Government of the Republic of Trinidad and Tobago

Second National Communication of the Republic of Trinidad and Tobago

Under the United Nations Framework Convention on Climate Change

April 2013

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List of Abbreviations

C&I	Criteria and Indicators
CAREC	Caribbean Epidemiology Center
CBD	Convention on Biological Diversity
CBO	Community-Based Organisations
CCS	Carbon Capture and Sequestration
CDIAC	Carbon Dioxide Information Analysis Centre
CDM	Clean Development Mechanism
CNG	Compressed Natural Gas
COP	Conference of Parties
CREDP	Caribbean Renewable Energy Development Programme
CSO	Central Statistical Office of Trinidad and Tobago
DF	Dengue Fever
EMA	Environmental Management Authority
FAO	Food and Agriculture Organisation
FRA	Forest Resource Assessment
FY	Financial Year
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Gigagram (1 Gg = 1 kilotonne)
GHG	Greenhouse gas
GORTT	Government of the Republic of Trinidad and Tobago
GWP	Global Warming Potential
HACCP	Hazard Analysis and Critical Control Points
HSF	Heritage and Stabilization Fund
IMA	Institute of Marine Affairs
IMO	International Maritime Organisation
INC	Initial National Communication to the UNFCCC
IPCC	Inter-Governmental Panel on Climate Change
IRSF	Interim Revenue Stabilization Fund
ITCZ	Inter-tropical Convergence Zone

LST	Local Standard Time
LULUCF	Land Use, Land Use Change and Forestry
MCM	million cubic meters
MEEA	Ministry of Energy and Energy Affairs
MLD	million litres per day
MSW	Municipal Solid Waste
mtpa	metric ton per annum
NCD	Non-Communicable Diseases
NEP	National Environmental Policy
PETROTRIN	Petroleum Company of Trinidad and Tobago
PFE	Permanent Forest Estate
PRECIS-CARIBE	Providing REgional Climates for Impact Studies for the Caribbean
ProEcoServ	Project for Ecosystem Services
PTSC	Public Transport Service Corporation
RA	Revenue Assurance
Ramsar Convention	The Convention on Wetlands
RHA	Regional Health Authority
SFM	Sustainable Forest Management
SIDS	Small Island Developing State
SWMCOL	Solid Waste Management Company Limited
t DM/ha	Tonnes of Dry Matter per Hectare
THA	Tobago House of Assembly
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UWI	The University of the West Indies
V&A	Vulnerability and Adaptation
WASA	Water and Sewerage Authority of Trinidad and Tobago
WRA	Water Resources Agency of Trinidad and Tobago
WTTC	World Travel and Tourism Council

Foreword

The Ministry of the Environment and Water Resources (MEWR) of the Government of the Republic of Trinidad and Tobago (GORTT) is pleased to present the Second National Communication (SNC) of the GORTT to the United Nations Framework Convention on Climate Change (UNFCCC). Although Trinidad and Tobago is a Non-Annex I party to the UNFCCC, we remain committed to contributing to the achievement of the Convention's objective of "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Trinidad and Tobago, as a Small Island Developing State, faces great challenges in adapting to climate change while being relatively insignificant contributors to the problem. We have therefore combined strategies for mitigation and adaptation in the national climate change policy and other relevant climate-related policies and programmes established since the Initial National Communication (INC). These policies and programmes address issues such as the promotion of alternative/renewable energy; the pursuit of low-carbon development; the reduction of greenhouse gases; adaptation of priority sectors; and support for regional initiatives to achieve the objective of the Convention. The SNC builds upon the greenhouse gas (GHG) inventory baseline year of 1990, as reported on in the INC. However, there still exists gaps in the national data related to vulnerability and adaptation studies, and which are elaborated in the Chapter on Constraints and Gaps, including recommendations with respect to proper data collection and sharing; technology needs; capacity building; research and development constraints; and challenges to preparing national reports such as this.

The Government of Trinidad and Tobago has also begun to put in place innovative institutional arrangements to facilitate capacity building and mainstreaming climate change into national development. The Multilateral Environmental Agreements Unit (MEAU) in the MEWR is tasked with monitoring and coordinating national implementation of obligations under the UNFCCC and has recently led an initiative on developing a national network of climate change focal points in government ministries, agencies, statutory authorities, non-governmental organisations, (NGOs), community-based organisations (CBOs), industry, academia and the private fiduciary institutions. The network is aimed at facilitating an understanding of the respective roles of stakeholders in addressing climate change at the sectoral, sub-national and national levels. Additionally, the GORTT recognises the need for high-level oversight and has appointed an inter-ministerial committee tasked with monitoring the mainstreaming of climate change in national development. There is therefore in place a system of coordination at both lateral and vertical levels covering all relevant stakeholders.

The Environmental Management Authority (EMA), a line agency of the MEWR, provided oversight of the preparation of the SNC. During its preparation the EMA recognised the many challenges and limitations experienced by the team engaged in compiling the report.

The most significant challenge was access to data in useable formats to perform the necessary inventory of GHGs and assessment of vulnerability and adaptation. Looking ahead to the Third National Communication, we must learn from the experiences in preparing the previous two Communications. The Secretariat to the Convention notes that: "Accurate, consistent and internationally comparable data on GHG emissions is essential for the international community to take the most appropriate action to mitigate climate change, and ultimately to achieve the objective of the Convention."

The GORTT anticipates being able to deliver significantly improved communications through capacity building and technology transfer available to us as a party to the Convention. We see preparation of these reports as vital to increasing understanding of climate change in Trinidad and Tobago and to influencing global climate change policies that take cognisance of our unique challenges and difficulties. Trinidad and Tobago has played a leadership role at the international climate change negotiations in the recent past and we are determined to also demonstrate that leadership in addressing climate change at the national level.

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Senator the Honourable Ganga Singh
MINISTER OF THE ENVIRONMENT AND WATER RESOURCES
GOVERNMENT OF THE REPUBLIC OF TRINIDAD AND TOBAGO

Institutional Arrangements & Acknowledgements

The Environmental Management Authority executed the project, inclusive of securing the services of the consultants and managing the financial resources, to prepare the report and provided technical editing guidance. The Multilateral Environmental Agreements Unit of the Ministry of the Environment and Water Resources provided expert technical and policy guidance to the consultants, as required, during the entire phase of preparation of this report.

Funding was provided by the United Nations Development Programme through the Global Environment Facility.

Preparation of this report would not have been possible without the expert contributions from the consulting team from the University of the West Indies.

We also acknowledge the many other contributing partners from the public and private sector who provided data and information relevant to the project—these contributors are acknowledged by attribution within the report.

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Executive Summary

The Initial National Communication of The Republic of Trinidad and Tobago under the United Nations Framework Convention on Climate Change (UNFCCC) was prepared and published in 2001. This Second National Communication of The Republic of Trinidad and Tobago focuses on the compilation and analysis of the National Inventory of greenhouse gases (GHGs), vulnerability and adaptation studies, mitigation options as well as on recommendations with respect to proper data collection and sharing, technology needs, capacity building, research and development constraints and challenges.

The Republic of Trinidad and Tobago, as a signatory to the UNFCCC, is committed to playing an integral role in helping to achieve the ultimate objective of the UNFCCC.

Under Article 4 of the UNFCCC, the Republic of Trinidad and Tobago is required to publish, update periodically and make available to the Conference of Parties (COP) its National Inventory of GHGs and its national programmes to mitigate and adapt to climate change. Taking into account climate change scenarios, it is also expected that relevant future socio-economic and environmental policies and actions would be developed and implemented.

The baseline year for the inventory presented in this communication is 2000 but comparisons are made with the previous inventory year of 1990, reported on in the Initial National Communication, but also includes a trend analysis for the period 1990-2005, 2006 or 2008 where data was available. The revised 1996 Intergovernmental Panel on Climate Change (IPCC) guidelines were utilised in inventorying GHGs emitted from five sectors: energy, industrial processes, waste, agriculture and land use, land use change and forestry. Overall, there has been an observed increase of the GHGs emitted which is consistent with increased socioeconomic development. Over the period 1990 to 2006 GHGs emissions have approximately quadrupled for the energy sector.

There has been an increase in GHG missions in the transportation sector (1990 - 2005) which correlates with an increase in the number of vehicles for the same period. The main contributors to the increased GHGs emitted from the industrial sector were iron and steel, ammonia and cement production. The same increasing trend has been observed for the waste sector with the net annual emissions almost tripling from 15.96 gigagrams (Gg) in 1990 to 47.16 Gg in 2008. In the agriculture, forestry and land use sector there was an observed net storage of carbon mainly due to the relatively large forest cover (50%, 2 590 / 5 131sq km) in Trinidad and Tobago as well as good forest management practices.

In the compilation of the GHGs inventory, certain default emission factors were applied. This may have resulted in large uncertainties since these emission factors may not have been relevant to the processes. Therefore further research is needed to develop relevant emissions factors which are applicable especially in the industrial processes and agricultural practices.

Trinidad and Tobago, as a Small Island Developing State (SIDS), is particularly vulnerable to the effects of climate change. Some of the more vulnerable sectors are agriculture, water resources, biodiversity including coral reefs, tourism, health, marine and coastal resources. The scenarios analysed for future climate change utilised the **Providing REgional Climates for Impact Studies** (PRECIS-CARIBE), the interactive webpage for access to the results of the PRECIS Regional Climate Model runs for the Caribbean. Future changes in temperature and precipitation were assessed for the 2035, 2050 and 2075 time slices for the months of February and July since these months were identified as the coolest and wettest months respectively. The agricultural sector was noted as being particularly vulnerable in the central to southern parts of Trinidad compared to the northern parts and to Tobago. However, due to data unavailability, the vulnerability of specific crop types could not be modeled.

In the preparation of this Second National Communication, comprehensive vulnerability and adaptation analyses were challenged by the lack of appropriate data to facilitate adequate modeling with the one exception being health. It is expected that the Third National Communication would focus on vulnerability and adaptation studies.

Significant National Policy developments undertaken by the Government of Trinidad and Tobago since the Initial National Communication include: revision of the National

Environmental Policy (in 2006) and approval of a National Climate Change Policy, which provides for action on mitigation and adaptation as well as a National Forest Policy and a Protected Areas Policy (all in 2011) which also address climate change issues. The goal of the National Climate Change Policy is to provide policy guidance for the development of an appropriate administrative and legislative framework for the pursuance of a low-carbon development path for Trinidad and Tobago. This framework must be in harmony with other sectoral policies and promote suitable and relevant strategies and actions to address climate change, including sectoral and cross sectoral adaptation and mitigation measures. The aim of the National Forest Policy and the Protected Areas Policy is to guide the sustainable management of the natural forestry and wildlife resources of Trinidad and Tobago and the wise use of these resources, including their role in mitigating and building climate resilience.

The Government is implementing its climate change policy through the development of a strategy and action plan as well as other initiatives intended to result in the direct reduction and /or avoidance of GHGs emissions. For example, the Ministry of the Environment and Water Resources is coordinating initiatives towards addressing climate change from a policy and legislative perspective via development of a carbon reduction strategy in the transportation, industrial and power generation sectors. Current efforts to mitigate GHGs emissions in the transportation sector include the implementation of a project to "green" the Priority Bus Route, a dedicated bus transportation route that runs east-west in the northern and most densely populated area of the country. This project is expected to change diesel-operated buses to compressed natural gas (CNG) and replace conventional grid-powered street and traffic lights with those using solar power. Additionally, the Government has declared a policy regarding the increased use of CNG as an alternate motor vehicle fuel. CNG is less carbon intensive than gasoline and its use would result in a decrease of greenhouse gas emissions from the transportation sector.

It is expected that State-owned vehicles will be converted first. Some incentives have already been developed and implemented to allow for favorable consideration of conversion by private vehicle owners. These include wear and tear allowances and the removal of customs duty on CNG conversion kits. Some state agencies, such as the Environmental Management Authority (EMA), have already begun conversion of their vehicle fleet to CNG. However, in spite of these incentives there are a number of challenges which impact on the adoption of renewable energy initiatives in Trinidad and Tobago. These include:

- a cheap source of energy/fuel;
- excess power generation capacity at this point in time which makes demands for new sources of alternative energy less attractive;
- lack of a regulatory framework which would allow for renewable energy to enter into the national power grid; and
- Trinidad and Tobago Electricity Commission (T&TEC) regulations which require licenses for power generation.

The Government recognises these constraints and is actively pursuing a programme of policy and legislative reform. To this end, a policy and legislation analysis has been conducted and relevant recommendations are under active consideration. The Government also recognises the important role that all sectors of the society need to play in addressing climate change, particularly in the implementation of the National Climate Change Policy and in the decision making process. To this end the Cabinet has mandated the designation of climate change focal points in all government ministries, agencies, non- governmental organisations, industry and the private sector, academia and community-based organisations with a view to identifying key constituencies of stakeholders and so engage them in the policy and decision making process. Public awareness and education activities on broad environmental issues are spearheaded by the EMA through an educational and public awareness programme at a national level for issues concerning climate change. This awareness programme is directed to all age groups and takes the form of pamphlets, TV commercials, posters, competitions and lectures. A significant part of this programme also includes cooperation with non-governmental organisations and community-based organisations in reaching out to coastal communities and stakeholders.

The major constraint in the preparation of the Second National Communication was one of data availability and accessibility of sectoral models for vulnerability analysis. Significant gaps remain in the available sources of national data which need to be filled. This would facilitate adequate future analyses. Financial resources were made available by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP) to address this issue. However, additional resources would be required for sectoral modeling and capacity building for vulnerability analyses.

Chapter 1 National Circumstances

The Republic of Trinidad and Tobago is an archipelagic state in the southern Caribbean, lying northeast of the South American nation of Venezuela and south of Grenada in the Lesser Antilles. It also shares maritime boundaries with Barbados to the northeast and Guyana to the southeast. Figure 1.1 shows a map of the Republic of Trinidad and Tobago.

Figure 1.1 Map of the Republic of Trinidad and Tobago.

Source: (Ezilon, 2012)

Overview

The Republic of Trinidad and Tobago covers an area of 5 131 square kilometers (1 979 square miles) with the island of Trinidad being the larger and more populous of the two main islands. Tobago is much smaller, comprising about 6 % of the total area and 4 % of the population. The capital of the Republic of Trinidad and Tobago is Port of Spain.

Climate

The Republic of Trinidad and Tobago lies approximately between 10º N and 11.5°N latitude, and 60º W and 62º W longitude, off the eastern coast of Venezuela. Moving southwards, they are the last two islands of the Caribbean archipelago with Trinidad being the most southerly. As a result of their southerly location, Trinidad and Tobago experiences two relatively distinct seasonal climatic types:

- **Tropical Maritime** which is experienced during January to May with warm days and cool nights with relatively low rainfall. The rainfalls at nights are mainly due to daytime convection.

- **Modified Moist Equatorial** occurs between June and December. It is characterized with hot humid days and nights, low wind speeds and increased rainfall. However, the rainfall is due not only to convection but also to equatorial weather systems (Trinidad and Tobago Meteorological Services, 2009).

These two climate types described above result in two distinct seasons, a dry season from January to May and a wet or rainy season from June to December. Tobago, the more northerly of the two islands, experiences a drier dry season and Trinidad a wetter wet season (Pollonais, 1998). Figure 1.2 depicts the average monthly rainfall for the period 1960 - 2006 measured at the facilities of the Meteorological Services of Trinidad and Tobago (Piarco, Trinidad), and shows the difference between the monthly rainfall for the dry and wet seasons. Figure 1.3 shows the pattern of the average annual rainfall for the same period.

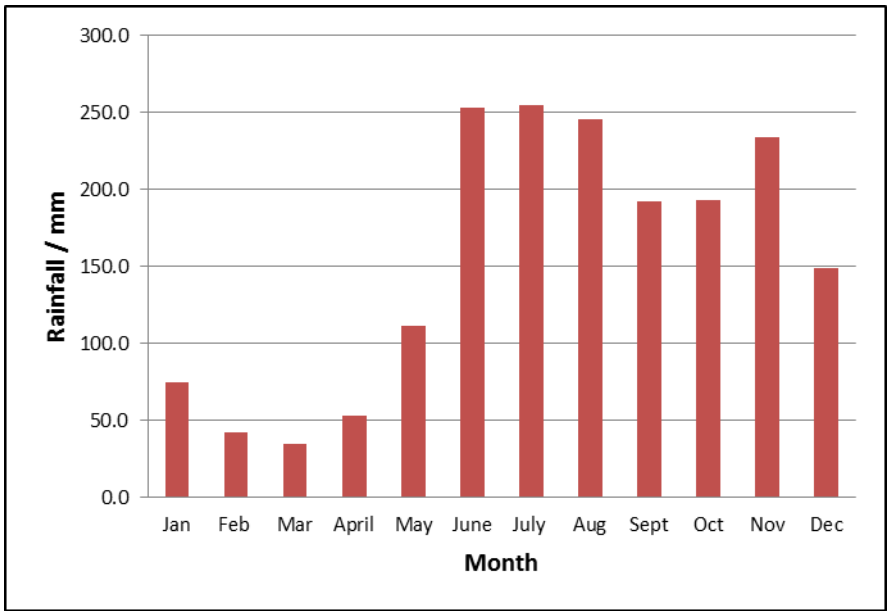


Figure 1.2 Average monthly rainfall at Piarco, Trinidad, for the period 1960 - 2006.

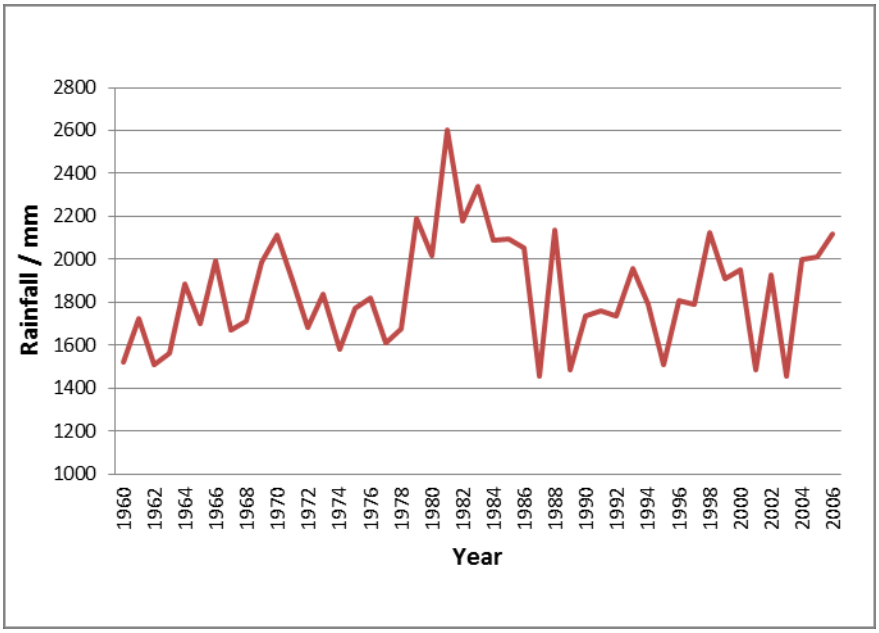


Figure 1.3 Average annual rainfall at Piarco, Trinidad, for the period 1960 - 2006.

Climatic Determinants

The main climatic determinants affecting Trinidad and Tobago are:

- The latitudinal position and strength of the Azores-Bermuda High, which is an area of permanent high pressure;
- The Inter-tropical Convergence Zone (ITCZ) which is the major rainfall/cloud-producing system that is largely responsible for the rainfall during the Caribbean's wet or rainy season;
- The Mid-Atlantic Trough of low pressure – an upper troposphere feature that assumes increased prominence mainly during the fall and early winter months of the Northern Hemisphere (September to November); and
- Daytime convection, orography and land size (Trinidad and Tobago Meteorological Services, 2009).

The controls that have minor effects on the climate are:

- The occasional intrusion of polar fronts into our latitudes, mainly during the dry season as shear lines, bringing with them some rainfall;
- Tropical waves and cloud clusters in the easterly wind current which is noticeable only during the hurricane season from June to November;
- Tropical cyclones, i.e. depressions, tropical storms and hurricanes, bring increased rainfall but cannot be given major determinant due to their low frequency and occurrence; and
- The sea breeze cooling effect (*Ibid*.).

The average maximum daily temperatures, minimum daily temperatures and the average daily temperatures at Piarco in Trinidad for the period 1960 - 2006 are shown in Figure 1.4.

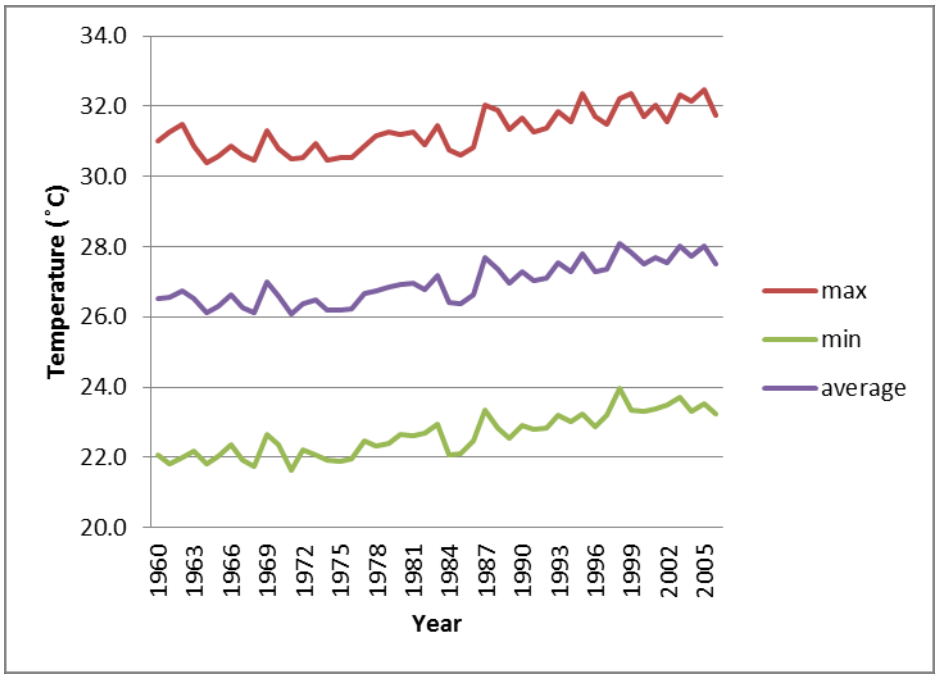


Figure 1.4 Average maximum daily temperatures, minimum daily temperatures and average daily temperatures at Piarco, Trinidad, for the period 1960 - 2006.

Winds

The following description of wind speeds and wind directions occurring at Piarco, Trinidad, was based on data for the period 1989 - 2009. The long-term average wind speed at Piarco was 3.15 m/s, with a mean wind speed of 3.35 m/s during the dry season and a mean of 2.61 m/s in the wet season. The wind speed showed a pronounced diurnal variation with winds during the night time period having average speeds of 1.4 m/s. Figure 1.5 shows that wind speeds reached a maximum at 12 noon Local Standard Time (LST) with an average value of 5.3 m/s. During the dry season this maximum increased to 5.9 m/s while in the wet season it decreased to 4.7 m/s.

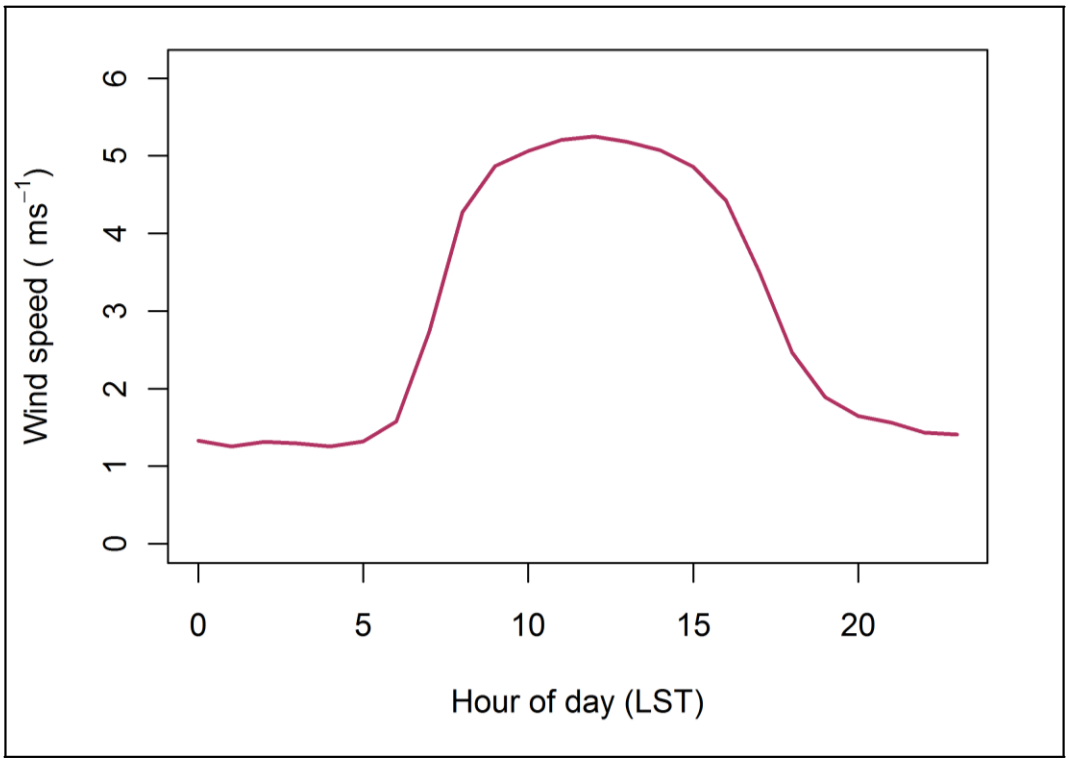


Figure 1.5 Diurnal variation in the mean wind speed, Piarco, Trinidad.

The wind speed frequency histogram for the period 1989 - 2009 is shown in Figure 1.6 and reveals a bimodal feature with two frequency peaks with the primary one occurring at 1-2 m/s and the secondary one at 4-5 m/s. Further disaggregation of the wind speed frequency data over this timeframe with respect to the dry and wet seasons showed that the primary peak slightly increased in frequency in the wet season. Wind speeds exceeded 4 m/s for 41 % of the time during the dry season and 28 % of the time during the wet season while the percentage of the occurrence of low winds increased during the wet season.

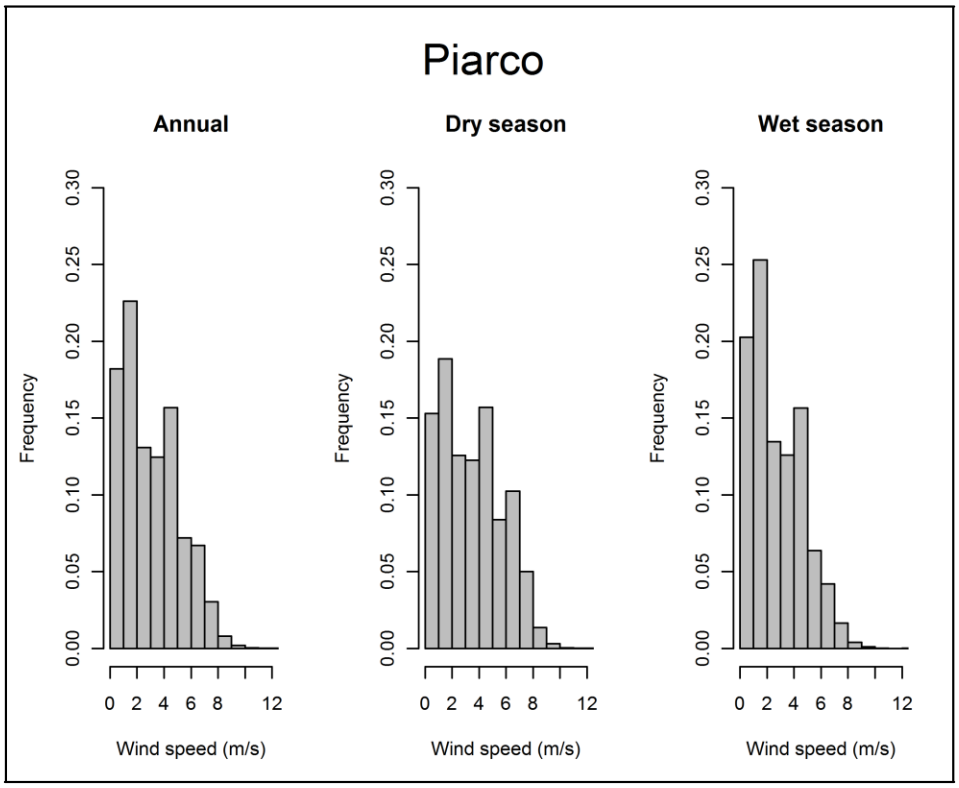


Figure 1.6 Frequency histogram of wind speeds for the period 1989 - 2009, Piarco, Trinidad.

The range of annual wind speeds as defined by the 25th and 75th percentiles in the dry season was between 1.3 m/s and 5.1 m/s. During the wet season the 75th percentile value dropped to 4.0 m/s indicating a smaller range of wind speeds during the wet season. The annual variability (standard deviation) in the wind speeds was 2.17 m/s. The variability in the wind speeds in the dry season was only 0.21 m/s higher than that of the wet season whose standard deviation was 2.01 m/s.

Throughout the year the winds were primarily from the east (46 %) and east-north-east (40 %), with a much smaller contribution due to northeasterly winds (6 %). Easterly winds occurred 45 % of the time in both seasons. The east-north-easterly winds decreased in occurrence by 9% as the year progressed into the wet season while the east-south-easterly winds increased in occurrence by 3.5 %.

Extreme Weather Events (Wind speed related)

The official Atlantic hurricane season extends from June 1st through November 30th. During the period 1961 - 2009, three hurricanes and nine tropical storms affected Trinidad and Tobago (Caribbean Hurricane Network, 2011). Winds associated with these tropical cyclones ranged between 31 km/h and 195 km/h. Of the two islands, Tobago is more susceptible to the threats posed by tropical cyclones. Of the twenty-six cyclones that passed close to Trinidad and Tobago during the period 1878 - 2000, twenty-five cyclones posed a threat to Tobago. Hurricane Flora (1963) caused the greatest damage to infrastructure and agricultural lands with damages estimated at US $30 million for Tobago and US $60 000 for Trinidad (Trinidad and Tobago Meteorological Services, 2002). During the period 1878 to 2000 about 40 % of the tropical cyclones occurred during the month of August and 20 % in September. Figure 1.7 shows an analysis of tropical systems passing within 60 nautical miles of Tobago in five year cycles over the period 1851 - 2010.The data reveal that most storms (3) occurred during the 2000 - 2004 cycle and the most severe hurricanes during the 1960 - 1964 and 2000 - 2004 cycles.

category 3-5 hurricanes: purple; category 1-2: red; tropical storms: blue

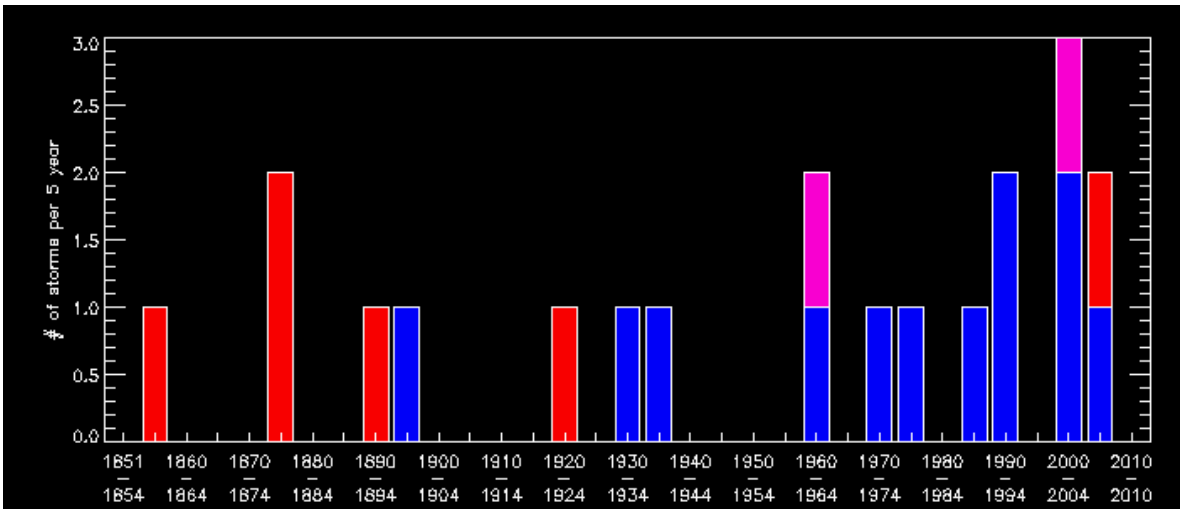


Figure 1.7 Tropical Systems passing within 60 miles of Tobago per 5 year cycle for the period 1851 - 2010.

Source: (Caribbean Hurricane Network, 2011)

Political Structure

The Republic of Trinidad and Tobago became an independent state in 1962 under the British monarchical system. This changed in 1976 when the republican system of government was adopted. The Constitution now provides for a President as Head of State who acts in accordance with the advice of a Prime Minister or Cabinet. The Constitution also provides for a Prime Minister whose duties, as head of the executive arm of Government, include informing the President about the general conduct of the Government.

The Parliament of the Republic of Trinidad and Tobago consists of the President, the Senate and the House of Representatives. Under the Constitution, the Cabinet is responsible for the general direction and control of the Government and is collectively responsible to Parliament. The Cabinet consists of the Prime Minister (who chairs) and other Ministers, one of whom is the Attorney General, chosen from among members of the House of Representatives and the Senate as appropriate, in accordance with the advice of the Prime Minister.

The Judiciary is headed by the Chief Justice who is appointed by the President after consultation with the Prime Minister and the Leader of the Opposition. The President, acting in accordance with the advice of the Judicial and Legal Service Commission, appoints Supreme Court Judges.

The Tobago House of Assembly (THA), which was established in 1980, is the local government body responsible for the island of Tobago, within the nation of Trinidad and Tobago. In addition to the normal local government functions, the THA handles many of the responsibilities of the central government, but lacks the ability to collect taxes or impose local laws or zoning regulations. Within the THA there are the Executive and the Legislative arms (Assembly Legislature). The Executive arm of the Assembly is headed by the Chief Secretary in his capacity as leader of the Executive Council, which has individual and collective responsibility for carrying out the functions of the Assembly through the several Divisions arranged for the purpose. To support the work of the Assembly there also is the Legislative Arm where all members of the Assembly meet in plenary and/or in select committees to make policy decisions with respect to the operations of the Assembly.

The political structure of Trinidad and Tobago has changed from that described in the Initial National Communication of the Republic of Trinidad and Tobago. The total number of seats in the House of Representatives (Lower House) has been increased from 36 to 41. This was achieved through redrawing boundaries of several electoral constituencies which were selected on the basis of population quotas per constituency. General Elections were held in November 2007 and filled these additional seats for the first time. Both the previous and current administrations have indicated intent to undertake constitutional reform that may result in further changes to this system.

Demographics

Population and population growth

Censuses are taken in Trinidad and Tobago every 10 years. Figure 1.8 shows the population trend over the 40 year period 1960 - 2000. During this timeframe the population of Trinidad increased from 794 624 to 120 8282 – an increase of 413 658 (52.06 %).With respect to Tobago the population increased from 33 333 in 1960 to 54 084 in 2000, an increase of 62.25 %. The total population of Trinidad and Tobago, 2000 census, compared with 1990 census showed an increase of 3.88 %. Of this Trinidad showed an increase of 3.5 % and Tobago 16.5 % respectively from the 1990 figures. The lowest growth rate over the period 1851 - 2000 occurred between 1990 - 2000 (0.39 %).

Population projections up to 2025 (Figure 1.9) predict that the total population of Trinidad and Tobago would be expected to increase slowly to about 1 310 888 by 2015 (3.8 % increase over the 2000 figures) and then decline over the next 10 years reaching a projected population of 1 294 347 by 2025.This projected decline can be linked to a number of indicators including decreasing birth rates and increasing migration with increased globalization.

For Trinidad, 2000 census, the population comprised 606 283 males (50.17 %) and 601 999 (49.82 %) females, showing an increase in males by 4.0 %, and females by 3.0 % over the 1990 figures. For Tobago, 2000 census, there were 26 768 males (49.49 %) and 27 316 females (50.50 %), showing increases of 14.7 % in males and 18.2 % in females over the 1990 figures.

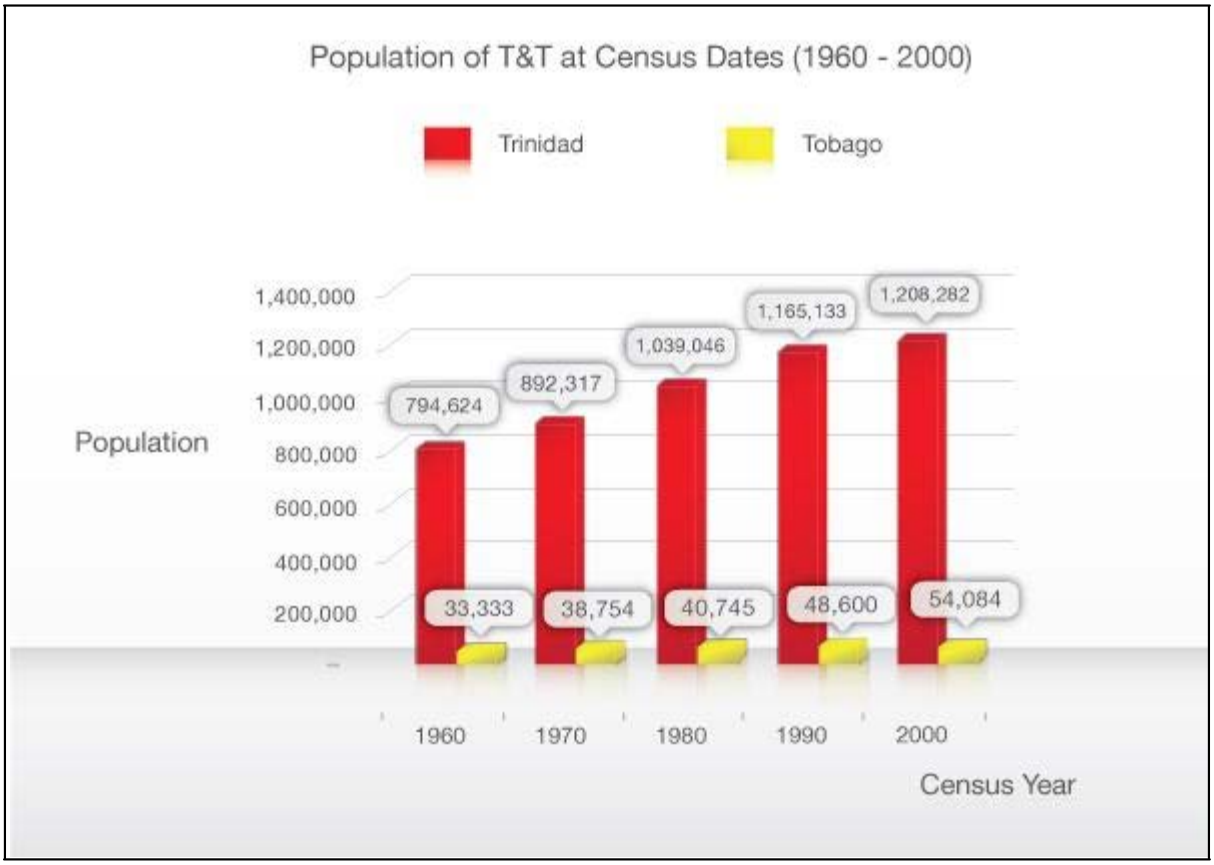


Figure 1.8 Population of Trinidad and Tobago at Census Dates for the period 1960 - 2000.

Source: (CSO Population Vital Statistics, 1960 - 2000)

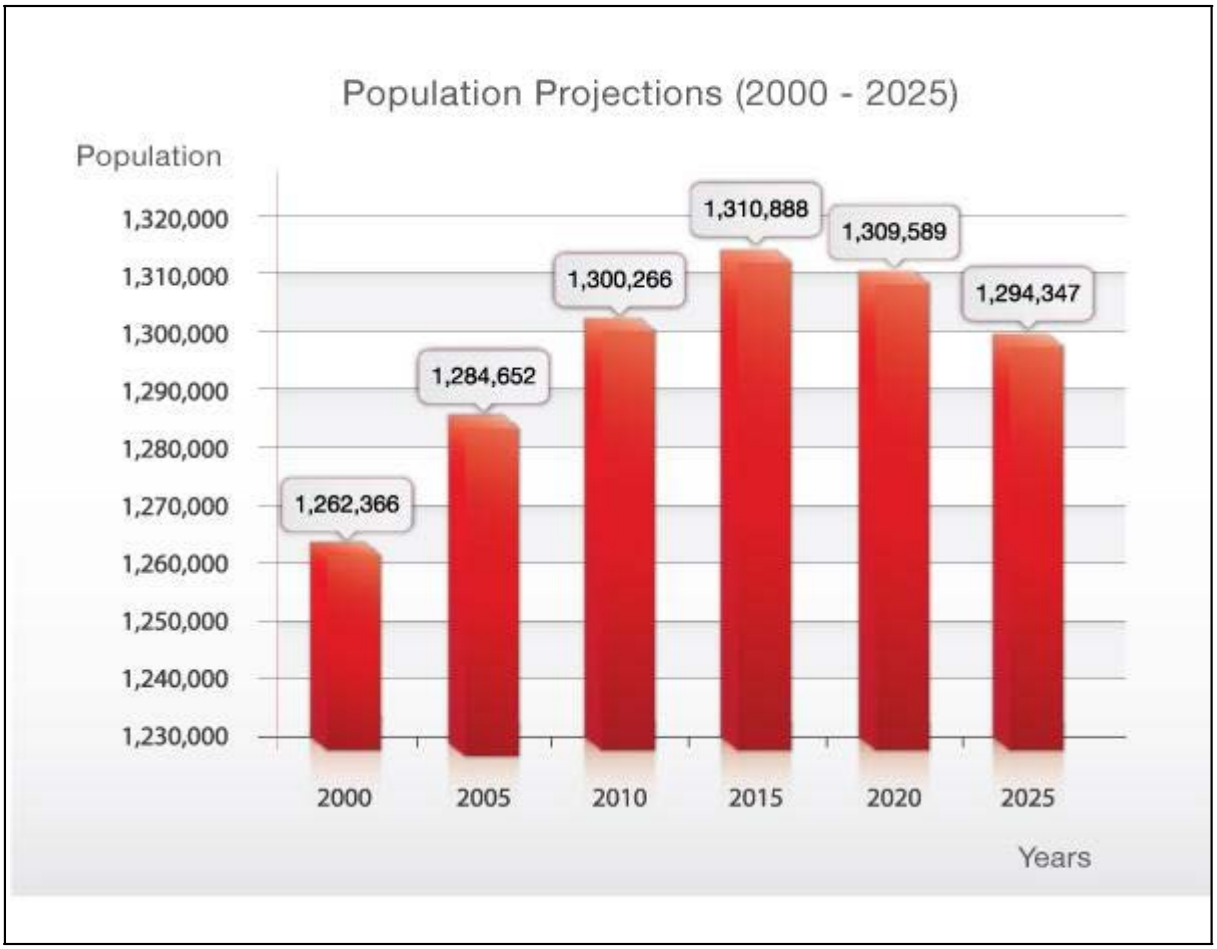


Figure 1.9 Population Projections for Trinidad and Tobago for the period 2000 - 2025.

Source: (CSO Population Vital Statistics)

Overall population density for Trinidad and Tobago in 2000 was given as 246 persons per square km, showing an increase of 3.80 % from 1990 data (237 persons per square km). The corresponding population density for Trinidad (2000 data) was 250 persons per square km and Tobago was 180 persons per square km, which is a percentage increase of 10.13 % for Trinidad and 11.11 % for Tobago over the 1990 figures.

At the 2000 census date, the crude birth rate was estimated at 14.36 births per thousand, while the death rate was 7.5 per thousand, creating a natural population increase rate of 6.9 per thousand.

The average life expectancy for the total population of Trinidad and Tobago is 70.86 years. For males, average life expectancy is 67.98 years and for females it is 73.82 years (Central Intelligence Agency, 2009).

Economic Profile

Trinidad and Tobago, the leading Caribbean producer of oil and gas, has earned a reputation as a good investment site particularly for hydrocarbon investments. Tourism is a growing sector, although it is not proportionately as important a contributor to real Gross Domestic Product (GDP) as in many other Caribbean islands. In 2011 GDP growth declined by an estimated 1.4 % following declines of 0.02 % and 3.3 % in the previous two years and due primarily to the international financial crisis of 2008 and 2009 (Figure 1.10). It should be noted also that this decline in GDP is reflective of the depressed performance in both the energy and non-energy sectors nationally. However, this decline in economic growth during the period 2009 - 2011 followed positive real GDP growth in 2005 - 2008. The slow rate of the growth in the national economy in 2011 was due primarily to lower energy production including domestic crude, methanol and natural gas, as well as the slowdown in the international environment. The non-energy sectors in Trinidad and Tobago were not immune to the contractionary impacts of the international financial crisis. Further, the manufacturing, distribution and construction sectors were particularly adversely affected due to the prevailing unfavourable local industrial relations climate and the imposition of a State of Emergency in the latter part of 2011(Figure 1.11).

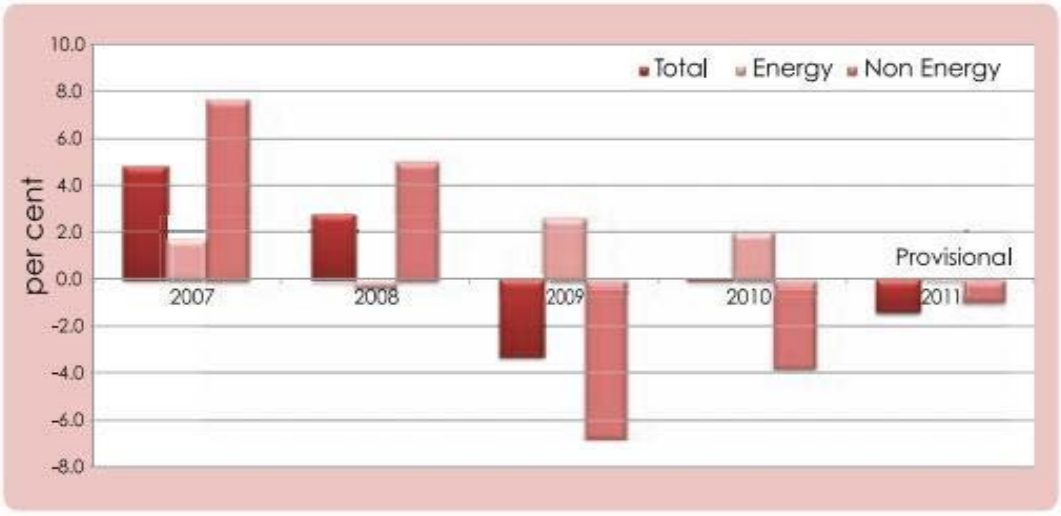


Figure 1.10 Real GDP growth rates for the period 2007 - 2011.

Source: (Central Bank of Trinidad and Tobago, *Annual Economic Survey*, 2011)

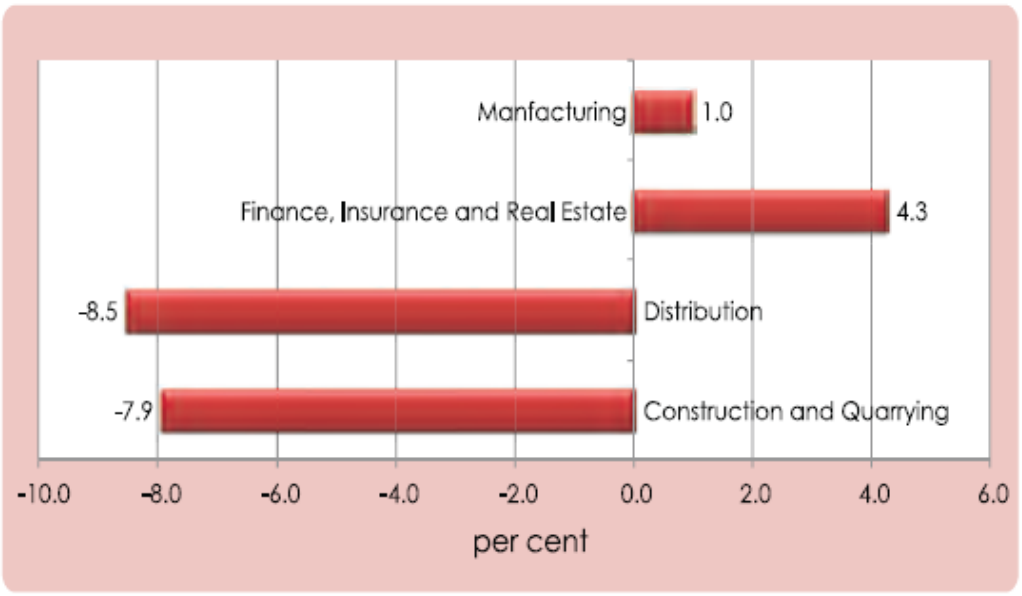


Figure 1.11 Real changes in GDP sub-sectors in 2007 - 2011.

Source: (Central Bank of Trinidad and Tobago, *Annual Economic Survey*, 2011)

Over the fiscal year 2011/2012 the Central Government has thus far recorded a budget deficit, following the trend over the past few years. This deficit is anticipated at TTD 7 642.4 million

and is compared to an estimated budget deficit of TTD 7 032.2 million in fiscal year 2010/2011.

An increase in transfers to State Enterprises was recorded from TTD 1 687.6 million in 2009/2010 to TTD 1 746.4 million in 2010/2011, showing the highest rise in subsidies within the past three fiscal years. However, systems are being put in place to ensure greater fiscal soundness in the operations of State Enterprises. This would lend credibility to the government's ongoing divestment program. Trinidad and Tobago's financial infrastructure is adequate by regional standards.

The buying value of the TT$ to the USD also showed only minor depreciation from 6.2440 to 6.3729, a percentage decrease of 2.06 % over the period 2005 - 2011. Table 1.1 shows the weighted average of TT$ Exchange Rate to USD for the period, 2005 - 2011.

Table 1.1 The Weighted Average of TT$ Exchange Rate to USD, for the period 2005 – 2011.

Year	**Weighted average of TT$ Exchange rate to USD**	
	Buying	**Selling**
2005	6.2440	6.2990
2006	6.2319	6.2996
2007	6.2735	6.3282
2008	6.2234	6.2891
2009	6.2735	6.3259
2010	6.3203	6.3757
2011	6.3729	6.4261

Source: (Central Bank of Trinidad and Tobago, 2009; Central Bank of Trinidad and Tobago, 2011)

The Piarco International Airport is the main airport serving the twin-island republic of Trinidad and Tobago. It is situated about 25 km east of the capital city of Port of Spain. A major

expansion of the airport, which included the construction of a new terminal building and high speed taxiways, was completed in 2001.The airport is equipped to accommodate most widebody aircraft and can handle peak hour passenger traffic of 1500 processing passengers. It serves as the hub for the national airline carrier, Caribbean Airlines, and is the third hub for Leeward Islands Air Transport (LIAT) carrier.

There is an extensive network of paved roads and utilities which are fairly reliable in the cities. However, some areas, especially rural districts, still suffer from water shortages, power failures and inadequate drainage. Infrastructure improvement, especially rural roads and bridges, rural electrification and telephone service and drainage and sewerage, are among the government's budget priorities.

Telephone service is relatively modern and reliable. Cellular service is widespread and has been the major area of growth for several years. The Internet has also come into widespread use. The CIA World Fact Book Report (2009) estimated that as of 2009 there were 1 894 000 mobile cellular sets and 293 300 telephone lines in use in Trinidad and Tobago. The combined fixed line and cellular density (2009) was 180 per 100 persons. Internet users were estimated at 593 000.These numbers have increased significantly over the last two years.

In Fiscal Year (FY) 2004 – 05, the government of Trinidad and Tobago decided to convert the existing Interim Revenue Stabilization Fund (IRSF) into a Heritage and Stabilization Fund (HSF). The broad objectives of the HSF are to save part of the energy sector revenues for stabilization, intergenerational wealth transfer and strategic investments. It is expected that the fund will allow Trinidad and Tobago to prepare for the post-petroleum and gas era by developing a diversified economy and attenuating the impact on the economy emanating from the volatility and uncertainty in the prices of oil and gas. The Heritage and Stabilization Fund (HSF) was established with the passing of the HSF Act. No. 6 in March 2007 (Ministry of Finance, 2012).

The HSF comprises two portfolios: A Financial Investment Portfolio, which would hold more liquid assets assigned to two accounts: a Fiscal Sustainability account and a Heritage account; and a Strategic Investment Portfolio based on a Strategic account.

Deposits in any financial year are made when oil and gas taxation revenues for that year exceed the budgeted medium-term oil and gas taxation revenues by at least 10 percent. Withdrawals from the fund would be for two purposes: **stabilisation** - in the event of a short fall in revenue from oil and gas taxation; and **strategic investment** - to undertake strategic and tactical investments in companies identified for this purpose. Sixty percent of the deposits to the HSF would be for the Financial Investment Portfolio and the remaining 40 percent for the Strategic Investment Portfolio. The assets comprising the Financial Investment Portfolio will be managed by the Central Bank as part of its external reserves. The overall HSF would be managed by a Board of Governors, which reports to the Minister of Finance (now referred to as the Minister of Finance and the Economy), and will publish a quarterly report.

Since the establishment of the HSF, there have been two deposits made to date: TTD 3 026.5 million in the fiscal year 2009/2010, and TTD 2 890.0 million in 2010/2011 which will be funneled into strategic national development mechanisms promoting economic diversification.

Renewable Energy

The Government of Trinidad and Tobago recognizes that energy security, efficiency and conservation and a sustainable environment are crucial to the country's economic sustainability. In light of this recognition and consistent with mainstreaming climate change into national development, the Government of the Republic of Trinidad and Tobago (GORTT) has begun to put in place the policy framework and enabling environment pursuant to national climate change policy objectives of pursuing a low- carbon development path in the context of its thrust towards national sustainable development. Both the Medium Term Policy Framework (MTPF 2011-2014) as well as the Sustainability Report (2012) allude to the GORTT's efforts to diversify the economy away from its skewed dependence on non- renewable resources to alternative, renewable energy sources. These efforts include fiscal incentives and capital investments and this policy shift is in keeping with the country's move to a greener economy. Evidence of this can be seen from the fact that the GORTT has taken some steps to promote the development and utilization of renewable energy resources by proposing a Solar Industrial Development Plan and a National Wind Resource Assessment Programme and developing Renewable Energy and Energy Efficiency (EE) initiatives (Ministry of Finance, 2011; Ministry of Finance, 2012). The GORTT recognizes that a national role must be played,

in collaboration with global partners, in mitigating the climate change threat. Table 1.2 lists some of the fiscal incentives the Government of Trinidad and Tobago has introduced to promote the utilization of renewable energy resources and energy efficiency devices.

Table 1.2 Government's incentives for Renewable Energy.

SOLAR	WIND	ENERGY EFFICIENCY (EE)
25 % Tax Credit on Solar Water Heaters (SWH)	0 % VAT on Wind Turbines	150 % Allowance for the design and installation of energy saving systems by an Energy Service Company(ESCO)
150 % Wear & Tear Allowance for SWH;SWH Plant, Machinery and Equipment, and Solar PV Systems	150 % Wear & Tear Allowance for Wind Turbines and supporting equipment	ESCO can write off value of assets in two years: - a)75 % Depreciation on plant, machinery and equipment acquisition; b) 25 % Wear& Tear Allowance in following year.
Conditional Duty Exemptions for SWH Manufacturers		
0 % VAT on SWH& Solar PV Systems		

Source: Ministry of Finance

The GORTT anticipates that among the potential benefits of adopting renewable energy initiatives are:

- Capitalising on opportunities for strategic economic benefits in a changing world environment;
- Creating new avenues for employment, revenue and foreign exchange generation;
- Contributing to a cleaner environment through the reduction in GHGs, thereby reducing global warming which can mitigate the impact of climate change, as well as achieving collateral benefits related to air quality and human health;
- Diversification away from dependence on non-renewable energy resources;
- Identification of sustainable alternative/renewable sources of energy that will be available even after depletion of the oil and gas resources; and

- Exploring opportunities for carbon trading under the Clean Development Mechanism (CDM) of the Kyoto Protocol.

In furtherance of the above, the Ministry of Energy and Energy Affairs (MEEA) is in the process of formulating a Renewable Energy Policy Green Paper that promotes renewable energy development and usage in Trinidad and Tobago. It is intended that this Green Paper would provide a framework for decision making by the Government in exploiting and harnessing the country's renewable energy resources

Agriculture

For most of its history, Trinidad and Tobago's agriculture has been export oriented – sugar, coffee, cocoa, citrus and copra – due to its profitability and reduced risk to producers. However, over the past 30 years, export agriculture has declined significantly with domestic agriculture now dominating. The consequence is that the sector has further diminished in relative importance in the economy. Globalisation and international trade developments now pose a significant challenge to the growth of the agricultural sector emphasising the need for increased productivity and competitiveness if profitability is to be achieved and investment attracted. Trinidad and Tobago has a land area of 5 131 square kilometers with farmland accounting for 25 % (131 572 ha) (Ministry of Food Production Land and Marine Affairs). Of this 131 572 ha, land use was as follows: cultivated cropland – 62.1 %; cultivated grassland – 3.4 %; fallow land – 6.6 %; new land being prepared for crops/pastures – 3.4 % and the rest not being utilised. The country has considerable ecological diversity that includes mountains, plains, forests, swamps and wetland areas, savannahs, rivers and waterfalls and a rich flora and fauna (Ministry of Food Production Land and Marine Affairs, 2001).

In 1999, 46 800 (9.1 %) of the labour force were employed in farming and livestock production, fishing and forestry, with tens of thousands in peripheral agricultural activities. As at June 2011, this figure drastically decreased to 20 500 or 3.5 % of the labour force. In 2011, the agricultural sector contributed approximately 0.6 % of GDP to the economy of Trinidad and Tobago. Sugar production as an official government industry was discontinued in 2003 with the government completely withdrawing from the industry in 2007. In this context it should be noted that the GORTT has signed a Financing Agreement (FA) (2010) in the sum of 16.551 Million Euros with the European Union for budget sector support related to the

diversification of approximately 76 000 acres of former Caroni (1975 Limited) lands. The FA is to support diversified use of the former Caroni lands in three focal areas: Residential Use; Agriculture (other than sugar cane), e.g. megafarms; and Light Industrial Estates (eTeCk).

One of the performance indicators of the FA relates to the development of an Environmental Stability Plan (ESP) and a Programme of Action for implementing the ESP. The EMA is charged with the responsibility of developing the POA, which is intended to ensure that the diversified use of the former Caroni lands occurs with minimal environmental impacts. The EMA has incorporated elements into the POA aimed towards mitigating effects on Climate Change from the change in land use.

Table 1.3 shows the Agricultural Sector Contributions to the economy for the period 1991 - 2011. The following are noted:

- The Agricultural Share of GDP at Current Market Prices in the year 1991 had a value of 3.4 % and drastically declined to a value of 0.6 % in 2011; and
- During the period of 1991-2011 the Agricultural Share of Labour Force decreased from 11.7 % to 3.5 %.

Table 1.3 Agriculture Sector contributions for the period 1991 - 2011.

Year	Gross Domestic Product (Market prices, TT$M)	Gross Domestic Product at Current Market Prices by Sector of Origin (TT$M)	Annual change of agriculture GDP (Current market prices, %)	Sectoral Composition of GDP at Current Market Prices	Agriculture labour force (persons)	Agriculture share of labour force (%)
1991	22 558.6	762.2	3.4	3.4	51 100	11.7
1992	23 117.6	8 701.6	5.2	3.5	49 100	10.8
1993	24 490.5	815.6	1.7	3.3	45 675	10.8
1994	29 311.7	651.4	-30.1	2.2	52 590	11.7
1995	31 697.0	733.1	12.5	2.3	47 800	10.1
1996	34 448.1	668.7	-8.8	1.9	42 275	9.0
1997	36 552.4	864.7	29.3	2.4	46 900	9.3

1998	38 197.1	828.3	-4.2	2.2	41 200	8.1

Table 1.3 Agriculture Sector contributions for the period 1991 – 2011 (continued).

Year	Gross Domestic Product (Market prices, TT$M)	Gross Domestic Product at Current Market Prices by Sector of Origin (TT$M)	Annual change of agriculture GDP (Current market prices, %)	Sectoral Composition of GDP at Current Market Prices	Agriculture labour force (persons)	Agriculture share of labour force (%)
1999	41 044.9	891.3	7.6	2.2	46 800	9.1
2000	513 370.6	697.2	-16.0	1.4	36 400	7.2
2001	55 007.3	707.6	1.5	1.3	40 100	7.8
2002	55 365.6	787.2	11.2	1.3	36 100	6.9
2003	66 168.3	674.6	-14.3	1.2	31 400	5.9
2004	83 652.5	637.0	-5.6	0.8	26 000	4.6
2005	100 682.0	487.3	-23.5	0.5	25 000	4.4
2006	115 951.2	657.3	34.9	0.6	25 700	4.4
2007	136 952.5	509.0	-22.6	0.4	22 400	3.8
2008	175 287.2	640.7	25.9	0.4	25 300	4.3
2009	124 358.8	739.3	15.4	0.6	23 300	3.9
2010	132 960.6	869.3	17.6	0.7	21 000	3.6
2011	143 880.7	926.5	6.6	0.6	20 500	3.5

Source: (Central Bank of Trinidad and Tobago, *Annual Economic Survey*, 2011)

Forestry & Land Use

Since 2010, there has been a marked increase in research to improve the accuracy in data collection with respect to the determination of the areas under forest cover in Trinidad and Tobago. The Food and Agriculture Organisation (FAO) in 2005 reported that only data on state forests were utilised in estimating the areas under forest cover since the permanency of private

forest was largely unreported. A recent study conducted by the FAO in 2010, estimates total forested areas to be 226 413 hectares (Food and Agriculture Organisation, 2010).

Forest Types

The most widespread forest formation is evergreen seasonal forests, which contributes 82 410 hectares or 36.4 % of the total forested area of Trinidad and Tobago (Food and Agriculture Organisation, 2010). The two main species which characterize the main canopy trees of the lowland areas are the *Carapa guianensis* (Crappo) and *Eschweilera subglandulosa* (Guatecare). Tropical evergreen sub-montane and montane forests occur in the mountains of the Northern Range of Trinidad. There are about 14 092 hectares of fragmented swamp forests and mangrove relicts around the coast. Tables 1.4 and 1.5 show the total forested area (Ha) by forest class for the period 1970 - 2010, and the total forests (including total secondary forests) for the period 1970 - 2010, respectively.

According to the FAO Report (2010) all lands lost from forests are placed under the section 'Other areas within forests'. The subset of data (Table 1.4) highlights the rate of loss of forested areas over the 1970 - 2010 period. Also according to the FAO Report (2005) the annual deforestation rate between 1990 and 2000 in Trinidad and Tobago was an estimated 2 000 hectares or 0.8 % of the forest area.

Major factors influencing the loss of forests in Trinidad and Tobago are improper land use from agricultural practices on hillsides, housing developments on mountains, non-legal settlement (squatting), commercial or illegal felling of trees, forest fires and natural disasters such as hurricanes (Pantin and Ram, 2010).

Table 1.4 Total Forested Area (Ha) by Forest Class, for the period 1970 - 2010.

National classes	1970	1994	1990	2000	2005	2010
Evergreen seasonal forest	98 180	88 718	90 295	86 352	84 381	82 410
Semi-evergreen seasonal	13 928	12 586	12 810	12 251	11 971	11 691
Deciduous seasonal forests	3 617	3 268	3 326	3 181	3 108	3 035
Dry evergreen forests	495	447	455	435	425	415
Seasonal montane forests	926	837	852	815	796	778
Montane forests	21 619	19 535	19 882	19 014	18 580	18 146

Table 1.4 Total Forested Area (Ha) by Forest Class, for the period 1970 - 2010.

National classes	1970	1994	1990	2000	2005	2010
Swamp forests	16 789	15 171	15 441	14 767	14 429	14 092
Secondary forests	22 650	20 467	20 831	19 921	19 466	19 012
Teak and pine plantations	16 308	15 000	15 000	15 000	15 000	15 000
Other plantations	5 306	5 306	5 306	5 306	5 306	5 306
Bamboo	528	528	528	528	528	528
Water	1 613	1 613	1 613	1 613	1 613	1 613
Other areas within forests	53 729	72 212	69 349	76 505	80 086	83 662
Private lands	201 312	201 312	201 312	201 312	201 312	201 312
Total forest owned by state	255 688	255 688	255 688	255 688	255 688	255 688
Private forest	56 000	56 000	56 000	56 000	56 000	56 000
Total land area (Ha)	**513 000**	**513 000**	**513 000**	**513 000**	**513 000**	**513 000**

Source: (Food and Agriculture Organisation of the United Nations, Forestry Department, Global Forest Resources Assessment Country Report for Trinidad and Tobago, 2010)

Table 1.5 Total Secondary Forests, for the period 1970 - 2010.

Year	Total Forested Area (Ha)	Total Secondary Forest (Ha)	Secondary Forests as a % of Total Forested Area
1970	256 346	22 650	8.84
1990	240 726	20 467	8.50
1994	237 863	20 831	8.76
2000	233 570	19 921	8.53
2005	229 989	19 466	8.46
2010	226 413	19 012	8.40

Source: (Food and Agriculture Organisation of the United Nations, Forestry Department, Global Forest Resources Assessment Country Report for Trinidad and Tobago, 2010)

Planted Forests

The total planted forest was estimated in 2010 to be about 20 306 hectares, comprising *Pinus caribaea* (Caribbean pine) and *Tectona grandis* (teak, introduced from Myanmar in 1913), plantations of 15 000 hectares and other commercial forest species with 5 306 hectares. The planted forests of Trinidad and Tobago contribute to about 8.97 % of the total forested area.

Forest Tenure

Most forested land is owned and administered by the state. State-owned forest, including all the Permanent Forest Estates (PFE), account for 255 688 hectares (Table 1.4) of the total forested area of Trinidad and Tobago, the remainder is in private hands.

Sustainable Forest Management (SFM) Policy Framework

The Republic of Trinidad and Tobago has long had a systematic approach to SFM. For example, its block management and shelterwood systems have been applied for more than 60 years. However, it lacks a system of Criteria and Indicators (C&I) suited to its needs, which would be an important part of any SFM policy framework. The Government is seeking to modernise its approach to SFM with the recent adoption of the National Forest Policy, which seeks to redress some of the shortcomings through streamlined instituional arrangements as well as updated regulatory frameworks.

Transport

Public Transport

The Public Transport Service Corporation (PTSC) is a Government-run bus-service responsible for road transport. Public transport is also provided by hired cars, privately owned taxis and maxi-taxis. Hired cars, maxi-taxis and PTSC buses carry passengers along fixed routes for fixed fares across most of the country.

The more densely populated areas of both islands are served by reasonably adequate roads. However, large sections of Tobago either have no motorable roads or are connected by narrow and poorly surfaced ones.

The Trinidad Government Railway was built while Trinidad was a colony of the United Kingdom. However, Trinidad's lone remaining railway, from Port of Spain to San Juan, was closed in 1968. As a strategy to address the traffic congestion on the nation's highways the National Renewable Energy Committee has recommended the introduction of a more comprehensive and reliable mass transit system inclusive of a rapid rail network which would have many benefits including the reduction of GHG emissions (Ministry of Energy and Energy Affairs, 2012).

Water Transport

The largest port installation for passengers and cargo is at Port of Spain. The Trinidad and Tobago Ferry Service operates two ferries daily between Port of Spain and Scarborough. These ferries are relatively fast and the fares relatively inexpensive, while a Water Taxi Service currently operates between the cities of San Fernando and Port of Spain. There is also a planned expansion of the Water Taxi Service to include new destinations such as Point Cumana to the west, and Chaguanas and Point Fortin to the south of the island.

The Port of Brighton is important for oil and asphalt loading. Also, there are oil terminals at Chaguaramas, Pointe-a-Pierre and Point Fortin. The port of Point Lisas is a deep-water port and accommodates principally the energy-based industries at the Point Lisas Industrial Estate. Port Point Lisas is located in the Gulf of Paria, 32 km south of Port of Spain and 20 km east of Venezuela. It is referred to as the "Gateways to the America" catering for containerised cargo from around the world. It has six berth and its services include: import/ export of containers; breakbulk cargo; transshipment; provision of stevedoring services. The port also handles large volumes of steel and project cargo, mainly for new plants on the adjacent estate, making it one of the top breakbulk ports in the region (PLIDECO, 2012).

Air Transport

All air facilities in Trinidad are concentrated at the Piarco International Airport situated about 26 km east of Port of Spain. On the western tip of Tobago there is a secondary main airport called the ANR Robinson International Airport. British West Indian Airways was the national airline of Trinidad and Tobago. However, it ceased operating in 2006. Caribbean Airlines became the new successor national airline of the Republic of Trinidad and Tobago in 2007. Caribbean Airlines operates domestic, regional and international services. A number of international airlines operate services out of Piarco International Airport mainly to United States, Canada, Central America and England.

Tourism

Tourism in Trinidad and Tobago has different development potentials for both islands, with Tobago having close to half of its GDP derived from this industry. This is a crucial sector, particularly for Tobago, and can be used to diversify the product portfolio of Trinidad and

Tobago, which currently is heavily reliant on the hydrocarbon industry for its revenue generation.

According to the World Travel and Tourism Council (WTTC) 2012 report, the total contribution of tourism and travel to Trinidad and Tobago in 2011 was estimated at TTD 11 984 700 representing 7 % of total GDP. According to the previous study by the WTTC in 2008, tourism and travel contributed to 40 % of Tobago's direct and indirect economic activity in 2008 and 98.1 % of direct exports from the island. In contrast, tourism and travel in Trinidad contributed to 13 % of the GDP for the year 2008. The stark difference in sectoral contributions may be attributed to Trinidad's heavy economic reliance on the hydrocarbon industry versus tourism for its revenue generation.

In 2011, the total contribution of travel and tourism to employment, including jobs indirectly supported by the industry, was 9.3 % of total employment (56 000 jobs), which equates to TTD 55.9 million.

The National Tourism Policy of Trinidad and Tobago (2010) recognises the differences between the product offerings of each island and the urgent need to diversify these product offerings. For Trinidad, the unique selling proposition is its cultural diversity, such as its Carnival and unique Christmas celebrations as well as its thriving business environment as the financial hub of the Caribbean. However for Tobago, its selling proposition is the semi-rustic and idyllic island-environment, focusing on leisure tourism. In both islands "Eco-Tourism" is an emerging product of economic importance. In addition to the foregoing and particularly germane to the potential impact that tourism could have on GHG emissions, the National Tourism Policy (2010) highlights the need to reduce the carbon footprint for the local travel and tourism industry.

Environmental Management Programmes

There are a number of environmental management programmes which contribute to the overall management of the environment in Trinidad and Tobago. These are:

Wetlands Management

Wetland management involves activities that can be conducted within and around wetlands, both natural and man-made to protect, restore, manipulate or provide to their functions and values. Effective wetland management requires knowledge on a range of wetland subjects (Turner and Gannon, 1995).

Trinidad and Tobago acceded to the Convention on Wetlands, the Ramsar Convention, in April 1993. This international Convention with 130 Contracting Parties at present is an inter-governmental treaty, which aims to conserve wetlands of international importance. The accession of Trinidad and Tobago to the Convention on Wetlands signaled to both the national and international communities the country's commitment to the promotion of wise use of our wetlands.

A National Wetland Committee was established in January 1995 with representatives of relevant Government ministries and non-governmental organisations. A draft National Wetland Policy was developed by the National Wetlands Committee to guide the integration of wetland conservation and wise use into Trinidad and Tobago's national planning.

At present there are three (3) sites in Trinidad and Tobago which have been declared Ramsar Sites – the Buccoo Reef/ Bon Accord Lagoon (Tobago), the Nariva Swamp and the Caroni Swamp (Trinidad) – totaling an area of 15 919 hectares (Ramsar Sites, 2012).

Wildlife Management

Wildlife management in Trinidad and Tobago has several legally designated protected areas/ categories. One such category is the Wildlife or Game Sanctuaries. There are thirteen (13) Wildlife or Game Sanctuaries designated under the Conservation of Wild Life Act (Chap. 67:01). These sanctuaries are intended to protect wild animal species by restricting hunting and collection of animals in and from such sanctuaries (Ministry of Legal Affairs, 2009). The Act prescribes for the facilitation of the development and adoption of appropriate wildlife habitat and species management to produce a stable ecosystem and populations. Strategies include:

- Conservation of natural habitats;
- Recovery to a safe status all wildlife species threatened with extension; and

- Manage habitats and migratory wildlife species for their intrinsic scientific and recreational value.

Watershed Management

The draft Watershed Management Policy is currently awaiting Cabinet approval. Its goals include among others, the integration of water resources management to contribute to sustainable development and the protection of environmental quality and ecological systems. Some of the key activities proposed under this Watershed Management Policy are:

- Prevention of conversion of forest reserve to other uses;
- Protection of critical watershed areas including source protection, restoration, conservation, flood buffers, slope stabilisation, intake protection, sedimentation reduction;
- Establishment of zoned uses for critical watersheds;
- Promotion of ecologically and technologically appropriate agro-forestry, soil conservation, reforestation;
- Development of approaches to control negative practices like quarrying and deforestation; and
- Development of a programme to address non-point pollution from storm water, agricultural runoff and septic tanks.

The Environmental Management Act

The Environmental Management Act, Chapter 35:05 undertakes the following:

- The establishment of an Environmental Management Authority to coordinate, facilitate and oversee execution of the national environmental strategies and programmes;
- The promotion of public awareness of environmental concerns; and
- The establishment of an effective regulatory regime which will protect, enhance and conserve the environment.

This Act also provides for the development of subsidiary legislation including those for waste management, water pollution, air pollution, environmentally sensitive areas and species, noise pollution and other programmes related to recycling and reuse. The subsidiary legislations provided for under this Act are at various stages of development. To date the Certificate of

Environmental Clearance (CEC) Rules, Noise Pollution Control Rules, Water Pollution Rules, Environmentally Sensitive Areas Rules and Environmentally Sensitive Species Rules have been completed. The Air Pollution Rules, Waste Management Rules and Beverage Containers Bill are in draft form.

Climate Change Policies

Some of the National Policies relevant to climate change are summarised below.

National Environmental Policy (NEP) (2006)

The NEP sets the overarching policy framework for environmental management in Trinidad and Tobago and addresses the key sectors relevant to climate change including reduction and management of greenhouse gas emissions through the application of clean technology and the enhancement of natural sinks for carbon sequestration. It also provides a holistic approach to adaptation issues including conservation and protection of natural resources and the attendant socio-economic considerations (Environmental Management Authority, 2009).

National Climate Change Policy (2011)

The purpose of this Policy is to establish a multifaceted framework for dealing with climate change and encompasses the effects of global warming and climate change issues relating to Trinidad and Tobago.

Some of the major objectives of this National Climate Change Policy include:

- Reducing or avoiding greenhouse gas emissions from all emitting sectors;
- Enhancing carbon sinks;
- Protection of the natural environment and human health;
- Conducting vulnerability assessments and implementing adaptation options
- Educating the wider public on the potential impacts of climate change and the recommended adaptation strategies; and
- Enhanced agricultural production and food security

National Policy and Programmes on Wetland Conservation for Trinidad and Tobago (2002)

This programme was developed to fulfill obligations under The Convention on Wetlands of International Importance (Ramsar Convention) to help manage the threats to the wetlands. The

policy also requires that governments protect, manage and restore wetlands in order to sustain and enhance their ecological and socio-economic values for future generations.

Some of the major objectives related to the protected wetland areas include the following:

- The encouragement of public protection of outstanding examples of wetlands in private ownership;
- To encourage the management of all privately owned wetlands to promote the protection of their functions;
- Promote the use of publicly protected wetlands as examples for education and awareness; and
- Integration of management of wetlands with watershed and catchment area management (National Policy and Programmes on Wetland Conservation for Trinidad and Tobago, 2002).

National Protected Areas Policy (2011)

The purpose of this policy is to establish an appropriate framework for the selection, legal designation and management of a national system of protected areas. The three objectives pursued in designating and managing protected areas are:

- To conserve the country's natural heritage, genetic, species and ecosystem diversity, evolutionary and ecosystem processes and biogeochemical processes;
- To conserve the country's cultural and historical heritage; and
- To optimise the contribution of protected areas to sustainable livelihood and human well-being, including opportunities for education and recreation (National Protected Areas Policy, 2011)

National Forest Policy (2011)

The purpose of the National Forest Policy is to guide the sustainable management of the forest resources of Trinidad and Tobago, including the use of these resources and the impacts and consequences of these resources.

The objectives of this policy include:

- Optimising the contribution of forest resources to livelihoods;
- Enhancing native genetic, species and ecosystem diversity; and
- Maintaining and enhancing the natural productivity of forest ecosystems (watershed functions, catchment area functions, etc) to provide important ecosystem services (National Forest Policy, 2011).

National Tourism Policy of Trinidad and Tobago (2010)

This policy acknowledges that global warming impacts on climate change which in turn may have a negative impact on the tourism industry. The effects of climate change can manifest themselves in the form of beach erosion, coral bleaching, water and food shortages, ecosystem collapse, sea level rise and extreme weather events.

The National Tourism Policy Goals shall be sustainably-based, people-centered, innovation and investment driven and supported by the private sector (Ministry of Tourism, 2010).

National legislation - both draft and in force - relevant to climate change issues include:

- Draft Air Pollution Rules (2010)
- Water Pollution Management Programme (2005)
- Water Pollution Rules (2001), as amended
- Draft Waste Management Rules (2008)
- Certificate of Environmental Clearance Rules (2001)
- Environmentally Sensitive Areas Rules (2001)
- Environmentally Sensitive Species Rules (2001).

Institutional Arrangements

The GORTT has recognised the need for appropriate institutional arrangements to be put in place to facilitate the coordination required for the preparation of national communications. This follow the adoption of the National Climate Change Policy which has a provision to be revised every five years. In this regard the following institutional arrangements have been established.

Multilateral Environmental Agreements/Climate Change Focal Point Network

In recognition of the need for building synergy across the various stakeholders given the cross-cutting nature of climate change, as well as the synergetic relationship across multilateral environmental agreements (MEAs), the Cabinet has approved the appointment of a Focal Point for multilateral environmental agreements with particular focus on climate change in all government ministries, agencies, statutory bodies, academia, the private sector, including the banking and insurance sector, industry, non-governmental organisations, and community based organisations. At the time of writing more than 120 nominations of focal points from these sectors have been secured and a network of focal point has been established with a view to identifying various constituencies of stakeholders at all levels with a role in addressing climate change including provision of data and information to facilitate reporting on nationa communications. The network is coordinated by the Multilateral Environmental Agreements Unit of the Ministry of the Environment and Water Resources.. It is envisioned that the nework will be engaged on a continuous basis for sharing of knowledge and information with a view to full stakeholder participation in decision-making at the policy and implementation levels.

Ministerial Coordinating Committee

In order to facilitate proper integration of climate change policies into national sustainable development, the Cabinet has appointed Ministerial Coordinating Committee to provide oversight at the ministerial level with a view to addressing barriers to implementation and providing overall oversight to the implementation of the National Climate Change Policy.

Undergraduate Climate Change Course at the University of the West Indies, St. Augustine

The Faculty of Science and Technology at the St. Augustine, Trinidad campus of the University of the West Indies has been running an undergraduate module on climate change impacts and management which includes training in GHG inventorying, vulnerability and adaptation as well as international policy over the past several years. This arose out of the recognition of the need for increased capacity on climate change issues and was a direct initiative taken after the preparation of the Initial National Communication. As a result, there has been an increased level of competency in addressing climate change issues.

Chapter 2 National Inventory of Greenhouse Gases

Introduction

This chapter reports on the total national emissions by sources and removals by sinks of greenhouse gases (GHGs). The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories guidelines and softwars were followed in the compilation of this inventory.

The results of the inventory satisify the reporting guideline for the year 2000. However, emission trends are also provided for the period 1990 to 2006 for comparative and information purposes.

Based on the industrial and other activities occurring in Trinidad and Tobago over the period 1990 – 2006, the emissions of carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and non-methane volatile organic compounds (NMVOCs) were estimated for the data that were available. The Sectoral and Reference approaches as defined in the 1996 IPCC Guidelines for greenhouse gas inventory have been used. The Reference approach uses national consumption data while the Sectoral approach utilises sectoral consumption data.

The Energy Sector

The energy sector GHG inventory was compiled using data obtained from the Ministry of Energy and Energy Affairs (MEEA) and the Trinidad and Tobago National Petroleum Marketing Company Limited. The Sectoral approach was used in the compilation of this part of the inventory and was based on fuel sales and not on the actual fugitive emissions from fuels due to the unavailability of data. The Sectoral approach covered the Energy Industries, Manufacturing Industries and Construction, Transport, Other Sectors (Commercial/Institutional, Residential and Agriculture/Forestry/Fishing) and Other (Government, Retail and Peddlers/Distributors).

The baseline year for the energy sector for the GHG inventory under the Initial National Communications was 1990. The total national CO_2 emissions under the Reference and Sectoral approaches as reported in the Initial National Communication of the Republic of Trinidad and Tobago were 16 454 gigagrams (Gg) and 887 Gg, respectively for 1990. The 1990 baseline year data were reanalysed using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories in the light of an **updated data set.** The revised calculations using this updated data set for the Reference and Sectoral approaches were 16 806 Gg and 19 885 Gg of CO_2 emissions, respectively. The difference in the sectoral emissions could have been as a result of access to data that may not have been available at the time of inventorying. Nonetheless, there is no large discrepancy between the Reference approach and the sectoral approach for 1990.

Reference Approach

The output using the Reference approach indicated a significant increase of CO_2 emissions for the period 1990 - 2006. These emissions increased from 16 806 Gg CO_2 emissions to 63 455 Gg CO_2 emissions, which represented approximately a fourfold increase over the last sixteen (16) years as shown in Figure 2.1. It should be noted that 1998 results are missing due to the unavailability of data.

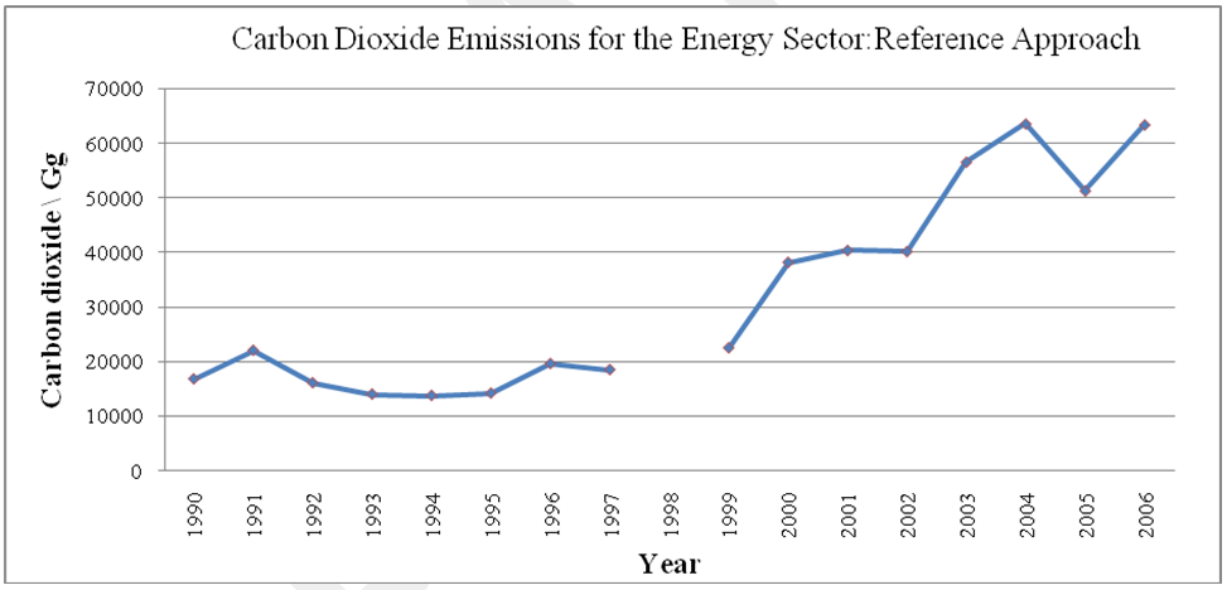


Figure 2.1 CO_2 Emissions for the Energy Sector using the Reference Approach, for the period 1990 - 2006.

Road Transport

The CO_2 emissions for the Trinidad and Tobago transport sector increased from 1 313 Gg in 1990 to 3 617 Gg in 2005. There was a noticeable increase in the CO_2 emissions from 2004 and 2005; however, the cause of the increase could not have been determined from the available data, and given the trend, is probably an aberration or inaccurate reporting value, as it is highly unlikely that this could be an actual increase in emission. The increase in CO_2 emissions from this sector can be correlated in general to the increase in fuel sales, probably as a result of an increase in the total number of registered vehicles. However, it should be noted not all fuel sold at the pumps is necessarily used in the country. The CO_2 emissions for national road transport for the period 1990 - 2005 and the total number of registered vehicles for the period 1990 - 2005 are shown in Figure 2.2.

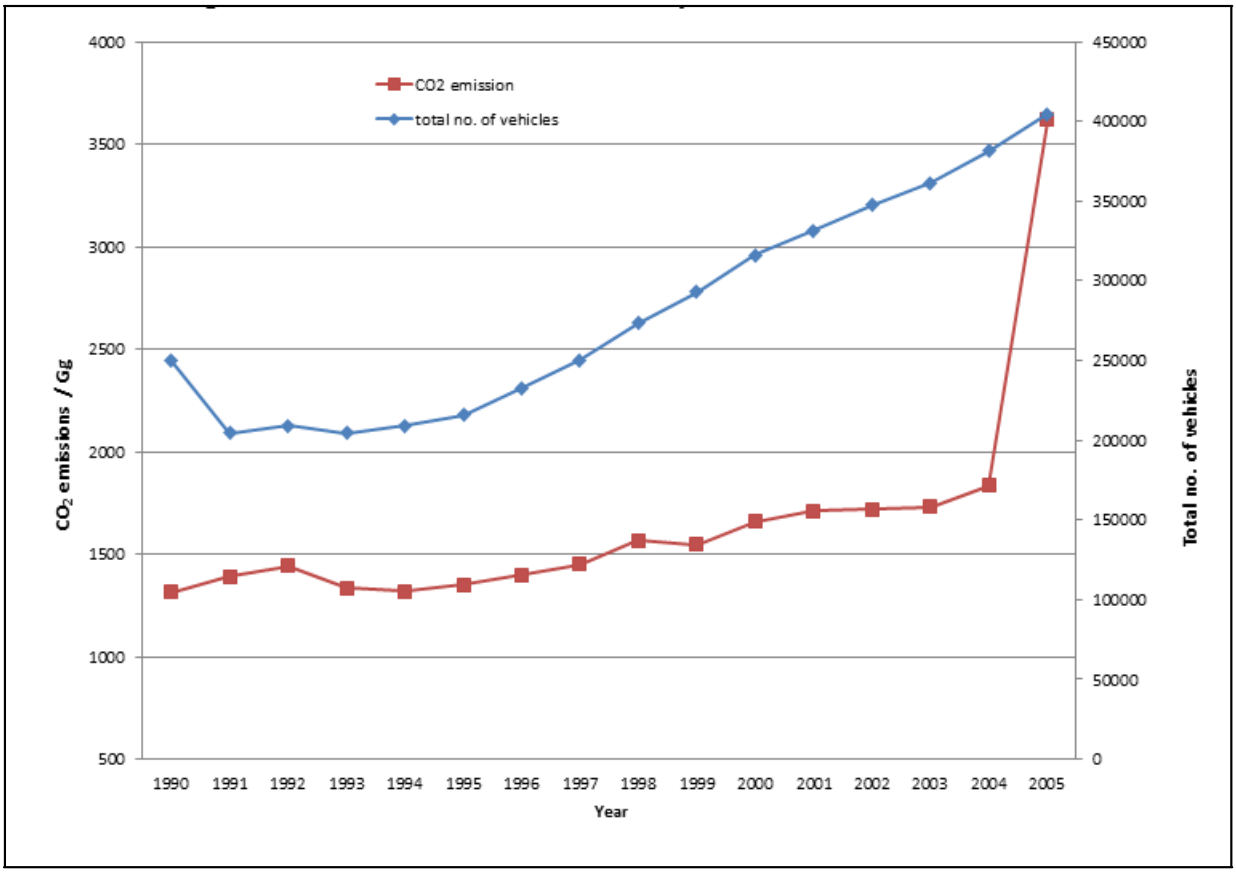


Figure 2.3 The CO_2 emissions for national road transport for the period 1990 - 2005 and the total number of registered vehicles for the period 1990 - 2005. It should be noted that the relatively high increase from 2004 to 2005 is likely due to inaccurate data as such an increase cannot be explained on the basis on the rest of the trend.

Power Generation

Approximately 99 % of the total power generation in Trinidad and Tobago is from natural gas. There has been a gradual increase in the CO_2 emissions from power generation for Trinidad and Tobago. A 43.3 % increase in the CO_2 emissions has been observed comparing the 2006 value of 2 488 Gg with the base year 1990 value of 1 736 Gg. This correlates with an almost doubling in electricity generation from approximately 3 600 000 000 to 7 000 000 000 kWh during the same time period. The CO_2 emissions for national power generation for the period 1990 - 2006 are shown in Figure 2.3.

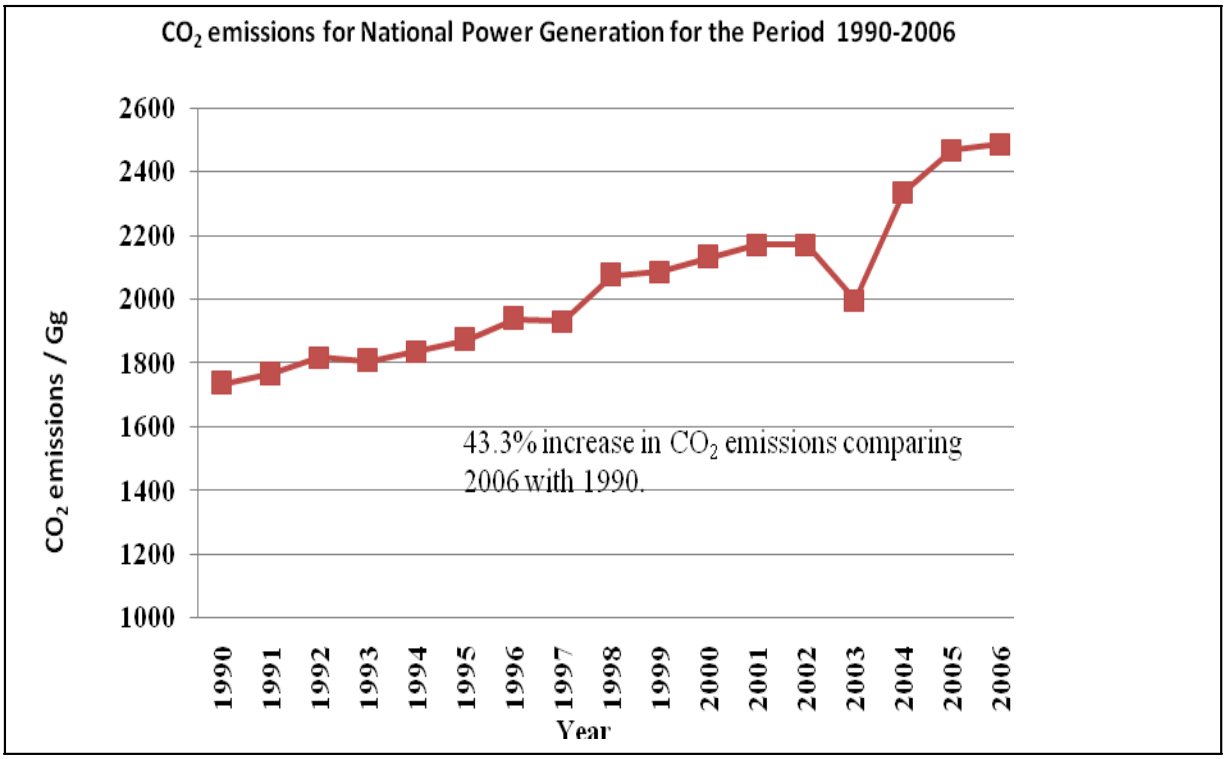


Figure 2.3 The CO_2 emissions for national power generation for the period 1990 - 2006.

Industrial Processes Sector

The inventory for the Industrial Processes Sector was compiled using a variety of data sources. The Central Statistical Office, the Central Bank and individual industrial sector companies provided most of the information used in compiling the GHG Inventory for this Sector.

Figure 2.4
summarises the CO_2 emissions from the Industrial Processes Sector from 1990 - 2008.

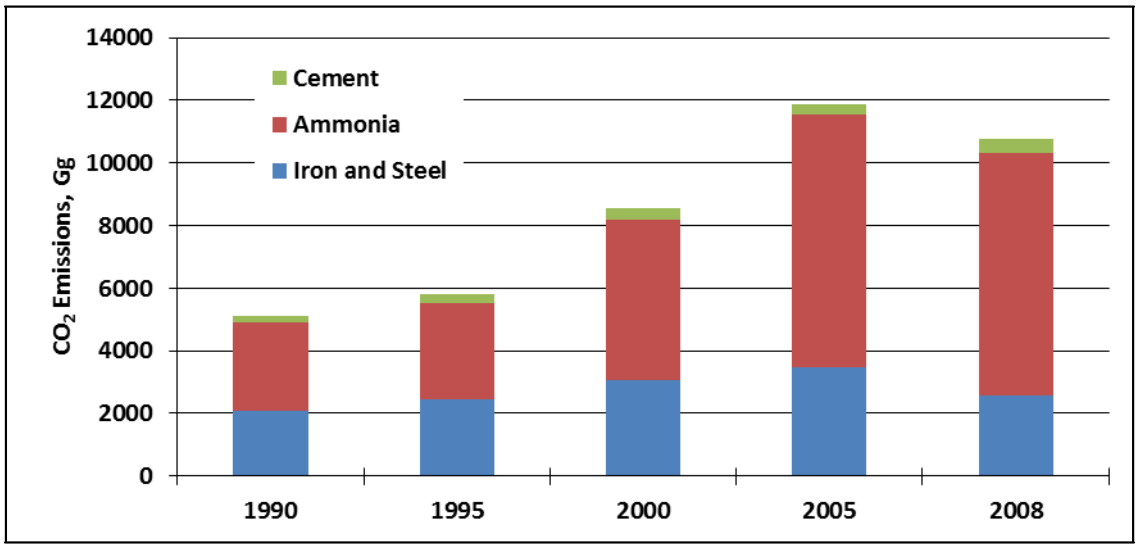


Figure 2.4 CO_2 emissions from the Industrial Processes Sector for the years 1990, 1995, 2000, 2005, 2008.

Figure 2.4 indicates an overall increase in CO_2 emissions, with the greatest percentage coming from ammonia, then iron and steel and lastly cement. The overall relative proportions of the CO_2 contribution for these three main emitting industries have not changed significantly since 1990. Figure 2.5 illustrates in more detail the total direct GHG emissions from the Industrial Processes Sector presented as Gg of CO_2 equivalents. From 1990 to 2008, the total CO_2 emissions increased by 111 %, however it was not a steady rise over the entire period. Total CO_2 emissions remained fairly constant from 1990 to 1995 at approximately 5 500 Gg, and then displayed a slow but steady increase to about 12 000 Gg in 2003, where the CO_2 emissions reached a plateau until 2006. There was a sharp spike in CO_2 emissions in 2007, reaching 17 067 Gg. This appears to have been driven by an increase in the production of wire rods at Arcelor Mittal. This production was not maintained and hence the total CO_2 emissions dropped to 10 785 Gg in 2008.

Methane emissions over the same period showed a steady rise. The increase in the level of methane emissions from 2000 is due to increases in methanol production. Currently there are seven methanol plants in operation in Trinidad with a total production capacity of

6 620 000 MT/year. Two of these plants (Atlas and M 500) came on stream in 2004 – 2005 and have a combined production capacity of 3 790 000 MT/year. Although the methane levels are increasing, the impact of methane emissions on the overall direct GHG levels is likely to be low. The amount of methane released (measured as CO_2 equivalents) is up to 40 times less than that of carbon dioxide.

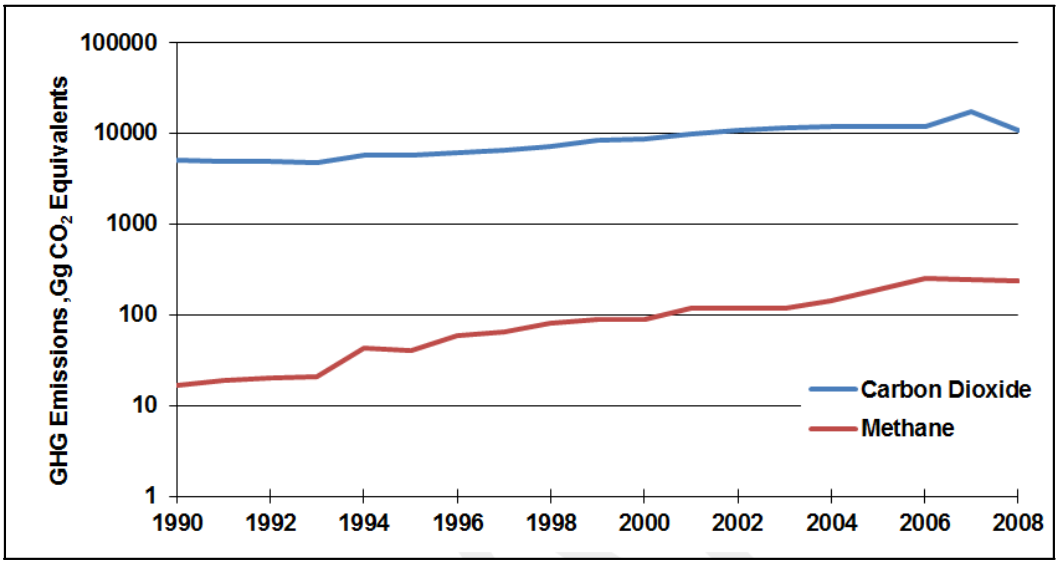


Figure 2.5 Direct GHG emissions for the Industrial Processes Sector for the period 1990 - 2008. Data is presented as Gg of CO_2 equivalents.

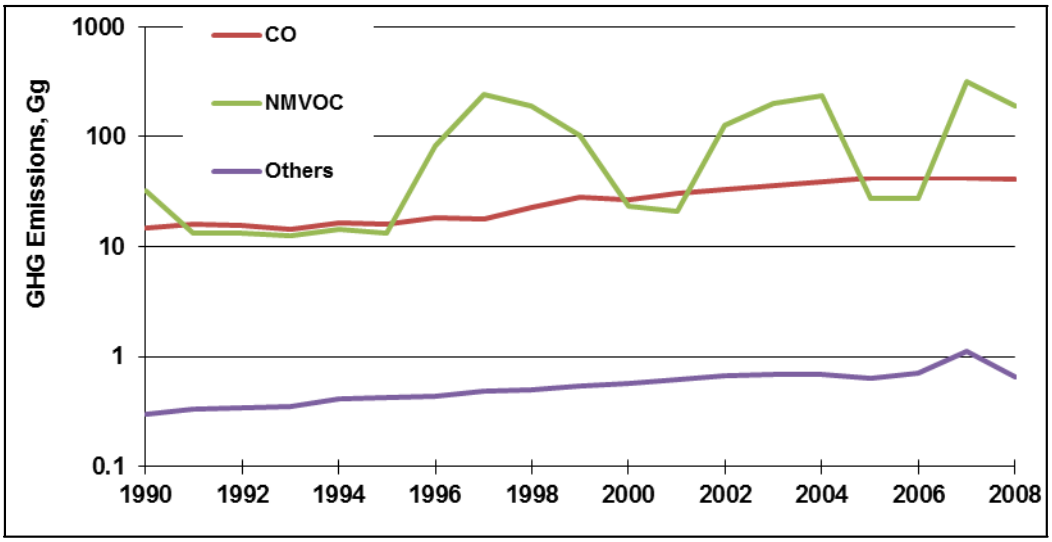


Figure 2.6 Non CO_2 / CH_4 emissions for the Industrial Processes Sector for the period 1990 - 2008.

Although CO_2 and methane are the main contributors to the GHG emissions, NMVOC and carbon monoxide are significant secondary contributors, while other gases (nitrous oxide, nitrogen monoxide, nitrogen dioxide and sulphur dioxide) play a minor role. These emissions are summarised in Figure 2.6. The NMVOC emissions showed three major peaks in 1997, 2004 and 2007, due primarily to increased road paving activities. In addition, the Food and Drink industries also add NMVOC, but unfortunately, data on the Food and Drink industries were unavailable past 2000. Therefore, although the quantum of NMVOC emissions after 1998 is probably underestimated, the major component in this sector is undoubtedly from road paving.

Agriculture and Land Use, Land Use Change and Forestry Sector

The inventory for these sectors were estimated using activity data derived mainly from the FAO database (in the case of agriculture) and from the FRA (Forest Resource Assessment) and the World Bank databases (in the case of the LULUCF sector). Some limited data from local sources such as the Ministry of Food Production, the Central Bank, Central Statistical Office (CSO) and the Environmental Management Authority were also utilized. The data requirements for conducting GHG inventories in these sectors are quite extensive. However, historically these institutions have not acquired the data in a format needed to perform an inventory of GHG based on the IPCC guidelines and arrangements to address this are now being put in place. Since the Initial National Communication (INC), which was produced more

than a decade ago, the external data sources have improved in the quality and definitely the accessibility of their data. Since the reliability of the data was even more questionable at the time of the INC report, the GHG inventory for the baseline year 1990 for this sector was **recalculated based on the updated data set** and reported on in this report which also includes an inventory data for the year 2005, so that a comparison can be made between those two years for these two sub - sectors.

Agriculture

The comparison between GHG emissions for the years 1990 and 2005 is given in Table 2.1. The gases accounted for in this sector include CH_4, CO, N_2O and NO_x (the empty boxes in Table 2.1 are not applicable). For both years (1990 and 2005) the largest emissions were associated with CH_4 resulting from enteric fermentation in domestic livestock and CO from the burning of agricultural residues. In fact enteric fermentation accounted for 71 % and 90 % respectively of the total CH_4 emissions for 1990 and 2005 from this sector. The CH_4 emission from enteric fermentation in 2005 (3.21 Gg) in relation to that in 1990 (3.69 Gg) was just 13 % lower. In contrast the CO emission in 2005 (5.48 Gg) due to burning of crop residues was only 29 % of the amount estimated for 1990 (19.01 Gg). The major decline in the emissions due to burning of agricultural residues is linked to the significant decline in the sugarcane industry leading up to the year 2005. By that time it was clear that the state was no longer interested in continuing to financially support the industry and yields had already begun to show major declines, arising out of reduced acreages and lower productivity levels from existing fields. Otherwise, there were no major differences in emissions from other source categories.

Table 2.1 Comparison of GHG emissions from the key source categories for the years 1990 and 2005.

	Greenhouse Gas Emissions (Gg)							
Activity	**CH_4**		**N_2O**		**NO_x**		**CO**	
	1990	**2005**	**1990**	**2005**	**1990**	**2005**	**1990**	**2005**
Enteric Fermentation	3.69	3.21						
Manure Management			0.05	0.08				
Rice	0.57	0.10						

Cultivation								
Burning of crop residues	0.91	0.26	0.03	0.01	1.08	0.31	19.01	5.48
Soil Emissions			0.90	0.74				
TOTAL	5.17	3.57	0.98	0.83	1.08	0.31	19.01	5.48

Land-Use, Land-Use Change and Forestry

In this sector the focus was on activities that serve as sources and/or sinks of CO_2 such as changes in forest and other woody biomass; forest and grassland conversion; and abandonment of managed lands. The estimates for both 1990 and 2005 showed that this sub-sector was a net sink of CO_2 from the atmosphere. The major activity that led to this sub-sector being a net sink of CO_2 was the abandonment of agricultural lands (that has been taking place since the rise in industrial activity during the 1960's and 1970's) and to a lesser extent the forests plantations that have been established since the introduction of teak in the early part of the last century, and pine and some local hardwoods in mid-century and beyond. The accumulation of soil carbon in these abandoned lands also would have contributed, though not as significantly.

When agricultural lands are abandoned, there is a re-growth of secondary forests and an accumulation of carbon in the top layers of the soils that can be quite rapid at first and then slows down as time proceeds; this can continue serving as a sink for as much as 100 years. Accordingly, the methodology distinguishes land that has been abandoned for the past 20 years and that which has been abandoned for more than 30 years. Since recently abandoned land re-grows at a faster rate and therefore accumulates more carbon annually than that which is more than 20 years old, a default value of accumulation of 10 t DM/ha (tonnes of dry matter per hectare) for the former and 2.6 t DM/ha for the latter case were used in calculations.

Recent evidence from the electronic database of the World Bank Report (2010) shows land under agricultural activity has continued to decline since the 1970's (Figure 2.7) and though only marginally, more agricultural land had been lost in the 20 years leading up to 2005 (approximately 210 km^2) than in the 20 years leading up to 1990 (approximately 180 km^2) (Figure 2.7).While it is expected that some of this land would have been utilised for built

developments and other activities that may not allow it to accumulate carbon and serve as a sink for CO_2, this latter data set was not available for further analysis for the purpose of this inventory. The World Bank database only went back as far as 1967 and so it was also uncertain how much agricultural land may have been abandoned for more than 20 years prior to 1990. An assumption was made that this was negligible and most of the land-abandonment would have occurred post industrialisation. For this reason, the inventory showed that in 2005 the LULUCF sub- sector was a slightly greater sink than in 1990.

Figure 2.7 Changes in the agricultural land area in km^2 (vertical axis) in Trinidad and Tobago for the period 1967 - 2009.

Source: (World Bank Report, 2010)

Waste Sector

The Waste Sector GHGs inventory was compiled using data obtained from the Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL) and utilised only data sets from Municipal Solid Waste (MSW), as the remaining data sets were unavailable. As such the total GHG for this Sector must be considered as an underestimation. Figure 2.8 shows that while there was a gradual increase in CH_4 emissions from the Waste Sector, the net annual methane emissions have approximately tripled from 15.96 Gg in 1990 to 47.16 Gg in 2008. However, this is a relatively small increase in absolute terms.

According to the Draft Integrated Solid Waste/Resource Management Policy for Trinidad and Tobago, household waste, mainly organic waste such as food and vegetables have increased, together with household hazardous waste such as batteries and spent detergent containers and non-biodegradable items such as plastics (Ministry of Local Government, 2012). These increases may be as a result of a more structured waste collection data system and thus the organic wastes are now being accounted for. As previously mentioned due to lack of data for the liquid waste, the inventory report for the waste sector would be an underestimation because only municipal data was used. These methane emissions may also be linked to the population increase. In 1990 the total population of Trinidad and Tobago was 1 227 443 as compared with the increased population of 1 308 587 in 2008, an increase of 6.6 % over this period (Central Statistical Office, 2012).

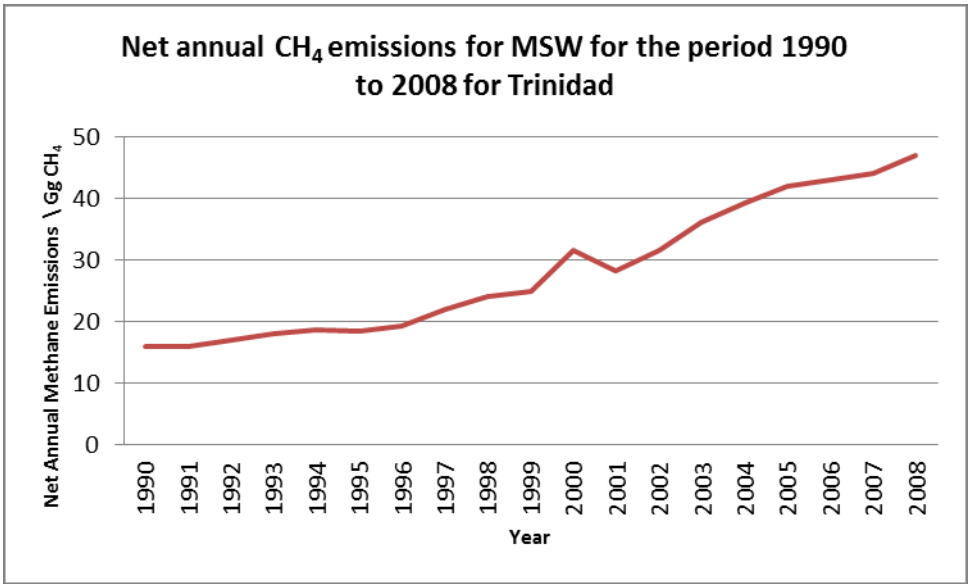


Figure 2.8 The net annual methane emissions for Municipal Solid Waste for the period 1990 - 2008.

Data Gaps

The production of an accurate greenhouse gas inventory requires a large amount of data from a wide variety of sources. One of the biggest challenges faced by the compilers of the inventory, both the initial and the second, was the difficulty in accessing relevant information. The data gaps identified in this second inventory are noted in Table 2.2. The gaps identified refer to

cases where either no data were available, the data were not current, or the data were in a format that could not be readily disaggregated. Uncertainty also arises in the application of emission factors that are not country-specific as those in the default methodology may not be relevant. As such the use of default emission factors in the estimation of greenhouse gas emissions in various sectors would have contributed to uncertainty in the estimation. Accordingly, it is recommended that relevant research be conducted to develop, where appropriate, applicable emission factors in the various emitting sectors and activities.

Table 2.2 Data gaps identified during the compilation of the Second GHG Inventory.

The Energy Sector	
Period	Details

1999 – 2006	• No imported lubricants
	• No feedstock
	  o LPG
	  o Naphtha
	  o Natural gas
	  o Other fuels
	• No fuel consumption for
	  o Residential sector
	  o Agriculture/ Forestry/ Fishing

1990 – 2006	Fugitive emissions • Number of oil wells drilled • Number of oil wells tested • Number of producing and capable wells • The amount of gas stored • The amount of gas distributed • The amount of gas flared from production • The amount of gas vented from transmission • The amount of flaring and venting with respect to oil production • The amount of oil transported by tankers
1990 – 1997	Lubricants • International bunkers
The Waste Sector	
1990 - 2008	• Waste water
The Industrial Processes Sector	
1990 – 2008	• PVC • Urea • Coffee roasting • Fish production
1995 – 2008	• Sugar production • Meat and poultry production • Animal feed
1998 – 2008	• Alcoholic beverage production (beer, wine, rum, whiskey, etc.) • Margarine production

Agriculture Sector	

1990 - 2005	• Livestock subsector:
	  • Dairy and beef cattle populations not available
	  • Poultry data available only for broilers and for 1990, 1993 and 1996
	  • Pig data only for private farms and for 1990, 1993 and 1996
	  • No population data for buffalo, goats, sheep, horses, mules, asses, ducks, turkeys and geese
	  • No local data on the relative distribution of animal wastes managements systems
	• No data on acreages in rice production or on the proportion of rainfedvs irrigated
	• The FAO database only provides distribution of irrigated vs rainfed for the year 1990
	• No definitive data on the use of organic amendments in rice production
	• No data on residue/crop ratio
	• No data on extent of residue burning except for sugarcane
	• Fertilizer N rates not known
	• Local data for fertilizer use not available after 1994
	• No emission factor values for any of the categories

Land Use, Land Use Change and Forestry	
1990 – 2005	• Area of teak and pine forests only for 1990 - 1996. • Area of mixed hardwoods planted available only for 1995. • Roundwood production not available beyond 1996 • Fuel wood production only for 1994, 1996, 1997 and 1998 • Other wood use data not available • No data available for forests area converted • No data on the fraction that is burnt on-site, off-site or left to decay • No data on agricultural land abandoned and allowed to regenerate naturally • No definitive information on the land use changes in relation to acreages and soil types • Except for an estimate from a local authority on area receiving lime, there is no data available on lime use

Chapter 3 Vulnerability and Adaptation

Introduction

Recent IPCC reports suggest that the component of Vulnerability and Adaptation (V&A) needs to be critically assessed so as to reinforce a nation's ability to deal with the negative effects of climate change. Trinidad and Tobago, being a Small Island Developing State (SIDS), finds itself more vulnerable to rising sea levels, rising surface temperatures, and increased frequency of hurricanes.

In order to assess vulnerability to future climate change, climate scenarios were developed using PRECIS-CARIBE, the interactive webpage for access to the results of the PRECIS (Providing REgional Climates for Impacts Studies) Regional Climate Model runs for the Caribbean. The site has been developed to facilitate online access to the climate change scenarios developed by the Cuban Meteorological Institute utilising PRECIS. PRECIS is a PC-based regional climate model developed by the Hadley Centre of the Meteorological Office of the United Kingdom for use by non-Annex I Parties to the United Nations Framework Convention on Climate Change (Cuban Meteorological Institute (INSMET), 2012).

Scenarios were developed for future changes in temperature and precipitation for the months of February and July respectively, and for the years 2035, 2050 and 2075 using the A2 (worst case) and B1 (best case) scenarios as defined by the IPCC. February was chosen on the basis of it being the coolest month on average and July being the wettest month on average. Results of these analyses are given in Figures 3.1 to 3.4.

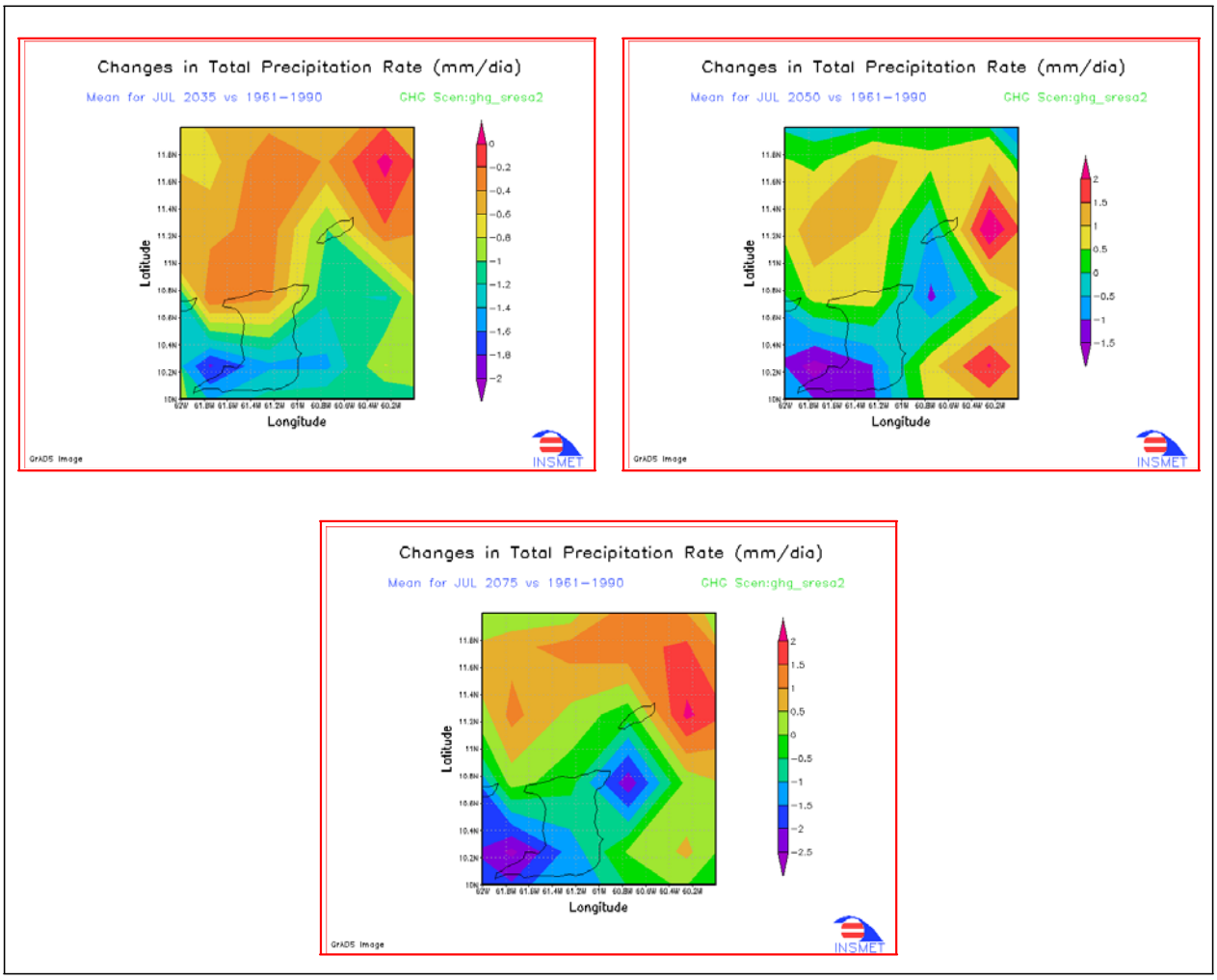


Figure 3.1 Projected changes in precipitation for July for 2035, 2050 and 2075 for the A2 scenario.

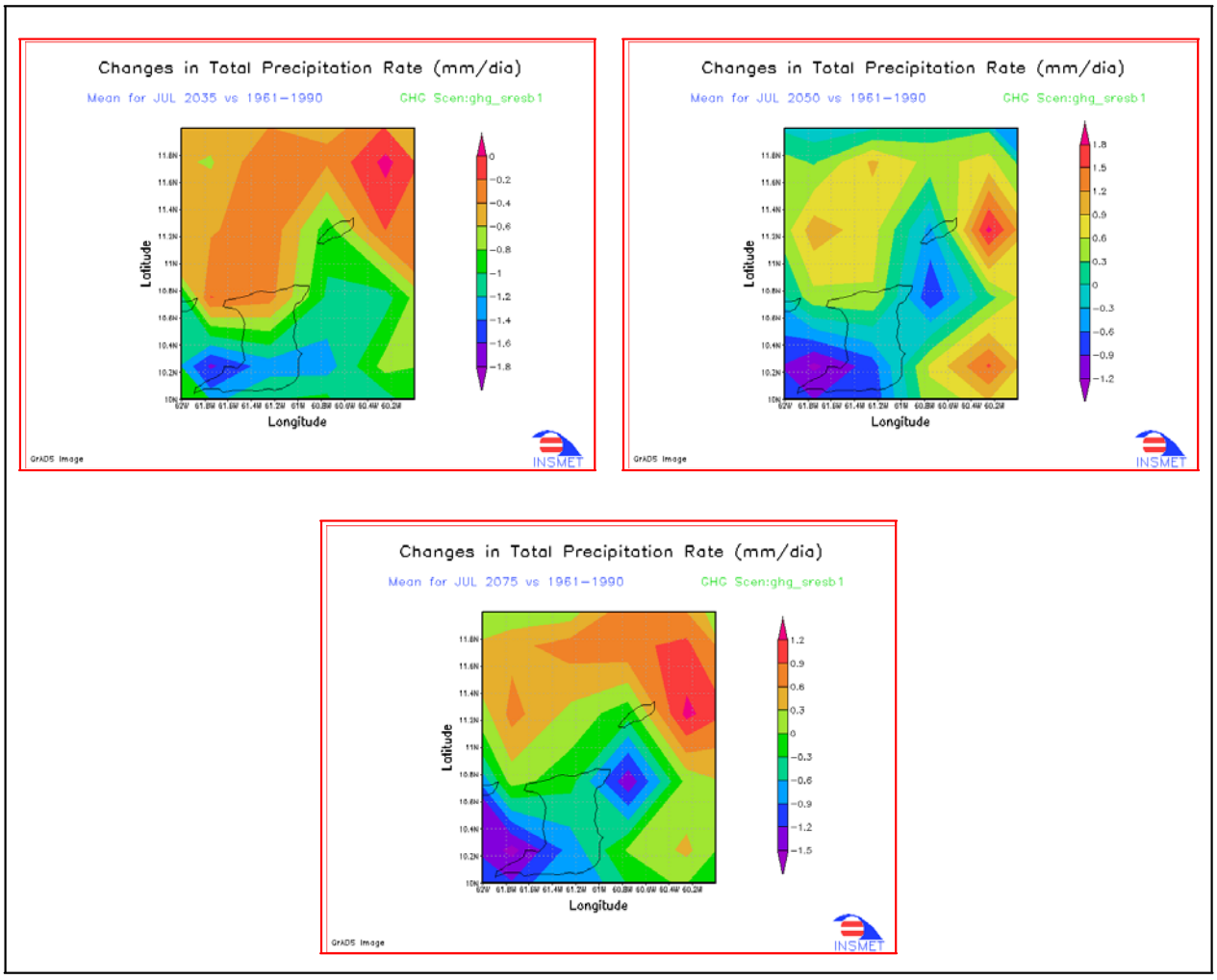


Figure 3.2 Projected changes in precipitation for July for 2035, 2050 and 2075 for the B1 scenario.

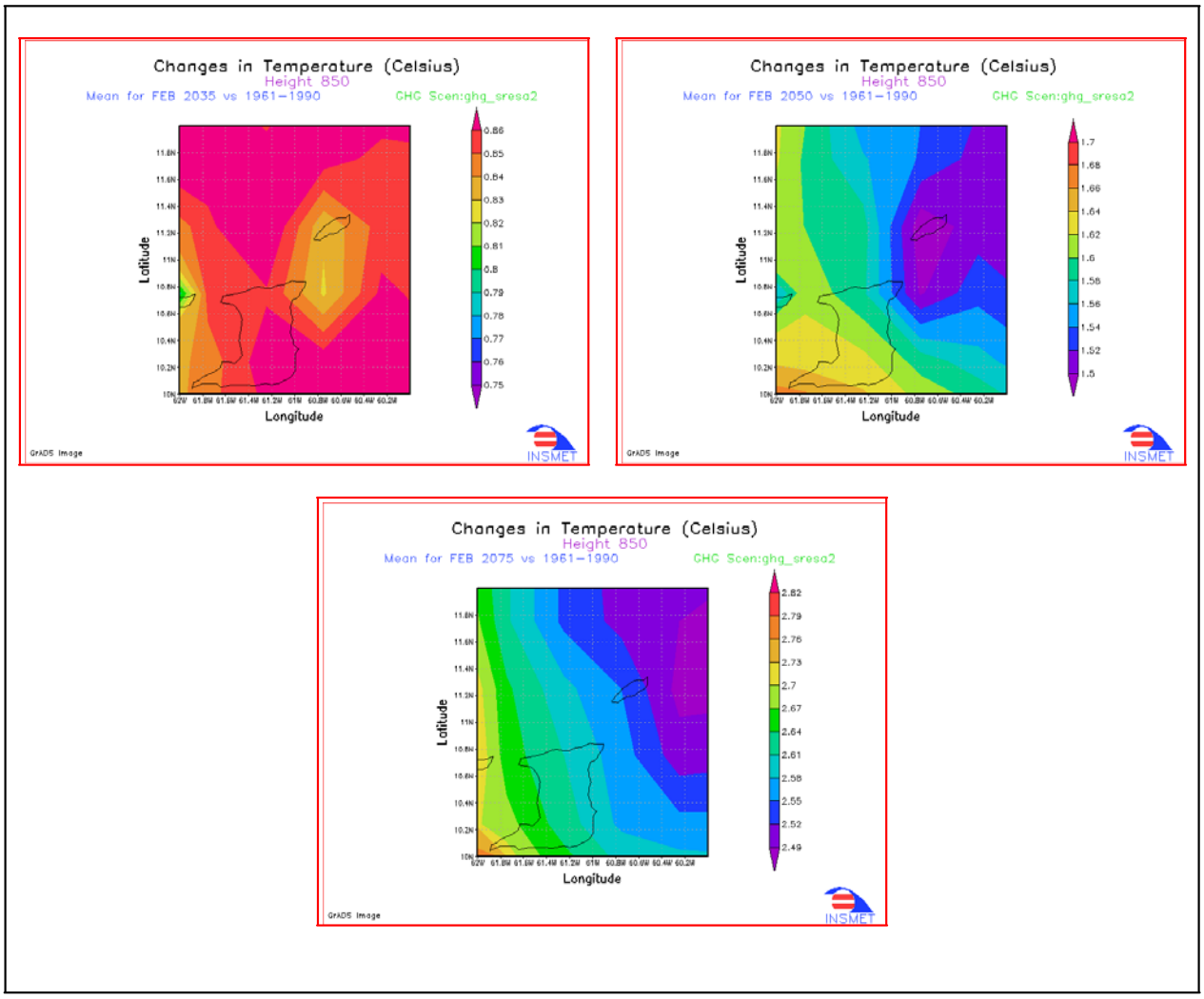


Figure 3.3 Projected changes in surface temperature for February for 2035, 2050 and 2075 for the A2 scenario.

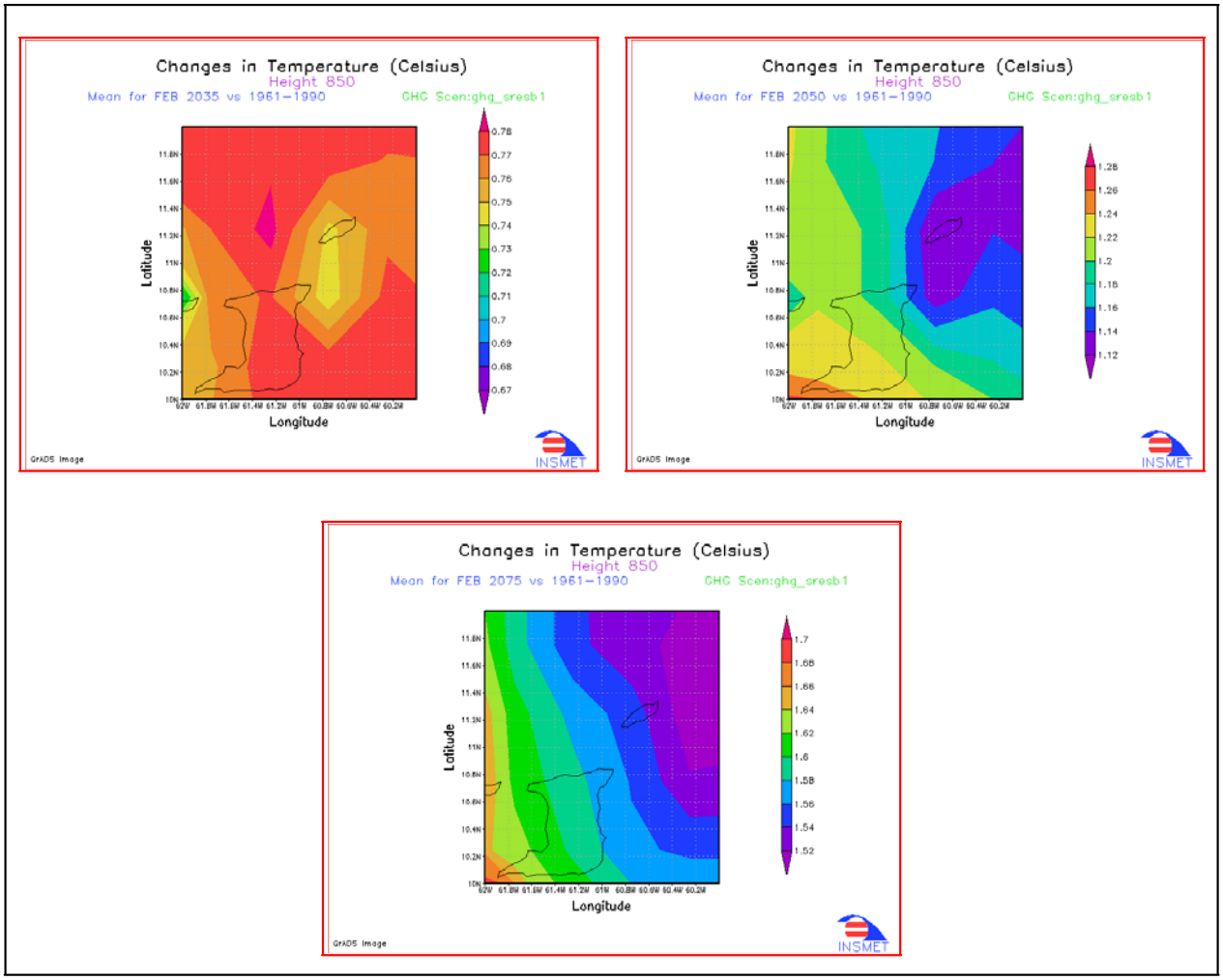


Figure 3.4 Projected changes in surface temperature for February for 2035, 2050 and 2075 for the B1 scenario.

Trinidad and Tobago has identified the following priority sectors based on their biophysical characteristics and socio-economic importance: Agriculture; Water; Human Health; Tourism; Coastal Zones; Land Use/Forestry

Table 3.1 shows the percentage contribution of various sectors as percentages of National GDP. The data indicate that the agricultural sector contributed the lowest of all the major economic sectors. Notwithstanding the relatively low contribution, the agricultural sector

supports a significant section of the population through subsistence farming and crop cultivation and thereby represents a significantly vulnerable sector. Additionally, GORTT is actively pursuing a policy of increased agricutlural production in order to increase national food security. Accordingly, assessment of the vulnerability of this sector would be critical in planning adaptation measures to ensure sustainability in the face of the adverse effects of climate change.

Table 3.1 Percentage Contribution of Sectors of the Economy to National GDP for the period 2003 - 2006.

Sectors	**2003**	**2004**	**2005**	**2006**
Petroleum	38.5	38.1	38.2	41.2
Manufacturing	7.0	7.0	7.2	7.2
Services	53.7	53.6	53.7	50.8
Agriculture	1.1	0.72	0.74	0.7

Major commodities of the agricultural industry include coconuts, citrus, cocoa, poultry, cattle and vegetable crops. Agriculture production is greatly dependent on the availability of water and the atmospheric temperature regimes. From the projections illustrated in Figures 3.1 to 3.4, temperatures are likely to increase for both the A2 and B1 scenarios for each time slice, but with the greater changes being projected for the central to southern parts of Trinidad compared to Tobago. The same trend appears to be the case for decreased precipitation. Parts of central and southern Trinidad support the bulk of the agricultural activities. Increases in temperature coupled with lower rainfall or less effective rainfall could result in increased soil aridity and considerable decreases in agricultural yields. Increased intensity and frequency of storms, drought and flooding, altered hydrological cycles and precipitation variance have implications for the local agriculture industry. Projected climate change impacts on the agricultural sector are therefore to have a more pronounced effect in the central to southern parts of Trinidad compared to other areas and Tobago. The Medium-Term Policy Framework (2011 - 2014) is an action- directed policy framework by the Government of Trinidad and Tobago and is meant to bring focus to the work by the Government (Ministry of Planning and Sustainable Development, formerly Ministry of Planning and the Economy, 2011). In this Policy the Government has identified the agriculture

sector as a critical sector that can contribute to economic and social development, and thereby economic diversification away from the dominant oil and gas based economy while at the same time ensuring national food security. Through implementation of this Medium-Term Policy Framework, the Government intends to revitalise this sector and make it more competitive by developing production of different varieties of staples and other food types that are being currently imported. In order to incentivise increased production, emphasis will be placed on improving access roads, drainage, irrigation and water management systems, agro-processing, marketing and providing support to farmers in research and development. In this regard, planning for the adaptation to the projected impacts of climate change becomes a critical component of the further development of this sector. Analysis of specific crop vulnerabilities to climate change was not possible at the time of preparation of this report due to lack or unavailability of sufficient data.

Planned adaptation measures are conscious policy options or response strategies, often multi-sectoral in nature, aimed at altering the adaptive capacity of the agricultural system or facilitating these specific adaptations. Relevant examples include deliberate crop selection and distribution strategies across different agriclimatic zones, substitution of new crops for old ones and resource substitution induced by scarcity (Easterling, 1996). Long-term adaptations involve major structural changes to overcome adversity such as changes in land-use to maximise yield under new conditions, application of new technologies, new land management techniques, and water-use efficiency related techniques. With respect to water-use and agriculture, the Medium-Term Policy Framework 2011 - 2014 has included a strategy for the sustainable management of water resources that requires planning and integration to ensure growth and transformation in the agricultural sector. The Government has planned to strengthen institutional capacity of the relevant institutions for water management in agriculture (Ministry of Planning and the Economy, 2011).

Given the projected changes in temperature and precipitation for the time slices of 2035, 2050 and 2075, consideration would have to be given to agricultural zoning based on soil capability and land use potential. The Government's climate change policy envisages implementation through the revision of existing sectoral policies. Accordingly, the agricultural policy will have to be revised to take into consideration these projected changes and be based on adequate stakeholder consultation. Consideration would have to be given to effective and proper soil

management practices that preserve soil quality with respect to high levels of fertility, productivity and an improved capacity to retain moisture.

Synergy with water conservation methods and technologies would also be taken into account to ensure the balance between increased domestic demand for potable water and increasing demand for agriculture and industry. To this end, the Government will continue to look at other options including desalination.

However, adequate crop modeling still remains a critical need to inform crop resilience and options for new crop varieties. The selection of crops and cultivars with tolerance to abiotic stresses (e.g. high temperature, drought, and flooding, high salt content in soil, pest and disease resistance) allows harnessing genetic variability in new crop varieties.

Land-use Change and Forestry Sector

The forest resources of Trinidad and Tobago are vulnerable to the adverse impact of climate change. This vulnerability is exacerbated by unsuitable and unsustainable practices such as illegal quarrying, illegal logging, unplanned development, bush fires and slash-and-burn agriculture, along with the inherent fragility of the forest ecosystems. Forest and bush fires continue to be a concern particularly in the dry season often resulting in large amounts of forests being burnt. In addition, land demand for habitat and agriculture places further pressures on the Forestry Sector. Control of these activities could go a long way in coping with future climate changes. It is likely that future changes in temperature and rainfall will create increasingly favorable conditions for forest and bush fires particularly in areas of central to south Trinidad that has significant forest resources and forest reserves. This would also increase stresses on biodiversity resources that themselves will be impacted on by temperature and precipitation changes.

The Government recognises the pressures placed on the forestry sector and the often competing interests for land space in a Small Island Developing State to meet development demands and aspirations, and the additional challenges that will be posed by a changing climate. To this end, a **Forest Policy and Protected Areas Policy** were approved by the national Parliament in 2011. These polices aim to strengthen the institutional, management and administrative capacity to effectively manage the country's forest and natural resources and which takes

climate change into account. These policies will create new and more efficient administrative structures which will intensify assessment and monitoring, establish new tools and indicators to rate vulnerability and target research efforts to cope with climate change. It is envisaged that implementation and enforcement of the present forestry policy, in addition to forthcoming legislation such as the National Parks and other Protected Areas Bills and the Planning and Development of Land Bills, should provide an adequate set of protocols for sustained use and conservation of the forest and watershed resources of the island.

Implementation of these policies will enhance climate resilience through conservation and preservation as well as build synergy with community livelihoods and watershed management. Additionally, greenhouse gas emissions from deforestation in Trinidad and Tobago will be managed.

Implementation of these policies will also take specific adaptation issues into account including agro-forestry approaches such as changes in land use choice (Kabat et al. 2005), management intensity, hardwood/softwood species mix, timber growth and harvesting patterns, changes in rotation periods, salvaging dead timber, shifting to species more productive under new climatic conditions, landscape planning to minimise fire and insect damage, providing connectivity and adjusting to altered wood size and quality (Spittlehouse and Stewart, 2003).

Water

The surface water sources in the Republic of Trinidad and Tobago are shown in Tables 3.2, while the groundwater production and safe yields are shown in Tables 3.3 and 3.4. The Caroni Arena Reservoir is a surface reservoir located in the Caroni Basin which lies between the Northern Range and the Central Range.

Table 3.2 Surface water sources in Trinidad and Tobago.

Facility	**River System**	**Capacity (MCM/yr)**
Caroni Arena Reservoir	Caroni – Tunapuna	125.0
North Oropouche Intake	North Oropouche	33.2
Hollis Reservoir	Quare, Crayfish	13.9
Guanapo Intake	Guanapo	6.8
Hillsborough Reservoir	Hillsborough East, West	2.5
Courland Intake	Courland	3.3
Navet Reservoir	Navet, Nariva	31.5
Minor Intakes		13.5

Source: (Water Resources Agency, 2001)

Table 3.3 The public water supply system of Trinidad and Tobago.

System	Components
Northern Systems	Hollis Reservoir and other smaller intakes serve Arima and surroundings.
North Oropouche	River Intake to serve Sangre Grande, Arima and Westwards.
Caroni Dam and WTP	A major reservoir in the North Central to serve the North and South of the island in an approximate 50:50 ratio.
North-West System	Water from Caroni North is supplemented by seven (7) well fields and rivers.
Southern System	Water from Caroni South for areas in Central (including Point Lisas) and South.
Navet Scheme	The second largest reservoir in the Central area to serve the City of San Fernando and suburbs.
Isolated South Plants	Small intakes and well field within the South one-third of the island to supply parts of South on a localized basis
Tobago – South West System	Hillsborough impounding reservoir, two (2) intakes and eight (8) wells to supply Scarborough and the West of the island.
Tobago – Isolated Plants	Three (3) small intakes and four (4) wells supply the rest of the island on a localised basis.

Source: (Water Resources Agency, 2001 - National Report on Integrating the Management of Watersheds and Coastal Areas in Trinidad and Tobago)

The Caroni Basin is densely populated and has high concentrations of biodiversity extending from the coastal mangrove and swamp fringes in the west to the forested Northern Range. Since it is one of the major suppliers of water throughout Trinidad, its vulnerability to climate change and sea level increases will impact ecosystem dynamics and the availability of water.

Table 3.4 Groundwater production, safe yields in Trinidad and Tobago – deep water bedrock aquifers.

Public and Private Sector Water Supply	Production (MCM/yr)	Safe Yield (MCM/yr)	Additional Potential (MCM/yr)
Trinidad	3.50	547.50	544.00
Tobago	3.31	66.40	63.09
TOTAL	6.81	613.90	607.09

Source: (Water Resources Agency, 2001)

The development of wells within the bedrock fracture systems of Trinidad and Tobago has reduced the dependence on the surface water infrastructure and has increased the reliability in the water production output. In addition, the water production capability has become less vulnerable to the effects of natural phenomena (drought, floods) which may impact upon the surface water systems.

Table 3.5 Consuming water demand (Million Cubic Meters/Year), for the period 1997 - 2025.

Demand Category	Year (MCM/yr)				
	1997	2000	2005	2015	2025
Domestic	118	120	142	171	203
Industrial, Major	36	51	66	92	112
Industrial, Minor	9	9	11	13	15
Irrigated Agriculture	10	10	10	10	10
Unaccounted	124	124	128	118	141
TOTAL	297	314	357	404	481

Source: (Water Resources Agency, 2001)

Table 3.5 shows the consuming and assessment demands for 1997 to 2005. The projected demands for 2015 and 2025 were computed by the Water Resources Agency using an estimated growth rate of the population as 1.2 % per annum, beginning with a base population of 1.3 million in 1995 and a per capita consumption of 2000 liters per day. However, it should be noted that these are only crude approximations and can vary significantly bearing in mind the recent projections by the Central Statistical Office (Figure 1.9) that the population is expected to show only a slow increase up to 2015 followed by a decline over the next ten years reaching a projected population of 1 294 347 by 2025. In addition, demand for irrigation water by the agricultural sector is expected to increase significantly arising out of government's renewed thrust to revitalise the agricultural sector. The relatively high per capita consumption is skewed by the high industrial demand.

The projected decrease in precipitation and increase in temperature coupled with increasing demand for water are likely to place significant stresses on the water sector, making it especially vulnerable to the impacts of climate change. Specifically, likely increases in evaporation and evapo-transpiration as well as reduced precipitation will affect groundwater recharge rates. Coastal aquifers and reservoirs located in coastal areas will be susceptible to salt-water intrusion and inundation. In recognition of these anticipated impacts, the nexus between watershed management and forest and protected areas become more apparent and important as adaptation planning approaches.

To this end, Government in its implementation of the **Forest Policy** and the **Protected Areas Policy** will be aiming at maximising synergy with the **Water Resources Management Strategy**. The Water and Sewerage Authority is currently developing plans to manage storm water as a resource and for flood control using the Singaporean model. Also based on the successful experience with desalination for industrial water demand to augment domestic potable water demands, Government has signaled its intention to continue to explore desalination as an adaptation option to meet the projected increase demand and reduced natural supply. Government has already embarked on a retrofitting of the existing pipe distribution system which accounts for a significant amount of **unaccounted for water** through leakage estimated at 120 million cubic metres per year (Table 3.5). Once this programme is completed, and coupled with desalination efforts, water availability would be considerably enhanced and

would also reduce vulnerability in the health sector arising out of secondary impacts on this sector from direct impacts on the water sector.

Human Health

Vulnerabilities

The vulnerability of the health sector will be driven largely by changes in temperature, precipitation and humidity as Trinidad and Tobago has a tropical climate, although non-climatic influences will also contribute to, and exacerbate vulnerability.

A recent report Kumarsingh and Chadee (2008) considered health in relation to other sector vulnerabilities particularly in relation to water and transport. Their findings are summarised in Table 3.6.

Table 3.6 Direct and indirect effects of climate change on health in the short and longer terms in Trinidad and Tobago.

Climate Change Effect on Health	Short Term	Longer Term
Direct	Increased deaths/injuries from heat waves – elderly/infirmed, the young, and outdoor workers Direct injury or death – from flooding, landslides or hurricanes Increase in hunger and malnutrition from crop failure and increased food prices Increase in respiratory morbidity and mortality - from increased dust and ground-level ozone	Psychological effects – anxiety and depression- from increasing insecurities, stress Increased coronary diseases from decreasing quality of life and resulting increased stress Trauma from permanent loss of homes from inundation through sea level rise or increased seasonal flooding or landslides
Indirect	Increase in water-borne diseases, diarrhoeal diseases, vector-borne diseases: dengue (high risk); leptospirosis (high risk); lyme disease; malaria (medium risk).	Long term physical and psychological conditions resulting from disease and increasing insecurity of water, food and shelter.

Heat due to increase in average ambient temperature and extremes

An increase in temperature will affect health directly via heat stroke and dehydration – the elderly/infirmed, the young and outdoor workers are regarded as most vulnerable. There is a local perception that heat-related deaths only affect people of temperate climates. However, the recent experience of tropical countries such as India where thousands of heat-related deaths have been reported (Confalonieri et al. 2007), suggest that this potential threat should be included in public awareness programmes. Increased stress and aggression are also likely consequences of temperature rise.

Increased incidences of flooding due to projected increased rainfall intensity

The densest population settlement in Trinidad and Tobago occurs in the Caroni Basin. The area is considered vulnerable to climate change and sea level rise and is home to many species of wildlife, critical life-sustaining facilities and the main reserves of surface and groundwater. Similarly vulnerable low-lying areas occur in the south west, east and north east of Trinidad and in the south west of Tobago as identified in the Initial National Communication.

Large population settlements in Trinidad are located in all the foothills of the northern range – extending from east to west and south of the Northern Range. Tobago is more dominated by highland and consequently a greater percentage of settlements occur on steep slopes. A combination of erodible soils and inadequately constructed houses make these settlements particularly vulnerable to storm activity. Tobago lies at the edge of the current hurricane belt and is expected to be increasingly affected by these storms. Trinidad is less frequently impacted by hurricanes, but projections for more intense systems could pose serious threats to both islands (Kumarsingh and Chadee, 2008).

Other large settlements are located on low-lying floodplains where frequent flooding has led residents to commence relocation efforts. Projected increase in rainfall intensity is likely to result in increased incidences of flooding with the corresponding likely increase in the risks of water borne diseases (diarrhoeal diseases) and vector-borne diseases (dengue; leptospirosis; lyme disease; malaria).

Likelihood of drought-like conditions due to projected long term decrease in precipitation

The projected changes in rainfall for the time slices 2035, 2050 and 2075 are likely to give rise to drier average conditions. Increased arid conditions are likely to result in longer or more frequent episodes of poor air quality resulting from local bush fires and from dust originating from the Sahara. Gowrie (2008) examined pediatric asthma case admittance in relation to the quantity of dust and pollen counts. It was found that on days when there were 10 or more asthma cases admitted, there was either or both of dust present in concentrations of 30 ppm or more and pollen counts of 30 grains/ m^2 /day or more or in the preceding 0-5 days. Ramkissoon (2010) found 58 species of bacteria from 17 families associated with Sahara dust. The projected increases in aridity on the African continent are likely to exacerbate these impacts during the dry season and Sahara dust visitation episodes.

Indirect climate change effects on health

All the above will impact agricultural production thereby affecting livelihoods directly by - decreasing food security, increasing price instability further discouraging production and therefore increasing poverty and hunger. This in turn will likely to have negative impacts on health via the effects of malnutrition, loss of energy, inability to work, stress and depression and increasing vulnerability to a variety of diseases including vector borne diseases such as dengue and malaria. Populations of vectors, particularly ticks, mosquitoes and rodents, and their behaviour, range and disease carrying abilities will also be affected by floods, droughts and heat waves. Of particular concern in Trinidad and Tobago as in other parts of the Caribbean and Central America is the increasing seriousness of outbreaks of dengue fever.

Indirect health impacts arising from impacts on water supply

Although around 92 % of the 1.3 million inhabitants have access to drinking water, this supply is only available to around 26 % on an uninterrupted, 24/7 basis. The remainder of those supplied receives water on a weekly schedule, while a number of communities are still without a regular supply. Some 30 % of the population has a sewerage connection, while 58 % rely on soak-aways or septic tanks and a further 10 % use pit latrines (Kumarsingh and Chadee, 2008). The Water and Sewerage Authority of Trinidad and Tobago (WASA) recognises that "Despite a high life expectancy (approaching 70 years) and a low infant mortality rate (2.4 per 1,000

births) water-related diseases are still widespread and figure among the leading causes of mortality, which is indicative of low water and sanitation service levels."

While the samples from the Navet reservoir were negative for coliforms, 50 % of samples taken at various points along the WASA supply route contained coliform bacteria indicating faecal contamination (Table 3.7 and Figure 3.5). Welch et al. 2000 studied the areas Toco, Rampanalgas, Matura and Salybia and found that 79 % of household water samples which included those from storage vessels contained coliforms. 14.5 % of the bacterial isolates from these samples produced verocytotoxins suggesting the presence of *E. coli* 157 or other enteropathogenic *E. coli* strains. The authors (Welch et al. 2000) could only speculate as to the source of this contamination. A subsequent study (Agard et al. 2002) found increasing contamination from the reservoir (0 %), to standpipe (15.2 %), to household mains (53.5 %) to household drinking water (80 %) in San Fernando (Table 3.7). This increase in contamination mirrored the decline in chlorine levels along the distribution main from reservoir to home. Hemme et al. (2009) found significant quantities of ammonium, nitrate, and soluble reactive phosphorus in water storage containers. Collection of rainwater supplements WASA sources in rural areas.

Cryptosporidiosis has been found in children and HIV infected adults (Tikasingh et al.1986; Rawlins and Baboolal 1996). Inadequate sewerage and sanitation increase the risk of water supplies being contaminated particularly in times of flooding. A study on *Cryptosporidium* contamination of three watersheds upstream of reservoirs found most contamination in the most urbanised watershed and concluded that leakage of inadequately treated sewage was responsible. The study also found significant contamination from wildlife but agricultural activity did not appear to contribute further to the contamination (Philip et al. 2007).

Projected decreased precipitation and decrease in potable water supply is likely to exacerbate existing conditions.

Table 3.7 Chemical and microbiological contamination in Trinidad and Tobago water supplies.

Water source/watershed		**Chemical & Microbiological Contaminants**	**Reference**
Urban	WASA supply to homes in San Fernando	Thermotolerant coliforms and *E. coli*	Agard et al. 2002
Rural	WASA supply to: • Matura • Rampanalgas • Salybia • Toco	Faecal coliforms and *E. coli*	Welch et al. 2000
	Non-WASA supply to: • Matura • Rampanalgas • Salybia • Toco	Faecal coliforms and *E. coli*	Welch et al. 2000
	Water drums • Tamana (2005)	Soluble reactive phosphorous (SRP), phosphates, ammonia & nitrates	Hemme et al. 2009
Watershed	• Hollis • Aripo • Maraval	*Cryptosporidium* oocysts	Philip et al. 2007

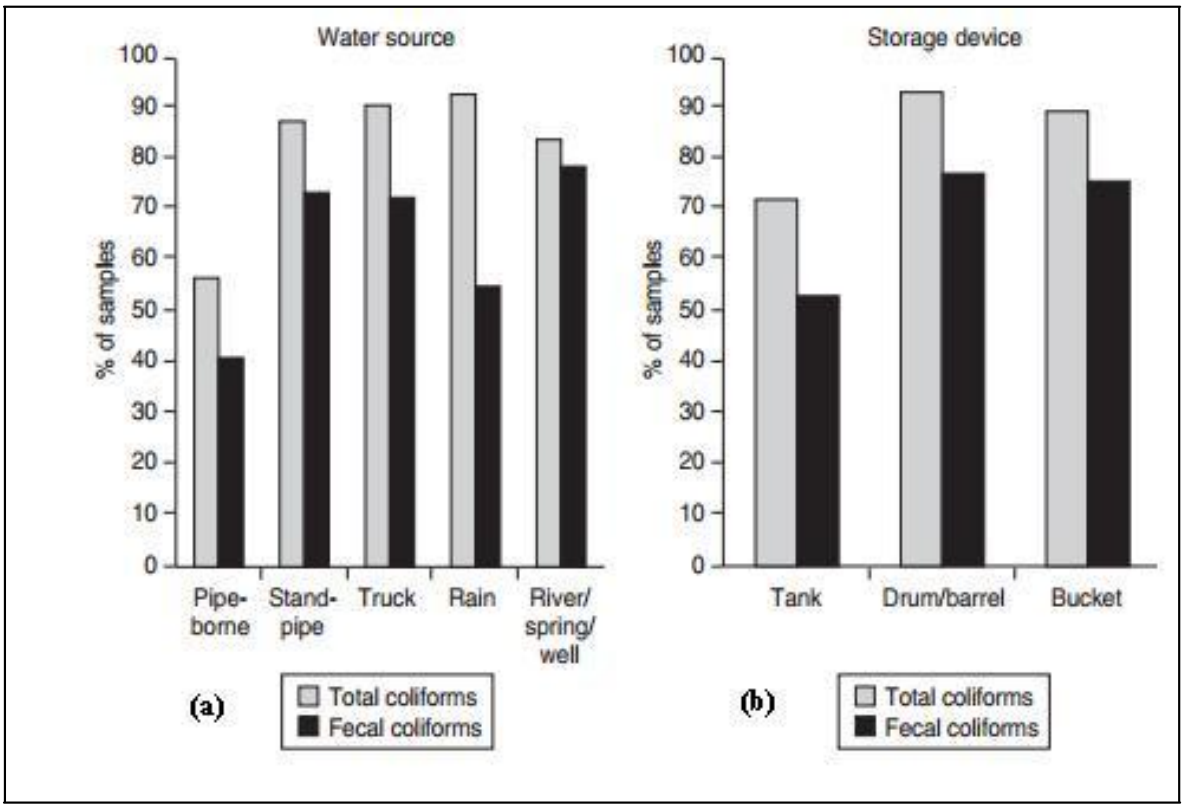


Figure 3.5 Percentage of samples contaminated with total faecal coliforms in (a) water sources and (b) storage devices, Trinidad, 1998.

Adopted from (Welch et al. 2000)

Vector-borne diseases

A study on dengue fever (DF) and climate variability in Trinidad and Tobago (Chadee et al. 2006) confirmed the seasonal nature of outbreaks with transmission taking place in the rainy season. The study also suggested that temperature may act as a trigger for the onset of DF during the rainy season. The presence of all four serotypes in the country increases the vulnerability to serious outbreaks.

The most important vector-borne disease worldwide continues to be malaria. Trinidad and Tobago was declared malaria free in 1965. However, residual cases of infection with

Plasmodium malariae were identified in South Trinidad as recently as 2003. Of the 10 cases reported, four were found to be imported, one was a relapse case and five were described as cryptic. In the presence of other health stresses such as poor diet that may result from climate change-related poor harvests, further recrudescence of malaria may occur leading to reestablishment unless surveillance and management continue.

Leptospirosis is an acute febrile infection caused by bacterial species of the genus *Leptospira*. Infection is caused by exposure to water, damp soil, or vegetation contaminated with the urine of infected wild and domestic animals such as dogs and rodents (Gubler et al. 2001). Outbreaks often occur after flooding.

Other communicable and emerging and re-emerging diseases

Cases of Meningococcal infections continue to be registered with no evident trend suggesting epidemiological outbreaks. The majority of cases are found in the under-19 age group. Acute hemorrhagic conjunctivitis showed an increase during 2003. Salmonellosis, shigellosis, influenza and viral hepatitis B showed increasing registry from 2002 to 2004. Prevalence rates for Hansen's disease have remained unchanged since 1999. No cases of Lymphatic filariasis (LF) have been reported since 1982. A national survey conducted in 2002 in school children (6-12 years) using ICT (immunochromatographic card tests) provided evidence of the interruption of LF transmission in Trinidad (Kumarsingh and Chadee 2008).

Adaptation Approaches

Anticipatory adaptation planning can prove to be the most effective for human health impacts of climate change given the inter-relatedness of other sectoral impacts such as on the water and agricultural sectors. In this regard, a mixture of approaches to maximise synergy is likely to have maximum efficacy. Public education and awareness is a key component of such an approach which can result in increased resilience. Additionally, water management strategies including addressing the distribution system for potable water and thereby increasing access by a larger segment of the population, will result in a decrease in health risks and increased resilience to climate change vulnerability.

Government also has a rigourous immunisation programme which will continue and be enhanced in order to increase resilience to preventable diseases.

The Ministry of Health and the Regional Health Authorities (RHAs) are in the process of mainstreaming health promotion initiatives and integrated management of non-communicable diseases (NCDs) including health promotion in schools. The Medium-Term Policy Framework 2011 - 2014 is promoting a socially transformed Trinidad and Tobago and advocates for a health system that is of the highest standard and which emphasises preventative medicine. Citizens will have access to quality health care and would be expected to be less prone to health problems, in particular, non-communicable diseases (NCDs).

Through the upgrade and expansion of hospitals and Enhanced Health Facilities, Government's Chronic Disease Risk Factor Screening Campaign, its mobile clinics as well as the establishment of a Tobacco Control Unit , this social imperative of transforming our society is expected to be met (Ministry of Planning and the Economy, 2011). Policies are in place for the majority of these issues but require further reinforcing and compliance at all levels together with improved monitoring and surveillance systems.

The Insect Vector Control Division of the Ministry of Health provides services for its mosquito vector control programme based on comprehensive house to house inspections using a large work force. However, the relatively low level of educational attainment of some of the field staff means that intensive ongoing training in basic behaviour and communication skills for meaningful public interaction is required.

Environmental health services within the Ministry of Health remain focused on inspections and registrations for food safety and the monitoring for mosquito vector control and general sanitation within communities and institutions. Currently Environmental Health is an integral part of the Ministry of Health, although eventual decentralisation to the RHAs under the Health Sector Reform Programme is planned.

Collaboration between the Health and Agricultural sectors exists in a joint Food Safety Committee. Even though responsibilities are clearly demarcated and enshrined in existing legislation, there is need to enhance institutional capacity of both sectors to carry out comprehensive food safety programmes and projects. Poor sanitation practices at food preparation establishments (including mobile food units) have contributed to periodic food illness outbreaks, especially in hotels. During the period 1981 - 2005 most of the 42 973

reported cases of food-borne illnesses in the Caribbean (Caribbean Epidemiology Centre [CAREC] Surveillance Database, October 2008) were from Trinidad and Tobago (37 %), with an annual average of 633 cases over the reporting period with a low 102 cases in 1981 and a high of 1308 cases in 1990. Preparation of local instructional materials as well as training of foodhandlers, currently being done by the Caribbean Industrial Research Institute (CARIRI) among other agencies, would assist food inspectors to more effectively communicate with food handlers and the general public and introduce the application of Hazard Analysis and Critical Control Points (HACCP).

Ongoing research on the vector of dengue fever - the mosquito *Aedes aegypti* - at the University of the West Indies, St Augustine Campus, Trinidad, the Ministry of Health Insect Vector Control Division, Trinidad and Tobago, and the Caribbean Epidemiology Centre, Port of Spain, Trinidad, has built up a body of knowledge and experience that was recently fruitfully combined with climate and meteorological experience at the University of the West Indies, Mona Campus, Jamaica. This collaboration has resulted in the publication ***Climate Change and Dengue in the Caribbean*** (Chen et al. 2007), which will also serve as a valuable resource to increase understanding and inform adaptation approaches in the region.

The Insect Vector Control Division carries out an ongoing programme of surveillance, spraying and public education supported by an active research programme in collaboration with the UWI. Research into the ecology of the vectors, particularly *Aedes aegypti*, is of continuing international significance in its academic breakthroughs and in its practical relevance for vector control. For example identification of key premises, key containers, and mosquito distribution around key premises coupled with pre-seasonal spraying programmes all assist in keeping cost of spraying down and in increasing efficiency and effectiveness.

Epidemiological research has confirmed that outbreaks of DF are a rainy season phenomenon but also that it may be exacerbated by increasing minimum temperatures. Figure 3.6 shows monthly total rainfall and average minimum temperatures from 1990 - 2007 and monthly dengue cases between 1996 and 2004. The increase in minimum temperature over the period is evident. The increase in dengue cases follows the increase in both rainfall and temperature by about three weeks.

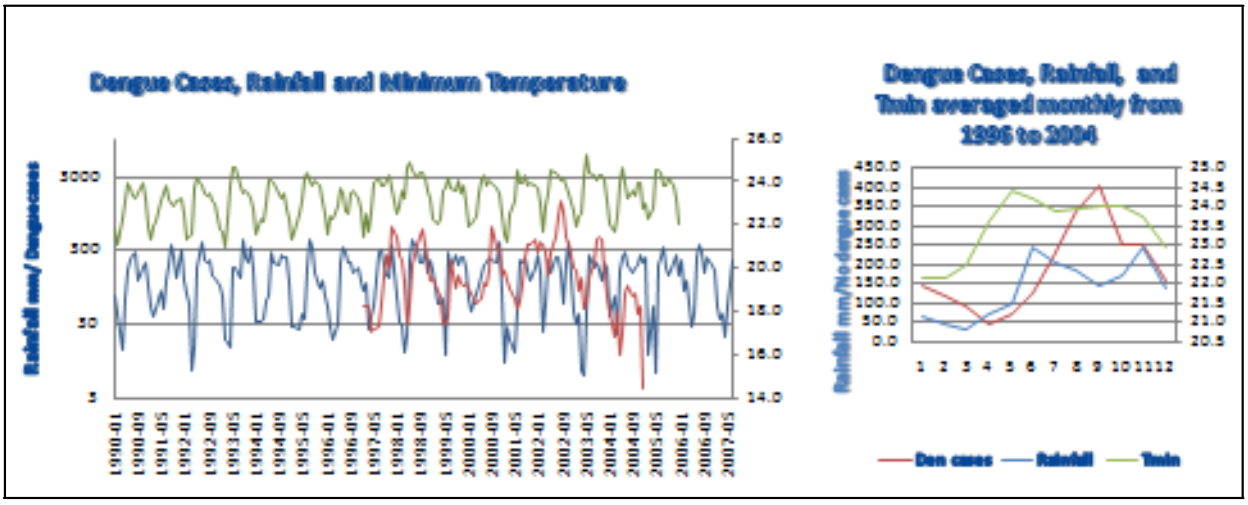


Figure 3.6 Dengue cases in relation to rainfall and temperature.

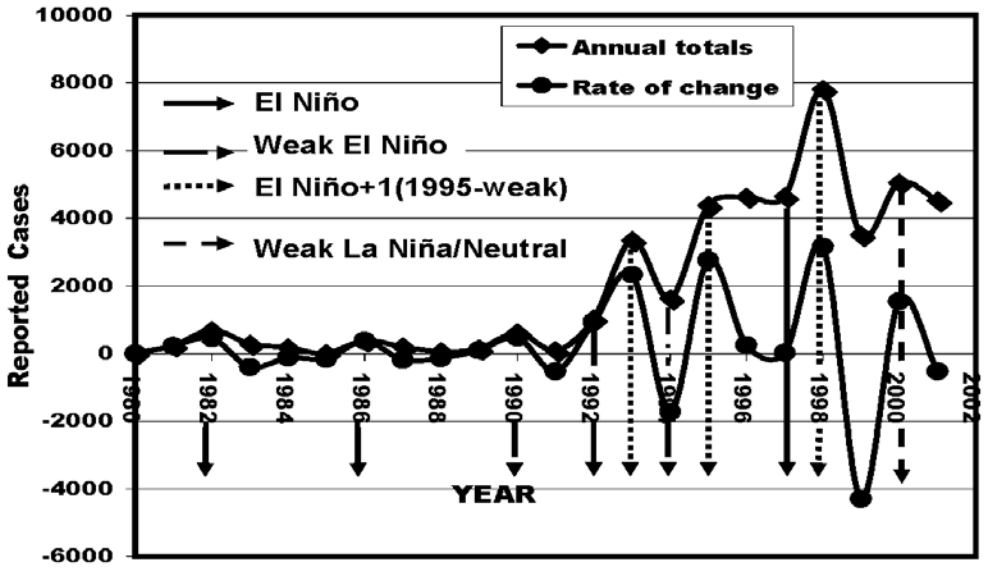


Figure 3.7 Dengue cases in relation to El Niño.

A Knowledge, Attitude and Practice (KAP) study (Rawlins et al. 2006) that included a section on potential links between climate change and dengue found that a majority of respondents in Trinidad and Tobago noted the wet season link with dengue fever. In addition, a number of respondents also identified increased breeding habitats over increased temperature–related speeding up of the vector life cycle as well as virus replication in the mosquito host as important links. Heslop-Thomas et al. (2008) suggested that the weakness of dengue control strategies has been their reactive rather than adaptive nature. However, an early warning system for dengue outbreaks in the Caribbean has been formulated (Amarakoon et al. 2006) but has not yet been implemented. Dengue cases were examined in relation to temperature and rainfall in the Caribbean, principally Trinidad and Tobago, Barbados and Jamaica over the period 1980-2001. It was found that in years with early warmer periods epidemics appeared to occur early, which was a scenario more probable in the year after an El Niño (an El Niño+1 year; Figure 3.7). A temperature index based on a moving average temperature appeared to be most effective in gauging the potential onset of dengue.

Similarly a system for detecting the seasonal increase in *Aedes aegypti* has been formulated and validated for Trinidad and Tobago but has not been included at this point in time in adaptation strategies at national level (Chadee et al. 2006 and Chadee 2009). The predictable increases in *Aedes aegypti* populations and dengue cases at the beginning of the rainy season were used to develop a pre-seasonal treatment strategy that was effective in controlling both mosquito populations and dengue case increase (Figure 3.8).

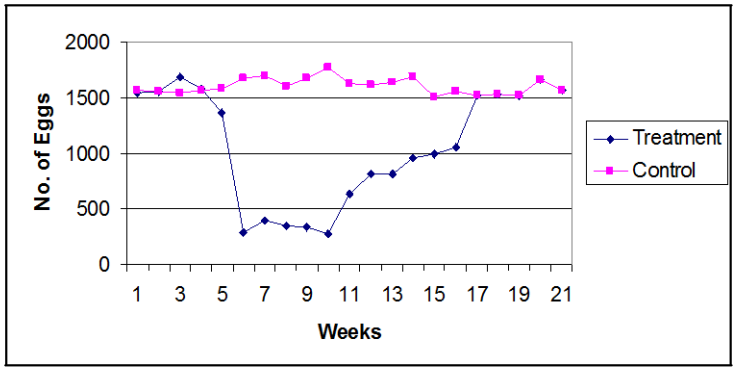
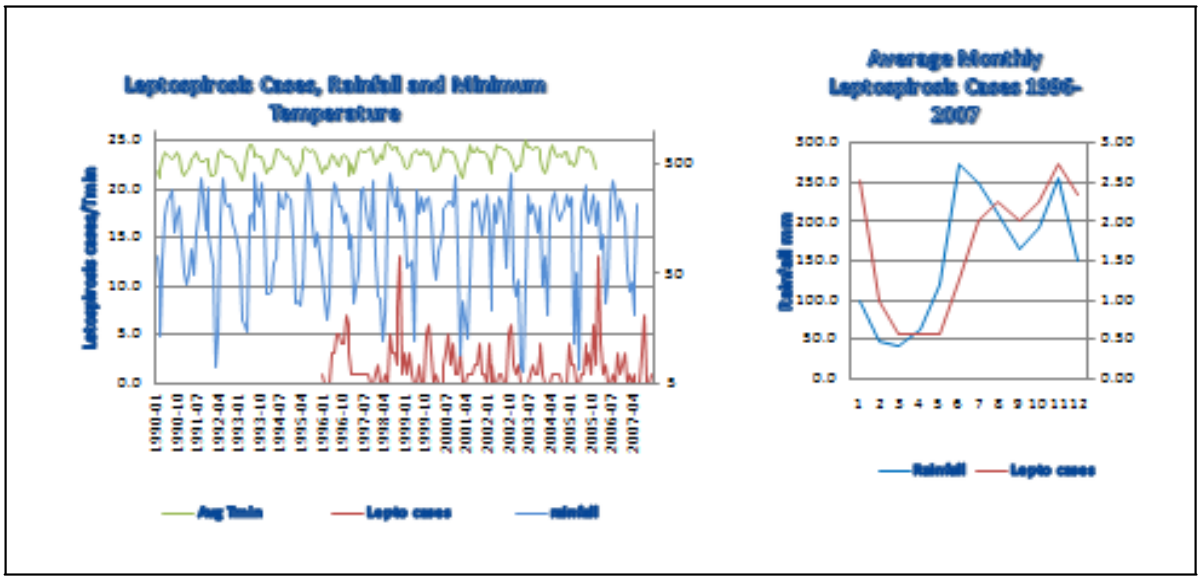


Figure 3.8 Efficacy of pre-seasonal treatment with temephos on Aedes aegypti *ovitrap egg counts in Curepe (treatment) and St. Joseph (control), Trinidad.*

Leptospirosis currently does not occur in large numbers in Trinidad and Tobago (Mohan et al.2009). The average annual number of cases in the period 1996 to 2006 was 22 – 7 cases occurring in the dry season, January to June, and 15 cases in the wet season, July to December. Monthly rainfall distribution and Leptospirosis cases over the period 1996 - 2007 and the monthly average number of cases and rainfall over the period are shown in Figure 3.9. There is only a slight lag in case occurrence/reporting after the onset of the rainy season suggesting that infections occur immediately after the rains begin. Geographic Information System (GIS) of case locations showed that most occurred in sub-urban areas on residential lands. A KAP survey revealed a low level of awareness of the disease but dissatisfaction with government rodent control services. A Strength Weakness Opportunity Threat (SWOT) analysis revealed lack of rodent control resulted from insufficient funding (Mohan 2010).



(a) *(b)*

Figure 3.9 Leptospirosis cases (a) in relation to rainfall and minimum temperature for the period 1990 - 2007 and (b) in relation to monthly rainfall for the period 1996 - 2007.

Public perceptions found via KAP studies in relation to climate change (Rawlins et al. 2006) ranked sector importance in the following order: health, water resources, agriculture, biodiversity and coastal degradation. Health issues were ranked: food-borne diseases, water-borne diseases, heat stresses, respiratory diseases and vector-borne diseases, perhaps

confirming the existing effects on health of poor air and water quality referred to above. In spite of the general population's knowledge of dengue and its causes, water-related illnesses are considered more serious suggesting that, until people have a reliable potable water supply, they will continue to treat the threat of vector – borne diseases as less important and attempts to involve communities in environmental clean-up programmes will continue to fail.

In light of the above, Government has recognised the critical need for adaptation planning to avoid the provision of costly health care services *ex-post facto.* In this regard, Government has put systems in place to ensure that the pre-emptive approaches outlined in Table 3.8 are actively pursued.

Table 3.8 A proposed adaptive strategy for the reduction of climate changes effects on health.

Strategy	Action	Impact
Pre-seasonal Interventions	Cleaning of water canals	Flooding management
	Treatment of water	Dengue and vector control
	Source reduction programme	Environmental sanitation and mosquito control
	Refresher training	Capacity building
	Planning – monitoring and evaluation	Assessment of impact
	Health Promotion	Community Empowerment

Tourism

Although tourism is not a sector per se, it is highly dependent on other cross-sectoral amenity services such as biodiversity, agriculture, coastal zones, water etc. As such tourism and especially ecotourism (defined by the International Ecotourism Society as "responsible travel to natural areas that conserves the environment and improves the well-being of the local people") is likely to be indirectly impacted on and may be significantly affected by the impacts of climate change depending on the scale of such impacts on the contributing sectors. This is

significant since the Government of Trinidad and Tobago in its 2010/11budget has identified tourism as "an important platform to create sustainable jobs and increase contribution of tourism to GDP". The country's tourism potential is expected to follow a growth trajectory. The total contribution of travel and tourism (including the wider effects from investment; the supply chain and induced income impact) was 7.0 % of GDP in 2011 and is expected to grow by 3.7 % to 7.2 % of GDP by 2012 (World Travel and Tourism Council, 2012).The percentage share of Travel and Tourism **DIRECT** contribution to employment was 5.2 % in 2011 whereas the TOTAL contribution to employment was 9.3 %. .

Coral Reefs

Tobago's coral reefs play an important role in sea, sun and sand tourism. The limestone from the dead coral builds the beautiful white beaches that draw many tourists to the region. The coral also allows a diversity of fishes, sea grass and mangrove to form habitats. Reefs act as barriers, reducing wave energy, creating calm waters and lagoons along stretches of the shorelines of Tobago.

Climate change is posing a threat to the coral reefs as gradually warming seas contribute to coral bleaching across the region in 1998, 1999 and 2005 (Burke et al. 2008). A study by The Buccoo Reef Trust and Coral Cay Conservation in collaboration with the THA and the Travel Foundation on the effect of the 2005 'warming' event that led to extensive bleaching in the Caribbean Sea has indicated that overall bleaching of hard corals was found to be 66 %. The reefs on the northern shores of Tobago experienced a reduced level (less than 20%) of bleaching for reasons which are still unknown. Notably, those reefs on the southern shores were most affected, with some areas experiencing over 85 % bleaching. The study also found that bleaching by species to be highly variable both within and between species. Lapointe et al. (2010), and Potts et al. (2004), specifically recognise the ongoing chronic impacts relating higher microalgae cover to live hard corals as a result of continuous nutrient overloading in southwestern Tobago. With most of Southwestern Tobago becoming heavily populated it is no surprise that the main source of pollution stems from inadequately treated sewage as found by the IMA. It is surmised that this variance in bleaching intensity may be related to the fact that the northern shores have more stressors such as sewage, nutrient runoff and tourist activity, which make them more vulnerable (Tobago House of Assembly et al. 2012). As such special

attention will have to be given to reducing land based sources of pollution being emitted into the oceans. Also, increasing intensity of storms in recent years as well as bleaching, which leave corals more susceptible to diseases, have damaged the coral reefs in Tobago thereby hindering its recovery from other threats. Another threat is ocean acidification caused by increased uptake by the oceans of the increased anthropogenic atmospheric carbon dioxide, which may hinder coral growth and regeneration in the years to come (Orr et al. 2005).

Coastal Zones

The coastal zone is a dynamic environment that is constantly changing in response to the superimposed forces such as winds, waves, tides and currents. Human activity such as the construction of ports and harbors, coastal protection structures, buildings, pipelines and reclamation can alter these forces which can have significant effects on the coastline. Areas that experience a loss of material are in a state of erosion. Coastal development in Trinidad and Tobago includes transportation links, human settlements, industrial estates and energy-based installations and related appurtenances. The coastal zone therefore represents an important physical area in which critical economic activity occurs, particularly in the energy sector.

Coastal erosion can be either a natural phenomenon or a result of man's interference or a combination of both. It can be short (seasonal) or long term. The natural erosion of a coast may be affected by several factors such as, geology (the resistance of the outcropping coastal formation), shape and orientation of the coastline, waves and current, sediment supply, sea level rise and storms and hurricanes.

Coastal erosion is a major problem in Trinidad. It undermines the stability of structures including roads, vacation and residential homes and defence works. It removes coastal agricultural land, destroys recreational areas (beaches) and causes loss of habitat.

Coastal Changes in Trinidad

Figure 3.10 is a map of Trinidad showing different coastline statuses as erosion, dynamic or accretion. These are indicated by yellow, green and blue respectfully. Most of the coastal erosion is seen in the southern peninsula of Trinidad.

The eastern shoreline from Matura to Galeota has been suffering extensively from erosion over the years. This coast is exposed to the Atlantic Ocean and is subjected to large swells especially during the North Atlantic winter period, storms and hurricanes. The coastal area of Cocos Bay located between the Nariva and Ortoire Rivers is undergoing severe erosion at a rate of approximately 1 metre per year. Along some sections of the Manzanilla-Mayaro Road the high water line is approximately 8 metres from the road. During swell events, the uprush reaches the road, thereby threatening the stability of the road. As a consequence, in 2006, a coastal protection structure (rip rap) had to be constructed along a section of Cocos Bay.

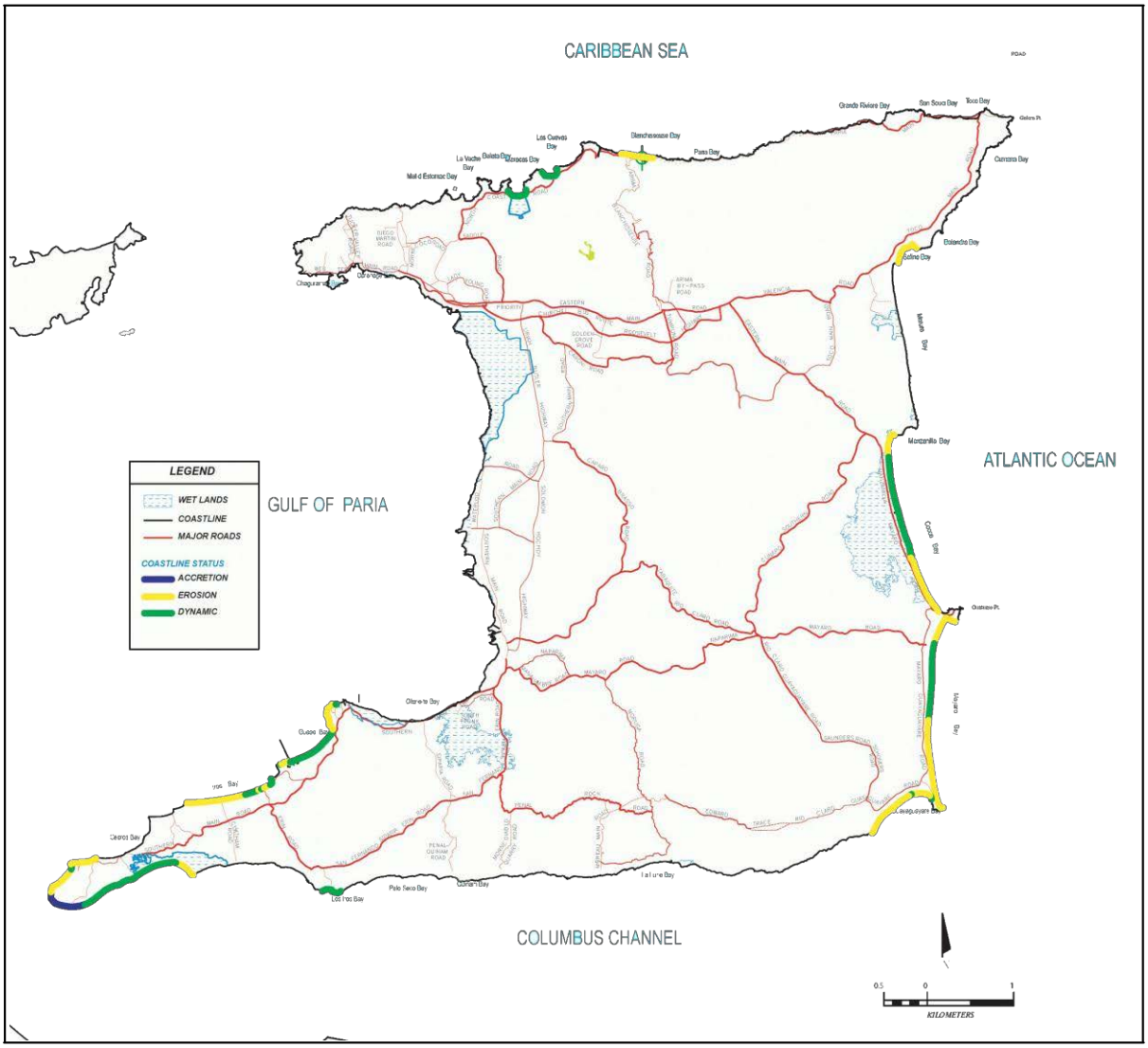


Figure 3.10 Map of Trinidad showing areas of coastal erosion.

The northern and southern sections of Mayaro Bay are also undergoing erosion. At the northern end of Mayaro Bay the shoreline is receding at a rate of 0.9 m per year. Beach sand mining has been observed at Mayaro Bay. This activity can impact on the beach, which may result in coastal erosion and make this low-lying coast vulnerable to rises in sea level and changes in storm characteristics.

On the south coast, the geological outcrops consist mainly of unconsolidated silts, clays and sandstone, which provide little resistance to oncoming waves. The entire coastline of Guayaguayare Bay except for the areas of the Wetland at the eastern part of the bay has been eroding over the last century. Further, from 1996 to present, the western part of the bay has been altered due to the laying of gas pipelines (Figure 3.11). The coastline at the central section of Guayaguayare Bay, east of Rustville Road receded 3.9 metres during the period 1996 - 2004.

Figure 3.11 Westerly view of Station 3, West Guayaguayare Bay, showing erosion of shoreline as a result of pipe laying activities.

Figure 3.12 Punta del Arenal, Trinidad - a coastal area where accretion is taking place.

Fig 3.12 shows one of the few coastal areas where accretion is taking place which is at Punta del Arenal on the southwestern peninsula. During the past fourteen years the breaches accreted vertically and migrated. The shoreline of the west coast of Trinidad has been experiencing erosion over decades even though this is the most sheltered coastline of Trinidad. During the last 20 years this shoreline has changed significantly as a result of erosion, coastal development, reclamation and coastal protection structures. Within the last ten years two seawalls and a breakwater were constructed in Clifton Hill and Guapo Beaches in Point Fortin to prevent erosion of the shoreline. At present, erosion is still taking place at the eastern section of Guapo Beach. The other areas along the west coast of Trinidad, which are experiencing severe erosion, are Corral Point and Columbus Bay. Erosion has resulted in a great loss of coconut estates in the southwest Peninsula of Trinidad.

Projected sea level rise coupled with projected increase in the intensity of extreme events are likely to place coastal zones and the biophysical, physical and socio-economic activities therein under increased stress. Increased erosion, inundation and coastal flooding increase the risk of displacement of communities and disruption of economic activities given that most of the infrastructure, communication and transport links and socio-economic activity through trading ports etc. are located within the coastal zone. When one considers the impacts on increasing sea surface temperatures on coral reefs which provide natural defense against storm surge, the synergetic effect will increase coastal vulnerability and have secondary impacts on already vulnerable sectors such as water and tourism. The energy-based infrastructure is important in

this regard given its importance to the economy of Trinidad and Tobago. For example, a study by Singh et al. (2007) outlined the vulnerability of the State-owned Petroleum Company of Trinidad and Tobago (PETROTRIN) and the measures being anticipated to mitigate these impacts.

Adaptation of Priority Sectors

In accordance with the Government of Trinidad and Tobago's National Climate Change Policy, proposed approaches to address vulnerability and adaptation to climate change will be predicated on comprehensive vulnerability studies on an ongoing basis in order to avoid costly maladaptation interventions. Further, the Government recognises the inter-sectoral and cross-sectoral nature of climate change vulnerability and the need for a commensurate approach to adaption and adaption planning. Nonetheless, the Government also recognises that adaptation to current climate variability and building climate resilience in potentially affected sectors can serve long term adaptation needs under a changed climate. In this regard, Table 3.9 outlines some approaches that are consistent with existing policy. These include creating and strengthening where appropriate, the institutional framework to build long-term capacity to address climate change, both in the international as well as national contexts.

Table 3.9 Climate change policy-relevant approaches to adaptation and adaptation planning in major vulnerable sectors in Trinidad and Tobago.

Major Concerns	**Actions at Local Level**
Climate change	
• Change in the Earth's Climate and its adverse effects are common concern of humankind. • Developing countries and particularly Small Island Developing States, face increased risks of the negative impacts of change and therefore most vulnerable to these impacts. • The United Nations Framework Convention on Climate change (UNFCCC), to which Trinidad and Tobago is a signatory, is the key	• Meet all the commitments and obligations under the UNFCC. • Build and enhance scientific and technological capabilities, *inter alia*, through continuing support to the Intergovernmental Panel on Climate Change (IPCC) for the exchange of scientific data and information especially in developing countries. • Develop and transfer technological solutions. • Enhance the implementations of national, regional and international strategies to monitor the earth's atmosphere, land and oceans by improving monitoring stations.

Major Concerns	Actions at Local Level
Climate change	
instrument addressing climate change. • Climate change is expected to increase the vulnerability of these countries in the context of poverty, land degradation, accesses to water and food, and human health.	• Improve techniques and methodologies for assessing the effects of climate change, and encourage the continuing assessment of those adverse effects by the IPCC. • Reduce the risks of floods and droughts by, inter alia, promoting wetland and watershed protection and restoration, improved land-use planning, improving and apply more widely techniques and methodologies for assessing the potential adverse effects of climate change on wetlands.

Major Concerns	Actions at Local Level
Biodiversity	
• Biodiversity plays a critical role in overall sustainable development and poverty eradication, and is essential to human well-being and livelihood. • Biodiversity is currently being lost at unprecedented rates due to human activities. • The convention is the key instrument for the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of genetic resources.	• Implement the Convention (CBD) and its provisions, including active follow-up of its work programmes and decisions through national, regional and international action programmes, in particular the national biodiversity strategies and action plans, and strengthen them into relevant cross-sectional strategies, and programmes and policies. • Integrate the objectives of the Convention into global, regional and national sectoral and cross-sectoral programmes and policies. • Promote the ongoing work under the Convention on the sustainable use on biological diversity, including on sustainable tourism, as a cross-cutting issue relevant to different ecosystems and sectors. • Encourage effective synergies between the Convention and other multilateral environmental agreements, *inter alia*, through the development of joint plans and programmes, with regard to their respective mandates, regarding common responsibilities and concerns. • Strengthen national, regional and international effects to control invasive alien species, which are one of the main causes of biodiversity loss, and

Major Concerns	Actions at Local Level
Biodiversity	
	encourage the development of effective work programmes on invasive alien species at all levels. • Promote practical measures for access to results and benefits arising out of biotechnologies based upon genetic resources, in accordance with Articles 15 and 19 of the Convention including through enhanced scientific and technical co-operation on biotechnology and biosafety, including the exchange of experts, training human resources and developing research-oriented institutional capacities. • Implement actions recommended in the National Biodiversity Strategy and Action Plan.
Major Concerns	**Actions at Local Level**
Deforestation/Land Degradation	
• Sustainable forest management of both natural and planted forests and timber and non-timber products is essential to achieving sustainable development and is a critical means to eradicate poverty. • Land degradation through unsuitable land use planning and development has given rise to decreased land use potential, agricultural viability and desertification.	• Take immediate action on domestic forest law enforcement and illegal international trade in forest products, including forest biological resources, and provide human and institutional capacity building related to the enforcement of national legislation in those areas. • Take immediate action to promote and facilitate the means to achieve sustainable timber harvesting (prevent illegal logging). • Support the United Nations Forum on Forests, the assistance of the Collaborate Partnership on Forests, as key intergovernmental mechanisms to facilitate and co-ordinate the implementation of sustainable forest management at the national, regional and international levels, thus contributing to, inter alia, the conservation and sustainable use of forest biodiversity. • Implement the CBD's expanded action-oriented work programme on all types of forest biodiversity, within the involvement of all relevant stakeholders. • Develop and implement integrated land

Major Concerns	Actions at Local Level
Deforestation/Land Degradation	
	management and water-use plans that are based on suitable use of renewable resources and on integrated assessments of socio-economic and environmental potentials. • Promote programmes to enhance in a sustainable manner the productivity of land and the efficient use of water resources in agriculture, forestry, wetlands, and aquaculture. • Strengthen the implementation of the United Nations Convention to Combat Desertification (to which Trinidad and Tobago is a signatory) to address causes of land degradation in order to maintain and restore land. • Formulate national action programmes to ensure the timely and effective implementation of the Convention and its related projects.
	• Explore and enhance synergies between the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity and the Convention to Combat Desertification, with due regard to their respective mandates, in the implementation of plans and strategies under the respective Conventions. • Integrate measures to prevent and combat desertification as well as mitigate the effects of drought through relevant policies and programmes, such as land, water and forest management, improved use of climate and weather information and forecasts, early warning systems, land and natural resource management, agricultural and ecosystem conservation.

Major Concerns	Actions at Local Level
Marine and Coastal Resources	
• Oceans, seas, islands and coastal areas form an integrated and	• Promote the implementation of Chapter 17 of agenda 21 which provides the programme of action

Major Concerns	Actions at Local Level
Marine and Coastal Resources	
essential component of the earth's ecosystem and are critical for global food security and for sustaining economic prosperity and the well-being of the national economics of most developing countries.	for achieving the sustainable development of oceans, coastal areas and seas through its programme areas of integrated management and sustainable development of coastal areas, including Exclusive Economic Zones, marine environmental protection, sustainable use and conservation of marine living resources, addressing critical uncertainties for the management of the marine environment and climate change, strengthening international and regional co-operation and co-ordination and sustainable development of small islands. • Promote integrated, multidisciplinary and multi-sectoral coastal and ocean management at the national level. • Develop ocean and coastal zone policies and mechanisms on integrated coastal zone management. • Implement the work programme arising from the Jakarta Mandate on the Conservation and Sustainable use of Marine and Coastal Biological Diversity of the Convention on Biodiversity. • Implement the RAMSAR Convention, including its joint work programme with the Convention on Biodiversity, and the programme of action called for by the International Coral Reef initiative to strengthen joint management plans and international networking for wetland ecosystems in costal zones, including coral reefs, mangroves, seaweed beds and tidal mud flats • Enhance protection of the marine environment from pollution by actions at all levels to *inter alia*, implement the conventions and protocols and other relevant instruments of the International Marine Organisation (IMO) relating to protection of the marine environment from marine pollution and environmental damage caused by ships, including the use of toxic anti-fouling paints. • Improve the scientific understanding and assessment of marine and coastal ecosystems as a fundamental basis for sound decision marking, through actions at all levels to, *inter alia*, increase

Major Concerns	Actions at Local Level
Marine and Coastal Resources	
	scientific and technical collaboration, including integrated assessment at the global and regional levels, for the conservation and management of living and non living marine resources, and expanding ocean-observing capabilities for the timely prediction and assessment of the state of the marine environment. • Build capacity in marine science, information and management through *inter alia*, promoting the use of environmental impact assessments and environment evaluation and reporting techniques, for projects or activities that are potentially harmful to the coastal and marine environments and their living and non-living resources.

Major Concerns	Actions at Local Level
Waste Management	
• The prevention and minimisation of waste as well as the maximisation of reuse and recycling are key elements towards the sustainable use ofthe natural resources, along with the use of environmentally friendly alternative materials.	• Develop waste management systems, with highest priorities placed on waste prevention and minimisation, reuse and recycling, environmentally sound disposal facilities, including technology to recapture the energy contained in waste, and encourage small-scale waste-recycling initiatives that support urban and rural waste management and provide income-generating opportunities. • Promote waste prevention and minimisation by encouraging production of reusable consumer goods and biodegradable products and developing the infrastructure required. • Implementation of obligations under the Basel Convention, to which Trinidad and Tobago is a signatory, to provide a useful and effective framework for dealing with waste management at the national level.

Source: (The Ministry of Planning and Development Vision 2020 Report on the Environment)

Chapter 4
Policies and Measures to Mitigate Climate Change

The Government recognises that emissions of GHGs will increase as Trinidad and Tobago continues on its path of its socioeconomic development in order to provide the necessary services and amenities that will reduce poverty and increase the quality of life of its citizens. To this end, the Government aims to achieve in the medium to long term a development path that will utilise an optimum energy mix to facilitate this development which will also result in emissions reduction and avoidance. This is reflected in the Government's Sustainable Development Report (Ministry of Planning and the Economy, 2012).This Report advocates that all plans for national development relating to resource allocation and utilisation must incorporate the concept of sustainability in order to ensure long-term economic, social and environmental stability. This Sustainability Report is structured around the two (2) core themes which were the focus of the Rio +20 United Nations Conference on Sustainable Development. These are:

(1) Green economy in the context of sustainable development and poverty eradication; and
(2) The institutional framework for sustainable development.

Currently the Ministry of Planning and Sustainable Development, through the Town and Country Planning Division, is involved in a number of projects and initiatives which will allow for sustainable land use, wiser planning and a focused developmental plan, rooted in rational policy making. These projects include the National Physical Development Plan, the ProEcoServ Project and the Land Use Policy.

National Climate Change Policy

The overarching policy directive for addressing climate change mitigation in Trinidad and Tobago is the National Climate Change Policy.

The goal of the policy is to provide guidance for the development of an appropriate administrative and legislative framework, in harmony with other sectoral policies, for the pursuance of a low-carbon development path for Trinidad and Tobago through suitable and

relevant strategies and actions to address climate change, including sectoral and cross sectoral adaptation and mitigation measures.

The National Climate Change Policy will be guided by the following mutually interactive objectives:

- Reducing or avoiding greenhouse gas emissions from all emitting sectors;
- Enhancing carbon sinks;
- Conserving and building resilience of human and natural systems to adapt to the adverse impacts of climate change, including through capacity building and the application of cleaner and energy efficient technologies;
- Protection of the natural environment and human health; and
- Enhanced agricultural production and food security.

Some guiding principles the policy will follow in relation to the response to climate change are:

- sustainability;
- consultative and multi-partite approach;
- precautionary approach;
- multisectoral and inclusive of mitigation and adaptations actions; and
- evidence-based.

Implementation of the National Climate Change Policy is expected to be supported by the existing regulatory framework. The Environmental Act, Chapter 35:05 establishes a regulatory body in the Environmental Management Authority (EMA) which is responsible for standards and incentives for the protection of the environment. The EMA is also mandated to regulate the impact of economic activity on the environment through environmental audits and permits for the use of natural resources. Climate change considerations are included in the conduct of environmental impact assessments in development planning including for mitigation of greenhouse gas emissions through the support of the Government of the Republic of Trinidad and Tobago and the Inter-American Development Bank (IDB) with the help of a Technical Cooperation Grant (Ministry of Finance, 2011). In this context it should be noted that The EMA is about to finalize a Technical Cooperation with the IDB to strengthen its capacity

regarding climate change considerations in terms of institutional strengthening as well as review of relevant legislation. This Technical Cooperation is aligned with another Policy Based Loan from the IDB to the GORTT for mainstreaming climate change considerations.

Currently there is also in preparation a budget sector-support grant from the European Union (EU) for 8 million Euros related to climate change and carbon reduction.

Renewable Energy Policy

The Government has committed to the development of a **Renewable Energy (RE) Policy (**Ministry of Energy and Energy Affairs, 2012**)**. A framework has been developed that recognises the importance of developing the country's **RE** resources and the complementary role of energy efficiency (EE) to the achievement of long term sustainable development and energy security and as a mitigation strategy to address the issue of climate change. Such development holds great potential for promoting increased investment, enhancing research and development and providing opportunities for the creation of high-value jobs while generating increased foreign exchange and revenues.

Transportation

The transportation sector represents a significant source of greenhouse gas emissions. The Government has instituted a policy of mandating the conversion of all state-owned vehicles to compressed natural gas (CNG), which has begun. In order to facilitate private owners of vehicles to pursue conversion to CNG, the government has put in place several fiscal incentives including tax measures to support the cost of the conversion kits; the importation of CNG vehicles and increasing the number of CNG stations that will provide a cheaper fuel alternative.

The Trinidad and Tobago Water Taxi Service was instituted on the 29th December 2008 in an attempt to provide mass transit options between the two major cities of Port of Spain and San Fernando. At peak traffic hours with four Water Taxi Service vessels in use, vehicular emissions are estimated to be reduced by a factor equivalent to that of approximately 1000 cars. Full operation of the ferry system (which consists of 8 vessels) is estimated to result in reduction of 3000 cars daily on the nation roadway (Ministry of Transport, 2009).

Additionally, the Government intends to replace the current fleet of diesel buses with CNG-ready buses, which will also result in a reduction in emissions. To this end, the dedicated Priority Bus Route (PBR) has been marked for conversion into a "green" route through the deployment of CNG buses, solar traffic and street lights and the testing of pilot electric or hybrid buses.

Energy Efficiency

Trinidad and Tobago Electricity Commission (T&TEC) is mandated by the **Regulation Industries Commission (RIC) Act** Section 6 (1) (D) (2002) "*to carry out studies of efficiency and economy of operation and of performance by service providers and publish the result thereof*". This Act was established on 20th October 1998 (Act No. 26, 1998).The regulatory body under this Act is the Regulation Industries Commission which ensures the compliance of T&TEC to this Act (Rolingson, 2007).

One of the objectives of the Trinidad and Tobago Electricity Commission (T&TEC) energy efficiency plan is to educate the public about the conservation of electricity. One form of conservation of energy proposed by T&TEC is the change from incandescent to fluorescent bulbs that will reduce carbon dioxide emissions by 15 %, since the power consumption will be reduced by 15% (Trinidad and Tobago Electricity Commission, 2010).

T&TEC recently introduced a Geographic Information System that will assist its Department of Health and Safety and Environment in collecting system information to support reports. This will help in the spatial analysis of data in distribution and use of conserving electricity (Martel et al. 2009).

In addition to these measures, the EMA is managing a project to install solar-powered equipment and solar power for surveillance cameras (photovoltaic (PV) system) as part of a National Security initiative for a Police Surveillance Bay (PSB) network along the Uriah Butler and Solomon Hochoy Highways. To date 9 of the 13 PSBs have been equipped with Solar street lights, signage, flashing amber lights and lighted road pavement markers, as well as PV systems for surveillance cameras.

Carbon Reduction Strategy

The Government, in collaboration with UNDP is conducting relevant studies with a view to developing a carbon reduction strategy in the transportation, power generation and industrial sectors by analysing intervention options through policy and technology. To this end a business as usual development baseline is expected to be constructed and a low-carbon development pathway defined, and the socio-economic analysis of intervention options identified. this is expected to result in a suite of practical, feasible and effective actions aimed at reducing or avoiding emissions. It is expected that the analysis of the intervention options will include the use of relevant planning models for each sector. Additionally, a strategy for mainstreaming climate change in national development and for the implementation of the National Climate Change Policy is underway through grant funding by the IDB.

Solid Waste/Resource Management Policy

The Government in February 2012 drafted an **Integrated Solid Waste/Resource Management Policy for Trinidad and Tobago**. The vision of the policy is to create a sustainable community which seeks a better quality of life for current and future societies by maintaining nature's ability to function over time. It minimises waste, prevents pollution, promotes efficiency and develops resources to revitalise local economies. The solid waste hierarchy that encourages prevention over disposal, with its associated goal of protecting the country's air, land, water and other natural resources and the public health, is central to attaining the goal and objectives of sustainability and best practices in solid waste management (Ministry of Local Government, 2012). The goals of the policy are as follows:

- To manage waste in a manner that will protect public health and the environment and that will conserve natural resources;
- To manage waste as an integrated management system in accordance with the preferred hierarchy where the focus is placed on prevention rather than disposal. The hierarchy seeks to minimise land-filling, with an increased emphasis on maximising the reduction of waste volumes, through the initiatives of reuse, recycling and source segregation;
- To manage waste in a cost-effective manner that maximises environmental benefits and minimises long-term financial liability for the population; and
- To cause generators to take responsibility for the environmentally sound management of their waste and to identify, allocate and communicate solid waste management system costs equitably among those who use or benefit from the system.

The policy categorizes the waste into the following: household waste, hazardous waste, bio-medical waste, industrial waste, electronic waste and special bulk waste. The collections of data for the above mention waste will allow for are a more precise GHG inventory emission.

Mitigation and Abatement

Industrial Processes Sector

The industrial processes sector mitigation and abatement of greenhouse gas emissions can be grouped into the following general areas: energy efficiency, materials efficiency, waste reduction and carbon dioxide capture and storage.

More efficient use of energy would result in a reduction of GHGs emissions in a number of ways. The use of less energy for the same process would require less fuel combustion and hence less carbon dioxide production. This "energy efficiency" aspect can be thought to also include other things such as fuel switching, use of waste materials, heat recovery/ energy cascading and renewable fuels and energy efficient buildings (commercial as well as domestic). Heat recovery is widely practiced in industry and is a standard mechanism for improving energy efficiency. This could involve the capture of waste heat from manufacturing processes to heat water for electricity production or to pre-heat an incoming feed streams so as to reduce the amount of heating required in the processes. The use of renewable fuels can be applied in many industries. This would include the use of biomass for combustion, resulting in reduced net carbon dioxide emissions versus fossil fuel combustion. In addition, biogas produced from landfill sites can also be exploited for combustion. Solar and other alternative energy sources such as wind have great potential for reducing carbon dioxide emissions, but currently there is little commercial use of these in industry in Trinidad and Tobago. The carbon reduction strategy for the industrial sector will inform the feasibility of mitigation options in this sector.

Materials efficiency and recycling has to do with the reduction of energy use and hence greenhouse gas emissions by the choice of materials for processes and recycling of materials in processes. For the most part, industrial energy reduction will occur more through recycling processes. Recycling of aluminum can save up to 95 % of the energy needed to produce the metal from bauxite ore, while recycling scrap iron can utilise up to 33 % of the energy needed to produce iron from virgin ore. Recycling is also common in non-metal industries such as glass production.

Passage of the draft air pollution rules in the near future is aimed at regulating air pollution emissions with a view to eventually including mandatory greenhouse gas emissions reporting. It is anticipated that these measures in tandem with capacity development in small and medium enterprises to manage greenhouse gas emissions will incentivise and provide the policy and regulatory framework to employ cleaner technology and reduce emissions. It is also envisioned that the mandatory reporting of greenhouse gas emissions will form an integral part of the institutional arrangements for the collection, collation and compilation of GHG data for national reporting.

Carbon Capture and Sequestration (CCS) has a high potential for the abatement of greenhouse gas emissions in industry. Numerous studies suggest that there is extensive worldwide potential for permanently storing large quantities of CO_2 in geological formations. Estimates currently range between 2 – 11 trillion metric tons (Carbon Capture and Sequestration, 2011). The process of CCS requires carbon dioxide produced at the industry to be concentrated and then stored by the production of mineral carbonates (reacting with lime, for example), injected into geological formations or the ocean or even used as feedstock by other industries. This can be feasible if large amounts of carbon dioxide are produced and are relatively pure, requiring little processing. Trinidad and Tobago's ammonia industry has captured its carbon dioxide emissions and feed it to the methanol industry. The use of CO_2 injection into oil bearing formations for enhanced oil recovery (Class II wells) is also an attractive proposition. Currently a few of the oil drilling companies operating in Trinidad are exploring the feasibility of this option.

With recent developments regarding CCS and the CDM, Trinidad and Tobago is undertaking the necessary feasibility studies that will include establishing the legislative and policy framework to become "CCS ready".

Emissions reduction through participation in the CDM has been previously challenged by the knowledge and capacity to negotiate the CDM process to register CDM projects as well as by lack of interest and economic scale to make it attractive to industry. However, Trinidad and Tobago is participating in a UNEP-Riso project aimed at building capacity for CDM participation. At the end of the project it is anticipated that CDM projects will be developed, and PETROTRIN has submitted a CDM project on gas recovery.

In summary, the short to medium term policy-based and mitigation measures being undertaken are:

1. Development of a carbon reduction strategy for the major emitting sectors: transport, power generation and industrial sectors;
2. Conversion of state-owned vehicles to CNG with a view to incentivising conversion of privately-owned vehicles;
3. Conversion of the public bus system from diesel to CNG with a view to use fully CNG powered buses;
4. Examine the feasibility of electric-powered or hybrid buses in the public transport system through a pilot project;
5. Replacement of conventional streetlights and public lighting to solar powered street lights;
6. Installation of solar-powered streetlights on new highways and roadways;
7. Development of a green Government policy aimed at increasing energy efficiency in government offices and maximising waste recycling opportunities;
8. Legislating air pollution with a view to incentivising the use of cleaner production technology in the industrial sector; and
9. Examine the feasibility of renewable energy sources such as wind power for supplementing power supplies to existing and new housing stock through the Government's housing programme.

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