water
Punta Gorda	1,420	Ground Water Wells
San Pedro	2,095	Sea Water (Rev. Osmosis)

During the drought period, the prevailing higher air temperatures caused an increase in water demand for the BWS systems that went beyond the increase in number of connections (See figure below). This increased water demand was met by BWS through an increased number of hours and cost of operation of its plants, and no significant rationing. Thus, the drought had two effects: one, an increased consumption of water by users – with a corresponding higher cost – and, two, an increased cost of operation at BWS.

Figure 3-2

MONTHLY DRINKING WATER SALES IN 2003-2004 AND 2004-2005



Data Source: BWS.

Table 3-8

[10] Electronic-mail communication by BWS to the Consultant, 29 June 2005.

INCREASE IN ELECTRICITY USE
FOR WATER SUPPLY,
FEBRUARY TO MAY 2005

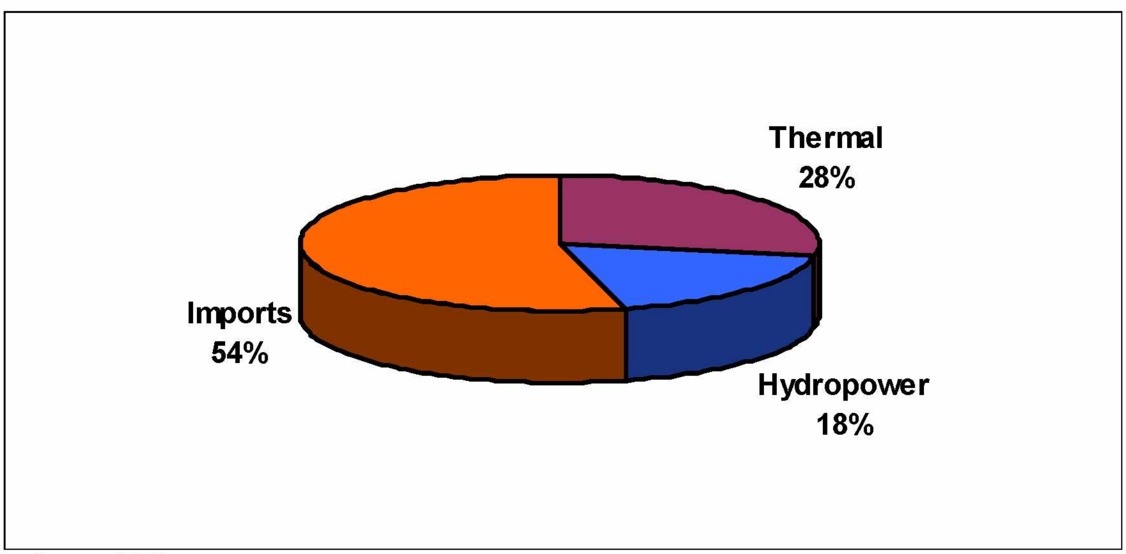
Sub-system	Increase in electricity use (per cent)
Belize City	15.6
Hattiesville	19.2
Corozal	23.0
Orange Walk	24.4
Belmopan	22.5

5. Electricity

The total electricity demand of the country is met by the system operated by Belize Electricity Limited (BEL), a privately owned enterprise. With a total of 66,000 customers – in residential, industrial and commercial sectors, as well as public lighting – the system has a peak demand of 66 Megawatts. Total energy demand for the system is met through generation in BEL's diesel-powered units, purchases of electricity from the *Mollejon* hydropower plant, and imports of energy from Mexico's *Comisión Federal de Electricidad* (CFE) grid.

Figure 3-3

STRUCTURE OF ELECTRICITY PRODUCTION IN BELIZE DURING 2003



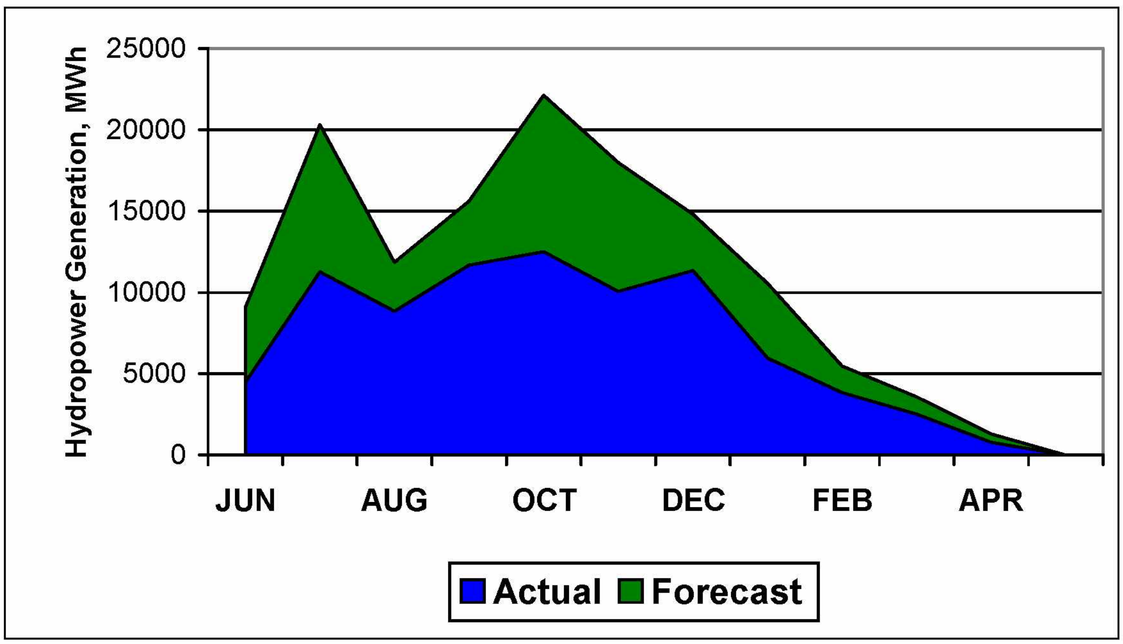
Source: BEL.

Since early 2004 and up to June 2005, two factors have modified the previous pattern of energy production. First, the drought caused the generation in the Mollejon hydropower plant to be seriously curtailed, as water availability was drastically reduced. Second, the significant rise in international oil prices made thermal plant generation less attractive than energy imports from Mexico.

Actual hydro generation was much lower than the originally envisaged production forecast (See figure 3-4). The shortage of hydropower generation was met through generation at the thermal power plant, with its increasing production costs. [11] To meet the country total demand, more imports were made from the CFE grid (See Figure 3-5 below).

Figure 3-4

ACTUAL VERSUS FORECASTED HYDROPOWER GENERATION, 2004-2005

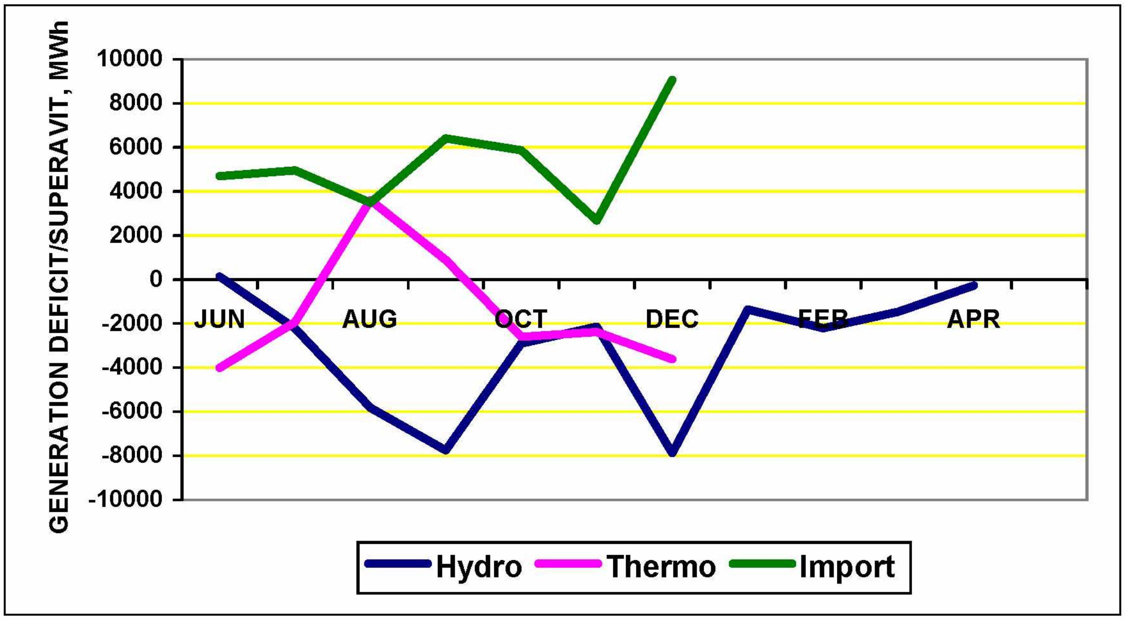


Source: BEL.

[11] To have substituted hydropower generation through imports from Mexico, the unit cost of electricity would have been nearly 700 Bz$/MWh.

Figure 3-5

MEETING THE HYDROPOWER DEFICIT THROUGH ALTERNATIVE SOURCES IN BELIZE (JUNE 2004 to MAY 2005)



Data source: BEL.

With the above scheme of production, the utility managed to reduce the overall, negative impact on the average cost of electricity production, and to meet – with a high degree of economic efficiency – the double problem posed by the rising oil prices and by the shortage of water for hydro production caused by the drought.

Nevertheless, the impact of the drought on generation costs still remains in the equation, and must be estimated separately in order to ascertain the isolated effect of the natural event.

IV. ESTIMATION OF DAMAGE AND LOSSES CAUSED BY THE DROUGHT

1. General considerations

As indicated in the Background section of this report, the estimation of the impact of the drought in Belize is to be used as an exercise in the training seminar to be undertaken during August 2005.

The available data on the effects of the drought on the main affected sectors is described in chapter three of this report. The information contained herewith, however, is not sufficient to carry out a full, comprehensive damage and loss assessment for the disaster. Nevertheless, it is more than sufficient to illustrate the manner in which the assessment should be carried out, and provides the necessary inputs for the training exercise.

In this final chapter of the report, the Consultant outlines the methodological procedures to be used, and the basic assumptions to be made, for the assessment of drought impact. From this, participants in the training seminar should be able to conduct the exercise for the assessment of drought impact on the most affected sectors of the Belizean economy.

In the assessment of damage and losses use is to be made of the *ad hoc* methodology developed by ECLAC, [12] with some recent simplifications and with an adaptation to the specific case of drought. The simplifications refer to the adoption of the following definitions:

Damage: the total or partial destruction of physical assets, measured in physical terms and expressed in monetary value at replacement cost: and

Losses: changes in economic flows arising as a result of the disaster, including production that will not be obtained, its increased production costs, diminished revenues and increased operational costs in the provision of services, and unexpected expenditures.

The main general assumption, in addition to those specific for each sector that will be described later on, is that the drought has already ended by June 2005. While there is no scientific evidence to support this assertion, the time frame for the analysis of the drought will therefore be the period from June 2004 to May 2005.

For the assessment of losses, the ECLAC methodology bases its results in the estimation of the difference in economic performance between the non-disaster situation and the actual situation after the disaster. In this special case of drought in Belize, the economic performance of the affected sectors during the period June 2004 to May 2005 is to be compared with the one that would have occurred in the same period had the drought not taken place. To put it differently, the baseline for the assessment is the forecasted performance of the sectors made at the beginning of 2004, when no news had been received about the probable occurrence of a drought.

[12] Economic Commission for Latin America and the Caribbean, *Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters*, 2003.

Nearly all countries make such sectoral forecasts at the beginning of each calendar year, with varying accuracy. Belize is no exception, except in the cases of a limited number of sectors, as will be described in the following sections of this chapter. In any case, analyzing the recent trends of sectoral development and making educated projections of performance for the drought period can overcome such gaps. Each sectoral analysis and assessment is described in the following sections.

2. Agriculture

The analysis of the agriculture sector requires the utilization of the agricultural year, rather than the calendar year. This is due to the fact that some of the crops and plantations extend their growth and collection cycle beyond the month of December.

Data on the actual performance of the sector is described in Chapter III of this report, with breakdowns by individual products including grain and vegetables crops as well as plantation crops.

The Agriculture Department does not make any forecasts on the expected acreage and unit production or yield for each agricultural year, due to lack of sufficient resources in the field. Therefore, in order to determine the baseline for comparison of expected versus actual sector performance, an *ex post facto* analysis will have to be made for each product.

In addition to the above described information gap, no detailed statistics on prices at different levels are available for the analysis. In this case, again, some assumptions will have to be made that will be described in the case of each product under consideration.

Table 4-1

FARM-GATE PRICES OF SELECTED AGRICULTURAL PRODUCTS
IN BELIZE FOR 2003 AND 2004

(BZ$/pound)

Product	2003	2004
Grains		
Black beans	0.80	0.79
Red kidney beans	0.75	0.79
Corn	0.20	0.20
Rice paddy	0.22	0.22
Sorghum	0.14	0.14
Soybean	0.34	0.34
Vegetables		
Cabbage	0.75	0.59
Cucumber	0.50	0.50
Hot pepper	1.00	1.27
Sweet pepper	2.50	2.12
Tomatoes	1.00	1.40
Irish potatoes	0.65	0.69
Onion	0.60	0.74
Carrot	0.60	0.67
Other products (BZ$/L.Ton)		
Sugarcane	41.53	46.07
Sugar	27,100	39,400

Source: MAFC, and international price for sugar from UNCTAD.

The following step-by-step procedure is to be followed for the analysis, undertaking it separately for each affected agricultural product:

1. Develop production forecast for each individual agricultural product:

    a. Since the available data on surface area devoted to each crop in the 2004-2005 season does not clearly show whether it is the resulting acreage after losses caused by the drought, adopt the surface area of the previous agricultural season (i.e. year 2003);
    b. Assume the best or highest unit yield of the last three seasons, as the one that would have prevailed in the 2004-2005 season; and
    c. By combining the above two figures, estimate the projected or forecasted production volume for each product that would have been obtained in the 2004-2005 season if the drought had not occurred.

2. Estimate production losses due to the drought, by:

    a. Comparing the actual production volumes to the above estimated forecasted volume;

b. Adopt unit price – paid at farm-gate levels – for each product that are not affected by scarcity or speculation, such as those of the previous season (See Table 4-1 above), and

c. Combine the two figures to obtain the production loss value due to the drought.

3. Livestock

No estimates are required since the cattle and poultry growers associations have made their own calculations, as presented in table 3-5.

4. Agro-industry and commerce

In the case of the agro-industry and commerce sectors, separate estimates must be made for the case of the sugar milling process and for the processing of other agricultural products. In all cases, however, the general procedure involves making use of the data on production losses in the primary production of the processed goods, derived in Section 2 above, and applying slightly different criteria for the estimation of the actual agro-industrial losses.

a) Sugar milling

For this case of agro-industry, the following procedure and steps must be followed in order to estimate the losses due to the drought:

1. Adopt the production volume forecast of the primary product (sugarcane) as developed under Section 2;

2. Adopt the best sugarcane/sugar ratio that prevailed before the drought occurred (as given in table 3-6);

3. Combine these two figures to obtain the forecasted volume of sugar that would have been obtained in the 2004-2005 season if the drought had not occurred;

4. Estimate agro-industrial volume production losses by comparing the following figures:

    a. The forecasted volume of sugar for the non-drought condition, and

    b. The actual volume of sugar produced by the mills in the 2004-2005 season (given in table 3-6);

5. Adopt the international unit price of sugar for the 2004-2005 season (BZ$ 39,400 per long ton, from table 4-1), and

6. Estimate the value of agro-industrial and marketing losses in the sugar milling operation due to the drought, by combining the figures obtained in steps 4 and 5 above.

b) Other food processing industries and commerce

Since no detailed information is available on losses in the processing and marketing of other food products, due to the absence of special surveys, an indirect method is to be used for their assessment.

This is possible in cases of disasters when the installed capacity of the agro-industrial and commerce sectors is not directly affected, but where their production sustains losses due to reductions in the inputs that they derive from the (primary) agricultural sector. This case usually occurs after disasters caused by natural phenomena of hydro-meteorological origin – mainly drought [13] and floods [14] – that negatively affect the production of the primary sector. The agro-based industrial and commercial sectors become indirectly affected in view of their forward linkage along the production chain.

It is to be noted that this alternative, indirect procedure can only be applied to disaster cases where no damage has been sustained by the agro-industrial and commercial facilities, since it enables the estimation of losses in value added due to the absence of primary production as an input for the processing industry and the marketing sector.

The following steps are to be followed for the indirect estimation of losses in the agro-industry and commerce sectors:

1. Ascertain the volume of primary production losses that will not be available as inputs for the agro-processing industry, for each of the individual agricultural products affected by the drought, by:

    a. Adopt the volume of production loss for each affected agricultural product, as obtained under Section 2 of this chapter;

    b. Estimate the volumes of said products that are normally retained by the producers for their direct consumption, [15] and

    c. Determine the net volumes of each product that will then not reach agro-processing industries and commerce, as the difference between a) and b).

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[13] A very similar case to that of the 2004-2005 Belize drought was that of the Central American drought in 2001, where the same indirect method was successfully used. See ECLAC and CCAD, *El impacto socio-económico y ambiental de la sequía de 2001 en Centroamérica*, January, 2002.

[14] But other similar cases as well, such as the December 2004 tsunami that affected fishery and agricultural production in the Indonesian Provinces of Aceh and North Sumatra. See *Indonesia: Preliminary Damage and Loss Assessment; The 26 December 2004 Natural Disaster*. The Consultative Group on Indonesia, 19 January 2005, where this indirect loss assessment procedure was used.

[15] This is to take into consideration that farmers normally retain part of their production for direct use as food for their families, and they sell the remainder for processing and marketing (In the case of grains, 15 to 25%; vegetables, around 10%; and other products, 4%).

2. Analyze statistical data on unit prices for all the affected products, measured at farm-gate, wholesale and retail levels, for at least the year when the disaster occurred and the preceding one. It is assumed here that the price differential between wholesale and farm-gate prices is representative of the added value that is obtained through agro-industrial processing, and that the differential between retail and wholesale prices reflects the value added in the marketing of the products. Special care must be exercised in order to use unit prices that are not affected by the scarcity caused by the disaster, as this would affect the results and provide invalid estimations of the losses.

3. Estimate the (value added) production losses in agro-industry and commerce due to the disaster, by combining the price differentials described in point 2 above and the net volumes obtained in point 1c).

In the case of Belize, no comprehensive statistics on prices were available, except in the case of farm-gate or producer prices. Wholesale prices are available for some products, especially those under control by the Government. Thus, the procedure described above cannot be followed in detail. A further, simplified procedure must therefore be adopted, even though the accuracy of its results will be lower than usual. Nevertheless, an order of magnitude result will be possible to achieve, until detailed information on different price levels of agricultural products can be obtained in the future.

Based on experience accumulated by ECLAC in many past, similar exercises, the order-of-magnitude levels of prices shown in table 4-2 can be adopted for the analysis.

Table 4-2

THEORETICAL STRUCTURE OF PRICE LEVELS
FOR SELECTED AGRICULTURAL PRODUCTS

Price level	Per cent in relation to producer prices for:	
	Grains	Vegetables
Farm-gate or producer price	100	100
Wholesale price	166	135
Retail price	184	145

By using the data on producer prices included in table 4-1, in combination with the values given in table 4-2, it will be possible to estimate the value added losses in the agro-processing and commerce sectors, using the step-by-step procedure described in the preceding pages of this report. It must be noted, however, that losses in the marketing of processed agricultural products will be negligible since the commerce sector entrepreneurs will most likely have imported the goods that were not processed in the local agro-industries, and thus did not sustain losses. It is also possible that the profit margin in the commerce sector may be smaller, though, due to the higher unit price and transport costs of the goods acquired abroad, but at this point in time there is no information that may enable any better estimation of this losses. Thus, in the exercise, only losses in the agro-industry process are to be estimated.

4. Drinking water supply

As described in the preceding chapter, the drought caused two types of losses for the drinking water supply sector: increased consumption and cost of water to users due to the higher air temperatures, and higher pumping and other energy costs to the water utility (BWS). These losses are to be estimated separately.

For the estimation of higher water consumption costs, in the absence of more detailed information, it should be assumed that no new users were added to the water supply system in the past two years, and that the increase in water sales in 2004-2005 *vis a vis* that of the previous year are due exclusively to the higher demand of the users in view of the drought.

A comparison is to be made of monthly water volume sales for the period May 2004 to April 2005, to those of the previous year (see table 4-3 below). An average water rate of BZ$ 0.0175 per gallon should be used for the estimation of the value of increased costs paid by the users.

In order to make a first estimation of increased energy costs for the water supply utility, the partial data provided by BWS on per-cent power cost increases for the period February-May 2005 and included in Table 3-8, is to be used. A reference value of BZ$ 1.96 million must be used for total energy consumption in 2003.

Since no information is available on the value of the power consumption in each of the above subsystems under normal circumstances, some assumptions will have to be made in order to extrapolate the above values, and to arrive at a preliminary estimate of total energy cost increases in the utility due to the drought in the period February to May 2005. First, it should be assumed that each subsystem has a weight in total energy consumption proportional to the number of users that it serves (as shown in Table 3-7). Second, it should be assumed that under normal conditions, there exists a constant relation between electricity costs and water sales.

Table 4-3

MONTHLY DRINKING WATER SALES BY BWS
IN 2003-2004 AND 2004-2005

(Million gallons)

Month	Monthly sales	
	2003-2004	2004-2005
May	146.7	141.5
June	143.5	147.9
July	137.8	139.4
August	134.5	149.8
September	139.7	158.9
October	134.1	150.8
November	129.6	136.3
December	128.3	133.4
January	129.7	134.8
February	130.0	129.1
March	133.2	142.5
April	162.5	176.2

Source: BWS.

5. Electricity

The estimation of losses for the electrical sector must reflect the higher costs incurred by BEL in substituting the hydropower that it was not able to acquire from the *Mollejon* power plant during the drought months, by generation in its own thermal power plant. The forecasted and the actual generation obtained at Mollejon during the drought months is shown in Figure 3-5 and given in Table 4-4 below.

It will be assumed that given the expected very high rates of the Mexico electricity at peak load times, the hydropower shortage was met exclusively through generation at BEL´s thermal power plant.

Since no actual unit cost of electricity generation in each of the available sources (thermal, hydropower and imports from Mexico) have been made available, use should be made of the following unit values, adapted from an electric sector diagnosis prepared in 2003: [16]

[16] See *Energy for Sustainable Development; Toward a National Energy Strategy for Belize, Energy Sector Diagnostic*, 5 November 2003.

	Bz$/KWh
Hydropower plant	0.134
Thermal power	0.170
CFE Off-Peak	0.140
CFE Peak	0.760

Despite the above figures, it should be taken into consideration that the price for thermal power plant generation varies in direct relation to the international price of fuel. Thus, the rate of BZ$ 0.170 per KWh that prevailed in 2003 must be adjusted according to the recent international fuel price increases (See Table 4-5).

Table 4-4

FORECASTED AND ACTUAL MONTHLY HYDROPOWER GENERATION AT MOLLEJON PLANT, 2004-2005

	Power generation, MWh	
	Forecasted	Actual
June 2004	4,485.2	4,626.0
July	11,276.0	9,043.6
August	8,843.6	3,021.7
September	11,688.1	3,931.0
October	12,516.3	9,605.0
November	10,068.9	7,923.1
December	11,342.2	3,466.5
January 2005	5,960.0	4,596.6
February	3,840.0	1,635.3
March	2,520.0	1,067.6
April	790.0	515.4
May	N.A.	N.A.

Table 4-5

INTERNATIONAL PRICES OF DIESEL FUEL

(US$/Gallon)

Year/Months	Fuel Cost	Year/Months	Fuel Cost
2003, August	1.000		
2004		2005	
June	1.209	January	1.441
July	1.265	February	1.508
August	1.348	March	1.694
September	1.433	April	1.749
October	1.636	May	N.A.
November	1.576		
December	1.446		

Source: US DOE.

6. Summary of impacts

Once the sectorial estimates described in the preceding sections of this report have been completed, they must be aggregated in order to ascertain the total impact caused by the drought in the country.

To determine the magnitude of the disaster for the country, the total amount of estimated damage and losses should be compared to the gross domestic product of Belize in 2004.

It is to be noted that the overall macroeconomic impact of the drought cannot be estimated because key information is missing. The impact on economic growth can be estimated by reviewing the estimate of GDP for 2004 that is included in the ECLAC annual economic survey, and/or in any similar estimates that the Central Bank may have, by introducing the revised sectorial production losses that arise from the exercise described here. The impact on the external sector (the balances of trade and payments) cannot be attempted because no sufficient quantitative information is available in connection with exports and imports of the affected products. Furthermore, no analysis of the possible impact of the drought on inflation can be made since no statistical information is kept on price variation over time of the affected goods. And, finally, it is not possible to measure or estimate the impact of the drought on the fiscal budget, since no information is available on increased expenditures and/or decreased tax revenues incurred by the government.