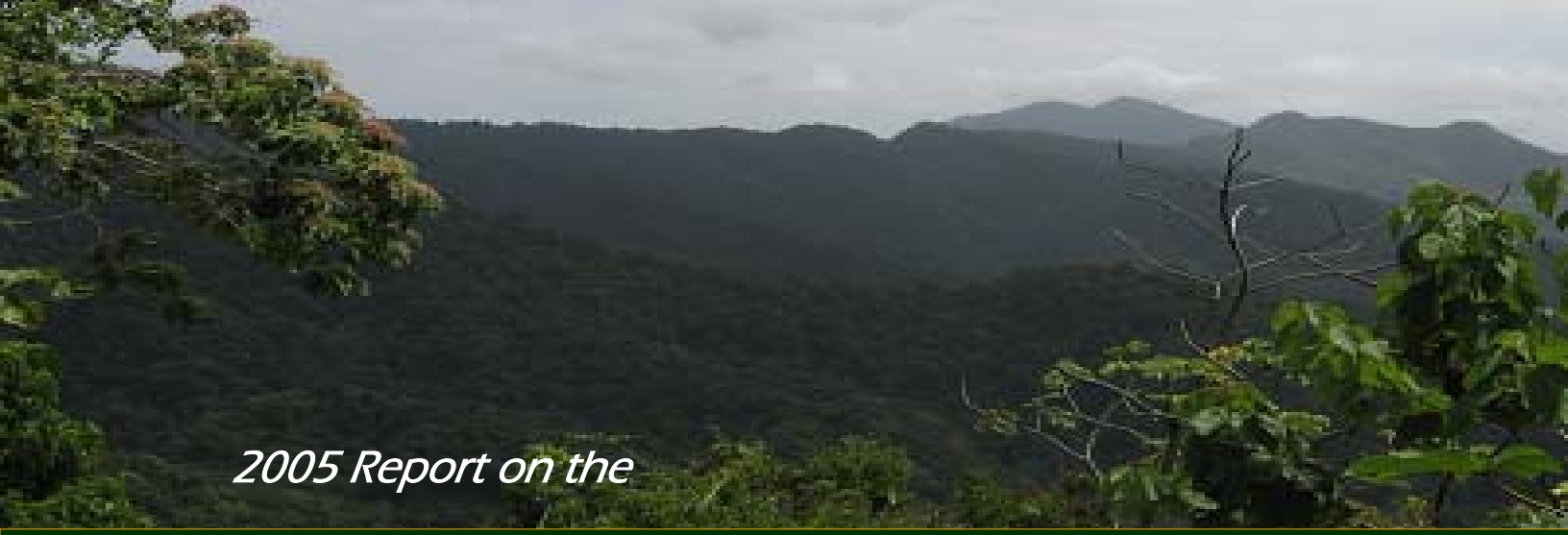
Report on the State of Land Resources of Trinidad and Tobago

2005



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Acronyms & Abbreviations

ACP	-	African, Caribbean and Pacific Countries
CaFANN	-	Caribbean Farmers and NGO Network Caribbean Farmers and NGO Network
CARDI	-	Caribbean Agricultural Research and Development Institute
CAWTP	-	Caroni Arena Water Treatment Plant
CBO(s)	-	Community-based Organisation(s)
CEC	-	Certificate of Environmental Clearance
CEPEP	-	Community Environmental Protection and Enhancement Project
CNIRD	-	Caribbean Network for Integrated Rural Development
CSO	-	Central Statistical Office
CTA	-	Technical Centre for Agricultural and Rural Cooperation, ACP-EU
DNRE	-	Division of Natural Resources and the Environment
EDIP	-	Environmental Data and Information Project
EEZ	-	Exclusive Economic Zone
EIA	-	Environmental Impact Assessment
EMA	-	Environmental Management Authority
EMBD	-	Estate Management and Business Development Company Limited
ESA(s)	-	Environmentally Sensitive Areas
EU	-	European Union
EVI	-	Environmental Vulnerability Index/Indices
FAO	-	Food and Agriculture Organisation of the United Nations
FAOSTAT	-	Food and Agriculture Organisation Corporate Statistical Database
GDP	-	Gross Domestic Product

GORTT	-	Government of the Republic of Trinidad and Tobago
HBS	-	Household Budgetary Survey
IADB	-	Inter-American Development Bank
ICM	-	Integrated Crop Management
ITTO	-	International Tropical Timber Council
IMA	-	Institute of Marine Affairs
IUCN	-	World Conservation Union (formerly the International Union for the Conservation of Nature and Natural Resources
ITCZ	-	Inter-tropical Convergence Zone
IPM	-	Integrated Crop Management
LAD	-	Land Administration Division
LNG	-	Liquefied Natural Gas
LSA	-	Land Settlement Agency
LSD	-	Land and Surveys Division
MALMR	-	Ministry of Agriculture, Land and Marine Resources
MDP	-	Ministry of Planning and Development
MEEI	-	Ministry of Energy and Energy Industries
MPHE	-	Ministry of Planning, Housing and the Environment
MPU	-	Ministry of Public Utilities (formerly the Ministry of Public Utilities and the Environment (MPUE))
NAP	-	National Action Programme
NRWRP	-	National Reforestation and Watershed Rehabilitation Programme
NEP	-	National Environment Policy
PET	-	Polyethylene Terephthalate
NGO(s)	-	Non-government organisation(s)
OAS	-	Organisation of American States
PAHO	-	Pan American Health Organisation
PROCICARIBE	-	Caribbean Agricultural Science and Technology Network System

RIOD	-	Reseau International des ONGS pour la Desertification International Network of NGOS for Desertification
SIDS	-	Small Island Developing State(s)
STCIC	-	South Trinidad Chamber of Industry and Commerce
SWMCOL	-	Solid Waste Management Company of Trinidad and Tobago Limited
THA	-	Tobago House of Assembly
TCPD	-	Town and Country Planning Division
UK	-	United Kingdom
UNCCD	-	United Nations Convention to Combat Desertification
UNFCCC	-	United Nations Framework Convention on Climate Change
US	-	United States
USDA	-	United States Department of Agriculture
UTT	-	University of Trinidad and Tobago
UWI	-	The University of the West Indies
WASA	-	Water and Sewerage Authority
WHO	-	World Health Organisation
WRA	-	Water Resources Agency
WWF	-	World Wildlife Fund

Chapter 1

Introduction

Photograph 1: A View of the Upper Maraval Valley

Trinidad and Tobago is endowed with a diverse land resource base compared to other Small Island States (SIDS) of similar size. It possesses a range of soils, minerals and ecosystems which are utilised to achieve the country's development goals. The country's development and its land resources are therefore closely inter-related and inter-dependent.

However like most SIDS, its small size, coupled with its complex land tenure systems, soil types, topography and climatic variation, restricts the area available for human settlement, agriculture, forestry, mining/quarrying, tourism and infrastructure, and creates intense competition among land use options.

Most aspects of environmental management in Trinidad and Tobago are directly dependent on and influenced by the planning and utilisation of its land resources. Competing demands and a lack of a comprehensive land use planning and development mechanism have led to unsustainable utilisation, overuse and degradation of the

country's land resources. Moreover, extreme climatic events and other natural disasters particularly tropical storms and landslides, have impacted adversely on the land resources of certain regions of the country (for example, North Coast of Trinidad and Windward Tobago) to such an extent that corrective measures must be taken for recovery of the region's economies.

Planning for and ensuring sustainable development of Trinidad and Tobago requires that consideration be given and actions taken to address its land management and degradation challenges. The United Nations Convention to Combat Desertification (UNCCD) to which Trinidad and Tobago became a signatory on August 6, 2000, provides a suitable framework within which Trinidad and Tobago could tackle land degradation and implement solutions to promote sustainable management and wise use of land resources. The implementation of the UNCCD is expected to strengthen the prevention and correction of land degradation and enhance the framework for sustainable management and wise use of land resources.

Although Trinidad and Tobago is not characterised as having dryland conditions, land degradation and the impacts of land degradation are major development and environmental issues. By becoming an Affected Country Party to the Convention, Trinidad and Tobago has expressed its willingness to adopt and be guided by the principles and processes of the Convention for addressing the land degradation that the country currently experiences.

1.1 Rationale and Purpose

In reviewing the progress in implementing the UNCCD in Trinidad and Tobago, it is important to assess the current state of the country's land resources including examining the factors which affect their management and utilisation, the extent, causes and impacts of land degradation, and current efforts to combat land degradation. Towards this end, this Assessment builds on and updates the results of two projects:

- *The State of the Land of Trinidad and Tobago* undertaken as part of the Environmental Data and Information Project conducted by the Environmental Management Authority (EMA)[1]. The project gave an account of country's land resources, determined their state (extent, causes and impacts of land degradation), and identified management strategies and practices to prevent and correct degradation. In addition, data and information on the country's land resources were reviewed and assessed, and an inventory was developed on available data and information sources. Measures for enhancing existing data collection methods and technologies were also recommended.

[1] Kairi Consultants Limited, 1999. Environmental Data and Information Project (EDIP): Land. Conducted on behalf of the EMA (Final Report).

- *The First Report on the Implementation of the UNCCD in Trinidad and Tobago* undertaken by the Ministry of Public Utilities and the Environment (MPUE)[2]. The study involved the review of the existing literature on land degradation and related policy issues in Trinidad and Tobago; the conduct of interviews with key officials involved in public policy functions of relevance to land degradation; and conduct of a workshop held in April 2002 to obtain the views of stakeholders on the issues addressed in the Report.

1.2 The Approach

The results of the Assessment of the land resources of Trinidad and Tobago were achieved through undertaking the following key activities:

- A review of the existing data and literature on socio-economic characteristics and land resources of, and land degradation noted in Trinidad and Tobago;
- Generation of quantitative and qualitative data through interviews with key personnel (from communities, government agencies and non-government organisations (NGOs), and through field and drive-by surveys;
- Conduct of situational analyses, including the examination of the country's political, economic, physical, social, technological and environmental situation as they affect land management and degradation;
- Analysis and examination of the institutional framework governing land management and to combat land degradation in Trinidad and Tobago (international conventions, national policies, programmes and projects) based on the review of available literature and discussions with key stakeholder agencies; and
- Identification and prioritisation of the issues relating to land management and degradation, and the identification of priority areas for corrective action.

1.2.1 Participatory Process

The UNCCD process calls for collaboration among Government and non-government agencies in dealing with the issues and problems of land degradation/desertification. The approach taken was participatory in mode, involving stakeholders at both public sector and private sector levels. The following initiatives were undertaken:

- Meeting with and working closely with the *Interim National Coordinating Committee for the Implementation of the UNCCD in Trinidad and Tobago*. The Committee consists of experts from various public agencies involved in land management and from the NGO sector. Two working sessions were held with

[2] Dennis Pantin and Seth Tyler, 2002. United Nations Convention to Combat Desertification: First National Report of Trinidad and Tobago. Prepared on behalf of the Ministry of Public Utilities and the Environment (MPUE)

the Committee to determine and explore the extent, causes and impact of land degradation, and identify corrective measures for combating the problem.

- Meetings with public, private and NGO sector agencies involved in land management and environmental management. Individual meetings were held with representatives of these agencies including various divisions of the Tobago House of Assembly (THA) (including Public Utilities and Infrastructure, Environment, Community Development, Agriculture, Tourism, among others), Environment Tobago, and Caribbean Network for Integrated Rural Development (CNIRD). These meetings were held to obtain information on the land resources and land degradation in Trinidad and Tobago; to identify sources of secondary data on the same; and to explore the issues relating to land management and degradation in Trinidad and Tobago;
- Meetings with community-based organisations (CBOs) in affected areas – A meeting was held with the National Arm of the International Network of NGOs for Desertification[3] on the drafting of the UNCCD National Action Programme (NAP).
- Conduct of the four National Awareness Seminar and Public Consultations held in North, Central and South Trinidad and in Tobago. Over 190 persons attended these one-day seminars geared at raising awareness of the UNCCD, the International Network of NGOs for Desertification (RIOD) and to discuss and explore the issues of land degradation in the context of Trinidad and Tobago. The seminars were also used to identify critical areas where land degradation is taking place, and to formulate corrective actions to address the issues identified.

Photograph 2: Parlatuvier, Tobago

[3] Forms part of the International Network of NGOS for Desertification

1.3 The Structure of the Report

The *Second Chapter* of the Report provides a description of the natural environment and socio-economy of Trinidad and Tobago. It gives an account of the climate and land resources including an examination of the country's forest, water resources and biodiversity.

Chapter Three provides definitions of land degradation and desertification and identifies the extent, type, causes and impact of land degradation and where possible attempts to quantify and give examples of the problem.

Chapter Four examines the legislative, policy and institutional framework for land management in Trinidad and Tobago and identifies gaps which may hamper proper land management. The Chapter also identifies the international conventions of relevance in the fight against land degradation in Trinidad and Tobago. In addition, it looks at the key programmes and projects currently being undertaken to address land degradation.

Finally the Report concludes with *Chapter Five* which summarises the key priority areas for action to correct land degradation in Trinidad and Tobago.

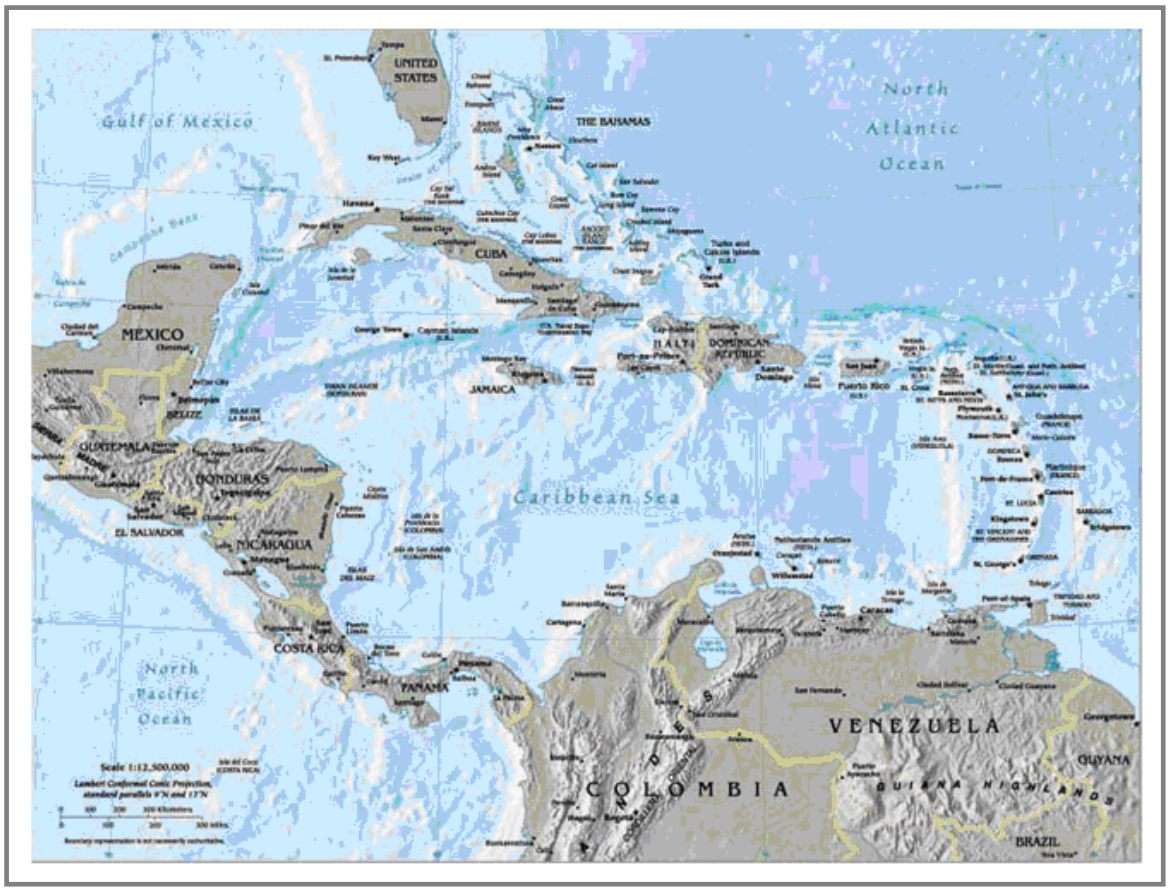
Chapter 2

Trinidad and Tobago in Context

2.1 Natural Environment

2.1.1 Location

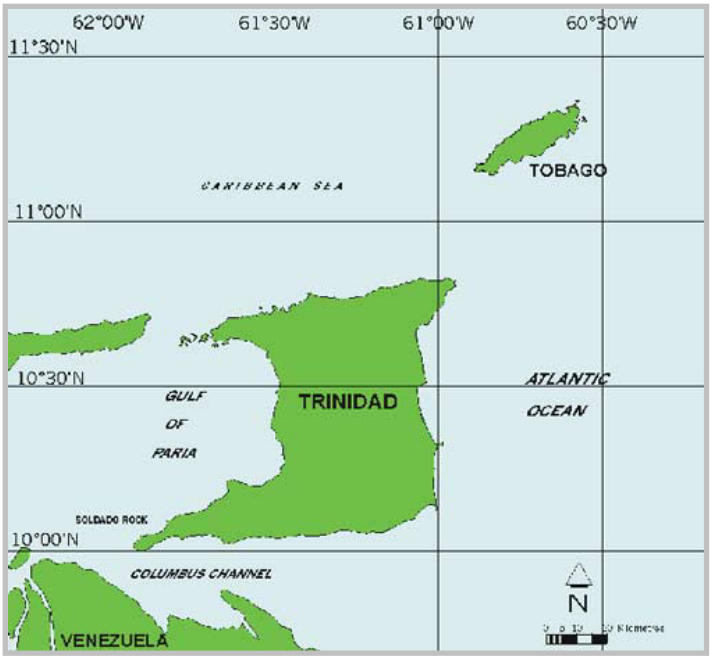
Trinidad and Tobago, the most southerly of the Caribbean islands, is an archipelagic State, situated appropriately between 10^0 2' and 11^o 12' north latitude, and 60^0 30' and 61^o 56' west longitude (Figure 1). The country consists of the two larger islands, Trinidad and Tobago, and 21 smaller islands and islets.



Source: CIA Sourcebook

Figure 1: Trinidad and Tobago in Relation to the Caribbean Region and Latin America

Trinidad is separated from Venezuela by a distance of about 13 kilometres, and from Tobago by a distance of 32 kilometres (Figure 2). Tobago is located northeast of Trinidad and is separated from Trinidad by a channel which is nearly 12 kilometres in width. The two main islands have a total land area of 5,128 square kilometres, while the country has an Exclusive Economic Zone (EEZ) in 2003 extending to some 60,659 square kilometres[4]. Much of the country's exclusive economic zone lies in shallow enough depths to permit exploitation of petroleum, natural gas and other seabed resources.



Source: http://www.hydrocarbons-technology.com/projects/pointfortin/images/img5.jpg

Figure 2: Map of Trinidad and Tobago

Trinidad and Tobago is located on the continental shelf of South America and immediately adjacent to the outflow of the Orinoco River. The outflow of the Orinoco River influences the country's marine ecosystems and delivers land-derived nutrients and sediments to the shelf which supports significant fisheries resources. The country's terrestrial biota is largely South American in origin.

2.1.2 Climate

Trinidad and Tobago has a humid tropical marine climate with little seasonal or diurnal variation. The country lies within the belt of the Trade Winds, which provides a fairly constant strong wind flowing from the east. The islands are affected mainly by the subtropical anticyclone belt and the inter-tropical convergence zone (ITCZ), and it is the movement and location of these two systems which give the weather its seasonal characteristics. As a result, rains tend to be distributed roughly in two seasons. The dry

[4] Earthtrends Coastal and Marine Ecosystems Statistics
http://earthtrends.wri.org/pdf_library/country_profiles/coa_cou_780.pdf

season is experienced from January to May and a wet season from June to December. There is also a short dry spell, the *Petit Careme*, during September and October.

During the wet season from June through to the end of November, there is risk of tropical storms and hurricanes. However, owing to its southern location the country is less vulnerable to tropical storms and hurricanes than most of the Caribbean region.

In the Island of Trinidad, average annual rainfall is 2,200 millimetres. However, depending on location and topography, there can be a wide variation between different areas on the Island. In the eastern section of the Northern Range, rainfall can reach as high as 3,800 millimetres, and for the same period be as low as 1,200 millimetres both on the off-shore islands of the northwest peninsula and in the southwest peninsula of Trinidad. The pattern for Tobago is comparable with that of Trinidad in quantity, seasonality and spatial distribution. Here, rainfall ranges between 3,800 millimetres in the Northeast and 1,400 millimetres in the Southwest. Figure 3 shows the annual rainfall for Trinidad and Tobago for the period 1975 to 2005.

The mean annual average air temperature varies between 28 degrees Celsius (in the day) and 22.5 degrees Celsius (at nights). Average relative humidity is approximately 80 per cent, but ranges between 50 per cent in the dry season and 100 per cent in the rainy season. During the dry season, there is wide diurnal fluctuation in relative humidity. Figure 4 shows the mean monthly minimum and maximum temperature for Trinidad and Tobago.

The Northeast Trades dominate the wind regime, showing great steadiness throughout the year. The average wind speed ranges between 20 to 28 kilometres per hour, with the lowest speeds in the rainy season[5]. There is considerable local variation in wind directions, related to a range of factors including topography, the diurnal cycle and thunderstorm activity.

[5] State of the Environment 1996 Report

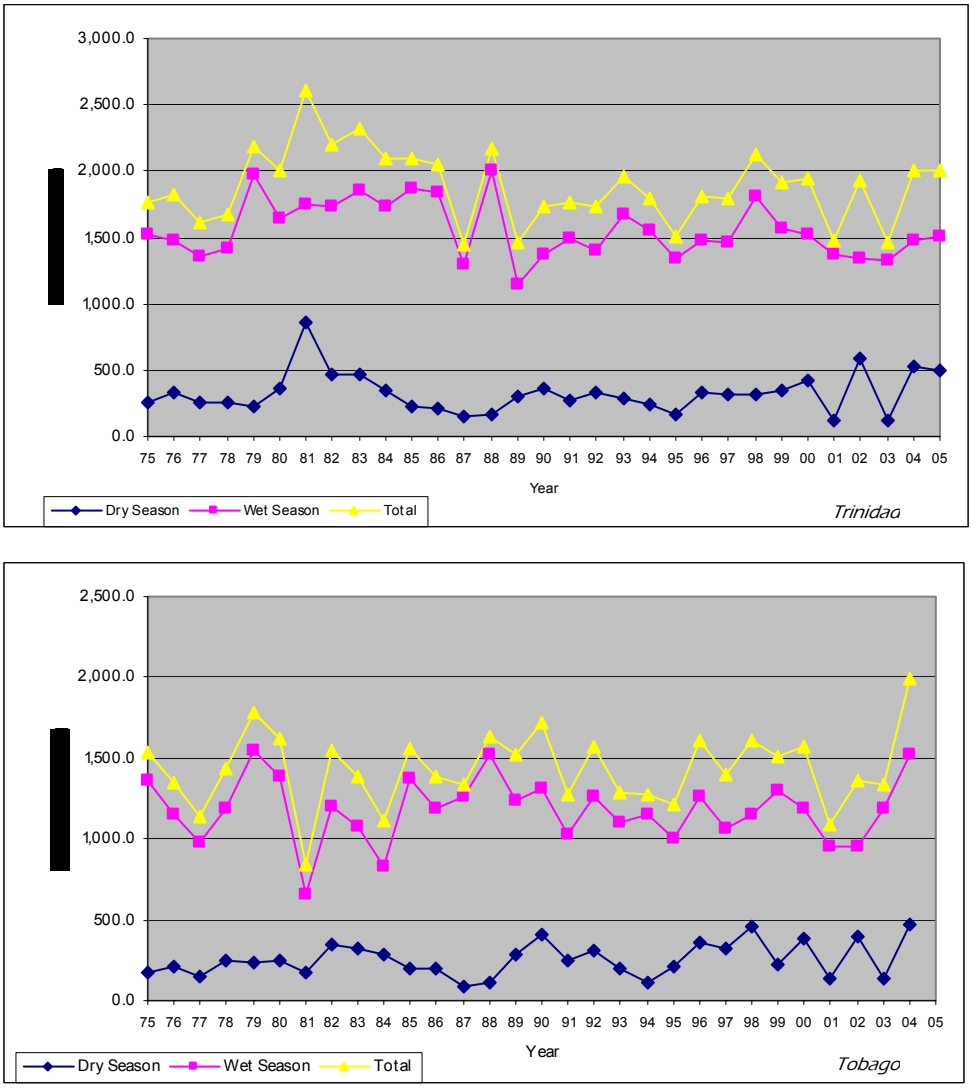


Figure 3: Annual Rainfall for Trinidad and Tobago, 1975-2005

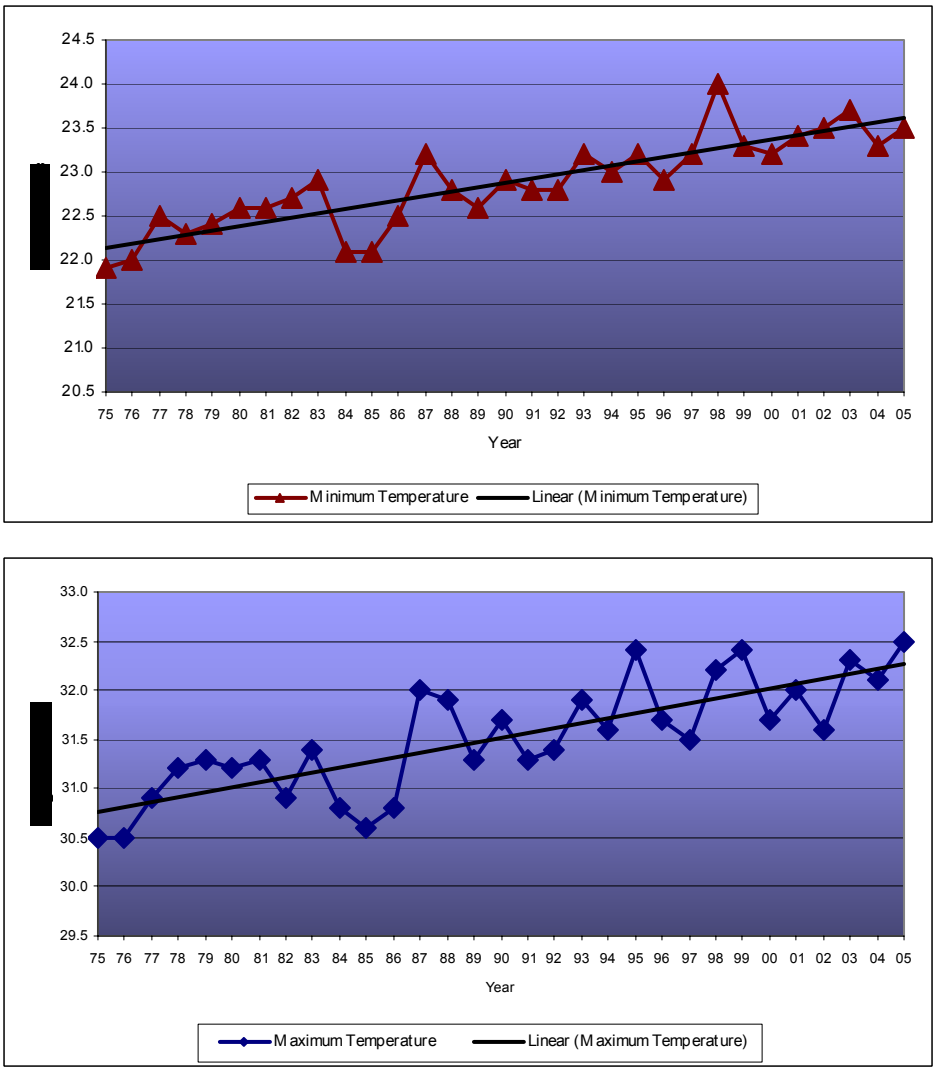


Figure 4: Average Monthly Minimum and Maximum Temperatures for Trinidad and Tobago, 1975-2005

2.1.3 Physiography and Topography

2.1.3.1 Trinidad

Trinidad has the following five physiographic regions, namely the three mountain ranges - Northern Range, Central Range, Southern Range, and the intervening lowland areas – the Northern and Southern Basins (Figure 5). The wetlands are common in coastal locations and serve as prime habitat for a diverse number of species.

The Mountain Ranges - The Northern Range is an area of rugged topography which runs the length of the North Coast. The average elevation of the Northern Range is between 500 metres and 700 metres with the highest peaks at 940 metres (El Cerro del Aripo) and 936 metres (El Tucuche). Figure 6 shows the topography of Trinidad and Tobago.

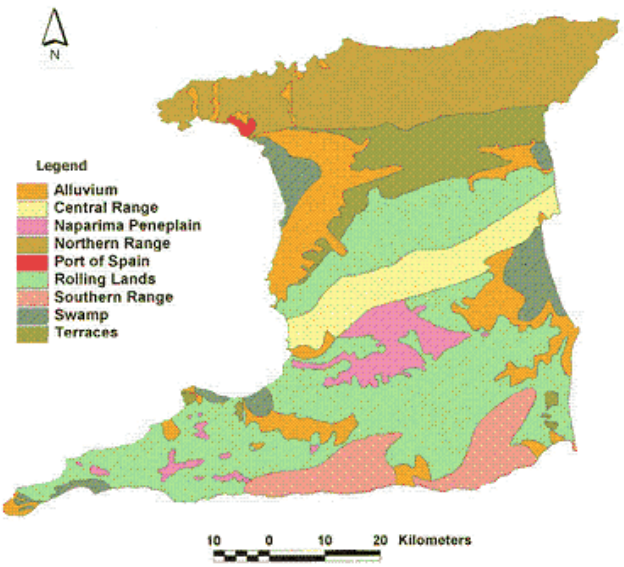


Figure 5: Geomorphology of Trinidad[6]

The natural drainage channels on the northern side of the Range which discharge in the Caribbean Sea are steep, narrow, gorge-like valleys. The southern slopes of the northern range are less steep and many of the large rivers in Trinidad have their sources on the southern slopes of the Northern Range. The Santa Cruz/San Juan, Maracas/St Joseph, Caura/ Tacarigua, Arouca, Oropuna, Guanapo, El Mamo, Aripo, Maraval, St Anns/Port of Spain, Diego Martin and Chaguaramas rivers originate from the southern slopes of the Northern Range. With the exception of the last four rivers, these rivers join together to form Trinidad's largest river, the Caroni which empties into the Gulf of Paria. The main drainage channel on the east coast is the North Oropouche River which receives, as tributaries from the Northern Range, the Rio Grande, Melajo and Guaico Rivers.

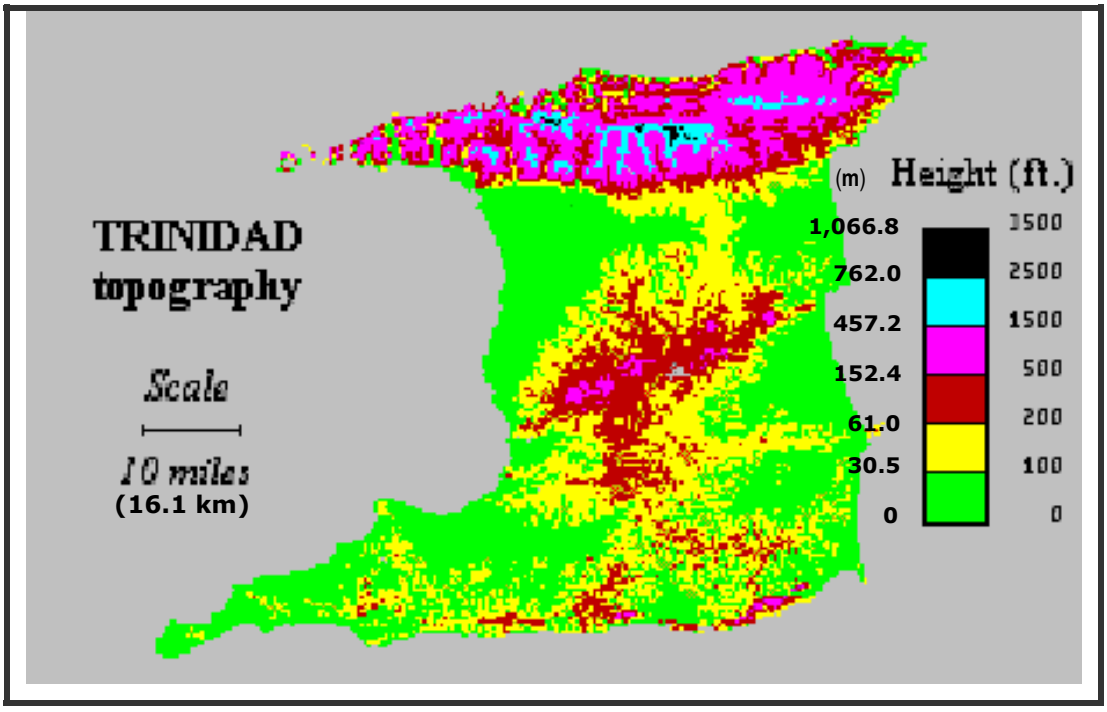


Figure 6: Topography of Trinidad

[6] http://www.procicaribe.org/networks/clawrenet/reports/z_tt/ttmp211.htm

The Central Range runs diagonally across the middle of the island from northeast to southwest. This Range consists mainly of hill-ridges radiating from rugged limestone peaks rising to 300 metres in the Montserrat District, 290 metres at Mount Harris and 335 metres at Mount Tamara situated at the eastern end of the Range. Ravines containing fast-flowing streams fed by springs separate the ridges, but these springs disappear during the dry season. Slopes are mostly mild except those on the southern flanks of the limestone peaks which are steep, up to 30 degrees.

The main rivers that arise from the northern side of the Central Range are Arena, Talparo, Tumpuna and Cumuto, which are tributaries of the Caroni River, and the Cunapa and Sangre Grande, which are tributaries of the Northern Oropouche River. The L'Ebranche River empties on the east coast and the Couva River on the west coast. The main rivers which arise on the southern flanks are the Guaracara and Poole Rivers, together with a series of rivers which drain into the Nariva Swamp.

The highest point of the Southern Range is the Trinity Hills (325 metres). From this point, the range terminates almost abruptly on the east in the low areas of Guayaguayare, although there is a remnant of the Range in the extreme southeast at Point Galeota. West of Moruga the Range splits into two sections, which peter out towards the Cedros Peninsula. The Range is drained on the eastern end by the Pilote River, in the centre by the Maraquite/Moruga River and on the west by the Erin River.

The Basins - The Northern Basin extends from the foothills of the Northern Range to those of the Central Range and consists of the floodplains and alluvial flats of Caroni and North Oropouche River systems; the Northern Terraces (which lies north of the Caroni and Oropouche rivers and east of Arouca); and the Las Lomas Peneplain (which occupies the Manzanilla District in the southeast of the region).

The Southern Basin consists of the Naparima Peneplain. The landscape of the Basin is gently rolling reaching its highest point in the San Fernando Hills at 260 metres. The peneplains are dissected by numerous small streams which become dry in the dry season and have high runoff rates in the wet season. The main drainage systems are the Poole, Guaracara and Oropouche Rivers.

The Wetlands - There are several wetlands in Trinidad. On the north coast the largest (approximately 25 hectares) is the freshwater swamp forest found at Maracas Bay. However, the largest and most diverse wetland in Trinidad and Tobago is the Nariva Swamp which is located on the southern section of the east coast. This wetland is a complex of freshwater marsh, freshwater swamp forest, palm forest and an eastern fringe of mangrove forest. The area, which covers approximately 6,234 hectares, supports a rich fauna including many threatened species, including the globally threatened manatee *Trichechus manatus*. The site is very important for several species in Trinidad and Tobago, and is critical for the maintenance of the biological diversity in the region. Because of its ecological importance, it was declared a Ramsar site in 1992. Although long an area of small scale mixed farming activity and artisanal fishing, in the recent past, it was subjected to tremendous pressure from large-scale intensive rice farming which has since been brought under control.

The North Manzanilla and the Manzanilla Windbelt are both systems of estuarine mangrove also found on the east coast. In addition, the North Oropouche Swamp occupies a small area at the mouth of the North Oropouche River.

Mangrove swamps are also dominant on Trinidad's south coast. The largest of these is Los Blanquizales which consists of approximately 840 hectares. In general, wetlands along this coast have been only slightly modified by human activity. On the west coast, the main swamps are the Caroni in the north, the Couva River/Carli Bay in the central, the South Oropouche and Roussillac in the south, and the Cedros in the southwest. Caroni Swamp, the largest mangrove swamp in Trinidad and Tobago, consists of 3,265 hectares, is an important critical habitat for a number of bird species, including the Scarlet Ibis *(Eudocimus ruber)*. Urban development and industrialisation have negatively affected the west coast wetlands, and in some instances have greatly modified and severely damaged these systems.

2.1.3.2 Tobago

There are two main physiographic regions in Tobago; the Main Ridge, an area of highland running for about two-thirds of the length of the island in a southwest to northeast direction, and the coastal plain in the southwest. As a result, the topography at the north eastern part of Tobago is precipitous with the 200 metres contour being within seven kilometres of the coastline (Figure 7). The highest point is found in the Main Ridge which stands at 600 and 650 metres above sea level. The five perennial rivers which originate from the Main Ridge and drain to the north are the Bloody Bay, Castara, Englishman's Bay, Parlatuvier and Courland Rivers. Draining south to the Atlantic Ocean are the Richmond, Goldsborough and Hillsborough Rivers.

Most of the wetlands along the Windward Coast of Tobago are mangrove swamps (e.g. Petit Trou and Little Rockly Bay) which have been affected by human activity. There is no dominant wetland type along the leeward coast. The wetlands range from mangrove swamps to freshwater marshes, annual floodplain to freshwater ponds. The largest wetland in Tobago is the Bon Accord Lagoon/Buccoo Bay wetland which is approximately 105 hectares. This wetland is closely associated with the Buccoo Reef and the seagrass community in the Bon Accord Lagoon. It is a critical habitat for various types of waterfowls and has been affected greatly by urban and tourism development.

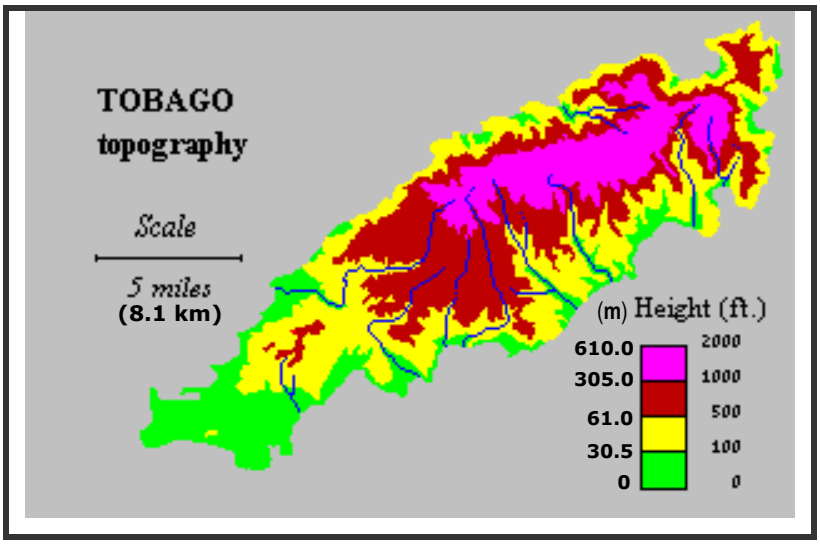


Figure 7: Topography of Tobago

2.1.4 Geology

2.1.4.1 Trinidad

The geology of Trinidad is characterised by sedimentary and metamorphic rocks which cover more than 95 five per cent of the island, with the other five per cent, comprising of igneous rocks. The geology of the island is shown in Figure 8.

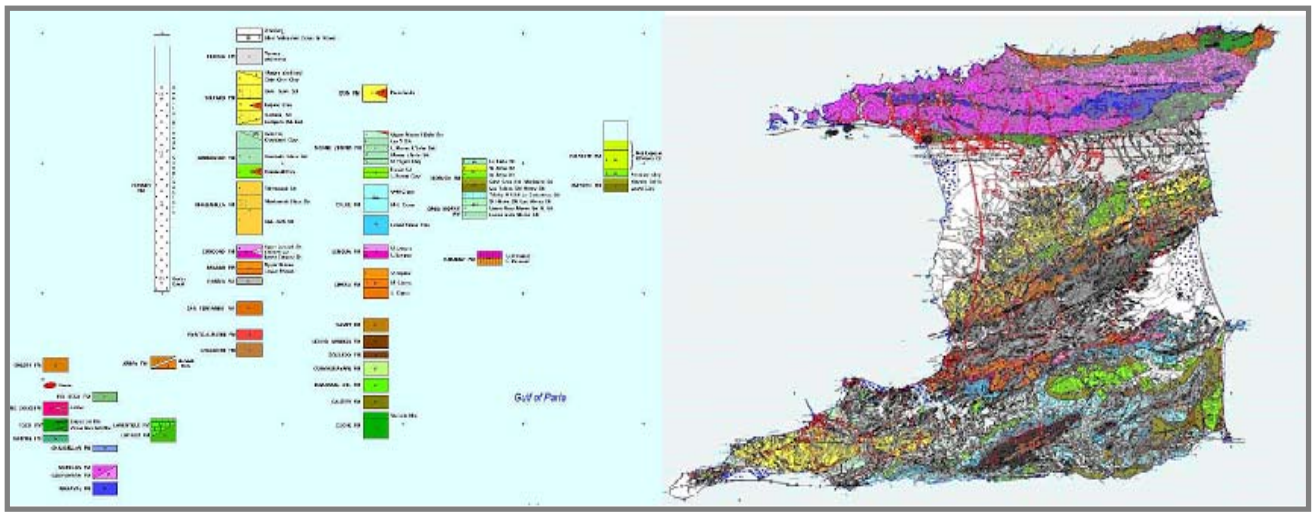


Figure 8: Geology of Trinidad

The Northern Range consists mainly of metamorphic rocks of the Cretaceous period which is a continuation of the coastal ranges of South America into the Caribbean. A large portion of the Northern Range is made up of micaceous schists and phyllites, which makes the region prone to landslides particularly when its forest vegetation is removed. A small area in the eastern region of the Northern Range also consists of igneous rocks (andesites).

Alluvia and colluvial deposits are found on the terraces and in the valleys and floodplains of most northern rivers. The Northern Basin, which is made up of the East West Corridor and Caroni Plains, is mainly comprised of sedimentary silts and clays, with superficial gravel terraces and river and swamp alluvia.

The Central Range is a folded anticlinal uplift consisting of sedimentary rocks from the Cretaceous and Eocene era, with Miocene formations along the southern and eastern flanks. The Naparima Plains and the Nariva Swamp form the southern shoulder of this uplift.

The geology of the Southern Basin and Southern Range is sedimentary. The Southern Basin consists of Miocene and Pliocene sands, clays, and gravels which overlie oil and natural gas deposits, especially north of the Los Bajos Fault. The Southern Range, which forms the third anticlinal uplift, consists of sandstones, shales, siltstones and clays formed in the Miocene era and uplifted in the Pleistocene period. Oil sands and mud volcanoes are especially common in this area.

2.1.4.2 Tobago

The geology of Tobago, like that of Trinidad, is closely related to that of the South American continent. Tobago consists of about 50 per cent igneous rocks, with about 33 per cent covered with sedimentary rocks. Figure 9 shows the geology of the island. Northeast Tobago consists mainly of metamorphic rocks made up of North Coast schists and intrusive igneous rocks, while the southern and south eastern parts of the island are made up of volcanic materials. The underlying geology of a significant portion of the Northeast is made up of unstable formations which render the region highly susceptible to land slips[7]. The south western end of the island consists of a flat coral limestone platform that extends seaward to form the offshore coral reefs.

[7] Final Report on North East Tobago Management Plan Project (NO. 8 ACP TR 005) prepared by the Environment and Development Group and Kairi Consultants Limited on behalf of the THA and the Government of the Republic of Trinidad and Tobago [GORTT] (2003)..

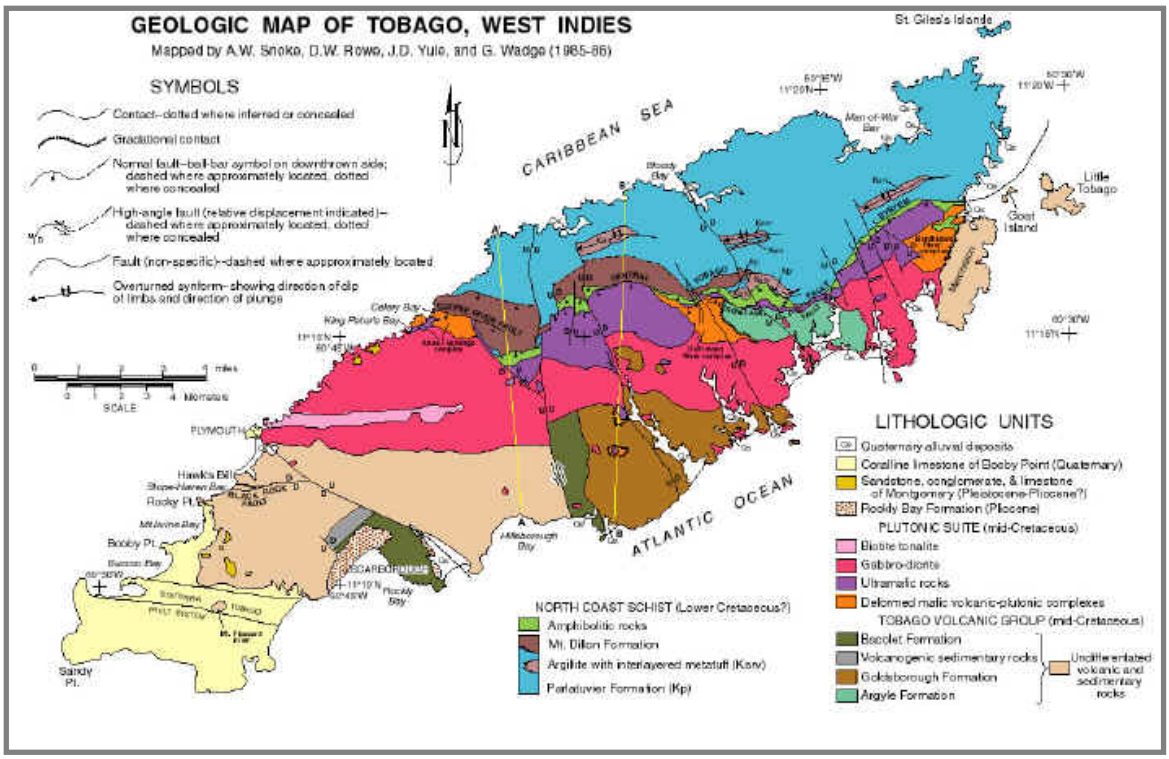


Figure 9: Geology Map of Tobago

2.1.5 Hydrocarbon Resources

Trinidad and Tobago has an abundance of hydrocarbon resources relative to its area and population size. These resources are concentrated in the southern-most area of Trinidad. In this area two classes of hydrocarbons occur in commercial quantities - asphalt and crude oil.

2.1.5.1 Asphalt

The 46 hectare Pitch Lake at La Brea is one of the well-known deposits of natural asphalt in the world. It was first used locally for road surfacing in 1815. The present depth of the lake is estimated at 87 metres and at current extraction rates, It is expected to last another 400 years.

2.1.5.2 Crude Oil

Although the first known oil well in Trinidad was drilled in 1866, commercial oil production only commenced in 1908. Up to the early 1950's production was confined to reservoirs under the land area. Exploitation of fields in the Gulf of Paria began in the 1950's and the fields off the east coast were discovered in 1968. Today, programmes for secondary recovery from land operations have been initiated to extract formerly uneconomic deposits. At current rates of production known reserves of petroleum are expected to last to 2017.

2.1.6 Mineral Resources

Trinidad and Tobago has several mineral deposits of economic value. The more economically important ones include sands and gravels, limestone, clays, andesite, porcellanite and tar/oil sands.

2.1.6.1 Trinidad

Limestone Deposits: There are three main types of limestone found in Trinidad. The Laventille limestone formation is found only at Laventille, Point Gourde, and some of the offshore islands. The Rio Seco or "blue" re-crystallised limestone formations occur throughout the Northern Range from the Santa Cruz Valley eastward. These limestones are hard and dense and are well suited as road aggregates and building material. Rubble "yellow" reefal limestone occurs in the Central Range. This yellow limestone, which is utilised for the manufacture of Portland cement, is a prime mineral asset.

Sand and Gravel Deposits: Extensive deposits of the "Melajo" and "Guanapo" gravels occur from Wallerfield through Valencia to Matura in the eastern region of the Northern Basin. The quartzitic sands also found throughout this area include a valuable deposit of silica sand at Matura used for the manufacture of glass. Additionally, deposits of fine-grained plastering sand occur where the aquifers at the southern margin of the Northern Basin outcrop, and at scattered localities elsewhere. Sand and gravel of various grades are quarried for use in the construction industry.

Clay Deposits: Clay is the most abundant and extensively utilised non-petroleum raw material. Clay deposits are concentrated in the Northern Basin. Areas where clay material is located include Longdenville, Wallerfield (near Arima), Valencia-Quare River area, Mayo, Carlsen Field, Guatapajaro Road, four miles south of Cumuto, Arima-Blanchisseuse Road, San Rafael, Central Trinidad, and Plaisance Industrial Estate - Pointe-a-Pierre. Clays are primarily used in the manufacture of blocks, tiles and pottery.

Porcellanite: A formation of naturally burnt clays with pozzolanic properties occurs between Granville and Buenos Aires in the southwestern peninsula of Trinidad. This porcellanite material is used as an alternative to Portland cement and as a low grade road base material.

Tar/Oil Sands: Deposits of tar or oil sands, which are used as road surfacing material, occur in the Southern Basin, mainly in the area south of La Brea. These deposits are associated with hydrocarbons found throughout this area and are used as road paving materials.

Minor Mineral Deposits: These include fluorspar on Gaspar Grande Island; graphite in Maracas, St Joseph; gypsum in Agostini Street and Champs Fleurs; iron in Maracas Valley; quartz gravel in the Northern Range and argillite in south Trinidad.

2.1.6.2 Tobago

Andesite is part of the Bacolet Formation, which includes according to Maxwell (1948) "interbedded tuffs, tuff breccias and agglomerates and some intercalated flows." The two largest quarries in Tobago are sited in the andesitic rocks of the Bacolet Formation.

These are: Green Hill Quarry and Studley Park. Clay is found at the Winfield Scotts Quarry at Rocky Bay, Old Government Stock Farm and Bishops High School.

Unlike Trinidad, Tobago has no alluvial deposits of sand. Some of the sand used for the construction industry is obtained by sand mining on beaches and in river beds, particularly the Richmond and Goldsborough beaches and the Goldsborough River. Other minor mineral materials deposits in Tobago include chromium and copper.

2.1.7 Quarry Production and Reserves

Growth and development of the energy industry and the construction industry are highly correlated. The current growth in the energy sector has resulted in a boom in the construction industry and this growth is expected to continue with increases in oil and gas prices. In 2002, quarry production in Trinidad and Tobago stood at 6.9 million tonnes and during 2004 there was significant increase in quarrying due to increase demands for construction materials. This demand is expected to grow and a fourfold increase in quarry production is predicted by 2020 (Table 1).

Table 1: Quarry Production[8]

Mineral	Production (million metric tonnes)		
	2002	2010	2020
Valencia Sands and Gravels	4.1	8.1	10.2
Blue Limestone	1.0	2.0	4.1
Andesite	0.1	1.0	4.1
Yellow Limestone	1.5	3.0	5.1
Valencia Clays	0.2	1.0	3.0
Porcellinite	0.0	0.2	0.5
Tar Sands	0.0	1.0	2.0
Total	**6.9**	**16.5**	**29.0**

Most of the minerals extracted is utilised locally as road paving and construction materials, and for the manufacture of a variety of products, such as cement, abrasives, glass, fillers, putty, drilling fluids, concrete, clay and ceramic products (tiles, ornaments, etc.) in the downstream industry. The potential reserves in the country, as it stood at January 2004, were about 1,934 million cubic metres covering about 5,435 hectares (Table 2). About 50 per cent of these reserves are clays. However, a significant proportion (about 59 per cent) is situated in the Valencia area under approximately 2,000 hectares.

[8] Draft Quarry Policy of Trinidad and Tobago.

Table 2: Possible Un-audited and Un-risked Reserves[9]

Mineral	Reserves	
	Hectares	Millions Cubic Metres
Valencia Sands and Gravels	2,023.5*	229.4
Blue Limestone	202.4	114.7
Andesite	485.6	305.8
Yellow Limestone	242.8	114.7
Valencia Clays	2,023.5*	917.5
Porcellinite	93.1	22.9
Tar Sands	364.2	229.4
Total	5,435.1	1,934.4

** same area*

2.1.8 Vegetation

The biota and terrestrial habitats of Trinidad and Tobago reflect the ecology of equatorial South America. The country is endowed with a significant amount of natural forests, the extent of which was first documented in 1946 and is shown in the table below (Table 3).

Table 3: Extent of Indigenous Forests in Trinidad and Tobago

Indigenous Forest Types	Area (hectares)
Evergreen Seasonal Forests (hectares)	98,180
Semi-evergreen Seasonal Forests (hectares)	13,930
Deciduous Seasonal Forests (hectares)	3,620
Dry Evergreen Forests (hectares)	500
Seasonal Montane Forests (hectares)	930
Montane Forests (hectares)	21,620
Swamp Forests (hectares)	16,730
Secondary Forests (hectares)	16,630
Total (hectares)	**172,140**

Source: National Forest Action Programme prepared by Chalmers, 1992.

[9] Draft Quarry Policy of Trinidad and Tobago.

In 2003, 248,000 hectares or approximately 48 per cent of the total land area in Trinidad and Tobago was still classified as forest land, although much was under severe pressure from alternative uses (Table 4). State-owned forests accounted for 192,000 hectares or about 77 per cent of all forested lands. Nowadays, these forests are not exploited commercially for timber and, hence, are conserved primarily for ecological, educational, recreational, and scientific purposes.[h1]

Estimates of forest cover and calculations of forest loss and changes, which involves little or no field verifications, are based primarily on dated information derived from the last Forest Resources Inventory conducted some 25 years ago using 1969 aerial photography.

Table 4: Ownership of Forested Areas in Trinidad and Tobago

Category	Trinidad	Tobago	Total	%
Total land area (hectares)	482,500	30,300	512,800	100.0
Total forested area (hectares)	232,093	15,907	248,000	48.4
Proclaimed forest reserve (hectares)	127,474	3,958	131,432	25.6
Un-proclaimed forest reserve (hectares)	11,652	-	11,652	2.3
Other forested state lands (hectares)	36,967	11,949	48,916	9.5
Private forests (hectares)	56,000	-	56,000	10.9

Source: Annual Report of the Forestry Division 2003, MPUE (May, 2004)

Forest cover data is outdated and a new forest inventory is urgently required. Towards this end, the Forestry Division is working towards the development of new forest cover maps for the country.

2.1.8.1 Tobago

While the forests of Trinidad include the eight indigenous types, there are four major vegetation communities in Tobago, namely, littoral woodland, deciduous seasonal woodland, rainforest and swamp forests. The rain forest is found in the sheltered mountain valleys of the Main Ridge. Lower montane forest, xerophytic rain forest, evergreen formations and some elfin woodland also occurs (Davis *et al*. 1986[10], Thelen and Faizool, 1980[11]).

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[10] Davis, S.D., Droop, S.J.M., Gregerson, P., Henson, L., Leon, C.J., Lamlein Villa-Lobos, J., Synge, H. and Zantovska, J. 1986. Plants in Danger: What do We Know? IUCN, Gland, Switzerland and Cambridge, UK. 461 pp.

[11] Thelen, K.D. and S. Faizool 1980. Policy for the Establishment and Management of a National Park System in Trinidad and Tobago. Technical Document Forest Division/OAS Project on the establishment of a system of national parks and protected areas. Forest Division, Ministry of Agriculture, Port of Spain, Trinidad. 26 pp.

2.1.9 Soils and Land Capability

Trinidad and Tobago possesses a large number of soil types per unit area. These soil types are formed from the five main groups of geological parent materials: igneous rock, metamorphic rock, sedimentary rock, alluvial and colluvial deposits and volcanic formation. Apart from the parent materials, other factors also determine the types of soils formed, such as relief and physiography, geology, climate and vegetation. Trinidad and Tobago possesses a range of soils, the majority being fine sands and heavy clays. Many of these soils are highly erodible (that is, inherently prone to erosion), particularly those on gently to steeply sloping lands (Table 5).

Table 5: Classes of Soil Texture/Soil Slope Erodibility Factor[12]

Group	Slope					
	A 0-2	B 2-5	C 5-10	D 10-20	E 20-30	F +30
Clay	0	0	1	2	3	3
Clay Loam	0	0	2	3	4	4
Sand	0	1	3	4	5	5
Sandy Loam	0	1	2	3	4	5
Sandy Clay	0	0	1	2	3	4
Sandy Clay Loam	0	0	1	3	4	5
Loamy Sand	0	1	3	4	5	5
Loamy Fine Sand	0	1	3	4	5	5
Fine Sandy Clay	0	0	2	3	3	4
Fine Sandy Loam	0	1	2	3	4	5

0 = negligible erodibility; 1 = slight or low erodibility; 2 = moderate erodibility; 3 = severe erodibility; 4= very severe erodibility; 5 = extremely severe erodibility

2.1.9.1 Trinidad

There are 120 types of soils in Trinidad, with three soil series each occupying more than 40,000 hectares, namely the Talparo (which is widespread in Central and South Trinidad), the Maracas (which occurs only in the Northern range) and the Moruga (which occurs only in Central and South Trinidad). Seven other soil types, each occupy more than 10,000 hectares, while eleven soil series occupy more than 5,000 hectares. More than 60 per cent of the soils series each occupy less than 2,000 hectares. The soils of the alluvial valleys of the Northern Range and the East West Corridor are the most fertile and on these lands, there is often conflict among competing uses for residential, agricultural and industrial purposes.

About 30 per cent of the soils in Trinidad occupy flatlands that is land under five degrees (Table 6).

[12] Kairi Consultants Limited, 1996. National Parks and Watershed Management Project – Identification of Sub-watersheds. Prepared on behalf of Ministry of Agriculture, Land and Marine Resources - Final Report.

Table 6: Areas of Soils in Different Slope Classes[13]

Group	No of Soil Series	Total Area	Slope					
			A 0-2	B 2-5	C 5-10	D 10-20	E 20-30	F +30
Alluvial soils	49	124,721	99,999	23,912	806	5	0	0
Terraces soils	20	51,920	12,106	11,108	15,783	6,361	3,923	2,637
Upland soils	51	316,686	65	5,451	68,825	97,019	59,843	85,483
Total	**120**	**493,327**	**112,170**	**40,471**	**85,414**	**103,386**	**63,767**	**88,120**

Land capability is one of the systems used to determine the value of land for numerous uses. The land resources of Trinidad and Tobago are based on the United States Department of Agriculture (USDA) system which is based on the potential of soils for mechanised agricultural production and soil conservation. It is designed for determining the maximum intensity of land use consistent with low erosion risks and sustained productivity. The USDA system defines lands suited for cultivation as those in Classes I to IV. The best agricultural lands are Class I (those soils which do not require special land management practices), while Class IV soils require the special land management practices though best suited for tree crops and pasture grasses. Sixty nine per cent of the soils in Trinidad are designated as being of Class V to VII and are best suited for tree crops, timber and forest trees (Table 7).

Table 7: Land Capability of Trinidad Soils[14]

Group	No of Soil Series	Total Area	Slope Class	Land Capability Class							Per Cent of Total Area
				I	II	III	IV	V	VI	VII	
Alluvial Soils	49	124,721	A, B	2,198	7,224	63,912	32,993	7,966	10,428	0	25.3%
Terraces Soils	20	51,920	C,D, E,F	0	207	2,759	9,816	48,429	18,708	3,466	10.5%
Upland Soils	51	316,686	C,D, E,F	0	0	1,412	62,799	94,632	79,308	78,535	64.2%
Total	**120**	**493,327**		**2,198**	**7,431**	**68,083**	**105,608**	**151,027**	**108,444**	**82,001**	**100.0%**

2.1.9.2 Tobago

There are 43 soil series in Tobago, with 85 per cent of the acreage of land between Class I and Class V (Table 8). Thirty nine per cent of the soils are flat to gently sloping (Table 9).

[13] F. Hardy, 1974. Land Capability Survey of Trinidad and Tobago, No 6. Government Printery, Trinidad and Tobago.

[14] F. Hardy, 1974. Land Capability Survey of Trinidad and Tobago, No 6. Government Printery, Trinidad and Tobago.

Table 8: Classes of Soil Texture/Soil Slope Erodibility Factor[15]

No of Soil Series	Total Area	Land Capability Class							Per Cent of Total Area
		I	II	III	IV	V	VI	VII	
43	30,474	283	3,441	6,799	6,582	8,720	4,372	277	100.0%
43	**30,474**	**283**	**3,441**	**6,799**	**6,582**	**8,720**	**4,372**	**277**	**100.0%**

Table 9: Areas of Soils in Different Slope Classes

No of Soil Series	Total Area	Slope					
		A	B	C	D	E	F
		0-2	2-5	5-10	10-20	20-30	+30
43	30,474	2,307	4,403	5,145	6,755	8,392	3,472
43	**30,474**	**2,307**	**4,403**	**5,145**	**6,755**	**8,392**	**3,472**

2.1.10 Biodiversity

Trinidad and Tobago, is reported to be the most biologically diverse country in the Caribbean archipelago, with a wide array of biological resources resulting from its proximity to, and recent geological split from the South American mainland. The islands have eight main indigenous types of forest, and approximately 175 families and 2,500 species of plants. They provide a wide range of habitats which supports more than 400 species of birds, over 90 species of mammals, 93 species of reptiles, 30 species of amphibians and numerous species of butterflies. A number of these species are endemic. In an effort to maintain the country's biodiversity[h2], there are some 127,500 hectares of proclaimed forest reserve in Trinidad and Tobago, with an additional 11,650 hectares which are managed as such.

The coastal and marine areas of the two main islands contain a rich biological diversity of ecosystems that are of significant regional and global importance, in particular, mangroves, coastal swamps and coral reefs. They also contain many plants, small invertebrate and vertebrate species, including endangered ones, such as the leather back turtle. The Nariva Swamp, Caroni Swamp and Buccoo Reef/Bon Accord Lagoon Complex have been designated as Ramsar sites. A number of these sites have been identified for global and regional priority and are considered among the "Global 200" list of top global priority eco-regions by the World Wildlife Fund (WWF)[16].

[15] F. Hardy, 1974. Land Capability Survey of Trinidad and Tobago, No 1. Government Printery, Trinidad and Tobago.

[16] WWF has identified those large areas of the Earth that best represent the breadth of biodiversity and ecological processes. These large areas are called "eco-regions" and the list of priority eco-regions is known as the Global 200 eco-regions.

2.1.11 Water Resources

The network of rivers in Trinidad and Tobago has been described earlier in Sections 2.1.3.1.1 and 2.1.3.1.2. The largest watersheds contain the major river systems and drain the Northern and Southern Basins to the west into the Gulf of Paria and to the east into the Atlantic Ocean. The Caroni River is the largest watershed which drains two-thirds of the Northern Basin and eventually empties into the Gulf of Paria. Other major river systems are the South Oropouche River which drains South Trinidad on the west; the North Oropouche which empties in the east; and the Ortoire and Poole Rivers which merge and also drain in the east. The watersheds of Tobago are smaller than those observed in Trinidad with the largest being the Courland and the Hillsborough.

The aquifers of Trinidad are associated with the variety of gravels and sands in north, central and south of the island[17]. The major aquifers of Trinidad are the unconfined Northwest Peninsula Gravels and the Northern Gravels, and the confined Central Sands and Southern Sands. The minor aquifers include the Mayaro Sandstone and Guayaguayare Sandstone. The Northwest Peninsula Gravels extend from Chaguaramas to Port of Spain and are mainly recharged by direct infiltration of rainfall and by streambed infiltration and subsurface flow to a lesser extent. Therefore, maintaining a sizeable recharge zone is critical.

The Northern Gravels, which comprise those aquifers east of Port of Spain to just outside Arima and southward onto the Caroni Plains, are made up of alluvial deposits and gravel fans along the southern foothills of the Northern Range. The rivers in the valleys between Port of Spain and Arima recharge the aquifers as they flow over them on their way to the Caroni River. These aquifers are connected laterally.

The Central Sands are located on the southern section of the Northern Basin and extend in irregular bands in a north-easterly diagonal direction from Clayton Bay to Cumuto and dip in a north-westerly direction towards the Gulf of Paria. The Southern Sands are multiple-sand aquifers divided into the Erin Formation and Morne L'Enfer Formation. While most of the aquifers are exploited, it is the Northern Gravels and Northwest Peninsula Gravels that are the top producers.

Since Tobago is largely composed of igneous and metamorphic rocks, it is not considered rich in groundwater resources. However, recent hydro-geological studies in 2002 have identified the presence of substantial water resources in fracture systems of deep bedrock aquifers.

2.1.11.1 Water Availability

Management of the freshwater resources is a critical developmental issue for Trinidad and Tobago. Natural availability of the country's freshwater supply is affected by the occurrence and distribution of rainfall and the occurrence, movement and quality of surface water and groundwater.

The per capita water availability in Trinidad and Tobago is approximately 2,500 cubic metres per year. It is internationally accepted that countries/regions, which have an

[17] EMA, 1999. State of the Environment 1998 Report. Trinidad and Tobago.

annual per capita water availability level of 1,000 cubic metres and lower, experience chronic water scarcity, which could hamper economic development and human health and well-being. Thus, by international standards, Trinidad and Tobago is not a water scarce country. However, surface water availability which is the major source of water is strongly influenced by seasonal and spatial variations.

About 76 per cent of Trinidad and Tobago's water supply is derived from surface water sources, while the remainder is provided from groundwater sources[18]. Table 10 highlights the major surface sources in Trinidad and Tobago. The major surface water supply sources are the Caroni Arena Reservoir, North Oropouche Intake, Hollis Reservoir, Guanapo River, and the Navet Reservoir in Trinidad, and the Hillsborough Reservoir and Courland Intake in Tobago. These reservoirs are producing currently at levels just under their natural water availability and any excess availability from these catchments should be allocated to satisfy ecological requirements (20 per cent of availability).[h3]

Table 10: Surface Water Sources in Trinidad and Tobago[19]

Facility	River System	Capacity (mcm/yr)
Caroni Arena Reservoir	Caroni, Tumpuna	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 Intake		13.7
Total		**229.9**

The available surface water in Trinidad is estimated at 3,600 million cubic metres per year[20]. For the year 2000, water demand was estimated to be 336 million cubic metres, 10 times less than the available surface water. In 2000, water supply totalled 300 million cubic metres. This means that there was an 11 per cent (36 million cubic metres) deficit in 2000. Such deficit is worsened during severe dry seasons when surface water flows are at their lowest, adversely affecting the reliability of raw water supply.

The country's groundwater potential is estimated at 611 million cubic metres per year (545 million cubic metres per year for Trinidad and 66 million cubic metres for Tobago). Groundwater abstraction for 2000 was 82 million cubic metres per year (77 million cubic metres per year for Trinidad and four million cubic metres for Tobago) [Table 11].

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[18] Government of the Republic of Trinidad and Tobago, 2003. National Water Resources Management Policy Project: National Water Resources Management Policy. MPUE.

[19] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

[20] Government of the Republic of Trinidad and Tobago, 2003. National Water Resources Management Policy Project: National Water Resources Management Policy. MPUE.

Table 11: Production, Safe Yields and Additional Potential of Ground Water Sources in Trinidad and Tobago[21]

Public and Private Sector Water Supply	Production (mcm/yr)	Safe Yield (mcm/yr)	Additional Potential (mcm/yr)
Northwest Peninsula Gravels	29.72	30.02	0.35
Northern Gravels	26.18	28.10	1.92
Central Sands	13.70	8.72	-4.98
Southern Sands	9.89	26.32	16.43
Misc Aquifers	1.86	13.19	12.02
Rockly Bay Sands	0.14	0.30	0.16
Bloody Bay Gravels	0.20	0.33	0.13
Total Supply	**81.69**	**107.72**	**26.03**
Total Ground Water Production (public supply)	***72.09***		
Total Ground Water Production (private supply)	***9.60***		

Annual surface water and ground water availability for Tobago have been calculated at 140 million cubic metres and 65 million cubic metres, respectively[22]. The natural water balance suggests that there is sufficient water available to satisfy year round demand. However, the country continues to experience water supply problems, particularly during the dry season.

The domestic sector is the largest single user of water in the country, accounting for approximately 36 per cent of demand, followed by the industrial sector accounting for 18 per cent, and irrigated agriculture accounting for only approximately three per cent of demand. Unaccounted-for-water comprises 43 per cent of water demand. Although difficult to quantify, ecological demand represents an important user of water (Table 12). Water is necessary to maintain the productive ecology of Trinidad and Tobago's rivers and wetlands.

[21] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

[22] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

Table 12: Sectoral Water Demand in Trinidad and Tobago[23]

Category	*1997*		*2000*	
	mcm/yr	%	Mcm/yr	%
Domestic	118	39.7	120	36.0
Industrial, Major	36	12.1	51	15.1
Industrial, Minor	9	3.0	10	2.9
Irrigated Agriculture	10	3.4	10	2.9
Unaccounted-for-water	124	41.8	145	43.1
Total	***297***	***100.0***	***336***	***100.0***

2.2 Socio-economy

2.2.1 Population and Demography

The impact of human activity on the environment is significantly influenced by the demographic characteristics of the population, for example, its size and growth rate, distribution, density, age structure and composition, education and occupational structure, health status and income distribution[24]. Such an impact may be particularly acute in small island states like Trinidad and Tobago where the urban population densities are quite high. The demographic characteristics also affect settlement, consumption and production patterns of a population with direct implications for waste generation and disposal, natural resource depletion and contamination of the environment.

Trinidad and Tobago is now approaching the mature stage of the demographic cycle with the population growth rate now on the decline. In 2000, the population of Trinidad and Tobago was 1,262,366 persons. Of the total population, males accounted for 50.1 per cent and females 49.9 per cent. Some four years later (in 2004), the total mid-year population for Trinidad and Tobago was estimated at 1,209,646 persons. This drop in population of 52,720 or four per cent was due mainly to reduced birth rates and outward migration.

The population is concentrated in urban areas in northwest Trinidad (from Diego Martin to Arima), Chaguanas and its satellite communities, and in San Fernando. Approximately 43 per cent of the population live along the corridor of Northwest Trinidad in the valleys and along the foothills of the Northern Range. In Tobago, most of the population is concentrated in the southwest sections of the island. Population densities range from 3,632 persons per square kilometre in the Municipality of Port of Spain to 38 persons per square kilometre in the municipality of Mayaro/Rio Claro. The East-West Corridor, the strip of land extending along the foothills of the Northern Range in an east to west direction, is the most densely populated region of the country, with

[23] Government of the Republic of Trinidad and Tobago, 2003. National Water Resources Management Policy Project: National Water Resources Management Policy, MPUE.

[24] EMA, 1997. State of the Environment 1996 Report.

population densities being greatest in the urban centres of Port of Spain (3,832 persons per square kilometre) and Arima (2,882 persons per square kilometre).

San Fernando is the second most densely populated municipality of Trinidad and Tobago with a density of 2,980 persons per square kilometre. In addition, population has been increasing in Chaguanas, the country's youngest borough, at a significant rate since the mid 1970's and now stands at 1,130 persons per square kilometre. The characteristics of the population are detailed in Table 13.

Table 13: Distribution of Population in Trinidad and Tobago

Municipality	Area (sq km)	Population			No. of Households	Population Density	Persons per Household
		Male	Female	Total			
Port of Spain	13.5	23,415	25,616	49,031	14,487	3,631.9	3.4
San Fernando	18.6	27,094	28,325	55,419	16,016	2,979.5	3.5
Arima	11.2	16,260	16,018	32,278	8,400	2,882.0	3.8
Chaguanas	59.7	33,717	33,716	67,433	17,819	1,129.5	3.8
Point Fortin	23.9	9,665	9,391	19,056	5,715	797.3	3.3
Diego Martin	127.5	52,303	53,417	105,720	29,352	829.2	3.6
San Juan/Laventille	220.4	77,824	79,471	157,295	45,926	713.7	3.4
Tunapuna/Piarco	527.2	102,410	101,565	203,975	55,206	386.9	3.7
Couva/Tabaquite/Talparo	719.6	81,688	81,091	162,779	41,941	226.2	3.9
Mayaro/Rio Claro	852.8	16,642	15,501	32,143	8,514	37.7	3.8
Sangre Grande	898.9	33,749	31,931	65,680	16,960	73.1	3.9
Princes Town	621.4	46,766	45,181	91,947	23,492	148.0	3.9
Penal/Debe	246.9	43,251	40,358	83,609	21,779	338.6	3.8
Siparia	510.5	41,499	40,418	81,917	22,393	160.5	3.7
Tobago	300	26,768	27,316	54,084	15,180	180.3	3.6
Total	**5,128.0**	**633,051**	**629,315**	**1,262,366**	**343,180**	**246.2***	**3.7***

** - national average*
Source: Central Statistical Office (CSO) 2000 Census

2.2.2 Economic Activities

Economic development of Trinidad and Tobago depends primarily on its natural resource base which drives the petroleum, petrochemical, construction, manufacturing industries and agricultural sector. As one of the most vibrant economies in the Caribbean, the economy of Trinidad and Tobago remains strong after twelve straight years of real growth and the fifth year of exceptional growth, driven, in part, by LNG expansion. Over the period 2000 to 2004, total GDP increased by an average of 7.5 per

cent per annum. The country seems poised for continued positive economic performance.

The country's economic development and improvement in the living standards of its residents are based primarily on its hydrocarbon, petrochemical and metals sectors, with significant increases in exports, and its diversification efforts in services, tourism, manufacturing and agriculture. While the first energy boom was based on the country's oil reserves, at present the economy, which is driven by its offshore natural gas reserves, is experiencing a second energy boom. Trinidad and Tobago is experiencing a transition from an oil-based economy to a natural gas based economy. Apart from the recent increases in crude oil prices, the recent discovery of major offshore oil and gas fields has bolstered the current and future economic prospects.

The country's energy sector has allowed for the development of energy intensive industries, including a range of petrochemicals, including ammonia, methanol, urea and natural gas. Trinidad and Tobago ranks amongst the top five liquefied natural gas (LNG) producers in the world, is the largest exporter of ammonia and methanol, and is the third largest nitrogen producer globally. One of the world's largest methanol plants was completed and commissioned in Trinidad and Tobago in 2005[25].

Of the non-hydrocarbon sectors, distribution, construction, transportation, communications, and manufacturing all show signs of continued growth. Agriculture, however, has been experiencing stagnant growth rates.

2.2.3 Poverty

Despite its economic fortunes, poverty represents a deficiency in resources and is a challenge Trinidad and Tobago must overcome in order to achieve sustainable development. Since the 1980's, Trinidad and Tobago has experienced a general increase in poverty from 3.5 per cent in 1981/82 to 14.8 per cent in 1988[26]. A 2004 Inter-American Development Bank (IADB) study[27], based on data from the 1997/1998 Household Budgetary Survey (HBS) determined that current levels of poverty are much higher and is calculated as 24 per cent of the total population in 18.4 per cent of the total number of households. Approximately 8.3 per cent of the population are 'extremely poor' or indigent - that is, they cannot afford the cost of a minimum low-cost food basket.

Table 14 shows the distribution of poverty in Trinidad and Tobago. Although the largest population of poor people is found in St George (about 33 per cent), poverty is concentrated in pockets within this highly urbanised county (for example, in Cocorite,

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[25] Feature Address by the Honourable Patrick Manning Prime Minister of the Republic of Trinidad and Tobago at the Second Biennial International Conference on Business, Banking and Finance. Website of the Office of the Prime Minister of the Republic of Trinidad and Tobago.

http://www.opm.gov.tt/news/index.php?pid=2001&nid=sp060501

[26] Cited in Poverty Reduction and Social Development (Final Report). Prepared by Kairi Consultants Limited, on behalf of Inter-American Development Bank, Washington DC.

[27] IADB, 2004. Trinidad and Tobago – Poverty Reduction and Social Development (Final Report). Prepared by Kairi Consultants Limited, 2004. on behalf of the IADB, Washington DC.

Laventille, Sea Lots, Morvant, St Joseph, the hillside communities of San Juan, and Sherwood Park (The Congo, Arima).

Historically and currently St Andrew/St David, Nariva/Mayaro, St Patrick and Victoria have been the poorest areas in the country. However, in these counties the incidence of poverty is more diverse and thus a higher proportion of the population is poor. In addition, level of indigence in Nariva/Mayaro was more than twice the national average at 19 per cent; that is almost one in every five persons in this region of Trinidad is extremely poor. While it would be important to only target and implement poverty reduction projects in the specific communities within St George and in the rural counties it would be critical to target the entire county because poverty is more diverse and affects higher proportions of the population.

Table 14: Geographic Distribution of Poverty in Trinidad and Tobago

Area	As a Percentage of the Poor Population	As a Per cent of Total Population of the Area
Port of Spain	2.6	17.3
San Fernando	2.7	16.0
St George	32.9	21.1
Caroni	2.6	12.6
Nariva/Mayaro	4.9	39.4
St Andrew/St David	9.1	40.5
Victoria	20.6	33.0
St Patrick	15.3	34.9
Tobago	4.3	16.3

Source: Kairi Consultants Limited, 2004. Trinidad and Tobago – Poverty Reduction and Social Development (Final Report). Prepared on behalf of the Inter-American Development Bank, Washington DC

2.2.3.1 A Profile of the Poor

The characteristics of the poor population are similar for both Trinidad and Tobago. Generally, as expected, employment rates and education levels are lower for the poor and also households are larger and support more children. There are few poor persons who are professionals. The major occupational groups which poor persons occupy are craft, machine operators and other elementary occupations. Levels of poverty are higher in female-headed households, particularly African female headed households. Poorer Africans were found largely in urban areas and poorer Indians in rural areas. Additionally, a significant proportion of the poor were youths.

2.2.4 Land Use and Tenure

2.2.4.1 Land Use

Of its total land area of 512,800 hectares, Trinidad and Tobago has an estimated total arable land area of 75,000 hectares with an additional 47,000 hectares under permanent crops, while 11,000 hectares are under permanent pasture. Wetlands are said to occupy about 23,500 hectares, and forest 248,000 hectares of which 77 per cent is State-owned. Built development accounts for approximately 15 per cent of the country's total land area. Figures 10 and 11 show the land use maps of Trinidad and Tobago.

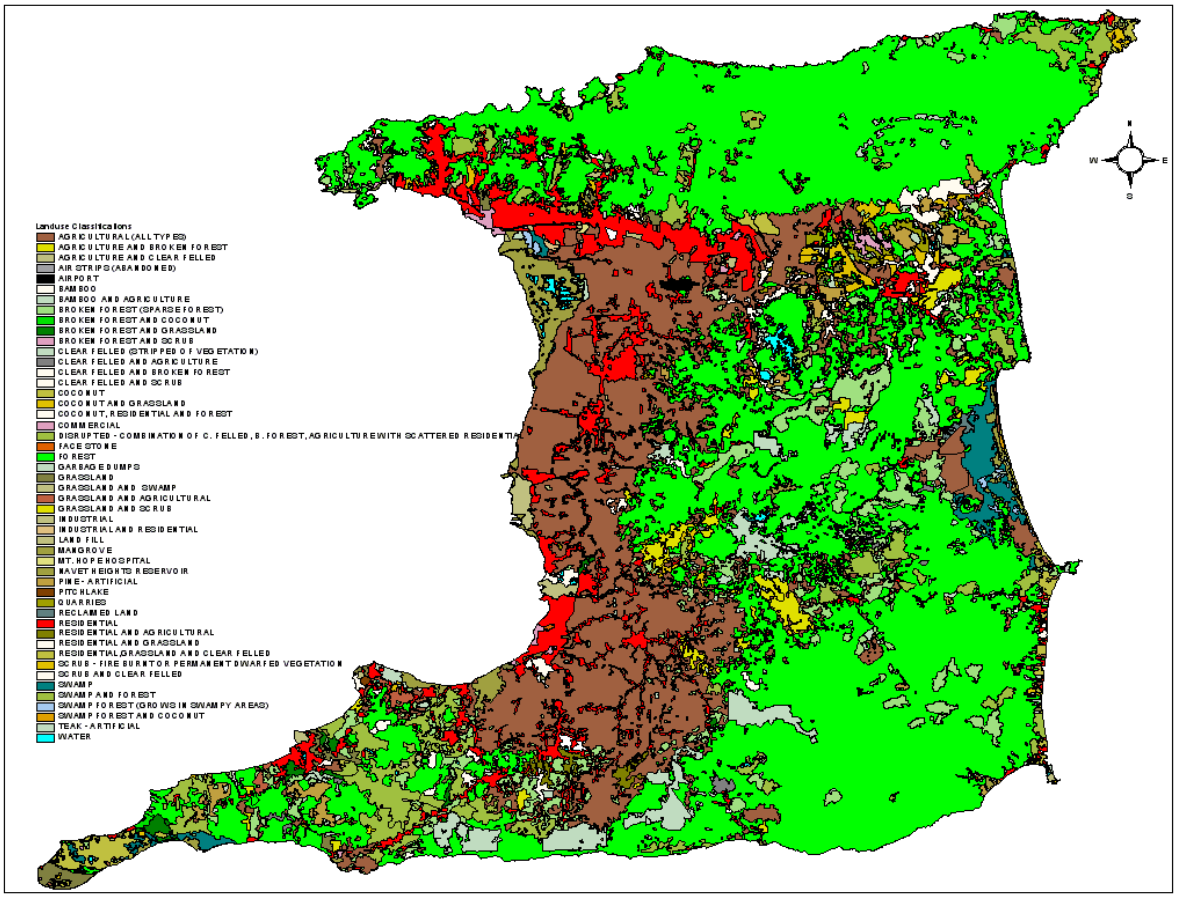

Figure 10: Land Use Map of Trinidad

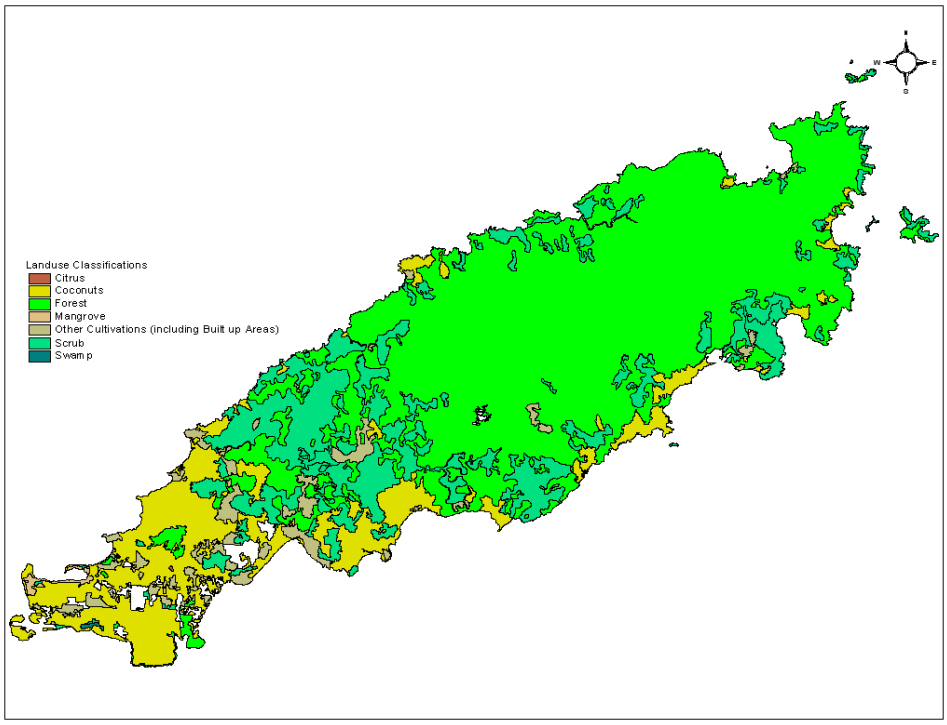

Figure 11: Land Use Map Tobago

Agricultural Land Use

The recent closure of Caroni (1975) Limited has had serious implication for agricultural land use and development since the company owned and controlled more than 30,000 hectares of the country's agricultural lands. Since its closure, all lands owned by Caroni have been vested in the State and are being managed by the Estate Management and Business Development Company Limited (EMBD). Tables 15 and 16 show the existing and proposed land use for former Caroni agricultural lands.

Table 15: Overview of Existing Agricultural Land Use of Caroni Lands

Type of Activity	Hectares	Percentage
Sugarcane (Estate)	15,057.2	62.6
Pasture	588	2.4
Citrus	1,351.2	5.6
Wine Making	180	0.7
Rice and other food crops	2,014.4	8.4
Tree crops	404.8	1.7
Aquaculture	113.6	0.5
Cane farming	4,354.8	18.1
Total (78.5% of Total Acreage)	24,064.0	100.00
Total Caroni Acreage	30,643.2	

Source: Report of the Inter-Agency Land Use Planning Team. April 2004

Most of the agricultural lands are currently being sub-divided for distribution to over 7,000 former Caroni workers. Sub-division of these lands into two acres and fifty acre parcels would have serious implications for future use and management. Care must be taken to ensure that these lands are managed sustainably and are used for agricultural purposes.

Table 16: Proposed Agricultural Land Use of Former Caroni Lands

No.	Section	Total Hectares	Proposed Activity	Land Class Capability	Proposed Hectares
1.	Caroni	2,316	Vegetables and food crops Rice	II, IV III, IV	316 1,384
2.	Orange Grove	1,501.2	Vegetables and food crops	III	296
3.	Jerningham	1,214.8	Vegetables Rice Food crops	III, IV III III, IV	220 440 196
4.	Todd's Road	958.8	Citrus Tree crops	III, IV, V III, IV, V	480 120
5.	Edinburgh	1,284.8	Food crops Dairy farms	III, IV III, IV	620 400
6.	Felicity	1,506.4	Rice Food crops Vegetables	III, IV III, IV III, IV	700 190 220
7.	Waterloo	1,367.2	Food crops Rice	III, IV III	500 460

No.	Section	Total Hectares	Proposed Activity	Land Class Capability	Proposed Hectares
8.	Exchange	1,584.4	Vegetables and food crops Sugarcane (estimated)	III III, IV	500 560
9.	Montserrat	1,667.6	Food crops Tree crops Forestry	III, IV, V IV, V, VI V, VI	126 720 70
10.	Esperanza	1,266	Small ruminants Food crops Forestry	III, IV, V VI V, VI, VII	280 300 140
11.	Reform/Williamsville	2,318.8	Food crops Sugarcane (estimated)	III, IV III, IV, V	600 800
12.	Cedar Hill	977.6	Sugarcane (estimated)	IV, V, VI	720
13.	Petit Morne	1,744.4	Sugarcane (estimated)	III, IV, V	800
14.	La Fortune 1 & 2	1,890.8	Livestock (beef) Sugarcane (estimated)	III, IV, V III, IV, V	1,160 160
15.	La Gloria	1,816.8	Citrus Livestock Food crops	IV, V, VI IV, V, VI IV, V	600 1,060 80
16.	Forres Park	999.2	Forestry Food crops	V, VI, VII II, IV, V	500 200
17.	Mora Valley	6,662.4	Cocoa Buffalypso	III, IV III, IV	72 590.4
	Total Under Agricultural Use*	**25,177.2**			**16,580.4**
***Excludes Built Development**					

Source: Report of the Inter-Agency Land Use Planning Team. April 2004

2.2.4.2 Land Tenure

The current land tenure patterns of Trinidad and Tobago are reflective of its history of colonialism. At various times in its history, the country was settled by the Spanish, French, and English settlers. African slaves, and later East Indian indentured labourers and a small contingent of Chinese workers were brought in to work on the agricultural estates. The colonising powers offered estate lands to European settlers as an incentive for settling in Trinidad and Tobago. As a result some of those large estates still belong to the descendants of the English, Spanish and French settlers.

After emancipation, the African slaves were obstructed from acquiring land by the systematic over-pricing of Crown lands, while the East Indian labourers were offered five or 10 acres in place of their return passage to India after their indentureship period was completed. This resulted in smaller agricultural villages predominantly inhabited by East Indian descendants and suburban and urban areas predominantly inhabited by

descendants of African slaves or immigrants from other Caribbean islands. These distinctions, however, are not as marked as they once were and have been eroded over time. However, the State remains the key land owner in Trinidad and Tobago. Today, the State controls over 50 per cent of the total land mass.

Land tenure in Trinidad and Tobago includes freehold, leasehold on private or State land and rented on private or State land, squatting on State or private land, and occupation of 'family land[28]'. About 52 per cent of all lands are owned by the State in 86,000 parcels, while private lands make up the remaining 48 per cent on 334,000 parcels[29].

Leasehold tenure on State lands provides lower income individuals an opportunity to own land. The State leases lands for residential, agricultural, commercial, religious or community purposes. Over many years of land leasing by the State, the system has become fraught with problems. These problems include the inadequacy of the State institutions to manage the leases, lack of information on the status of the leases, inability to monitor the land use, rampant breaches of lease terms, and tenure insecurity resulting from expired leases. In Trinidad and Tobago, it is estimated that 47 per cent of households do not have clear, registered rights to the land on which their houses are located[30].

2.2.5 People's Relationship with the Land (Culture and Traditions)

The traditional culture of Trinidad and Tobago, which is rich in its diversity, has promoted, the sense of interdependence, of man living in harmony with the environment. [h4]On a daily basis, the population interact and enjoy the land in various ways, with many religious festivals and ceremonies linked to various aspects of nature. The origin of some of these traditions can be traced to West Africa or India and Europe.

Trinidad and Tobago is also subjected to cultural influences from outside. The social positioning of material consumption, much of which is driven by the North Atlantic consumerist culture, has impacted on the way people use the land and behavioural patterns in respect of the management of the environment.

[28] Family land is a phrase used in the Caribbean where formal landowners die and their heirs do not pursue formal transfer of the title of the land. This situation may continue over generations resulting in land in which an ever-increasing number of kin hold un-subdivided interests that are not formally documented in the national cadastre. The percentage of land held under this type of tenure may be as high as 12.9.

[29] Ministry of Agriculture, Land and Marine Resources, 2005. Implementing the Trinidad and Tobago Land Adjudication and Registration Project Registration Project. A Presentation at the Real Property Rights and Development in Trinidad & Tobago, held at the Trinidad Hilton and Conference Centre on the 19th January 2005; South Trinidad Chamber of Industry and Commerce (STCIC) and the Inter-American Alliance for Accountability on Real Property Rights, with funding from the United States Agency for International Development. Website Source: http://www.southchamber.org/files/cms/LARP_Jan_05.PDF.

[30] Ministry of Agriculture, Land and Marine Resources, 2005. Implementing the Trinidad and Tobago Land Adjudication and Registration Project Registration Project. A Presentation at the Real Property Rights and Development in Trinidad & Tobago, held at the Trinidad Hilton and Conference Centre on the 19th January 2005; South Trinidad Chamber of Industry and Commerce (STCIC) and the Inter-American Alliance for Accountability on Real Property Rights, with funding from the United States Agency for International Development. Website Source: http://www.southchamber.org/files/cms/LARP_Jan_05.PDF.

The history of land use over much of the 20th century demonstrates the effect of the change in culture on the approach of the population to the environment. In the colonial period – Spanish and then British - agriculture was the dominant economic activity. After the end of slavery and during indentureship, a large percentage of the population lived and worked in or near to their village. Most lived off the resources of the land and were dependent on the land for their livelihood and support. Their relationship with the land reflected their sense of stewardship and responsibility for its protection, which guided the way the land was managed and people's behaviour with respect to access to, and use of, land resources. [h5]

As agricultural production became less important and residents migrated to urban centres, many estates were abandoned and traditional practices made way for 'modern' practices which often lead to deterioration of land resources. People's relationship with the land has become fractured and one of alienation, particularly in the urban and suburban centres. This disconnect of people from the land is translated into a number of social and environmental problems.

Like other small Caribbean countries, urbanisation and exposure of society to outside influences have brought with it a material culture and patterns of consumption which are heavily influenced by the norms of North America, in particular, and the North Atlantic in general. Quality of life is defined socially in terms of the approximation to what obtains in the United States, which is the main destination of the large migratory flow from the country. The consumer culture is reinforced by the mass media, and by close and continuing links between residents and relatives in North America. The impact has been considerable, touching such areas as eating habits, modes of transport, and home entertainment.

There are two major implications for Trinidad and Tobago SIDS. Firstly, it has to lay a massive infrastructure of roads to treat with the traffic caused by the predilection for private modes of transport. Secondly, it is increasingly challenged in the safe disposal of waste that is out of proportion with its capacity to manage landfill. High per capita income has made this problem particularly acute in Trinidad and Tobago[h6]. As a result, a major issue facing the country is the disposal of the ever-growing volume of solid and liquid waste which accompanies increased affluence and heavy reliance on imported goods the use of which creates problems in land use.

Chapter 3

Land Degradation in Trinidad and Tobago

It is widely recognised that land degradation is caused by complex interactions of physical, chemical, biological, social, political and cultural factors. [h7]Tackling the problems and issues of land degradation requires a mix of solutions which targets both the underlying and direct causes of land degradation.

Land degradation[31] is a biophysical process driven by natural and socioeconomic causes. Land degradation in Trinidad and Tobago lowers the actual and productive potential of land resources, reduces vegetative cover, and adversely affects soils, water availability, biodiversity and coastal and marine environments. If left unchecked, land degradation can lead to irreversible loss of the land resources on which socio-economic development of the country depends.

As a SIDS, land degradation further increases environmental vulnerability of Trinidad and Tobago and can reverse any positive socio-economic development trends experienced in the medium to long term. The 2001 and 2002 State of the Environment Report by the EMA provides estimates of the Environmental Vulnerability Indices (EVI) for Trinidad and Tobago[32]. The high scores estimated for some of the indicators suggest that land degradation is indeed an important development issue for the country (Table 17).

Table 17: Scores for Selected EVI

EVI		Description	Scores	Comments
22	Endangered Species	Number of endangered and threatened species per square kilometre of land area	7	The indicator reflects an overall high vulnerability of the country's biodiversity.
25	Rate of Loss of Natural Cover	Net percentage of land area changed by removal of natural vegetation over the last five years.	7	Trinidad and Tobago are highly vulnerable to the loss of naturally vegetated areas.

[31] A working definition for Land Degradation as formulated by the UNCCD Multi-sectoral Committee is the "reduction or loss of bio-physical or economic productivity of land resulting from a process or combination of processes arising from natural phenomena and human activities."

[32] The calculation of the EVI is based on the 50 indicators of environmental vulnerability, which have been selected by global scientific and expert review. This list includes 35 indicators of risk, seven of intrinsic resilience and eight indicators of environmental integrity for degradation.

EVI		Description	Scores	Comments
26	Fragmentation of Land and Habitats	Per cent of natural vegetative cover in fragments of less than or equal to 1,000 hectares, excluding those that occupy entire islands.	7	High incidence of habitat fragmentation placing high stress on species inhabiting that area.
31	Fertilisers	Tonnes of nitrogen, phosphorus and potassium fertilisers used per year per square kilometre of agricultural land (average over the last five years).	6	The vulnerability of the environment of Trinidad to damage caused by fertilisers is high.
32	Pesticides	Tonnes of pesticides used per square kilometre of agricultural land (average over the last five years).	7	The environment of the country is very vulnerable to damage from pesticides.
36	Renewable Water	Mean percentage of water usage per year met from renewable and non-declining sources.	7	There is a need to carefully manage rivers and watersheds.
38	Waste Production	Total net tonnage of generated and imported toxic, hazardous and municipal wastes per square kilometre	5	Moderately vulnerable to pollution of waterways, coastal regions and groundwater caused by large volume of wastes generated on an annual basis..
39	Waste Treatment	Mean per cent of hazardous, toxic, and municipal waste effectively managed or treated per year	4	The waterways, groundwater and coastal regions in Trinidad are at moderate risk to pollution from the improper wastes.
42	Mining	Tonnes of mining materials (ore plus tailings) extracted per square kilometre per year for an average of five years	7	The environment of Trinidad is highly vulnerable to land degradation which is associated with sedimentation of waterways.
45	Population Density	Total human population density (number per kilometre of land area)	6	The environment of Trinidad and Tobago is under stress to support the growing number of persons living on the islands and is highly vulnerable to damage associated with human activities.
48	Coastal Population	Density of people living in coastal settlements (that is with a city centre within 20 kilometres of the coast)	7	Coastal areas and associated ecosystems in Trinidad and Tobago are very vulnerable to pollution and other negative impacts of highly developed areas.

Source: 2001 and 2002 State of the Environment Report, EMA, 2003

Most of the land degradation witnessed in Trinidad and Tobago is caused by human action. Figure 12 characterises land degradation in Trinidad and Tobago.

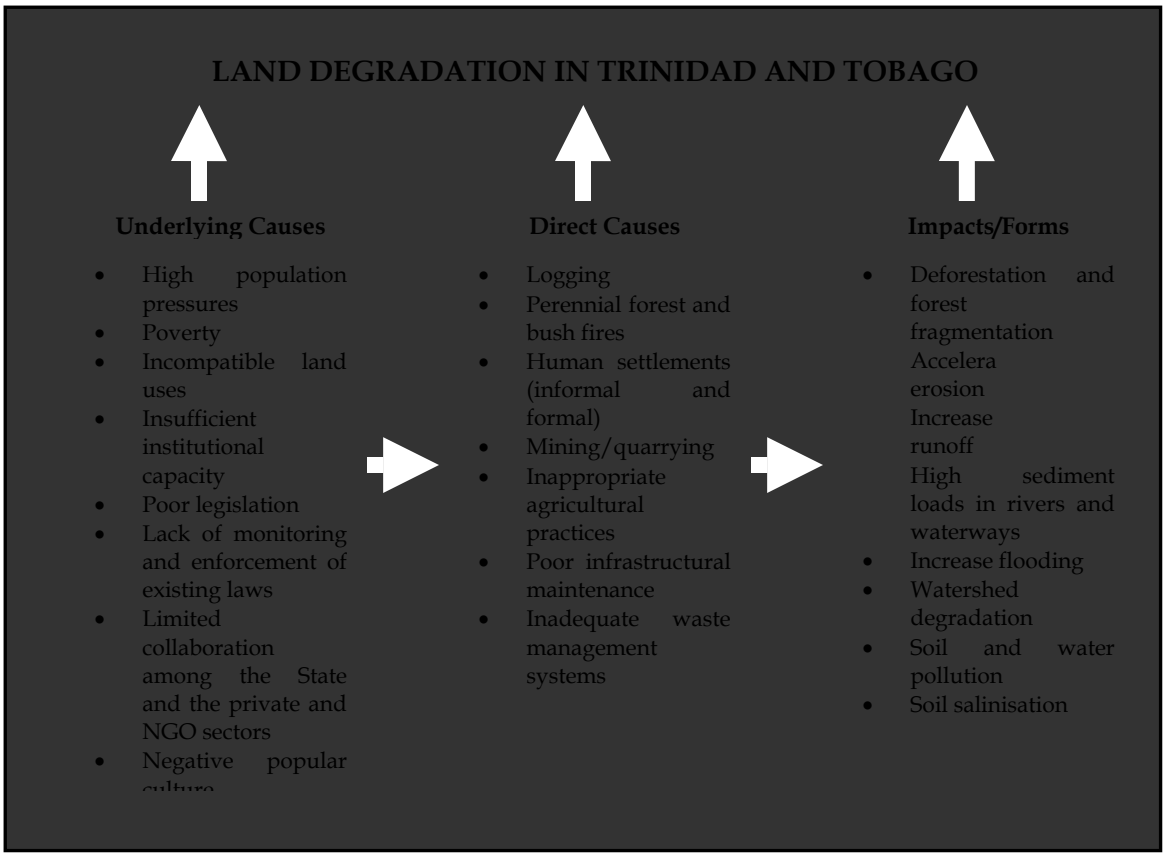

Figure 12: Causes and Forms of Land Degradation in Trinidad and Tobago

3.1 Types of Land Degradation in Trinidad and Tobago

In Trinidad and Tobago, the main types of land degradation are deforestation, accelerated soil erosion, declining soil fertility, the increased incidence of flooding, soil and water pollution/ contamination.

3.1.1 Deforestation

Deforestation is the conversion of forestland to other uses and decreased forest quality. It generally increases rates of soil erosion, by increasing the amount of runoff and reducing the protection of the soil provided by tree litter. Deforestation also leads to forest fragmentation and forest degradation.

According to the United Nations Food and Agriculture Organisation (FAO), deforestation in Trinidad and Tobago accounted for the loss of approximately 2,200 hectares of natural forests per year, or 0.8 per cent per year, during the period 1990 to

2000[33]. The 2001 to 2002 Report on the Environment[34] shows that Trinidad and Tobago is highly vulnerable to loss of its naturally vegetated areas and has a high incidence of land and habitat fragmentation[35].

There has been extensive deforestation in critical watersheds, associated with annual forest fires, logging, the practice of slash and burn agriculture, construction (site clearance and preparation), squatting, quarrying, gas and oil exploitation. Recent rapid urban and industrial development suggests that the rate of deforestation may have increased within the last five years. Deforestation significantly lowers the water table and causes siltation in water courses, increased flooding, and reduced perennial stream flow. Deforestation also reduces natural vegetation thus reducing available habitat and threatening the existence of the native flora and fauna.

3.1.2 Erosion

There has been increased soil erosion throughout [h8]Trinidad and Tobago. Erosion reduces soil productivity and adversely affects the environment. The last mapped data on the status of soil erosion in Trinidad and Tobago was produced some 30 years ago and is therefore outdated. Nonetheless, there is evidence that erosion is widespread in the northwest Trinidad, in the rolling hills in Central Trinidad and in the Courland watershed in Tobago. The consequence of increased erosion is the high sediment loads in river systems and waterways which reduces the capacity of the systems to carry runoff water. One of the main indicators of increased erosion is the high silt and sediment loads dredged from main river systems in Trinidad over the years.

Despite the fact that erosion is one of the main problems of land degradation, discussion of the impact of erosion remains anecdotal since there is no continuous, systematic programme to assess the extent of erosion in Trinidad and Tobago. However, periodic studies have generated some information on water runoff and soil loss. These studies mainly demonstrate large soil losses from bare steeply sloping soils. Soil loss on bare Maracas/Matelot soils, two main soil types on Northern Range, was up to 55 tonnes of soil per hectare in a three month period[36]. Another study on a Concordia soil in Tobago

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[33] Achieving the International Tropical Timber Council (ITTO) Objective 2000 and Sustainable Forest Management in Trinidad and Tobago. Report submitted to the International Tropical Timber Council by the Diagnostic Mission Established under Decision 2(XXIX) "ITTO Objective 2000."

[34] EMA, 2004. State of the Environment Report 2001 and 2002.

[35] Environmental Vulnerability Indicator #25 – Rate of Loss of Natural Cover (Net percentage of land area changed by removal of natural vegetation over the last five years). The indicator measures the risk of further losses of natural vegetation from deforestation, and losses of wetlands and other natural vegetation ecosystems. The country has a score of seven. However, confidence in this estimate is low.

Environmental Vulnerability Indicator #26 – Fragmentation of Land and Habitats as a percentage of natural vegetation cover in fragments of less than or equal to 1000 hectares, excluding those that occupy entire islands. Trinidad and Tobago both score a 7 for this indicator, with a high confidence level.

[36] Lindsay, J. I., 1979. Rainfall Erosivity, Soil Erodibility and Soil Loss Studies under Different Managements at Two Sites in Trinidad. M.Sc. Thesis, Department of Soil Science. UWI, St Augustine, Trinidad and Tobago.

showed extremely high soil losses from bare soil between 100 and 150 tonnes per hectare per annum[37].

Gully Erosion after land clearance for housing development

Landslide on North Coast Road, Trinidad

Photograph 3: Erosion and massive land movement are major forms of land degradation

3.1.2.1 Coastal Erosion

Erosion along the north and northeast sea coast has not been associated with coastal development principally because there are no industrial activities, and the residential use of the back beach is considered benign. However, erosion over the years has been quite noticeable and is accepted by residents as part of the long term natural processes.

On the south coast and the west coast, erosion is seen as consequential to the activities of the oil and gas companies. From Manzanilla on the south-east coast to Moruga, there has been erosion over the years but there has been an acceleration of erosion during the last 20 to 30 years. Headlands have been eroded and individual and family property has been lost in some places at the rate of roughly one metre per year. In the case of Guayaguayare, several residents indicated that they have had to relocate their houses at least once in order to avoid them being loss to the sea. There is the perception among residents that the pipelines which came ashore at Guayaguayare and particularly at Rustville, breached the coastal reefs in the near shore area that protected the coast line. Additionally, the construction and continual dredging of the channel are considered prime reasons for the increased coastal erosion. There are residents who indicated that erosion was no real problem until offshore oil and gas exploitation and production began in Guayaguayare in the 1950's (personal communication: David Neale, Consultant).

Coastal stability has been a source of concern for national agencies over the years. The Institute of Marine Affairs (IMA) which has been monitoring beach profiles for the last 12 years in Guapo and Irois Bays notes the problem of coastal erosion in these areas.

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[37] Ahmad, N. and Breckner, E, 1974. Soil Erosion on Three Tobago Soils. Tropical Agriculture (Trinidad); Volume 51:p313-324.

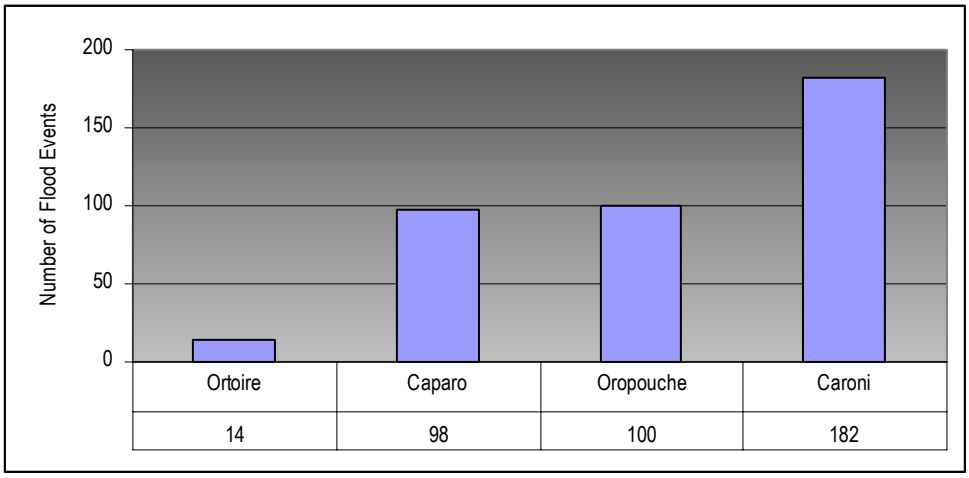
Even to the casual observer, the loss of beach is quite obvious along the Cedros and Icacos coast line (personal communication: David Neale, Consultant). The backshore land in much of the southwest comprises soft soil material on steep cliffs that collapse periodically. This is principally responsible for the erosion that over time alters the coast line.

Erosion along Trinidad's southwest and south coasts has prompted the construction of coastal protection measures by both the State and private entities in Manzanilla, Guayaguayare, Fanny Bay and Clifton Hill Beach, Point Fortin. However, the construction of coast defence works by the Ministry of Works and Transport (MWT) has been hampered by limited funding. Thus, less than 100 metres of wall have been constructed per year in communities like Guayaguayare. Apart from the erection of a few sheet piles, very little has been done on this coast. Currently, erosion threatens the main road connecting Sangre Grande and Rio Claro.

Photograph 4: Coastal erosion has become a common occurrence along Trinidad's southwest coast

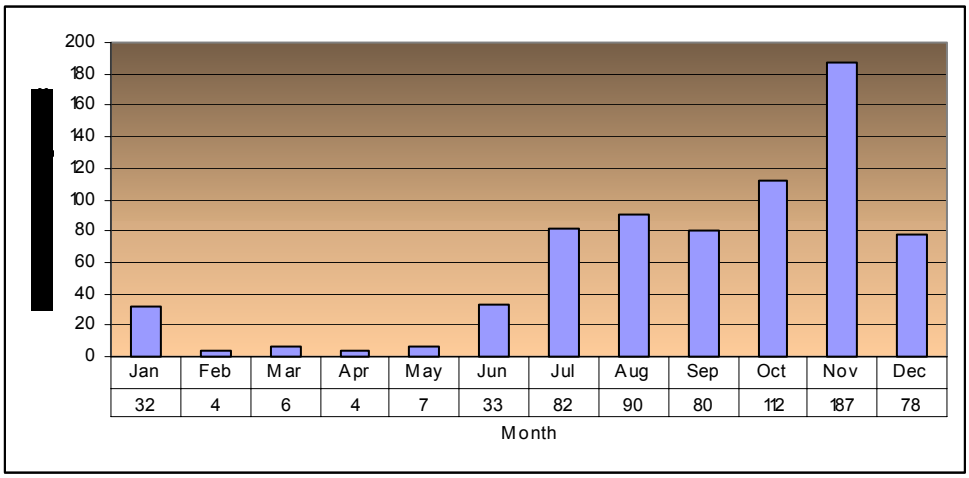
3.1.3 Flooding

The problem of flash and acute flooding has become an annual occurrence in Trinidad and Tobago. Among those areas most severely affected are Caroni, flood plains of the Carapo River, along the Eastern Main Road, downstream Port of Spain, Penal, Barrackpore and South Oropouche (Figure 13). Moreover, the problem no longer seems to be restricted to the traditional October to December period. Instead flooding now extends from June and January and seem to get an early start in the wet season when there are above average rainfall during the dry season. Figure 14 shows the distribution of flood events 1981 and January, 2005.



Source: Meteorological Services Division

Figure 13: Frequency of Flood Events



Source: Meteorological Services Division

Figure 14: Monthly Distribution of Flood Events

There is a strong correlation between unsustainable land use and land management practices and flooding. The chief causes of the flooding are those which reduce vegetative cover and reduce the capacity of waterways. These include:

1. Planned and unplanned housing development which remove trees and other vegetation and increase hard surface, thus reducing water percolation and increasing surface water runoff;
2. The increased occurrence of built development on flood plains which are the natural pathways for river overflows;
3. Quarrying activities which lead to deforestation and contribute significantly to the siltation of rivers thereby reducing the capacity of river systems;
4. The illegal dumping of solid waste in rivers and other waterways, reduces the capacity of drainage systems, which leads to overflowing;

5. Unsustainable legal and illegal logging which lead to deforestation, disrupted ecosystem services and reduced biodiversity; and
6. Slash and burn agriculture which leads to the burning of forests and shrub land and puts stress on the land, eventually leading to soil loss and reduced soil productivity.

Flooding has tremendous social, economic, physical and environmental costs. Flood waters have resulted in injuries and loss of lives and destroyed infrastructure, crops and livestock, and household, commercial and industrial assets.

Photograph 5: The incidence of flooding has increased over the years

3.1.4 Water Pollution

Pollution comes from agricultural, domestic and industrial sources and its evidence shows up in the country's river systems. In the first half of the century, agricultural pollution was largely associated with the sugar industry and the main areas affected were the Caroni and Cipero Rivers, coastal mangroves and the near-shore environment. While the impact of sugar industry will be reduced with the closure of Caroni (1975) Limited and the reduction of sugar cane production, commercial short term crop production (mainly vegetables and other field crops) would be the main source to agricultural pollution. The main agricultural areas are found in Northwest and Central Trinidad.

In more recent times, there is evidence of the build up of industrial pollution pressures associated with a wide range of industrial activities, ranging from the petrochemical industry to light manufacturing and this includes from both the small numbers of large industries and even larger numbers of medium and small industries. Surface sediments indicate significant levels of contamination with hydrocarbons on the west coast of Trinidad, probably due to contaminants from land-based operations transported via the Guapo, Vance, Oropouche and Guaracara Rivers[38].

Domestic wastewater management is to be a serious and chronic problem and there needs to be greater emphasis on addressing this issue. Apart from causing land degradation, discharged wastewater finds its way into the fresh water and marine environments where it can have negative public health effects.

The quality of the water in the streams and rivers is a litmus test on how well the land within water catchments is being managed. Soil, water, vegetation, and animal and human activity are inextricably linked and their interaction dictates whether the management of the land is ecologically sustainable. The monitoring of land based pollution, in the past, has been sporadic. Because of its importance as a water source, the Caroni watershed represents one of the key areas where detailed studies have taken place, the most recent of which is being undertaken now. Data from previous illustrate the pollution problem in northwest Trinidad (Table 18). A 31-day study of the pollutant load for the Caroni River at the Caroni Arena Water Treatment Plant (CAWTP) in 1997 estimated 5,713 tonnes with a daily average of 184 tonnes. Most of the pollutants (88 per cent) were derived from high sediment loads, with organic matter and organic contaminants, each accounting for five per cent. The Mausica/Manacal and Arima Rivers were heavily polluted and were rated fairly poor in water quality, while the Guanapo River was rated as having poor water quality[39].

[38] CEPNET/IDB Project - State of the Coasts Hypertext Report: Trinidad & Tobago. URL: http://grid2.cr.usgs.gov/cepnet/trini_tbgo/ttsoc/intro.html; (Last accessed: June 2005).

[39] EMA, 1997. Final Report on Pollution Sources Affecting the Caroni Arena Water Treatment Plant. Prepared by the Caribbean Industrial Research Institute of Trinidad and Tobago.

Photograph 6: The Cipero River

Table 18: Major Pollution Problem in Each River System from Aripo and Chaguaramas

River	Main Source of Pollution
Aripo	Quarrying and agricultural runoff
Guanapo	Quarrying and agricultural runoff
Cumuto	Agricultural runoff
El Mamo	Agricultural runoff
Arima	Urban runoff, industrial and municipal wastewater
Manacal	Industrial and municipal wastewater
Mausica	Industrial and municipal wastewater, urban runoff, agricultural runoff, construction runoff
Arouca	Urban runoff, construction runoff, agricultural runoff
Caura/Tacarigua	Agricultural runoff, urban runoff, construction runoff
Tunapuna	Urban runoff, construction runoff, industrial wastewater, agricultural runoff
Maracas/St Joseph	Urban runoff, construction runoff, industrial wastewater, agricultural runoff
Santa Cruz	Urban runoff, construction runoff, industrial wastewater, agricultural runoff
Black (Malick)	Urban runoff, construction runoff, industrial wastewater, agricultural runoff

River	Main Source of Pollution
Caroni	Urban runoff, industrial and municipal wastewater, agricultural runoff, construction runoff
St Anns/Port of Spain	Industrial and municipal wastewater, urban runoff, agricultural runoff, construction runoff
Maraval	Industrial and municipal wastewater, urban runoff, agricultural runoff, construction runoff
Diego Martin	Urban runoff, construction runoff, industrial wastewater
Chaguaramas	Urban runoff, industrial wastewater, agricultural runoff

3.1.5 Land Salinisation

The built up of soil salinity has resulted from poor maintenance of drainage infrastructure coupled with improper agricultural and land management practices in low lying coastal areas. These areas include Felicity in Central Trinidad and South Oropouche in South Trinidad.

Photograph 7: The Oropouche Lagoon shows evidence of salt water intrusion with the growth of weeds which are characteristics of the vegetative cover under saline conditions

3.2 Causes of Land Degradation

To develop effective approaches to land degradation, both the direct and root (underlying) causes have to be properly understood. The causes of land degradation can be a result of natural (inherent), direct and underlying factors. Natural causes are those conditions of the physical environment which increase the potential of land degradation and in a few instances can be the principal cause of land degradation. Some soils, for example, are highly erodible and naturally prone to landslides during heavy rainfall events.

Direct causes refer to those natural and anthropogenic factors that lead to land degradation. While its inherent characteristics may predispose the land to degradation and reduce the potential for recovery through natural processes, in more cases than not, it is human activities that accelerate the problem. For example, vegetable production on steep slopes greatly increases the risk of water erosion during high intensity rainstorm events. Annual fires reduce the ability of native forest to regenerate itself resulting in fire climax vegetation and accelerated soil loss.

There can be a number of root or underlying reasons for these direct causes of land degradation and these can be found within the wider social, cultural, economic, policy and legislative environment in which the society operates. For example, there are clear guidelines which restrict farmers from cultivating on steeply sloping lands. However, institutional framework to ensure that farmers adhere to these standards is clearly lacking.

3.2.1 Natural Causes

3.2.1.1 Natural Hazards

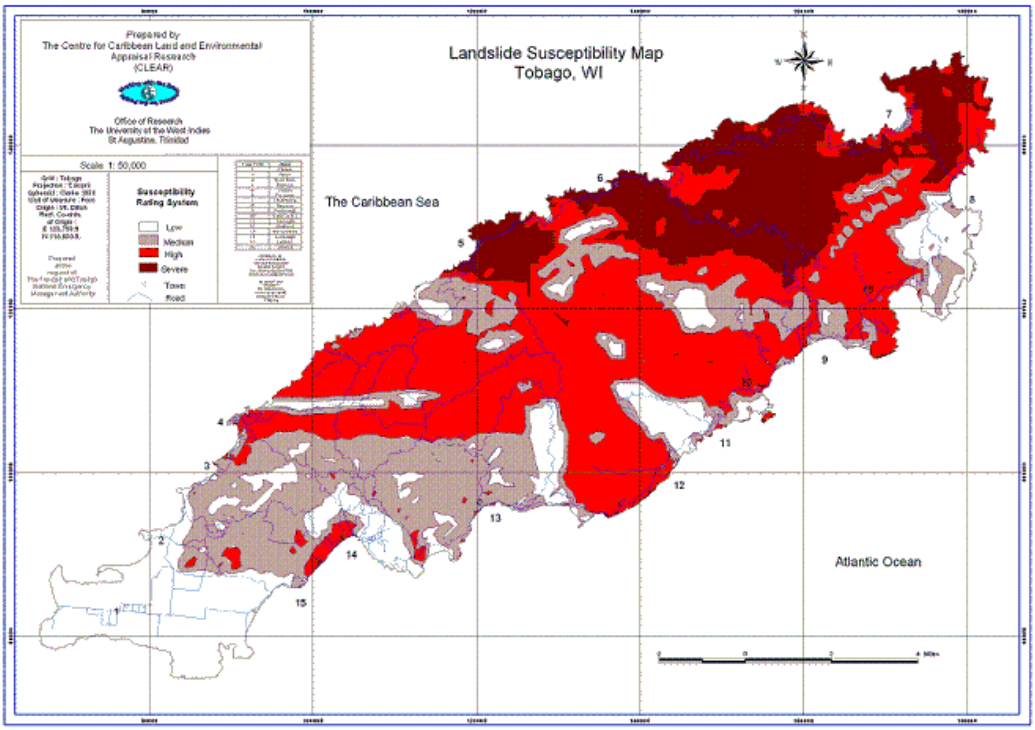
A number of bio-physical conditions can lead to the land having a high degradation potential. In Trinidad and Tobago, the major natural hazards, which act as predisposing factors for land degradation, are summarised below (Table 19).

Table 19: A Summary of the Pre-disposing Environmental Conditions in Trinidad and Tobago

Forms of Land Degradation	Natural Hazards
Water Erosion and High Sediment Loads	High rainfall intensity, steep slopes, unstable geology, high soil erodibility, landslide prone conditions
Reduced Soil Fertility	Strong leaching in humid climates Strongly acidic soils and/or low inherent fertility
Soil Salinisation	Soils in low lying coastal areas
Flooding	Lands with restricted drainage in flood plain areas

Forms of Land Degradation	Natural Hazards
Deforestation	Below average dry season rainfall Some vegetation are fire prone

In some cases, the landslide hazard is sufficient to give rise to land degradation without human interference. For example, the underlying geology of a large portion of the windward Tobago consists of unstable formations, which coupled with the generally steep slopes and frequent earth tremors, render the region highly susceptible to land slips[40] (Figure 15). The 2004 rainy season demonstrated how vulnerable the area is to landslides and the fact that not all the landslides were human-induced, since a number of landslides also occurred in heavily forested sections of the Main Ridge. Similar landslides also occurred in Trinidad's Northern Range during 2004.



Source: NEMA Tobago

Figure 15: Landslide Susceptibility Map of Tobago

[40] Final Report on North East Tobago Management Plan Project (NO. 8 ACP TR 005) prepared by the Environment and Development Group and Kairi Consultants Limited on behalf of the THA and the GORTT, 2003.

3.2.1.2 Drought Conditions in Trinidad and Tobago

Photograph 8: One of the many landslides which occurred in the forested sections of Northeast Tobago during the rainstorms of November 2004 in Speyside, Tobago.

Drought conditions in Trinidad and Tobago are associated with the occurrence of the phenomenon of El Niño[41]. During El Niño years, the Caribbean region usually experiences reduced rainfall and increased ambient temperature and consequently reduced water availability which negatively affects water supply and increases the incidence of forest and bush fires. The *2001 and 2002 Report on the Environment* indicated that Trinidad and Tobago has a low vulnerability to increasing frequency of dry periods. However, Trinidad and Tobago does appear to be adversely affected by the El Niño. Therefore, the relationship between this phenomenon and the local weather needs to be further studied. La Niña usually follows El Niño and locally results in increased rainfall during both the wet and dry seasons and this increases the incidence of flooding.

3.2.2 Major Underlying Causes of Land Degradation in Trinidad and Tobago

There are several underlying reasons for the land degradation identified in Trinidad and Tobago; among the major ones are high population pressures, poverty, incompatible land uses, insufficient institutional capacity, inadequate legislation, lack of monitoring and enforcement of existing laws, limited collaboration among State agencies and the

[41] El Niño is the global climate phenomenon which involves the warming of some sections of the Pacific Ocean and the weakening of the east-west trade winds. This large-scale abnormal warming of the surface of the eastern and central Pacific Ocean is known to occur every two to seven years, with varying degrees of intensity and duration. It is associated with significant changes to climate patterns all over the world, causing droughts and floods in parts of the Americas, Africa, Asia and the South Pacific. El Niño was recorded worldwide during 1981/1982, 1987/1988, 1997/1998 and 2002/2003. Among the more recent El Niño episodes, the 1981/1982 and 1997/1998 were the most severe and had profound effects on the world economy.

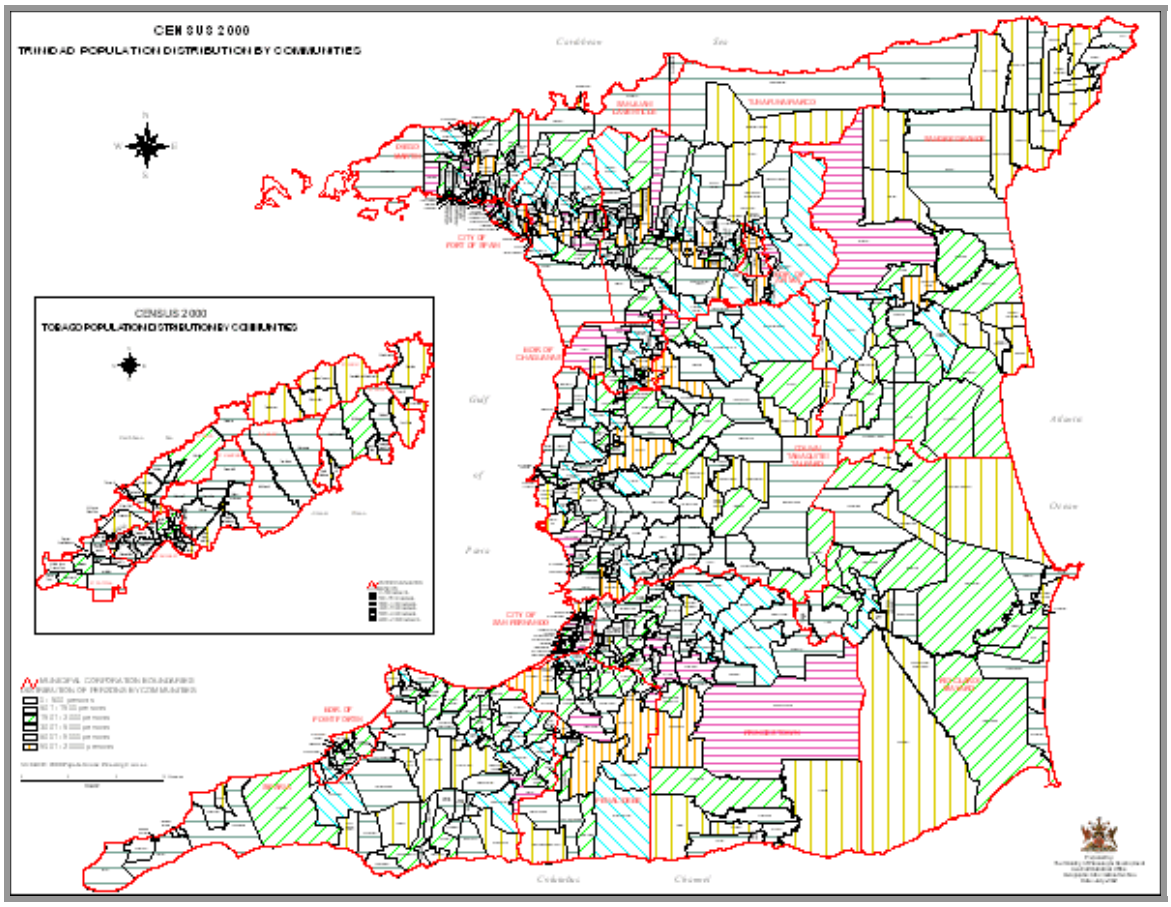
private and NGO sectors, and some negative elements of popular culture which promote wasteful consumption. These causes are outlined below.

3.2.2.1 High Population Pressures

While the population of Trinidad and Tobago has stabilised over the years and in fact may be on the decline, urbanisation and rural urban drift have resulted in the population concentrated in built up areas in the East West and North South Corridors of Trinidad and in southwest Tobago (Figure 16). Such population pressures are leading to increased human population densities in traditional urban neighbourhoods (for example, St James, Woodbrook, Maraval, Diego Martin, Tunapuna, Maracas and St Augustine). At present, there is an increasing trend to replace single family units with apartment buildings and town house complexes and increased use of sloping lands for housing. The increase in population density means that more people are being crowded into smaller spaces and thus significantly impacting on environment. This densification of traditional neighbourhoods has taken place without the corresponding upgrading of infrastructure and amenities and this has lead to inadequacy and failure of the existing infrastructure to meet ballooning demand (such as, clogged drainage systems, inefficient sewerage treatment facilities, inadequate local area road networks, poor garbage disposal systems, among others). [h9]

In the case of Trinidad, the town centres with greater opportunities for employment, education, government services and recreation, attract large transient population during the workday. Often the local governments are unable to cater to the need of these population, to the detriment of the environment. Port of Spain, for example, is said to have a transient population during weekdays as much as five times the number of the population that live in the city[42]. This high population places a burden on existing infrastructure and sanitation services, particularly the management of solid waste.

[42] Halcrow, 2000. Greater Port of Spain Local Area Master Plan: Technical Report. Prepared for Urban Development Corporation of Trinidad and Tobago Ltd, Ministry of Housing and Settlements, Trinidad & Tobago Local Area Plan. Website Source: http://www.nalis.gov.tt/plan2-Intro.htm.



Source: CSO

Figure 16: Trinidad and Tobago Population Distribution by Communities

3.2.2.2 Poverty

Not all economically poor communities are engaged in land degradation activities. However, some low income groups lack the means and resources to provide for some of their basic needs and have resorted to the unsustainable exploitation of natural resources. While squatting is not restricted to the landless and poor, historical patterns of inaccessibility to affordable land by some low income groups have exacerbated the problem of squatting.

These squatting communities cause a myriad of environmental problems including land degradation. For example, the 2004 IADB Poverty Reduction and Social Development Study using 1997/1998 HBS data showed the prevalence of poor sewage treatment facilities. About 62 per cent of the lowest quintile (the poor) was dependent on pit latrines. Some 72 per cent of the indigent was dependent on pit latrines (Table 20).

Table 20: Toilet Facilities by County[43]

County	Proportion of Total House-holds in Trinidad and Tobago						
	Pit Latrine	WC Sewer	WC not linked to Sewer	Other	None	Not Stated	T&T
Port of Spain	2.8	16.8	0.6	0	0	0	4.7
San Fernando	0.8	6.4	5.9	0	0	0	4.3
St George	29.8	72.3	29.0	50.0	85.7	0	38.6
Caroni	12.2	2.2	21.2	16.7	0	0	14.2
Nariva/Mayaro	5.3	0.2	2.0	0	0	0	2.7
St Andrew/ St David	9.2	0	4.1	0	0	100	4.9
Victoria	19.9	0.2	16.1	16.7	14.3	0	13.7
St Patrick	13.7	2.0	12.6	0	0	0	10.6
Tobago	7.1	0	8.6	16.7	0	0	6.3
Total	**100.8**	**100.1**	**100.1**	**100.1**	**100**	**100**	**100**

3.2.2.3 Incompatible Land Uses

Incompatible land uses are those which over time are not sustainable because they increase the risk of the occurrence of land degradation and reduce the potential of the land for recovery through natural processes. The primary land use categories encompass basic functions as residential, commercial, industrial, recreational, institutional, and agricultural uses. Any physical development is going to have some environmental impact. The degree or extent of that impact is dependent on factors such as the type of land use itself, the intensity of the development that is expected to take place on the land, and the physical characteristics of the land. The nature of particular land uses suggests a greater environmental impact for some than for others. However, inherently some sites are better suited for some uses compared to others. For example, the development of a recreational facility which one may assume to be low impact may in fact pose a greater impact upon the environment than other uses because of the demand for sewage treatment, traffic generation and the impacts on water quality. In the past, agricultural production has been established on locations that are considered marginal (steep slopes, wetlands, coastal zones, floodplains, etc.), but in fact they are environmentally sensitive that are unsuitable for such uses.

3.2.2.4 Insufficient Institutional Capacity

Experience has shown that when there is insufficient or limited institutional capacity to safeguard against unsustainable practices and behaviours environmental degradation follows. Environmental improvement requires an alignment of legislation with the country's principles of environmental sustainability as well as the effective implementation and strengthening of capacity of environmental agencies, including

[43] IADB, 2004. Trinidad and Tobago – Poverty Reduction and Social Development (Final Report). Prepared by Kairi Consultants Limited, 2004. on behalf of the IADB, Washington DC.

rationalisation and improving inter-institutional collaboration. The natural resources and environment of Trinidad and Tobago are governed by some 40 pieces of legislation and managed by about 28 state agencies, with the EMA playing a focal and coordinating role. However, this arrangement has been unsuccessful in curbing environmental degradation. Instead, the sector is currently characterised by deficiencies in its institutional structure and capacity.

3.2.2.5 Inadequate Legislation

The absence of legislation or inappropriate legislation often leaves the society without recourse to preventive action or cessation of those activities that can lead to environmental degradation. While it is recognised that regulations alone cannot protect all aspects of the environment, there is need for legal regulatory efficacy. Some of the national legislative frameworks for various aspects of environmental management are too weak and the penalties for non-compliance are not stringent enough to act as deterrents.

3.2.2.6 Limited Monitoring and Enforcement of the Environment

Environmental monitoring and the establishment of sound environmental information management systems are critical to the sustainable development of any country. Environmental monitoring affords the opportunity to better understand the interactions among the terrestrial, marine and climate components of the environment, assess the impact of changes on the provision of ecosystem services and processes, and to highlight the consequences of development policies on nature. There are various types of monitoring activities in place today (baseline monitoring, impact monitoring and compliance monitoring), which together can provide information to inform decision making processes. While there may be the institutional commitment by many State agencies responsible for the monitoring various aspects of the environment, oftentimes there are insufficient resources available to ensure continuity and to maintain the integrity of these monitoring programmes, including the availability of technical expertise, and adequate information management systems. The absence of baseline data and the lack of appropriate ecological monitoring are serious shortcomings when considering local efforts at environmental monitoring. Another is the lack of impact monitoring during the construction, and operation of large development projects. This is particularly relevant at present, given the country's current economic boom and the proliferation of construction and infrastructural projects.

For some, the idea of enforcement of legislation is the only way to elicit compliance. However, most agencies lack adequate capacity to enforce existing laws, while court cases can be long, drawn out processes.

3.2.2.7 Negative Elements of Popular Culture

Popular culture often encourages conspicuous consumption and 'throw-away' attitudes which generate pollution and insensitivity to the natural environment. Elements of popular culture enjoin society to get the new and larger things and the most advance systems in order to make life easier. As a result the population's lifestyles support the continuous upgrade of material assets often to the detriment the traditional values and

norms. Whilst modern day living drives society and people to consume more and more, this is done often without regards to the consequences to human health and the natural environment and to the needs of future generations.

3.2.3 Direct Causes of Land Degradation in Trinidad and Tobago

The principal direct factors leading to land degradation includes: i) informal and formal settlements; ii) inadequate agricultural practices; iii) annual forest and bush fires; iv) poor logging and forestry practices; v) quarrying; and vi) inadequate waste management systems; and poor coastal zone development. Table 21 refers to the main direct causes of land degradation.

Table 21: Main Causes of Land Degradation

Type of Degradation	Degradation Caused by						
	Perennial Forest and Bush Fires	In-adequate Solid Waste Manage-ment System	Formal and Informal Settle-ments	Logging and Poor Forestry Practices	Inadequate Agricultural Land Usage and Harmful Practices	In-adequate Main-tenance of Infra-structure and Amenities	Mining and Quarrying
Deforestation	X		X	X	X		X
Water erosion	X		X	X	X		X
Soil fertility decline	X	X	X	X	X		X
Flooding	X	X	X	X	X		X
Pollution		X			X	X	X
Salinisation					X	X	
All types of degradation	X	X	X	X	X	X	X

3.2.3.1 Trinidad

Perennial Forest and Bush Fires

Although not the sole cause of forest loss, annual forest and bush fires, reduce the productivity of soils and are seen as environmental nuisances causing damage and destruction to property and infrastructure. The term "bush fire" refers to fires in open, non-forested areas, such as roadsides and agricultural lands and large vacant lots in urban and suburban locations. A forest fire is an unplanned fire, which burns vegetation on lands under forest cover, including grasslands. The incidence of fires is correlated to the severity of the dry season. Table 22 summarises statistics for annual number of fires and total area burnt for the last 17 years.

Table 22: Summary of Forest Fires and Dry Season Rainfall for Trinidad between 1987 and 2003

Year	Dry Season Rainfall Amount (Jan-May) Millimetres	Number of fires	Area burned (hectares)
1987	152.5	502	21,420
1988	167.9	583	5,495
1989	308.1	146	970
1990	363.3	234	1,100
1991	272.7	229	680
1992	332.4	431	2,710
1993	293.7	228	1,570
1994	235.3	256	2,600
1995	160.0	516	7,245
1996	333.0	178	2,664
1997	322.9	156	446
1998	313.6	764	10,289
1999	351.9	167	988
2000	421.7	91	927
2001	118.9	464	5,309
2002	588.2	62	273
2003	124.0	347	4,723

Photograph 9: The incidence of annual forest fires has contributed tremendously to deforestation

The number of fires and total areas burnt increase during harsh dry seasons when drought conditions render both forested and non-forested lands more vulnerable to fires. There is some conflict about the amount of acreage that burn annually. Singh

(2001)[44] reported that 41 hectares (100 acres) of natural forested land burn annually. However, data from Forestry Division suggest that this figure could be closer to 82 to 123 hectares (200 to 300 acres), with larger acreage lost during severe dry seasons.

The most severe forest fires occurred during the drought of 1987, when it was estimated that over 21,000 hectares were burnt, of which over 4,100 hectares was estimated to be natural forests.

Fires in Trinidad and Tobago are caused by human activity. Fires are started for a number of reasons, with a significant number of them being deliberately set or started during the preparation of lands for farming (mainly for slash and burn agriculture).

The highest incidence of fires was reported on grasslands, particularly on the southern slopes of the western side of the Northern Range. Recurring fires on grasslands prevent regeneration of the forests. In addition, teak plantations tend to be quite susceptible to fires and so the largest areas burnt tend to be located in the teak plantations and natural forests of southwest Trinidad (in the Municipality of Siparia). In 2003, for example, four fires burned a total of 1,059 hectares in southwest Trinidad.

Illegal Logging and Poor Forestry Practices

Illegal logging is reported to be a major contributor to deforestation and biodiversity and the loss of revenue by government and private forest owners. Illegal logging primarily has economic roots since trees are usually harvested and supplied to sawmills.

Photograph 10: Illegal activities and unsustainable harvesting practices have led to deforestation and soil degradation over the years

[44] Kenny Singh, 2001. Fire Situation in Trinidad and Tobago. Noted in Global Forest Fire Assessment, 1990-2000. FAO.

Inappropriate Agricultural Land Usage and Harmful Practices

Agriculture is practised both on flat and steeply sloping lands in Trinidad and Tobago. However, it is the practice of agricultural production on steeper slopes which cause the greatest environmental problems[45]. Four agricultural practices pose the greatest threats, namely, squatting for agriculture, slash and burn agriculture, limited or no soil conservation practices on steep slopes, and pesticide use.

A1. Squatting for Agriculture

Agricultural squatting is reported to be one of the main causes of deforestation[46] in Trinidad, but is less a problem in Tobago. A variety of long term and short term crops are cultivated on plots ranging in size from under one hectare to hundreds of hectares on both state and private lands. However, this practice is not restricted to subsistence farmers, since commercial producers are also known to illegally occupy land. Some agricultural squatting is linked to shifting cultivation and the production of marijuana, where such squatters clear and occupy acreages in densely forested sections of the Northern Range and in southeast and southwest Trinidad. While some agricultural squatters may also live on the plot they farm, many do not reside there. Figure 17 shows the number and area of squatters in Trinidad and Tobago.

The practice of agricultural squatting is prevalent in the following:

1. The Northern Range – particularly in the Arouca, Tacarigua/Caura, Tunapuna, Maracas/St Joseph, Santa Cruz/San Juan and Valencia watersheds. Squatting for is also apparent along the rolling hills in the Arima watershed extending from Dunder Hill on the west and the northeast Bonaire to the east.
2. Central Trinidad – in the Central Range and Brickfield.
3. The Southern Watershed Reserve, Southwest Trinidad - which was cleared mainly for sugarcane cultivation.

Like residential squatting, agricultural squatting, which dates back to pre-emancipation times, has evolved into a complex issue. The statement on agricultural squatting in the Ramsar Report[47] on the Nariva Swamp could be universally applied to other areas of the country:

> *"By allowing several decades without land leasing assignment, the practice of squatting has developed strongly in the area, to the point that it has almost perpetuated squatting as an accepted part of the culture. It certainly is the most acute problem at the social, psychological, legal and economic levels."*

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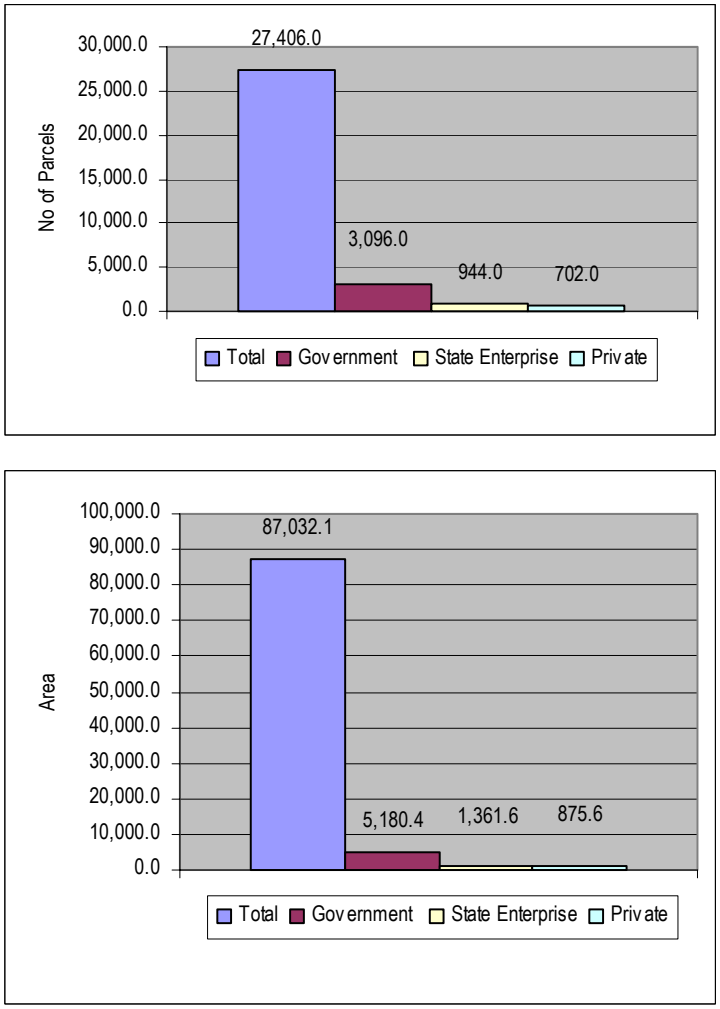
[45] Kairi Consultants Limited, 1999. Environmental Data and Information Project: Land. Conducted on behalf of the EMA (Final Report).

[46] Kairi Consultants Limited, 1999. Environmental Data and Information Project: Land. Conducted on behalf of the EMA (Final Report).

[47] Ramsar Convention Monitoring Procedure, Final Report [Report No. 35, February 1996]. Nariva Swamp, Trinidad and Tobago.

The Food and Agriculture Policy for 1995 to 1997 (the draft White Paper) indicates that landlessness and squatting are closely related and reflect the problems of acquiring land legitimately. The document expresses the view that most agricultural squatters are either unable or unwilling to make significant investments in the land they occupy and, therefore, tend to operate at low levels of technology, without appropriate soil conservation practices.



Source: 2001 Agricultural Census, CSO

Figure 17: Number and Area of Squatting and All Agricultural Parcels in Trinidad and Tobago

A2. Shifting Cultivation

Photograph 11: Slash and burn agriculture is no longer considered a sustainable method of land clearance for agriculture

In shifting cultivation, the land is completely cleared by slash and burn methods. This practice leaves the land exposed to the erosive power of rainfall before the crop is fully established. Fire is the common method of land clearance, but poor fire control often results in the burning of a much larger tract of land than can be cultivated.

Shifting cultivation, which is commonly practised on the slopes of the Northern Range, is much influenced by land tenure where farmers are squatting on State or private lands. Once a sustainable system, the long fallow periods allow the land to rejuvenate before cultivation was again attempted. However today, farmers resort to shorter fallow periods. Unfortunately under the current land tenure arrangement, there is little incentive for shifting cultivators to abandon the practice.

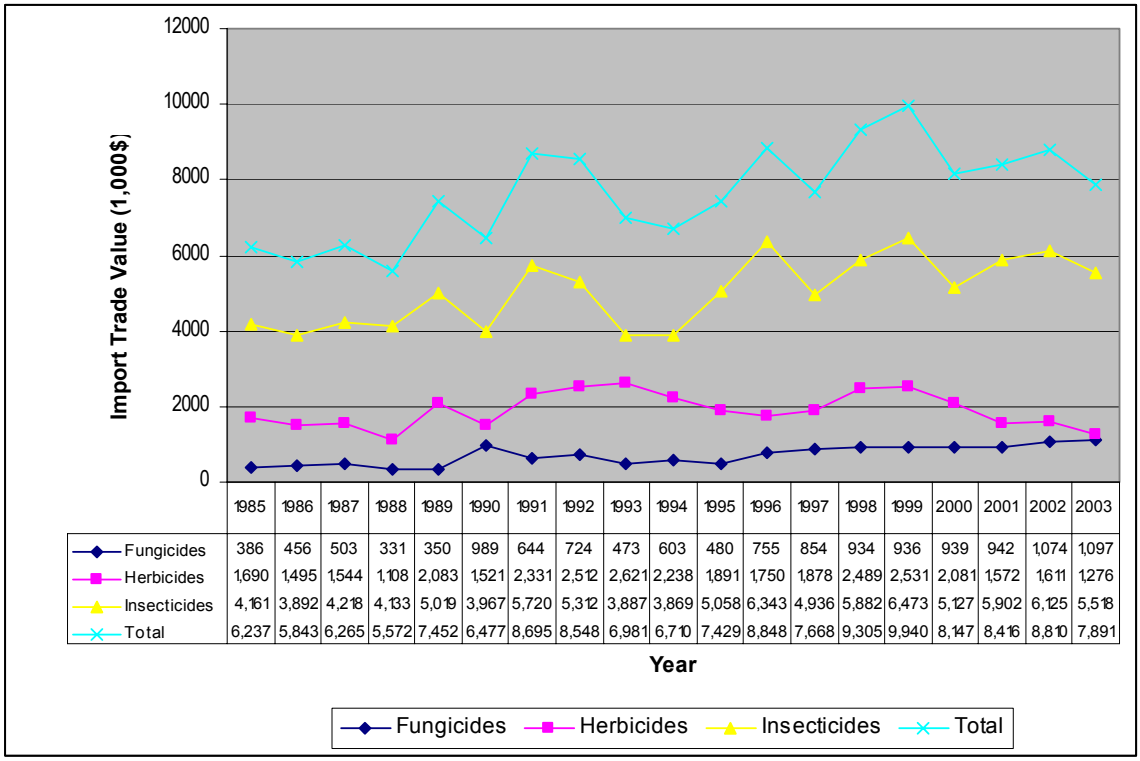
A3. Limited Soil and Water Conservation Practices

Most of the farmers who are squatters and who use slash and burn or shifting cultivation practice little or no soil conservation. Several soil conservation methods are available and over the years suitable methods have been recommended for Caribbean conditions. Most farmers cultivating on sloping soils tend not to practise appropriate soil conservation methods. An example of this is noted in Central Trinidad where farmers are known to till up and down the slope as oppose to across the contour. Failure to employ the correct methods increases soil erosion and sediment loads in runoff water.

A4. Misuse of Pesticides and Fertilisers

Agriculture has become a major source of non-point pollution. Farmers rely heavily on imported products to manage the many crop pests. Chemical pest control can account for a high proportion of the production costs (up to 30 per cent). Between 2003 and 2006 about 8.2 million kilogrammes of pesticides was imported into the country. According to

the then Minister of Health of Trinidad and Tobago, the country imported 2,400 tonnes of pesticides in 2004 (*Sunday Express* 13 November article "Safety Comes First")[48]. Figure 18 shows the value of the pesticides imported between 1985 and 2003. However, there is little information available today on the concentrations of pesticide residues in soils, surface and groundwater.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fungicides	386	456	503	331	350	989	644	724	473	603	480	755	854	934	936	939	942	1,074	1,097
Herbicides	1,690	1,495	1,544	1,108	2,083	1,521	2,331	2,512	2,621	2,238	1,891	1,750	1,878	2,489	2,531	2,081	1,572	1,611	1,276
Insecticides	4,161	3,892	4,218	4,133	5,019	3,967	5,720	5,312	3,887	3,869	5,058	6,343	4,936	5,882	6,473	5,127	5,902	6,125	5,518
Total	6,237	5,843	6,265	5,572	7,452	6,477	8,695	8,548	6,981	6,710	7,429	8,848	7,668	9,305	9,940	8,147	8,416	8,810	7,891

Source: FAOSTAT data, 2005; (last accessed June, 2005).
URL:http://faostat.fao.org/faostat/form?collection=Pesticides&Domain=Means&servlet=1&hasbulk=0&version=ext&language=EN

Figure 18: Value of Pesticides Imported (1985 - 2003)

A socio-economic survey of vegetable farmers' practices in Trinidad carried out by CAB International and the MALMR in 1995 reported excessive and unwarranted pesticide applications[49]. Although farmers recognised that pesticides are hazardous to humans and animals, the survey documented scant regard paid by farmers to operator safety. Their activities pose health and environmental risks.

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[48] As quoted in the Background Paper entitled, "Development of a National Programme of Action (NPA) for the Protection of the Marine Environment from Land-based Sources and Activities." Prepared by the IMA, May 2006.

[49] Report on the Regional Training Workshop on Farmer Participatory Methods for Ecological Crop Management held between 11 and 15 September 2000 at the Centre of Excellence, Macoya, Trinidad and Tobago. The Report was compiled/Edited by Moses Kairo, Anthony Little, Paul van Mele, Gesa Wesseler, Falguni Guharay, Gene Pollard, Cynthra Persad, David Dolly, Luz Palengleng, Martin Kimani. The Workshop was jointly organised by CAB International, CTA, CARDI, and PROCICARIBE in collaboration with the MALMR.

The patterns of pesticide use remain the same today, with a wide range of pesticides being used and the same pesticides being used on several crops to control different pests. Pesticide run-off has had negative effects on freshwater sources and the coastal environment. Some pesticides are known to persist in the soil, reaching toxic levels, which can limit soil productivity and fertility. Paraquat, for example, remains one of the most frequently used herbicides in Trinidad and Tobago, despite its property of binding strongly to clays and its persistence in some soils for up to 13 years[50].

A similar picture is painted for fertiliser use. An average of 6,593 tonnes of fertiliser was consumed in Trinidad and Tobago during the period 1993 to 2002 (Table 23). Existing data show that fertiliser consumption has declined considerably over the last five year (between 1997 and 2001), with an increase noted in 2002. This could be due to considerable decline in sugar cane production. However, fertiliser use in vegetable production remains high.

Table 23: Fertiliser Quantity, Value and Consumption in Trinidad and Tobago (1993 to 2002)[51]

Imports		Year									
		1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Nitrogenous Fertilisers	***Qty (Mt)***	500	1,000	1,000	1,000	1,000	400	300	704	465	988
	Val (1000$)	228	256	216	248	259	250	421	358	634	535
	Consumption (Mt)	3,000	3,000	3,000	6,000	6,000	5,000	4,900	7,278	626	1,155
Phosphate Fertilisers	***Qty (Mt)***	600	1,000	1,000	1,000	1,000	400	300	710	340	821
	Val (1000$)	197	307	465	982	189	458	415	454	235	286
	Consumption (Mt)	600	1,000	1,000	1,000	1,000	400	300	686	340	821
Potash Fertilisers	***Qty (Mt)***	1,800	1,400	3,000	3,430	3,600	1,400	600	1,258	774	1,282
	Val (1000$)	662	496	625	741	290	317	739	1,123	262	298
	Consumption (Mt)	1,800	1,400	3,000	3,430	3,600	1,400	900	1,240	774	1,282
Total	***Qty (Mt)***	2,900	3,400	5,000	5,430	5,600	2,200	1,200	2,672	1,579	3,091
	Consumption (Mt)	5,400	5,400	7,000	10,430	10,600	6,800	6,100	9,204	1,740	3,258

Farmers often do not apply fertilisers appropriately, and as a result over-fertilisation continues to be a problem in vegetable production.

The current situation, clearly demonstrates the need to develop and implement ecologically based crop production systems, and to rationalise the use of fertilisers and chemical pesticides. Over the years, ecologically sound pest control methods (integrated pest/crop management - (IPM/ICM) have been advocated and introduced, but their applications remain limited[52]. A number of reasons have been cited for this, the most important among these are:

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[50] EMA, 1999. Environmental Data and Information Project (EDIP): Land. Conducted by Kairi Consultants Limited on behalf of the EMA (Final Report).

[51] Source: FAOSTAT data, 2005; (last accessed June, 2005). URL: http://faostat.fao.org/faostat/ form ?collection=Fertilizers&Domain=Means&servlet=1&hasbulk=0&version=ext&language=EN

[52] Report on the Regional Training Workshop on Farmer Participatory Methods for Ecological Crop Management held between 11 and 15 September 2000 at the Centre of Excellence, Macoya, Trinidad and Tobago. Compiled/Edited by Moses Kairo, Anthony Little, Paul van Mele, Gesa Wesseler, Falguni Guharay, Gene Pollard, Cynthra Persad, David Dolly, Luz Palengleng, Martin Kimani. The Workshop was jointly organised by CAB International, CTA, CARDI, and PROCICARIBE in collaboration with the MALMR.

- The lack of a comprehensive national policy on ecologically-based agricultural production systems;
- The lack of formal linkage among the agencies involved in research, the dissemination of information and implementation of improved techniques. While the research is being carried out it may not be relevant to farmers' needs nor is information reaching farmers;
- Insufficiencies in the agricultural extension services (lack of funding and resources);
- Inadequate formal consumers' lobby to advocate for the production of safer foods despite increased awareness of health concerns by consumers, and an increase in the demand for pesticide-free foods; and
- A lack of critical knowledge, skills and abilities by the main actors involved in IPM/ICM to facilitate the implementation of IPM/ICM techniques.

While it may be argued that further education of farmers on safe operating practices regarding pesticide and fertiliser application is also required, the effectiveness of the current agricultural extension services programmes to farmers needs to be assessed and upgraded to meet the current realities of today's farmers. Over time the trend has been for farmers to increasingly seek advice and information on available and new products from commercial garden and agricultural shops (that are often only motivated by profits) rather than from the agricultural extension services.

In addition, there is an urgent need for comprehensive monitoring, regulation and control of fertiliser and pesticides use. This is includes drafting of appropriate legislation and the introduction of application standards and systems for production and marketing of ecologically based agricultural products. It would also be important to solicit the public media to generate publicity on adverse pesticide impact on health and the environment, and the needs, demand and benefits of ecologically sound agriculture and IPM/ICM, and to publicise the outcome of the environmental monitoring programme developed for fertiliser and pesticide use.

A5. Faulty Irrigation Water

Many agricultural fields and farms, particularly along the East West Corridor and Central Trinidad, are either downstream or are now surrounded by residential settlements and industries. Farmers have traditionally used and continue to use neighbouring streams and rivers as their sources of irrigation water. However, most of these water sources are contaminated by upstream discharges from residential and industrial actions. One of the harmful outcomes of this situation is the continuous use of the contaminated water for irrigation, thus loading agricultural lands with toxic materials. The extent of the problem is unknown.

A6. Salt Water Intrusion

Soil salinisation in SIDS is generally a problem in wetlands and coastal lowland. Salt water intrusion/soil salinity is not viewed as a major issue since it is mainly isolated to three key areas, namely Bejucal, Felicity, and Oropouche Lagoon. In these instances the

irrigation and drainage systems associated with these areas has deteriorated due to a lack of maintenance, thus resulting in saline soil conditions and a change in the ecology of the areas.

The problem has affected the lower and middle areas of the Oropouche lagoon. However, major repairs works have been undertaken within the last three years. Already these lands are showing the signs of recovery with the re-emergence of wetland plant species.

Industrial Activities

The major industries in Trinidad and Tobago are oil and gas, petrochemicals industries, cement, fertiliser, light manufacturing and food processing. These industries cause increased environmental pressures. The exploration and production of oil in south Trinidad dates back to the late 19th century and, therefore, some of oldest oil fields and pipeline systems in the world are found in southeast and southwest Trinidad. These infrastructures were developed in times when pollution and environmental management were not considered important issues and exact locations of many of these old pipelines are not known. From time to time, one of these old pipelines burst creating major human hazards and polluting surrounding lands.

Many forest areas in south Trinidad are criss-crossed by oil and gas extraction infrastructure. Large numbers of small wells are located in the forests and the pipelines servicing these wells form a dense network within the forest areas. Roads are maintained along the pipelines and to give access to the wells and these facilitate access to the forest. The criss-crossing of the forest with roads leads habitat fragmentation, introduces more light into forest, and changes the microclimate of the forest ecosystem. While, these roads facilitate access for the forest department and for recreational visitors, it also provides access for hunters, illegal loggers, marijuana cultivators and squatters. The actual area occupied by the oil and gas infrastructure does not constitute the major problem - rather it is the secondary impacts of the ready access that this infrastructure provides. Fires and oil spills associated with this infrastructure are a problem[53]. As a result, the Erin and Morne L'Enfer Reserve and the Cap-de-Ville Reserve virtually have been destroyed (Seepersad Rampersad, Forestry Division, personal communication).

It is difficult to determine the impact of the manufacturing sector on land resources of Trinidad and Tobago. Many of the larger manufacturers have environmental programmes. However, the monitoring of these environmental programmes and the discharges from these large industries and from smaller industries by the State need to be improved.

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[53] Achieving the ITTO Objective 2000 and Sustainable Forest Management in Trinidad and Tobago. Report submitted to the International Tropical Timber Council by the Diagnostic Mission Established under Decision 2(XXIX) "ITTO Objective 2000."

A1. Mining/Quarrying

Photograph 12: Open pit quarrying, as practised in Trinidad and Tobago, results in the removal of forest cover and top soil in order to mine the quarry materials

The mining sector is an important contributor to the problem of land degradation in Trinidad and Tobago. The impacts of the quarry industry intensify during periods of boom in local construction industry when the demand for quarry materials is at its highest. Quarrying occurs in various locations in the Northern Range, Northern Basin, Central Range and Southern Basin. Land degradation from quarry operations is associated with the reduction of the aesthetics of the landscape, disruption of the hydrological cycle, loss of biodiversity and increase in water, air and noise pollution.

The majority of the country's quarry resources are on State lands with a significant percentage of the quarrying operations being illegal. In 2004, there were 56 active quarries of which 80 per cent are located on State lands (Table 24). More than half of the 22 sand and gravel quarries are operating illegally. In 2002, half of the total 4.5 million cubic yards of sand and gravel material was produced illegally[54].

[54] Green Paper: Draft Quarry Policy for Trinidad and Tobago, Ministry of Energy and Energy Industries (MEEI,) 2005.

Table 24: Summary of Quarry Operations in Trinidad and Tobago in 2004

Type of Quarry	No of Quarries	General Location	Proportion of total quarried materials
Sand and Gravel	22	Northern Basin – (Valencia and Wallerfield)	70-80%
Andesite	3	Tobago	na
Blue Limestone	14	Northern Range (Maracas, Santa Cruz, Arima)	10-15%
Porcellinite	4	Southern Basin Chatham/Erin	na
Clay	4	Northern Basin, Central Basin and Central Range	na
Oil Sand	1	Southern Basin – Guapo	na
Yellow Limestone	5	Central Range	na
Plastering/Fill Sand	3	Central Basin	na
Total	**56**		

While mining generally create environmental challenges, illegal mining generates additional challenges, one of which is the change of land use from agricultural to quarrying brought about by wildcat operators mining in agricultural and forest designated lands areas in Valencia and Wallerfield.

Many quarries operate in an unsustainable manner with their actions contributing to land degradation. There is generally no control over the manner in which materials are won. Operators are known to quarry out entire parcels of land sometimes extending into other people's property. Several critical issues identified in the industry are: a) an absence of a well thought out approach to the mining or winning of material and restoration of the site; b) the lack of consideration to the location and systematic exploitation based on the local geology and geometry of the material; c) inefficient excavation, blasting and handling practices; d) poor layout of facilities within the site to facilitate quarry operations; e) little or no pollution control measures on site; f) inadequate disposal of solid waste from the mining site; and g) the abandonment of the site without remediation, leaving large holes filled with water which could be hazardous to humans and animals.

Processing of quarried materials also pose some challenges. The washing and crushing of aggregates result in water and dust pollution. Sometimes there is a diversion of the stream onto the site and releasing of that water back into the river without appropriate treatment to remove the large sediment loads.

The State must developed effective mechanisms for monitoring the status of quarry operations. With most of the quarries on State lands it would be important to regulate quarrying activity and overcome environmental problems. The 1979 report by a Cabinet-

appointed Committee on pollution and restoration of quarry sites indicated that the enforcement of existing legislation was a major hindrance. At the time the Committee made recommendations for specific changes in institutional and regulatory framework to ensure reduction of pollution. Seventeen years later, the EMA's position paper on Sand and Gravel Quarries and Wash Plants in Northeast Trinidad noted the same problems and the need for legislative and institutional reform in dealing with quarry management.[h12]

Formal and Informal Human Settlement

Settlement development in Trinidad and Tobago is regulated by the Town and Country Planning Division (TCPD), the EMA and the local municipality government agencies as well as several other government agencies.

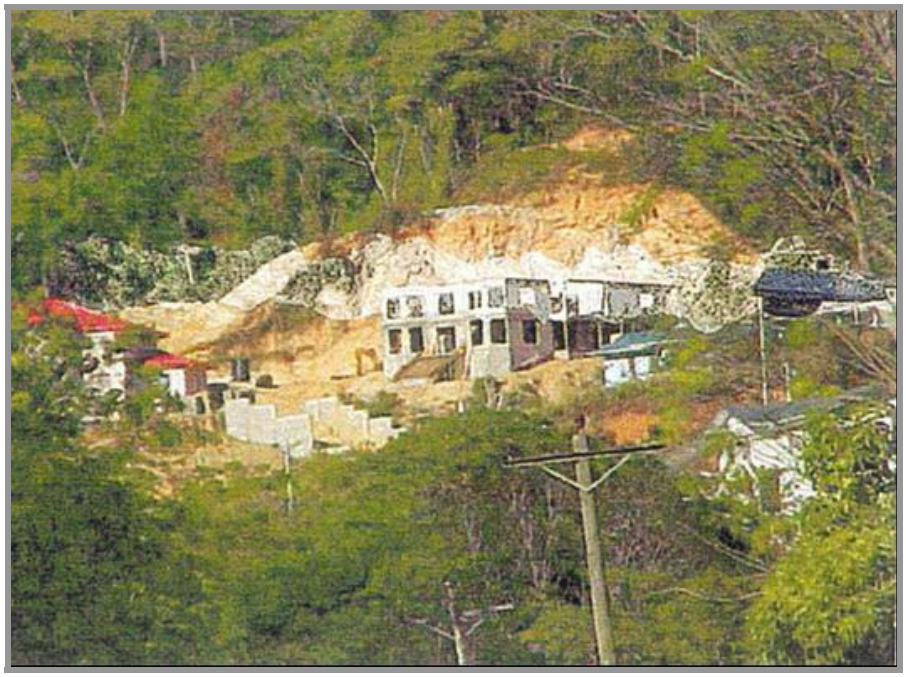
Planning approval, both preliminary and final, is controlled by the TCPD in respect of type of land use and intensity of use. Thus height, size, setbacks, site coverage, internal road way widths and the like are determined by this agency. The EMA is responsible for ensuring that physical development is not detrimental to the environment. Through the use of the Certificate of Environmental Clearance (CEC) process and the Environmental Impact Assessment Report, the EMA assesses development proposals identified as "designated activities" to determine the type of impacts, if any, and ways in which they can be mitigated. The Municipal Authorities are responsible for ensuring that physical development complies with the public health requirements (such as ventilation of buildings, safety rails and accesses and exits, roof and storm water drainage and on lot sewerage disposal systems), issue building permits for construction of structures, monitor building construction and provide certificates of completion. By law, no development can take place until approvals are given by these three agencies that operate in tandem.

Additional approvals are required from Fire Services, Factory Inspectorate, Electrical Inspectorate, the Ministry of Works' Drainage Division and the Ministry of Health's Public Health Department depending on the scale and location of the development.

The planning process for regulating the construction of built development does offer a framework which would minimise land degradation and maintain environmental quality. However, there are many instances where buildings have been constructed without the required planning approvals. The mechanism for monitoring and for taking corrective action against the construction of such structures has been weak. Thus, many housing developments have mushroomed in violation of sound environmental principles.

There has been some debate about the contribution of formal human settlements versus informal human settlements to land degradation. While there may be divergent assessments on the specifics of different types of settlement on degradation, all would agree that human settlements as a whole have indeed contributed tremendously to the current situation of land degradation and decreased environmental quality.

A1. Formal Human Settlements



Photograph 14: Poor land clearance practices during housing construction have led to scarring of landscape and increased sediment loads in waterways

In recent years there has been an increase in urban settlements as well as the intensification of development within the urban centres. Indeed, the last 20 years has seen increased built development including residential and industrial development, increased conversion of agricultural land to built uses, increasing incidence of squatting on both public and private lands, expansion of satellite communities and a movement towards higher density residential development.

New residential developments have occurred over the last two decades along the East-West corridor. Developments at Almond Court in Carenage, La Riveria in West Moorings and Bay Shore Towers on the Cocorite Highway are all located within a 10-mile stretch of the western section of the Corridor. Moreover all of these housing developments are high rise sea front properties developed in an area in which the single family detached house was and is the dominant residential form. A little further east between the Western Main Road and Mucurapo Road is the construction site of One Woodbrook Place which is an extremely densely planned residential community with commercial and recreational facilities.

New hillside communities constructed on the north-south oriented spurs of the western section of the Northern Range include Semper Gardens in Diego Martin and the Buoys in Carenage. These communities, also planned residential settlements, are migrating further up the hills and are increasing the density of the area by either building on green field sites or developing apartment buildings and town houses in areas where traditional housing was single family flats on large lot sizes.

Major residential communities are also being established in Trincity on what were productive sugarcane lands, and through village expansion, new housing settlements on recently abandoned sugarcane lands in Central are progressing with great speed. Here Government policy is converting farmlands to settlement in new areas such as Felicity, Picton, Waterloo and Mc Bean.

Squatter settlements has also increased in size and have become denser over the years as they support a larger number of residences in both the rural and urban areas, for example River Estate in Diego Martin, Pranz Village in Central Trinidad and Jacob Hills in Wallerfield.

Many of these settlements have led to land degradation and environmental concerns. Both formal and informal settlements have been constructed on inappropriate sites as well as with inappropriate techniques. Planned residential development on steep land and seafront properties have encouraged the bulldozing of slopes to create flat building sites on steep slopes as well as the removal of mangrove and filling in of swampy areas. These sites are inappropriate for building and need to be manipulated to the point where the original landscape is destroyed.

Photograph 15: Formal housing in Diego Martin Valley

Construction on hillsides utilising mechanical equipment disrupts the natural drainage patterns and destroys the local ecology. Current construction techniques which include removal of all vegetation and opening of trenches for the preparation of foundations expose earth that often remains unprotected for long periods with the results of wind driven pollution during the dry season and uncontrolled surface water runoff during the rainy season. Indeed, long after the super structure is built, the site clearance and

construction practices leave scarred landscapes, clogged municipal drains and contribute to on site erosion and down stream flooding.

A2. Informal Human Settlements (Residential Squatting)

Squatting is neither a recent phenomenon nor is it restricted to the urban centres. It can be traced to pre-emancipation times when it was the policy of the day to encourage the occupation of crown lands and abandoned agricultural estates (Wayne Huggins, Ministry of Housing: personal communication). The practice became widespread as a means of encouraging the newly freed African slaves to live close to the plantations as a source of labour. However, the deliberate over-pricing of land and the heavy taxation of small scale agriculture produce effectively denied the ex-slaves all the reasonable means of owning lands. At the time squatting was mainly limited to rural areas.

The indentured East Indian migrants were also discouraged from owning land. However, between 1869 and 1889 access to land became less restricted for East Indians who were first offered grants of land and then cash, in lieu of their return trip to India upon completion of their period of indentureship. During the early 1900s, squatting spread to urban areas with the influx of immigrants from islands. The 1960s and the 1990s witnessed an explosion in squatting as the demands for shelter increased and property and housing prices escalated. It has become a critical societal issue impacting both State and private lands.

Photograph 16: Squatter Housing, Usine, St Madeleine, South Trinidad

Squatter settlements have also increased in size and have become denser over the years as they support a larger number of residents in both the rural and urban areas. It is estimated that there are 25,000 squatter households on State lands and another 25,000 on

private lands[55]. Thus, over 15 per cent of the households in Trinidad and Tobago are squatters. The State Lands (Regularisation of Tenure) Act (No. 25 of 1998) identifies 254 squatter settlements on State lands of which approximately 52 per cent of the total squatter settlements on State lands are located in southern Trinidad (Table 25). Squatting is extensive in certain communities in South Trinidad, such as Point Fortin (32 squatter settlements), Penal (16 squatter settlements), Siparia (10 squatter settlements and Fyzabad (five squatter settlements). About 39 per cent of the total squatter settlements on State lands are located in North Trinidad, with Port of Spain accounting for 15 of these settlements, Arouca eight, Valencia seven, Diego Martin seven, and Sangre Grande five.

Table 25: Squatter Communities in Trinidad and Tobago[56]

Region	Number of Squatter Communities
Tobago	3
North Trinidad	98
Central Trinidad	22
South Trinidad	131
Total	254

Squatting has led to encroachment of forest reserves and other protected areas. An internal Forestry Department report in 2001 estimated that in 1994 about 11,593 hectares or eight per cent of total forest cover had been removed illegally which was due mainly to residential squatting[57].

The situation of squatting on private lands is not that clear and in the absence of information it is difficult to fully report on the extent of the problem. There is a need, therefore, for research on squatter on private lands if the whole issue of squatting is to be addressed satisfactorily.

Squatting create many environmental problems and hazardous conditions. The typical squatter settlement is generally devoid of basic infrastructure and amenities for sustainable development of the community. Housing and access are haphazardly developed as households lay claim on space for their needs. Water supply is often inadequate with households depending on public supply, water-borne trucks and rainfall. Drainage systems are generally absent and in flat locations like River Estate, Diego Martin would lead to frequent flooding. Waste management facilities and waste disposal are inadequate and residents have been known to resort to the burning of garbage as a means of disposal. On hillside communities this practice has led to bush

[55] Vision 2020: Housing Sub-Committee Report. August 18, 2003.

[56] Based on the information included in The State Lands (Regularisation of Tenure) Act (No. 25 of 1998)

[57] Forestry Division, 2001. Squatting in Forest Reserves, Prohibited Areas and Wildlife Sanctuaries. (unpublished document).

and forest fires. The origins of some of the bush and forest fires in northwest Trinidad could be traced to hillside squatter communities.

Photograph 17: Squatter Community on the Diego Martin Hillside

The State Lands (Regularisation of Tenure) Act of 1998 sought to regularise squatters on public lands but no provisions had been made to solve the problem on private lands. This Act led to the establishment of the Land Settlement Agency (LSA) which is in charge of the regularisation of squatters on designated areas and the containment of squatting. Regularisation of these settlements includes the upgrading and provision of services and provision of leasehold title.

Inadequate Environmentally Sound Waste Management Systems

Most of the solid waste generated in Trinidad and Tobago is disposed at the country's landfills; the rest is dumped indiscriminately at informal dumpsites and in waterways, leading to pollution, and the increased incidence of flooding. There is critical need for a significant change in the way waste is managed.

Over 500,000 tonnes of solid waste are produced annually from municipal, commercial and industrial sources. Most of the disposal sites throughout the country are inadequate and inefficient. There are few facilities for, and only isolated efforts at, recycling, while there is no formal facility for the treatment of toxic and hazardous waste. The disposal of hospital and medical waste is also a serious issue since there are no segregation mechanisms at source to reduce risk, and it is disposed of as part of the municipal waste stream. Greater efforts must be made to reduce the amount of waste generated, to sort waste at source and to increase substantially the re-use and recycling of waste. Additionally, the waste to be disposed must be done in a manner that is most efficient. The new technologies in waste disposal appear to offer a number of advantages which should be explored.

The control of the generation, storage, treatment, recycling and reuse, transport, recovery, and disposal of hazardous wastes are issues which have tremendous impact on land degradation in Trinidad and Tobago.

Most of the country's sewerage systems are in a state of disrepair. This has serious implications for human health and the health of the surface water resources and neighbouring lands. The WASA has embarked on a programme to address this challenge. However, a consistent and comprehensive approach is required to deal with this ever-increasing challenge.

Photograph 18: White waste[58] disposal is a major problem

A1. Solid Waste Management and Disposal

Solid waste management problems have escalated in Trinidad and Tobago over the past few decades as a result of interacting forces such as population growth, accelerated industrial development, increasing commercialism, unsustainable production, and

[58] Includes white goods such as refrigerators, stoves, washing machines, microwave ovens, dryers

consumption patterns[59]. The type and quantity of the waste has changed over the years with the increased consumption and greater amounts of increasing levels of commercial, industrial and household waste now reaching the solid waste disposal sites. The significant gain made by the Chase-Charlie-Away Litter Campaign and NAG-Charlie Litter Campaign of the 1980s in raising awareness to the issue of waste management has long since eroded, and the country was again suffers significant land degradation due to indiscriminate waste management and disposal practices

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Photograph 19: Informal waste disposal site managed by the San Fernando City Corporation

There are three major public landfill sites in Trinidad: the Beetham, which serves the northwest region; the Guanapo which serves the Northeast Trinidad; and Forres Park which serves the central and southern regions. In addition, there are three other active disposal sites in Trinidad established by regional corporations[60]. A private waste disposal facility operates in Guapo, Point Fortin and receives waste from the Point Fortin Borough and Municipality of Siparia. It is estimated that an average of one kilogramme of waste is generated per capita per day, with a range from 0.55 kilogramme per capita per day in the rural areas to a 1.75 kilogramme per capita per day

[59] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

[60] Pan American Health Organisation(PAHO)/World Health Organisation (WHO), 1998. A Visual Assessment of the Existing Solid Waste Disposal Sites in Trinidad and Tobago. Executive Brief. As cited in the 2003 Draft Report of the Sub-Committee on the Environment in the Formulation of a Vision 2020 Strategic Development Plan for Trinidad and Tobago.

for a highly commercialised and industrialised area such as Port of Spain[61]. Table 26 details the actual operations undertaken at the respective disposal sites in Trinidad.

Table 26: Operations at the Disposal Sites[62]

Disposal Site	Manage-ment	Waste Volume (tonnes/ day)	Com-paction	Cover	Leachate Manage-ment	Gas Venting
Beetham	SWMCOL	Yes	Yes	Weekly	No	Yes
Guanapo	SWMCOL	Yes	Yes	Weekly	Yes	Yes
Forres Park	SWMCOL	Yes	Yes	Weekly	Yes	Yes
Rio Claro/ Mayaro	Regional corporation	Na	No	No	No	No
Guapo	Private	Na				
Chaguanas	Regional corporation	Na	No	No	No	No
Toco	Regional corporation	Na	Occasionally	Occasionally	Yes	No

Although the Beetham area had long been used for dumping of solid waste, the landfill facility, which began receiving waste in 1970, receives about 774 tonnes of waste each day, or more than half of the daily tonnage of municipal solid waste delivered to the public landfills in Trinidad. The quantity of waste entering the Beetham facility has almost doubled in the last 10 years (Table 27).

Table 27: Municipality Solid Waste Delivered at the Beetham Landfill in 1993 and 2004

	1993	2004
Daily tonnage (Mt)	144,554	283,456
Annual tonnage (Mt)	396	777
Annual number of vehicles entering the facility	80,749	154,661
Daily number of vehicles entering the facility	221	424

Source: SWMCOL

The 1995 study shows that the components of municipality solid waste deposited at the Beetham landfill compared to the United States (US) figures (Table 28). Undoubtedly the composition of solid waste reaching the landfill has changed over the years, with greater consumption of goods in plastic and styrotex packaging and containers. Today more than 50 per cent the waste reaching the landfill could be recycled (Alban Scott, SWMCOL: personal communication).

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[61] Adapted from Environmental Priorities in Trinidad and Tobago. Sustainable Economic Development Unit, UWI for the EMA. As cited in the 2003 Draft Report of the Sub-Committee on the Environment in the Formulation of a Vision 2020 Strategic Development Plan for Trinidad and Tobago.

[62] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

Table 28: Composition of Solid Waste at Beetham (1995) and US Average

Component	Percentage	
	Beetham	US Average
Organics	26.7	24.0
Paper	19.7	38.0
Glass	10.5	6.0
Metals	10.4	8.0
Plastics	19.9	9.0
Textiles	7.3	15.0
Rubber and Leather	5.3	-

Source: SWMCOL

A similar situation is noted at the Forres Park and Guanapo Landfills (Table 29). Indeed the quantity of solid waste entering the facilities has increased over the years with the increase in residential areas and industrial activities in the regions which these landfills service.

Table 29: Annual Quantities of Solid Waste Disposed at the Three SWMCOL-Managed Landfills

Year	Annual Quantities (tonnes)			
	Beetham	Forres Park	Guanapo	Total
1993	144,554	66,132	33,170	243,856
1994	146,525	67,580	35,880	249,985
1995	143,101	70,747	33,322	247,170
1996	133,722	77,869	47,636	259,227
1997	177,434	79,378	39,069	295,881
1998	176,949	96,285	47,984	321,218
1999	172,263	113,858	49,863	335,984
2000	195,967	178,957	48,818	423,742
2001	200,527	104,809	73,440	378,776
2002	236,540	108,051	83,383	427,974
2003	269,440	131,449	85,307	486,196
2004	263,456	149,600	97,034	510,090
Total	**2,260,478**	**1,244,715**	**674,906**	**4,180,099**

Source: SWMCOL

The responsibility for solid waste management and disposal is shared by a number of agencies and therein lies part of the problem of solid waste management and disposal. SWMCOL was established in 1980, as the national authority with responsibility for management of the solid waste systems in the country. However, the regional governing bodies are responsible for collection of domestic waste within their individual municipality. Moreover, because there is no single responsible institution/agency, there is often duplication of efforts in some areas and negligence in others.

For various administrative and technical reasons, the collection and haulage of solid waste in the municipalities is an inefficient and ineffective operation. Collection scheduling problems are the main resultant problem. Often residents are not informed of schedule changes or they themselves create problems when they put out their garbage

at irregular intervals. In addition, all businesses have legal responsibilities for the waste they produce. However, these responsibilities are usually neglected, particularly in commercial sector. The municipal authorities are obligated to dispose of the waste of a commercial business within a limit. Beyond this weight it is the responsibility of businesses to dispose of their waste. However, businesses are known to neglect their responsibilities and put out large quantities of waste on the street at the end of the business day for disposal.

There is little or no regulation of the operations of the country's landfills. The three public landfills, all of which have passed the average 20-year lifespan recommended for operation of a landfill, operate at low level of efficiency and pose health and security risks to persons entering and operating within the facilities. The operations of the public facilities are plagued by low resources. [d13]

Little is known about the operations of the privately-owned waste facility in Guapo. While solid materials, surface run-off and leachate from wastes can have devastating effects on freshwater and marine ecosystems and can contaminate freshwater and groundwater supplies, there is no consistent and regular monitoring of these facilities. In recent times concerns have been voiced about the Guanapo and Beetham facilities as sources of contaminants which affect the groundwater and freshwater supplies. Safe handling of wastes at the facilities still presents a challenge since salvagers are known to indiscriminately sort and handle waste materials and at times unearth buried materials.

Where the local population (the generators of waste) fit into this scenario is another issue. Some argue that the country's problems of solid waste management start with people's negative perception and hands-off attitude about waste. Waste is considered just that, waste - something to dispose of at the first chance provided. While there has been talk about recycling, the citizenry does not actually place value on waste. There is the general perception that waste is somebody else's business once it leaves the home or business compound.

The existing legal framework does not comprehensively address the issues facing waste management. The problem of environmental pollution caused by solid waste is visibly evident throughout the island. The 1995 SWMCOL study estimated that about 85 per cent of the solid waste is disposed of at the public landfills. This figure may well have changed with the level of indiscriminate waste disposal being witnessed in the country, which leads to obstruction and clogging of rivers with garbage and debris, particularly those in the urbanised municipalities along the East West and Southern Corridors. Litter abounds in many secluded public spaces – beaches, parks, etc. – creating not only land degradation problems but also obnoxious odours and public health hazards. Illegal dumping has become a common practice with over 300 informal reported dumpsites throughout Trinidad.

Little attempt has been made to reduce amount of waste generated. In 1989, SWMCOL established waste recovery systems and markets for recyclable materials, including glass, paper, cardboard, metals, used-oil and textiles. The establishment of a recycling industry was meant to reduce the amount of waste entering landfills, while at the same contribute to the conservation of resources, employment creation and income generation, and to create a source of foreign exchange. However, the recycling industry

remains rudimentary. Most of the sorting is done at the landfills creating health problems for the persons who sort through the garbage to collect recyclable materials.

All the while the country remains with the challenge of disposing its waste. In recent times, the Government has been considering the various options to management of the country's waste problems. One such option is the use of a plasma-based system, which utilises high temperature (as high as 10,000 ^{0}C) ionised gas to convert waste to a vitrified substance with separation of molten metal. The technology converts waste into energy and slag. However, this is relatively new technology and as such, there is insufficient information to assess the cost efficiencies and the long-term environmental impacts. They also have a limited proven track record to demonstrate their operational reliability. It would be necessary to review the technology, along with others, to determine its applicability and feasibility in light of the need to develop an integrated solid waste management and cost-efficient system.

Photograph 20: A significant amount of garbage ends up in the country's mangroves

A2. Hazardous Waste Management and Disposal

As one of the most diversified and industrialised economies in the English-speaking Caribbean, Trinidad and Tobago generates a large amount of hazardous waste. Despite the fact that the country generates a large amount of potentially hazardous waste, there is no dedicated hazardous waste landfill or disposal facility. A large proportion of industrial and hazardous wastes generated is disposed of in the municipal solid waste stream or even dumped without any control. The SWMCOL Report to the EMA

conducted in 2000, provided a list of the main hazardous materials generated which is shown below:

- Waste acids/alkalis;
- Heavy metal sludge;
- Heavy metal slags, ashes and bag-house dust;
- Paint sludge;
- Oily waters, sludge and waste lube oils;
- Spent filter media;
- Spent catalysts;
- Waste solvents;
- Waste pesticides;
- Waste chemicals/pesticide containers; and
- Asbestos.

There is no recent comprehensive study that adequately estimates the quantity of hazardous waste generated and disposed of in the country. However, estimates of the quantities of various hazardous materials from a number of sectors in Trinidad and Tobago suggest substantial increases for each category of waste (Table 30). With the rapid increase in industrial activity since 1998, it is likely that there would be further increases in quantities of waste generated.

Table 30: Estimated Quantities of Hazardous Waste Generated for 1994 and 1998[63]

Waste Category	Quantity of Waste (x1,000)	
	1994	1998
Waste acids/alkalis	430 tonnes	630 tonnes
Heavy metal sludges	1,500 tonnes	2,200 tonnes
Heavy metal slags, ashes and baghouse dust	1,300 tonnes	1,900 tonnes
Paint sludges	240 tonnes	350 tonnes
Spent filter media	80 tonnes	100 tonnes
Spent catalysts	90 tonnes	130 tonnes
Waste solvents	240 gallons	350 gallons
Pesticide wastes	1,700 tonnes	2,000 tonnes
Wastewater from oily waste treatment	na	40,000
Asbestos	20	25

[63] Vision 2020 Planning Committee, 2003. Draft Report (Environment): Report of the Sub-Committee on the Environment in the Formulation of a Strategic Development Plan for Trinidad and Tobago.

A3. Domestic Wastewater Management

Domestic wastewater management continues to be a serious and chronic problem. Poor or non-existent piped sewerage systems in many rural and urban areas make sewage treatment difficult in Trinidad and Tobago. Only a fraction of industrial and municipal wastewater is treated before being discharged into the surrounding land and water resources. Since many of the existing systems are operated in an unsanitary manner without proper monitoring, they threaten human health, either directly through the contamination of water supplies or indirectly through the contamination of food and fodder.

Effective management strategies for wastewater treatment, including reuse are limited. Moreover, a lack of technical capabilities to operate and maintain the existing facilities for sewage treatment makes it difficult to control wastewater.

The septic tank has been an effective treatment method for wastewater in areas occupied by a limited population. A number of problems, however, have been identified, such as limited control over design, lack of sludge removal and poor facilities to dispose of sludge. Its extensive use in heavy populated areas makes this a serious challenge.

Coastal Development

Coastal development in Trinidad and Tobago includes housing, commerce and industry. While some industrial development has taken place on the south coast, most of the industrial activity over the last 20 years has been located on the west coast, and given current development plans, the west coast will continue to be the main recipient of major industrial development.

The north-west coast which extends from Sea Lots in the east to Staubles Bay in the west was historically the section of the coast where development took place and generally involved single family detached housing, light industry (such as sales and services of boat engines, repair and manufacture of pirogues and fishing gear, manufacture and repair of speed boats) and recreation such as hotels and beach houses. Within the last two decades, however, construction of housing especially high rise structures, commercial complexes (West Mall, Movie Town, Marriot, BHP Billiton Petroleum Office building, port expansion westward and coastal highway development) has accelerated coastal development and the consequential destruction of the mangrove.

Photograph 21: Faulty Coastal Defence Works, Goldsborough, Tobago

In the case of the south-west coast, industrial activity has been most pervasive. The construction of the port and LNG trains at Point Fortin and the port and industrial estate at La Brea, together utilized a significant expanse of coastal space. Other developments along that coast include the commercial and residential complex at Gulf City, the high density residential community at Embacadere and the redevelopment of public transportation facilities at the port of San Fernando. Some of these activities and particularly the industrial activities including the construction of the natural gas pipelines along the coast at Guapo and Point Fortin have altered the coastline.

Intensification of coastal development is felt by many residents to be responsible for acceleration of erosion on the south west coast. Indeed, along the coast from Point Fortin to Cap-de-Ville residents blame the dredging operations for the accelerated erosion while many visitors to the beach and residents of the area have felt that construction of the pipeline along the Guapo Bay is responsible for the loss of Clifton Hill beach.

The establishment of a reclamation line on the northwest coast was intended to ensure orderly development of the coast line. As a consequence, the line was expected to address continued illegal land reclamation, the need for more developable land along the coast and coastal environmental issues such as water pollution, tidal flushing, destruction of bio forms and the like. Unfortunately this line was never established and illegal reclamation continues virtually unabated. Recently, however, the EMA took action against a developer engaged in illegal reclamation works. Based on the results of that action, the Authority may be able to develop an approach to deal effectively with other violators.

3.2.3.2 Tobago

Annual Forest and Bush Fires

Forest fires generally occur as a result of one of several actions, namely, land preparation for farming, stimulation of grass growth for animal food, vegetation control and waste disposal.

Land preparation sometimes utilised the slash and burn technique for clearing land for planting and often the burning of dry vegetation to remove the debris. This practice over time has led to fire climax vegetation almost exclusively on privately owned lands from Moriah to Plymouth in the Courland watershed.

The burning of bush to stimulate the growth of grass shoots as pasture for farm animals is also a practice of long standing and continues to be used in several parts of the island. Fires also serve to control the growth of vegetation and as a form of waste disposal especially in the rural areas where solid waste disposal services are not offered or offered infrequently.

The use of fire for multiple tasks has led to an increase in forest fires over the years, to an expanding area of fire climax vegetation and increasing demand for fire fighting services as fires go out of control. The consequences for the most part are soil loss and increasing respiratory health problems.

Representatives of the Division of Natural Resources and the Environment (DNRE) noted that private land owners particularly in the Courland watershed, have not yet begun to participate in a Government financed reforestation program nor have they committed themselves to a long term approach to keeping the land green. Because of the limitation of the current legislation, private land owners cannot be compelled to participate in the reforestation programme and moral suasion appears to be non-effective.

Photograph 22: Forest fire in Delaford, Tobago

Record keeping on the number of forest and bush fires is far from satisfactory since only fires on state land are recorded and the record is essentially the number of fires by location.

Poor Agricultural Practices

Shifting agricultural practice is minimally used as a farming technique since farmers have adopted the new technology in land preparation. The Consultants were informed that fairly easy access to tractors has changed the pattern of land preparation. Additionally, systematic attempts are being made, with some success, to re-introduce the technique of terracing on hillsides farm lands.

Logging only takes place on private lands since it was banned on state land in 1985. Private operators have been using licensed portable saw mills of which some 15 are currently in operation. The portable system appears to be more effective since more of the tree trunks are being utilised. However, villagers in northeast Tobago have reported that both logging and illegal logging continue to be a notable challenge.

Waste Management and Disposal

Solid waste disposal is facilitated through the collection of solid waste at regular scheduled intervals by contractors and the THA, then to the landfill at Studley Park which is managed by the THA. As in the rest of the country, solid waste disposal and management pose a major challenge, manifested in irregular scheduling of garbage collection systems, the presence of informal (illegal) dump sites, littering, lack of a comprehensive and integrated recycling programme and questionable operations at the Studley Park facility.

A 1989 study of the solid waste generation and disposal situation in Tobago reported that about 15 tons of solid waste had to be disposed of on a daily basis[64]. Some 16 years later the volume of garbage would have increased considerably with growth in per capita incomes, altered patterns of consumption, and the rapid development of the tourism sector. There are no data which record Tobago's daily per capita generation of waste. Over the years, however, it is noted that the quality and composition of the waste have also changed significantly, containing less biodegradable materials. Instead, increasing amounts of plastics, aluminium, paper and cardboard packing cases are being used and disposed of by households and businesses. The disposal of polyethylene terephthalate (PET) plastic bottles is posing the biggest challenge in the country as well as in Tobago. Although most of these materials are recyclable, the development of a recycling programme may pose a challenge, since large quantities would be required to make the recycling of plastics and other materials viable.

Information on the management of the official landfill at Studley Park is limited and needs to be addressed particularly in light of the fact that the THA also functions as the

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[64] Akili, Kamau (date unknown), Solid Waste Management in Tobago.

URL: http://www.scsoft.de/et/et2.nsf/0/F41BF9A59573FB4805256766005B1512? (Last accessed June: June 2005).

environmental regulatory agency in Tobago. The Report of the Vision 2020 Sub-committee notes that there is no compaction, covering or leachate management of waste at the facility. It is evident that this site may be reaching its capacity and that soon an alternative site may have to be found. There is a need for the introduction of alternative methods of dealing with waste. Waste materials are not considered as useful products, and so reuse and recycling are not seen as alternatives.

Various types of hazardous waste are produced in Tobago; however like Trinidad, there is no facility to deal with these special types of waste.

Inappropriate Land Clearing and Construction Practices

Inappropriate construction techniques for buildings, roads and on-lot sewerage disposal were identified as principally responsible for land degradation. There was a lack of application of the building codes to construction and this was responsible for some of the problems of erosion and land movement. It was noted that houses were being constructed without guttering, down pipes and concrete skirting around houses. Thus houses particularly on hillsides do not channel surface water runoff away from the foundations and into drains designed to move water safely down the hillsides.

Poor practices in road construction include absence of directional flow for surface water runoff and ineffective compaction of the sub bases of some roads. Too many roads, drains and catch pits which directed water away from the edge of the pavements were either not constructed or functioning poorly. In several instances, surface water runoff ran off the road and directly down the unprotected slopes on both the Northside Road and Windward Road. Poor functioning catch pits which are intended to channel water safely under the roadways often act to undermine the very foundation of the roadways reducing strength and contributing to pavement failure.

Photograph 23: The 2004 Landslide at Flagstaff Hill, Charlotteville, Tobago

Poor placement and construction of on-lot sewerage disposal systems on hillsides were seen as contributing to some of the major land slides. The ingress of water into the soil

overtime appeared to have weakened soil strength and contributed to land slides in places like Charlotteville during the unusual rainfall in November 2004.

Photograph 24: Gabion baskets, a low tech method, are used to curb erosion and landslide, but still expensive to low and middle income homeowner

Chapter 4

The Existing Institutional Framework to Support the UNCCD

At present, in Trinidad and Tobago there are various State agencies that have statutory responsibility for various aspects of environmental management, and by extension are responsible for addressing sustainable land management issues. There are also public sector and civil society organisations that are engaged in land management projects and activities and play stewardship and advocacy roles in protecting land resources. In addition, there are many legal and policies instruments in effect which deal with various aspects of land issues. This multi-sectoral approach to land management results in:

- Overlaps among agencies involved in the management of land resources;
- Identifiable gaps in roles and responsibilities for land management;
- Uncertainty regarding resource utilisation;
- Conflicting legislation, for example, in the area of enforcement, penalties, etc; and
- Inadequate legislation to deal with the issues of land degradation.

4.1 Institutional Resources

4.1.1 Public Sector Agencies

There are several institutions in Trinidad and Tobago with statutory control over land management and protection based on their sectoral functions. Among the more important institutions, TCPD of the Ministry of Planning, Housing and the Environment (MPHE) and the EMA stand as pivotal organisations. The TCPD is the central government institution responsible for land use planning and development control. However, over the years the agency has lacked the capacity and resources to effectively monitor land development and to enforce the Town and Country Planning Act.

The EMA is the main focal point for environmental policy and management at the Central Government level and is responsible for coordinating the environmental aspects of development activities, in collaboration with the municipal governments and other central government sectoral institutions. The key functions of the EMA include:

- Developing and implementing policies and programmes for the effective management and wise use of the environment, consistent with the objectives of

the Environmental Management Act of 2000 and the National Environment Policy (NEP);

- Coordinating environmental management functions of persons in Trinidad and Tobago;
- Establishing and co-ordinating institutional linkages locally, regionally and internationally;
- Making recommendations for the rationalisation of all governmental entities performing environmental functions;
- Developing, establishing and monitoring national environmental standards and programmes relating to the environment;
- Monitoring of compliance with the standards criteria and programmes relating to environment;
- Taking all appropriate actions for the prevention and control of pollution and conservation of the environment;
- Issuing CECs;
- Making recommendations for a NEP; and
- Undertaking anything incidental or conducive to the performance of any of the foregoing functions.

As it relates to land management and protection, the EMA has responsibility for the control of water pollution, contaminated lands, solid and hazardous waste, regulating the use of land for solid waste disposal, improving sites as and when hazards need to be dealt with, and developing such land which may have been contaminated and remediated effectively to an environmental standard established by the EMA. Two of the most powerful instruments available to the EMA, for the sustainable management and protection of land resources are the Environmentally Sensitive Areas (ESAs) Rules of 2001 and the CEC of 2001. The former rules authorise the Authority to designate areas in Trinidad and Tobago as ESAs. Such designations are meant to conserve natural resources, protect the environment and to promote sustainable socio-economic development. Through such designations, the EMA may establish limitations on use of the area and the type of activities to be undertaken within the selected area. So far, Matura Forest, Aripo Savannahs and Nariva Swamp have been designated as ESAs.

The CEC Rules establish a comprehensive framework to ensure proper management of developed land and to safeguard these lands against degradation. These Rules apply to proposed developers who are planning to undertake any one of the 44 designated activities which cover a range of development from agricultural to heavy industrial development. Such developers must obtain a CEC from the EMA prior to the commencement of their project.

In addition, the Authority is expected also to develop an Environmental Code which includes the conduct of a comprehensive evaluation of written laws and various programmes which address environmental issues. The Code will provide for the overall consolidation, rationalisation and modernisation of these laws and programmes and in

its development, the Authority is expected also to review, revise and develop a package of incentives (direct government subsidies, the introduction of tax differentiation or tax incentives) to encourage sound environmental activities and performance, and a package of penalties (charges, fines) for product manufacturing process or usage which are in violation of the Environmental Code.

There are a number of agencies with sectoral and regional responsibility for various aspects of land management and control. Key among these institutions are the following:

- MPHE which has responsibility for setting policy direction for the environmental sector and for the supervision of a number of institutions, such as the EMA, and the TCPD.
- Ministry of Public Utilities (MPU) which has responsibility for setting policy direction for the environmental sector and for the supervision of a number of institutions, such as the Water and Sewerage Authority (WASA), the Water Resources Agency (WRA), the Water Resources Management Unit, SWMCOL.
- The Forestry Division (FD) of the Ministry of Agriculture, Land and Marine Resources (MALMR) has responsibility for the management of forest resources. Its responsibility has been traditionally limited to the management of forest resources on State lands and through the Forestry Act of 1999 a system of permits for the felling of certain species of trees and any trees on slopes over 30 degrees has been established. The Division's control on private forest is however limited.
- The WASA has responsibility for the development and maintenance of waterworks and sewerage facilities, the promotion and proper use of water and for the administration of the Water and Sewage Act of 1980 and sections of the Waterworks and Water Conservation Act (1980 Revision).
- The WRA, which currently forms part of the WASA, has responsibility for surveying, monitoring, research and development, water demand analysis, planning and allocations of water resources and the issuing of abstraction licenses.
- Municipal Corporations have responsibility for administration of the Regional Corporation Act of 1995 and sections of the Public Health Ordinance of 1950, and the execution of local infrastructural works, the disposal of municipal waste (solid and sewage) and the inspection of properties for health nuisances within their municipality.
- THA has responsibility for local governance in the island of Tobago. Its structure somewhat mirrors that of Central Government Ministries and so there are several divisions with responsibilities corresponding to their central government counterpart ministry. THA holds responsibility for certain aspects of environmental management and regulation, forest resources management, land development control, mining of quarrying materials and the collection and disposal of solid and sewage waste on the island of Tobago.

- The LSA has responsibility for implementing the State Lands (Regularisation of Tenure) Act of 1998 and administering the process of regularising the status of squatters residing on State lands prior to January 1998 and redeveloping their communities.
- The Drainage Division of the Ministry of Works and Transport has responsibility for planning, design, construction and maintenance of drainage, flood control measures, coastal protection works and irrigation interventions.
- The MEEI has responsibility for developing the energy and energy related industries and for monitoring, controlling and regulating the mining of the country's minerals – oil and gas, quarry materials and asphalt by both private sector and state agencies.
- SWMCOL has responsibility for managing the collection, handling, treatment and disposal of solid waste and for managing the country's three main landfills in Trinidad – Beetham Landfill, Guanapo Landfill and Forres Park Landfill.
- The MALMR has responsibility for agricultural planning and management, soil testing and research.
- The Land Administration Division (LAD) of the MALMR has responsibility for the administration and distribution of state-owned agricultural lands. The Division facilitates the leasing process and monitors fulfilment of lease conditions.
- Land and Surveys Division (LSD) has responsibilities for arranging surveys, verifying and approving surveys and ensuring valuations are carried out and executing leases of State lands. The Commissioner of State Lands, is the designated landlord of State lands.
- The IMA has responsibilities for the collection, analysis and dissemination of data relating to the economic, technological, environmental, social and legal developments in marine affairs, generally, and the formulation and implementation of specific programmes/projects to achieve this objective.

Figure 19 shows the relationship among the agencies with responsibilities for land use and management.

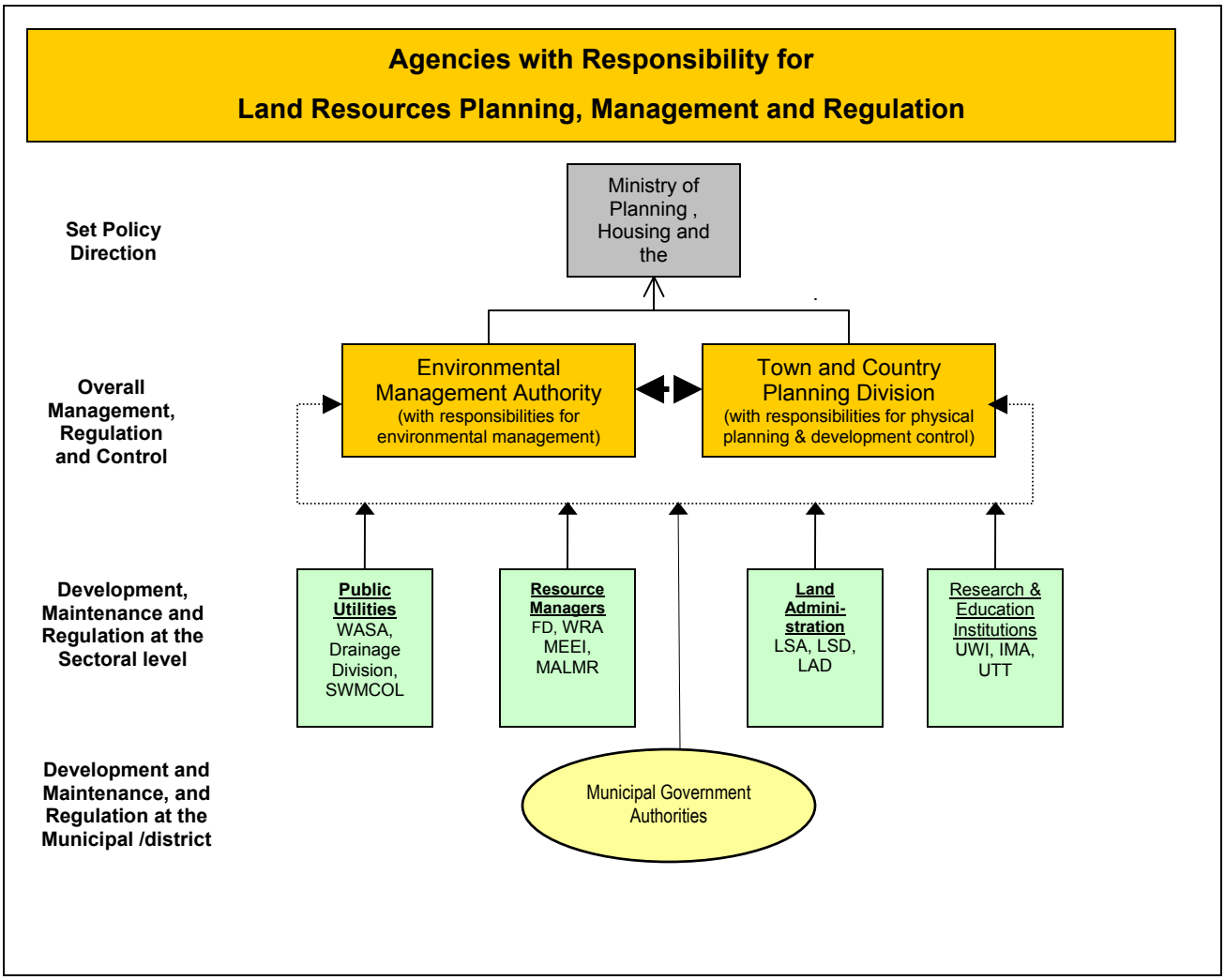

Figure 19: Existing Relationship among Agencies with Responsibility for Land Resources Planning, Management and Regulation

4.1.2 NGO and Community Sector

Over the years, the NGO and community sector has emerged as significant elements in championing, promoting and fostering sound environmental management at the local, national and regional levels. In more recent times, this trend has resulted in the formation of partnerships between the Government and NGOs/CBOs to address environmental issues of mutual concern, and in the implementation of natural resources co-management projects geared at environmental enhancement or remediation of degraded forest lands.

Already the Government and the sector are working in partnership with respect to the implementation of the UNCCD and have collaborated in undertaking the commitments of Trinidad and Tobago to the Convention.

In this regard, the NGO and community sector undertake many key functions as key stakeholders in the management of land resources. These functions include the following:

- Contribution to national development by addressing direct and indirect issues relating to land resources management;
- Involvement in community development, thus providing vital services, such as education, services about environmental and natural resource management, undertaking preventive and remedial programmes (forest rehabilitation and management programmes);
- Involvement on development steering committees both at the district and national levels;
- Formation of partnerships with State and private sector agencies in carrying environmental programmes and projects;
- In the areas of advocacy and acting as pressure groups in land resources issues, including reminding governments of past agreements and treaties;
- Advising and the provision of independent advice/feedback to State agencies and the private sector about environmental and related social issues;
- Co-ordination of the efforts of groups through umbrella organisations;
- Mobilisation of volunteers, advisors and people to undertake environmental management activities;
- Protecting the natural and physical environment and preserving cultural heritage given their intimate knowledge of grassroots issues and realities;
- Provision of a counterbalance to competitive and consumerism values with values that are traditional, people centred and co-operative; and
- Forming part of the repository of local and traditional knowledge for land resources management.

This sector is diverse and includes NGOs, not-for-profit organisations, and CBOs, some of which are informal in nature and may only act once an issue affect or threaten their livelihoods. However, there are those who are continuously engaged in 'quiet work' with little recognition or external assistance.

While some strictly operate in environmental sector, there are those whose main roles and functions are social in nature but who undertake environmental management activities as part of their programme of activities. The number of organisations and groups in the sector are large and their impact varied. A recent survey of agricultural organisations in Trinidad and Tobago revealed that there are over 100 of them in the country[65]. Figure 20 shows the composition of the NGO and community sector in Trinidad and Tobago.

[65] Based on the Regional CaFANN survey of Agricultural Organisations conducted by the Caribbean Agricultural Research and Development Institute (CARDI) in 2004.

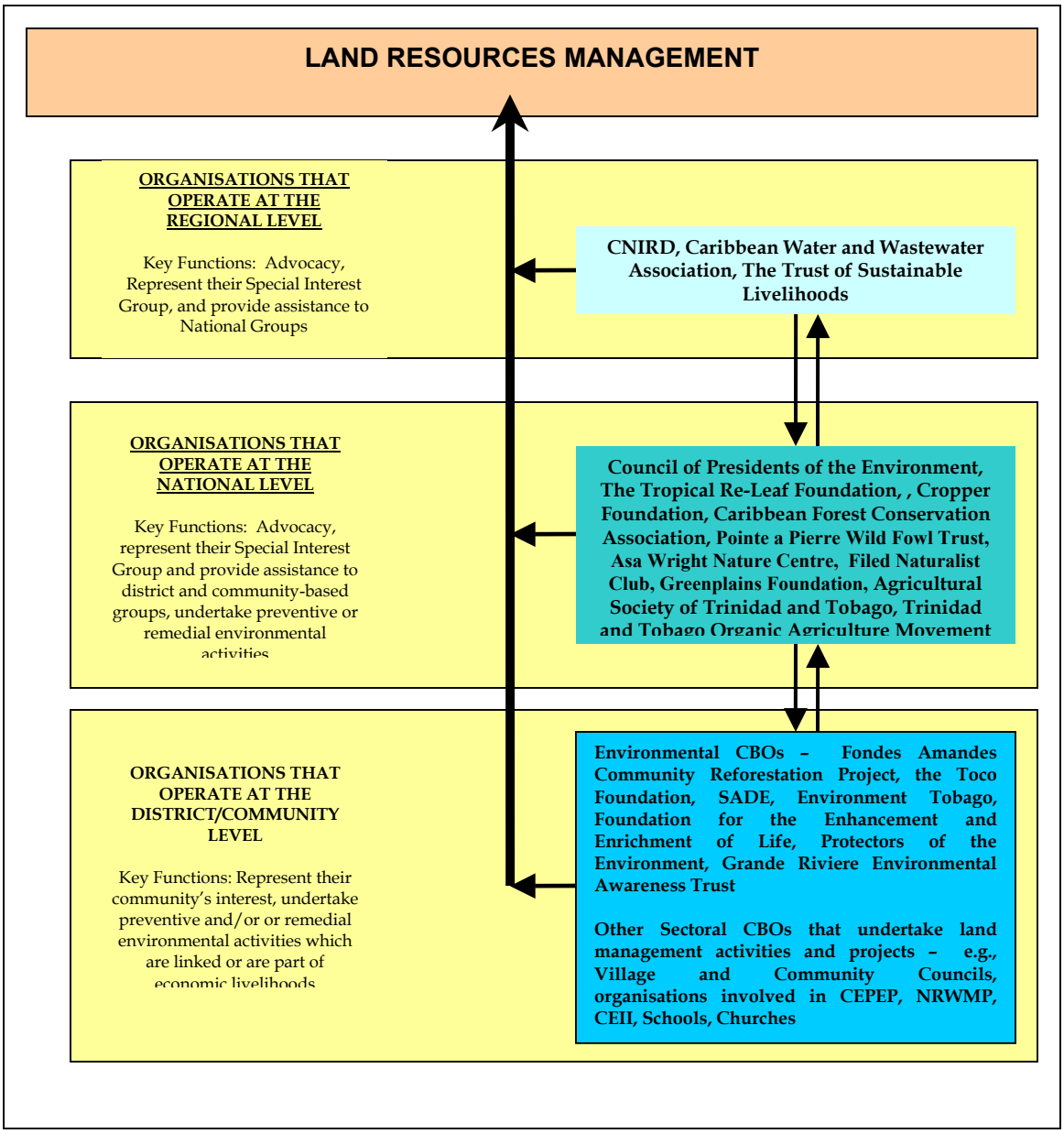

Figure 20: Composition of the NGO and Community Sector in Trinidad and Tobago as It Relates to Land Resources Management

4.1.2.1 Local RIOD

Like its international counterpart, the Local Chapter of the RIOD was established in Trinidad and Tobago to promote and enhance the participation of civil society at all levels of the implementation of the UNCCD and more specifically in the implementation of the NAP.

Established in 2002, so far the Trinidad and Tobago RIOD consists of seven members[66]. As the RIOD Caribbean NGO Focal Point for the UNCCD, the CNIRD plays a critical role in raising awareness of the Convention and the issues of land management and degradation in Trinidad and Tobago and the Caribbean and has actively partnered with the GORTT in the development of the NAP. However, the local Network remains in its infancy stage and must be strengthened if it is to play the vital role in bringing about a change in land practices in Trinidad and Tobago.

4.2 Existing Legislation and Policies

At present, Trinidad and Tobago does not have any legislation or policy framework which directly addresses the implementation of the UNCCD. However, there are a number of legislation, policies, plans and programmes which directly and indirectly combat land degradation and promote sustainable land management, and which are, therefore compatible with the aims and objectives of the UNCCD. The most significant of legislation and policies are noted in the Table 31 below.

Table 31: Legislation and Policies Relevant to Land Use and Management

Area of Land Management	Legislation/ Policies	Title	Summary
Land Use Planning and Development	Legislation:	The Constitution	Ensure the right of individuals to the enjoyment of private property.
		Town and Country Planning Act (Chapt 35:01 of 1969)	Control and regulation of land development in Trinidad and Tobago and provides a basis for structured land development and land use.
		Tobago House of Assembly (Act 40 of 1996)	Provided the THA with the responsibility for formulation and implementation of policies for the development of Tobago.
		Municipal Corporations Act (Act 21 of 1990)	Provisions for regional planning and physical development and provides the foundation for devolution of authority to the municipal authorities. Sets responsibilities for certain aspects of public health and infrastructure within their boundary.

[66] Environment Tobago, Caribbean Forest Conservation Association, Protectors of the Environment, The Biodynamic Association of Trinidad and Tobago, The Tropical Re-Leaf Foundation, Greenplains Foundation, Trinidad and Tobago Field Naturalists Club, and CNIRD.

Area of Land Management	Legislation/ Policies	Title	Summary
	Policy:	National Physical Development Plan of Trinidad and Tobago (1984)	Outlines how all lands in Trinidad and Tobago are to be used.
Environmental Management	Legislation:	Environmental Management Act (Act 3 of 2000)	Development and implementation of policies and programmes for the effective management and wise use of the environment; provisions for the co-ordination of environmental management among State agencies; provision of a regulatory regime for environmental management; establishment and operations of the Environmental Commission; granting and issuing of CECs; definition of responsibility of the EMA.
		Environmentally Sensitive Area Rules (2001)	Designation of environmentally sensitive areas and provision of guidelines for use and management of designated area.
		Certificate of Environmental Clearance (2001)	Outlines the activities, procedure and conditions for application of certificates of environmental clearance.
	Policy:	National Environmental Policy (2006)	Provision of policy direction for the conservation and wise use of the environment through providing actions for the protection of national resources, addressing pollution hazardous and toxic substances and the assessments of impacts, public information and environmental education.
Forest management	Legislation:	Forestry Act (Chapt. 66:01 1980)	Provisions for regulation of the removal of timber and other forest products and definition of the responsibilities of Forestry Division.
	Policy:	Forest Policy of Trinidad and Tobago (1942)	Provision of policy direction for the management of the country's forest resources.
		Draft Strategic Plan of the Forestry Division	Provision of strategies and measures for the operation of the Forestry Division and management of the country's forest resources.

Area of Land Management	Legislation/ Policies	Title	Summary
Water Resources Management	Legislation:	Waterworks and Water Conservation Act 1980 (Chapt. 54:41)	Provision for the control of natural water courses and outfalls, and for the removal of natural vegetation; and responsibilities of WASA.
		Water and Sewerage Act (Chapt. 54:40)	Provision for the establishment of the Water and Sewerage Authority (WASA) which is responsible for public waterworks and water supply and public sewerage systems.
	Policy:	Water Resources Management Policy (2003)	Provision of policy direction for management of the country's water resources including the development of the legislative and institutional framework for management of water resources.
Coastal Zone Management (Wetlands)	Policy	National Policy on Wetland Conservation for Trinidad and Tobago (2002)	Provision of a framework through which the wise use of the country's wetlands can be achieved.
Administration of State Lands	Legislation:	Land Adjudication Act (Act 14, 2000) Land Tribunal Act (Act 15, 2000) Registration of Titles to Land Act (Act 16, 2000)	Provision of a package of legislation which envisages a nation-wide systematic adjudication process whereby the legal interests in every parcel of land in the country will be determined and registered in a new, more efficient 'real property' registry; creation of a new court for land matters.
Mineral Mining or Quarrying	Legislation:	Minerals Act (Act 61 of 2000)	Provision for the licensing system for the extraction of minerals and setting of conditions for mining/quarrying operations.
		Petroleum Act (Chapt 62:01, Act 46 of 1969)	Provision of licensing system and establishment of conditions for the mining of oil and gas.
	Policy:	Draft Quarries Policy (2005)	Setting policy direction for management of the quarry industry including the establishment of new legislative and institutional framework for regulating the industry.
Management of Agricultural Lands	Legislation:	Pesticides and Toxic Chemicals Act (Act 42 of 1979)	Definition of the responsibilities of the Pesticides and Toxic Chemicals Control Board.
		Agricultural Fires Act (Chapt 63:02, Act 20 of 1965)	Provision of mechanisms and conditions for the regulation of the agricultural fire season; provision for fire permits and penalties for infringements.
	Policy:	Sector Policy for Food Production and Marine Resources 2001-2005	Provision of policy direction for food production.

Area of Land Management	Legislation/ Policies	Title	Summary
Solid and Hazardous Waste Management	Legislation:	Public Health Ordinance (Chapt 12 No. 4)	Empowerment of local authorities to inspect public and private properties, their districts for public health nuisances. Provisions for dealings with the pollution of water supply and the throwing of offensive matter into waterways.
		Litter Act (No 27 of 1973)	Provisions against the indiscriminate disposal of refuse and garbage in public places and for the appointment of litter wardens.
Management and Control of Squatting		State Lands (Regularisation of Tenure) Act (Act 25 of 1998)	Provisions which protect certain squatters from eviction from State lands, support the regularisation of tenure of the informal occupation of State land and provide for the establishment of land settlement areas.

4.3 Commitment to and Synergy with Other International Conventions

Trinidad and Tobago is also committed to a number of multi-lateral environmental agreements which are of relevance in combating land degradation at the national level and international level. These are outlined in Table 32 below.

Table 32: Relevant International Conventions

Convention	Year Signed and Ratified	National Focal Point	Synergy with the UNCCD
United Nations Convention on Biological Diversity	Signed: 1992 Ratified: 1996	MPHE	Land degradation can lead to habitat destruction and reduced biodiversity. Many actions and projects geared at improving biological diversity in fact supports wise use and management of the land resource base.
United Nations Framework Convention on Climate Change (UNFCCC)	Signed: 1992 Ratified: 1994	MPHE	Sea level rise will affect coastal areas. Climate change and changing weather patterns makes more areas vulnerable to land degradation. These Conventions support each other through the development and implementation of initiatives geared at changing agricultural management practices, preservation and proper management of forests, waste reduction, and the sustainable management and protection of coastal land resources.

Convention	Year Signed and Ratified	National Focal Point	Synergy with the UNCCD
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)	Signed: 1983 Accession: 1992	Wildlife Section of the Forestry Division	Wetlands are important land resources which over the years have experienced increasing pressure and degradation for human activities. The Conventions calls for the establishment of management system for the declared Ramsar site. Nariva Swamp was first declared a Ramsar site, followed by Caroni Swamp and Buccoo Reef.
Basel Convention	Signed: 1994	MPHE	The main aim of the Convention is *to protect human health and the environment by minimizing hazardous waste production whenever possible*. This Convention calls for an "integrated life-cycle approach", which involves strong controls from the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. Any proposed actions to be undertaken as part of this Convention is expected to reduce pollution due to hazardous waste and reduce land degradation in Trinidad and Tobago.

4.4 Programmes Compatible with the NAP

There are several current programmes which are compatible with the objectives of the UNCCD and which could form important elements of the implementation of the Convention. The more important ones include:

4.4.1 National Reforestation and Watershed Rehabilitation Programme

The National Reforestation and Watershed Rehabilitation Programme (NRWRP) was initiated in September 2003 and is expected to rehabilitate over 33,000 acres of degradation lands over a 10-year period. An important feature of this programme is the involvement of NGOs and CBOs in the co-management and protection of forest resources in degraded areas near and around their communities. To date, there are 51 community groups from various communities throughout Trinidad and Tobago involved in the rehabilitation efforts. The groups are expected to replant 50 acres in the wet season and protect this area in the dry season. So far, 1,000 hectares have been replanted.

Involving local communities and the adoption of a business (income generation) approach in the reforestation/rehabilitation programme are deemed as key components and includes strengthening the capacity of the communities to take action. Therefore, partnering with the community residents and engaging local contractors and labour

must be considered as critical success factors. This programme represents a pilot for the conduct of extensive natural resources co-management programme and therefore careful monitoring, evaluation and documentation of the processes involved in the programme are key elements of this initiative. At present, the programme NRWRP tends to focus on technical aspects of forest rehabilitation. However, greater attention needs to be paid to the socio-economic aspects of the programme to ensure viability, acceptance and sustainability. Lessons of past community-based forest rehabilitation efforts also must be taken on board to ensure success.

4.4.2 Community Environmental Protection and Enhancement Project

Community-based Environmental Protection Enhancement Programme (CEPEP), operated by SWMCOL, seeks to enhance the overall environment of Trinidad and Tobago, while serving as an incubator training project for small entrepreneurs and providing employment for the unskilled and semi-skilled persons. The Programme gives each community the active responsibility for its individual area. The concept of CEPEP attempts to stimulate a culture within these communities in which persons could utilise its natural recourses effectively, and be imbued as a whole with a sense of sustainable environmental management. Established in 2002, the Programme selected individuals and groups, based on their potential to become successful entrepreneurs, and assisted them, where necessary, to become registered companies. There are some 110 small and medium size contracting companies and over 5,000 workers under the Programme. The contracting companies are mandated to use labour from their respective districts, and were provided with soft loans and start up equipment with the expectation that they would eventually graduate into clients of the Small and Micro Enterprise Development Company Limited of Trinidad and Tobago.

4.4.3 Green Fund

The Green Fund, established in 2000, to '*encourage communities and organisations to undertake remediation, reforestation and beautification projects*'. The mechanism for the management of this fund is yet to be operationalised and no grants have been made under the programme. The Fund, which is supported by the compulsory contribution from business enterprises, could be an important source of funding for future community-based initiatives.

4.5 Emerging Institutional Issues

The public consultations highlighted the following legislative and institutional issues:

1. ***Rationalisation, harmonisation and modernisation of the legislative and policy framework*** for dealing with all aspects of land management in Trinidad and Tobago.
    a. The need for a more comprehensive and robust legislative and policy package to deal with the management of public health, quarry resources, solid waste, hazardous waste, medical waste, wastewater, watersheds,

water resources, soils, coastal zones and to address more 'soft' (social-related) issues, such as co-management of State-owned natural resources, partnering between the NGO and community sector and the State, and the institutionalisation of public participation in the development planning process.

b. Update and revisions are required to existing legislation to address the needs of a modern society and these include revisions to:

   i. Forests Act;

   ii. Conservation of Wildlife Act;

   iii. Sawmills Act;

   iv. Agricultural Fires Act;

   v. Pesticide and Toxic Chemical Control Act;

   vi. Town and Country Planning Act;

   vii. Tobago House of Assembly Act; and

   viii. Municipal Corporations Act.

c. There is a need for ***updating the Town and Country Planning Act and Municipal Corporations Act and the THA Act*** to include modern principles of land use and development giving due attention to the roles and responsibilities of the TCPD and the municipal authorities (which include the THA, Borough and City Corporations and the Regional Corporations). This also includes provisions for standards, guidelines and a code for various built development and for the establishment of an appropriate system of monitoring and enforcement, both at the national and municipal levels.

d. There is ***a need to speed up the current process of modernisation of the country's administration process***. The administration of land is currently being improved through a number of the initiatives including the enactment of Registration of Titles to Land, Land Adjudication and Land Tribunal Acts of 2000 and the development of appropriate institutional support. Provision of the supporting environment must be put in place in order for these laws to be implemented.

e. The ***lack of proper legal arrangements and other shortcomings in the administration of the quarry/mining industry*** become more obvious each year as illegal quarrying occurs unabated and in the wake of continued adverse environmental challenges and impacts. While the MEEI has major responsibilities for management and regulation of the industry and the enforcement of lease terms and legislation, some of its functions overlap with those of the Commissioner of State Lands, MPHE, EMA, TCPD, Forestry Division and municipal authorities. At present, the MEEI is actively pursuing legislative, institutional, administrative and fiscal

reform to address current inadequacies. However, greater collaboration is needed among critical agencies with overlapping responsibilities.

The Draft Quarry Policy of 2005 recognised some of the shortcomings of the Minerals Act of 2000 which currently governs the operations of the quarry industry. These include:

i. Absence of regulations for granting quarry licences;
ii. Ambiguity with respect to the procedures for assigning and terminating licences;
iii. Conflicts with existing legislative provisions, for example, the EMA Act;
iv. Ineffective and deficient regulatory control;
v. Inappropriate legislative mechanisms and institutional weaknesses;
vi. Absence of enforcement measures;
vii. Bias in the legislation which favours large scale entrepreneurs; and
viii. Lack of redress for investor complaints.

2. The ***need for greater collaboration among partners in land use planning and Management – there needs to be formal mechanisms of collaboration*** to ensure effective collaboration among the various stakeholder organisations/institutions; firstly among State agencies and secondly between State agencies and non-governmental bodies (the NGO and community sector and the private sector). Greater inter-governmental collaboration is required to address the containment of squatting, illegal quarrying and pollution control and in the areas of watershed and water resource management.

3. Over the years the ***Government has compromised their position as a model for good environmental stewardship and management*** by neglecting to follow the environmental and planning laws of the country. It would be important at this stage for the Government to demonstrate its commitment to sound environmental management.

4. ***Co-management of land resources*** affords Government the opportunity to improve the current management of some of the country's important of land resources. CEPEP and NRWRP can provide valuable lessons for the establishment of future projects and should be periodically evaluated and documented. However, there are other excellent examples of community-based projects from which lessons can be learnt to strengthen these large scale 'pilot' programmes. It would also be important to focus on the targeted communities and draw out the involvement of residents in informal activities to monitor changes in patterns of behaviour.

5. ***Inadequate monitoring and enforcement of existing laws and regulations*** retards proper land management and are considered to be among the primary underlying causes of land degradation. The issue of monitoring and enforcement must include both the revision of existing regulations to include stricter penalties and to clear up ambiguities and loopholes and preparation of regulations for existing laws (Pesticide and Toxic Chemical Control Act).

6. There are in fact ***many cultural and social aspects to land management and securing meaningful people's participation*** in the process and this becomes critical if lasting changes are to be made. There are mutual benefits to be derived and lessons learnt when the State and the non-governmental bodies work together to address societal issues. Therefore ensuring mechanism for involvement of people in the development process must be considered as a priority if the country is to address its land degradation issues.

7. People's attitudes, norms and patterns of behaviour towards the environment is reflected in the way they utilise and manage their natural resources. ***Land degradation reflects the poor choices and decisions the people of Trinidad and Tobago have made*** over the years. Changing traditions, the popular culture and modern lifestyles have brought unsustainable uses of natural resources; deforestation and pollution arising from an attitude that nature can absorb all that the population can give. The social requirements for protecting a delicate environment and ecosystem remain a major challenge in Trinidad and Tobago. Changing the way the population values its land resources and changing negative behaviours are critical requirements for reversing current land degradation trends.

8. ***Research and development in the area of land management remains disconnected from the needs of the country*** and must be coordinated and revised based on the problems of land degradation.

9. Many ***NGOs and CBOs lack the institutional capacity to be equal partners in development process with the Government and private sector***. There is need to strengthen the capacity of the NGO and community sector so that they could true partners in this process of combating land degradation.

10. Most State agencies lack the resources to make them good managers of the country's land resources. This includes the lack of technical personnel and equipment and inadequate organisational structures and mechanism, all of which contribute at times to low morale and poor work ethics.

11. Initiatives such as competitions, school and community-based environmental projects, etc. are not recognised as avenues for behavioural change and, therefore, not given the kind of support where they would make major differences in people's response to the environment and environmental issues, particular in urban and suburban centres where the problem of land degradation is perhaps more acute.

Chapter 5

Conclusion

It is widely recognised that land degradation is caused by complex interactions of physical, chemical, biological, social, political and cultural factors. Most of the land degradation issues witnessed in Trinidad and Tobago are human induced. Tackling these challenges requires a mix of solutions which targets both the underlying and direct causes of land degradation. Indeed, even some of the underlying causes themselves require a fuller analysis to more properly determine the sources of some historic inaction on the part of the State and their current consequences. However, if the links between the causes and severity of land degradation and their ecological and socio-economic impacts are to be properly established, this complex phenomenon that is land degradation will need to be assessed and quantified in a scientific manner.

Land degradation in Trinidad and Tobago lowers the actual and productive potential of land resources, reduces vegetative cover, and adversely affects soils, water quality and availability, biodiversity and coastal and marine environments. If left unchecked, land degradation can lead to irreversible loss of the land resources on which socio-economic development of the country depends. Based on this study, a number of priority areas can be identified for action. They are:

1. *Behavioural Change* – This involves a change in attitude and the choices people make when interacting with the land.
2. *Sustainable Management and Protection of Land Resources* – This involves the stabilisation and maintenance of forest cover, the reduction of land degradation and the introduction of programmes and actions to promote prudent use and conservation of land resources.
3. *Risk Reduction and Early Warning Systems* – Strengthening of existing early warning systems as an element for environmental risk management strategies at the national and community levels and to highlight their important relation to sustainable development.
4. *Institutional Development and Strengthening* – Strengthening the existing institutional capacity and the development of new structures to successfully implement the NAP.