Chapter 2. National circumstance

Second National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change

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I. Geographic and climate profile

Geographic situation and relief

Belize is a small independent country on the Caribbean coast of Central America, bordered on the north by Mexico and on the west and south by Guatemala (15° 53' to 18° 30'N Latitude; 87° 15' to 89° 15' W Longitude; Figure 1). The former British colony until 1981 (British Honduras) has a land area of 22,960 km^2 of which 95% is located on the mainland and 5% is distributed over more than 1,060 islands. Total national territory (including territorial sea) is 46,620 km^2. The country is well known as the home of the longest barrier reef in the Western Hemisphere. This 220 km reef stretches the entire coastline and is recognized by the United Nations as a World Heritage Site. The Government of Belize has also recognized the reef's uniqueness, protecting substantial portions in marine reserves.

Belize is physiographically very diverse because it lies at the boundary between two sharply contrasting geologies. Northern Belize is an extension of the Yucatan Platform, while southern Belize shares the mountainous geology of eastern Guatemala[1]. The Yucatan Platform consists of hard, dense limestone over red shale[2] that results in a topography consisting of low (approximately 250 masl), rolling limestone hills and escarpments. The escarpments are the result of north-northeast trending faults caused by the subsidence of the continental shelf toward the Yucatan Trough in the Caribbean Sea[3]. The dominant physiographic feature of the country is the Maya Mountains, which rise steeply from the coastal lowlands to a maximum elevation of 1124 masl. The Maya Mountains are a tectonically uplifted block of ancient metasedimentary, granite, and volcanic rocks[4] that occupy the south-central portion of the country, stretching west into Guatemala's Peten district. Surrounding the mountains are low karstic limestone hills that grade into an abbreviated coastal plain that meets with the Caribbean Sea.

Over 1060 mangrove cayes (small islands) and three atolls dot Belize's marine territory. Many of these are located along the barrier reef shelf, while the three atolls—the Turneffe Islands, Lighthouse Reef, and Glover's Reef—rest beyond the protective shelter of the barrier reef. Many of the cayes are uninhabitable, but those that are have often been settled or used by fishermen, or are developed for tourism. Many cayes and large sections of Belize's coastline stand at less than one meter above sea level, making these areas very vulnerable to storm surge from cyclones and rising sea levels.

Climate

Belize lies in the subtropical geographic belt and has a climate governed strongly seasonal variations in rainfall. Mean monthly temperatures range from 16° - 28° C in the winter months to 24° - 33° C in the summer[3] and humidity ranges between 40 and 99% throughout the year (mean = 80%; King et al. 1986). Distinct wet (June – Dec.) and dry (Jan. – May) seasons exist throughout the country and are most pronounced in the north. More than 80% of annual precipitation in southern Belize occurs during the wet season[5], and a strong precipitation gradient exists from north to south. Annual precipitation grades from approximately 1100 mm in northern Belize to 4000 mm in the deep south[6]. During the winter months (Nov. – Feb.) cold,

[1] Fairbridge 1975
[2] Viniegra 1971
[3] Hartshorn et al. 1984
[4] Bateson and Hall 1976
[5] Heyman and Kjerve 1999
[6] Walker 1973

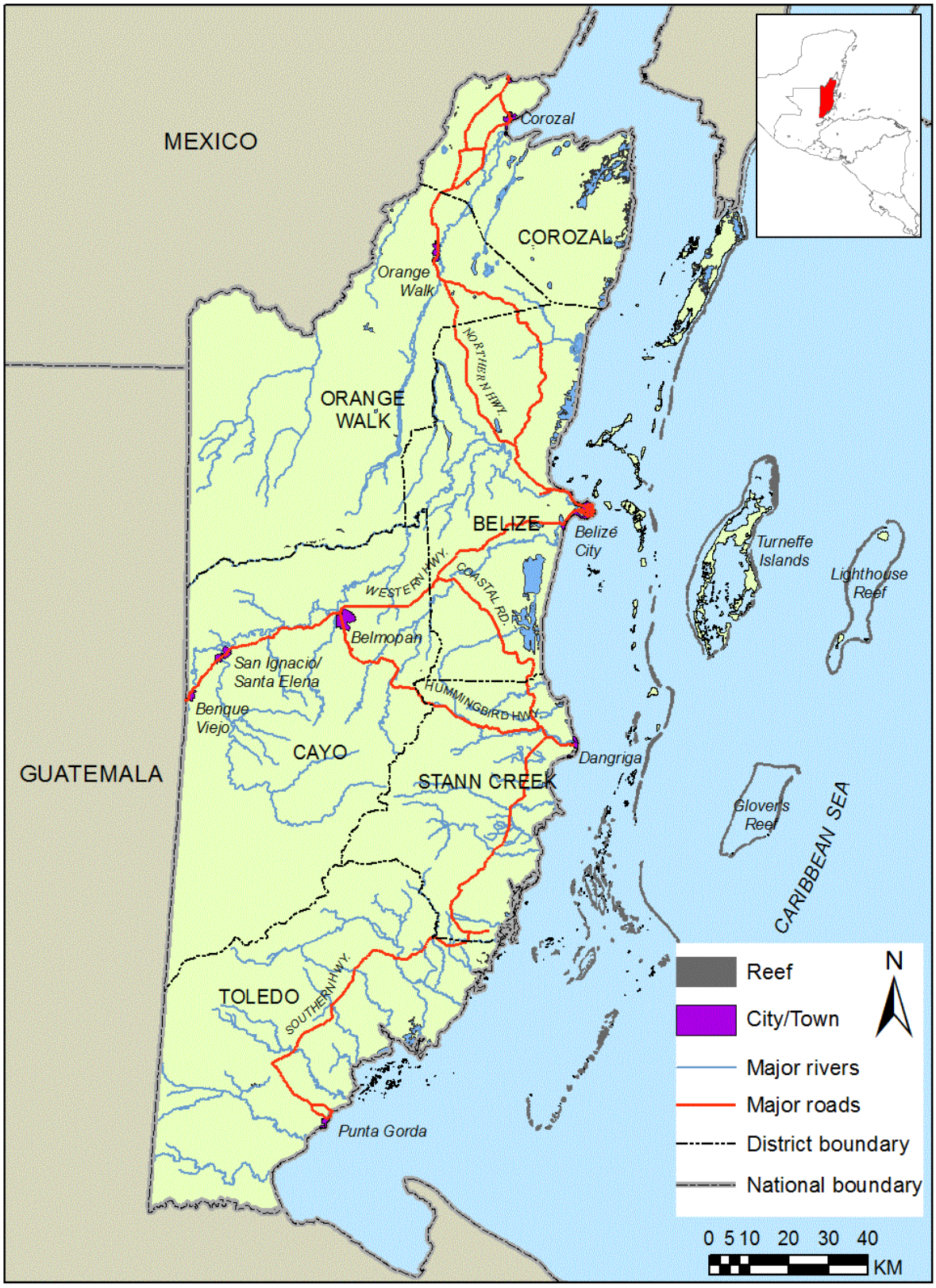

Figure 1. Locator map for Belize showing location in Central America (upper right), the six Districts, major highways, towns and cities, and rivers.

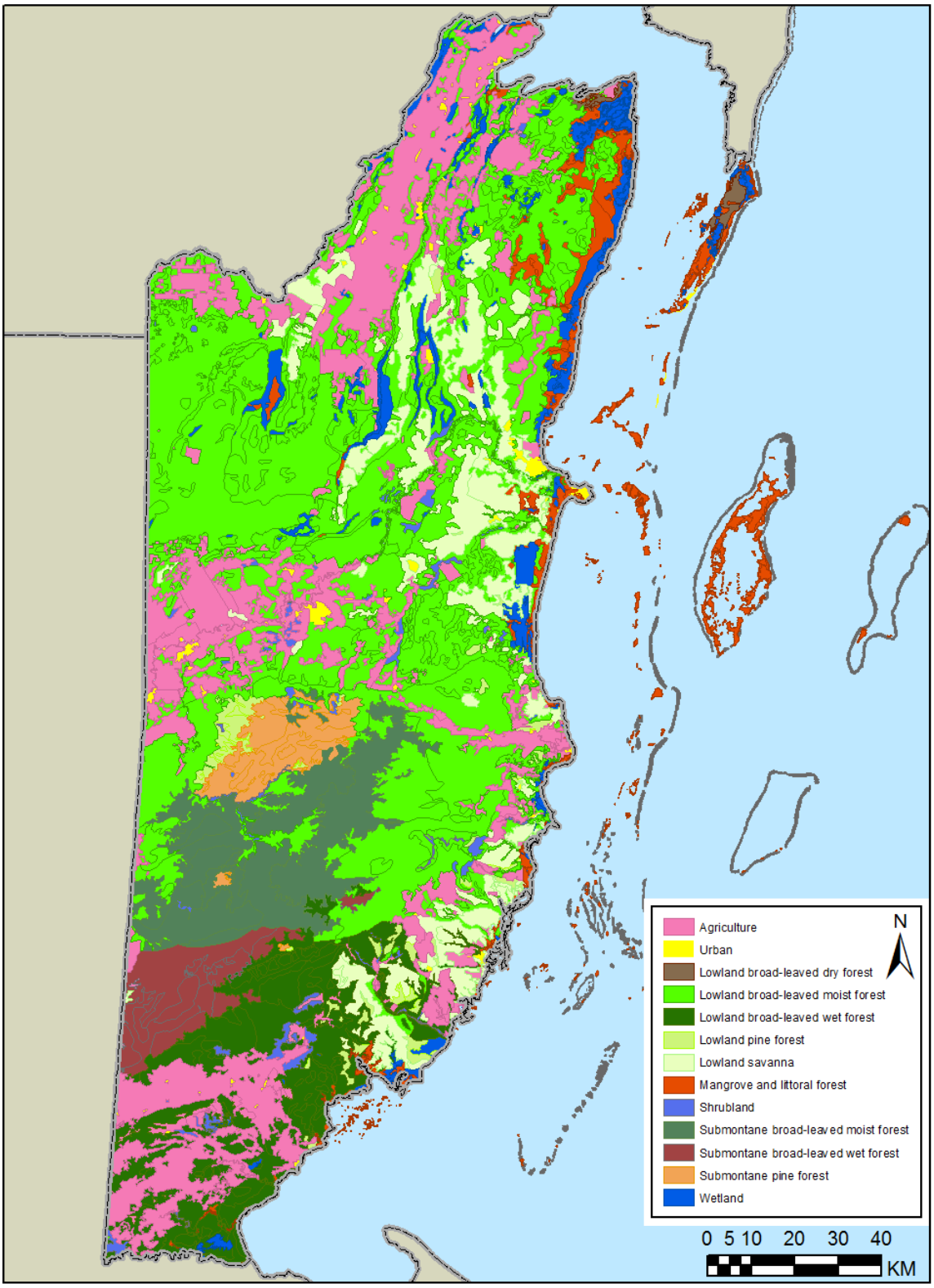

Figure 2. Major terrestrial ecosystem types of Belize (Meerman and Sabido 2004).

wet air masses, locally called “Northers”, occasionally descend from the north to cause heavy rains and choppy seas.

Belize has a long history of devastating encounters with cyclones (tropical depressions, tropical storms, or hurricanes), with major events recorded in 1931, 1955, 1961, 1971, 1974, 1978, 2000, 2001, and 2007[7]. Historically, tropical storms and hurricanes have affected the country once every three years, and, according to hurricane tracks available at from the US National Weather Service, are more likely to hit in the north than in the south[7]. Belize City, the former capital, was destroyed twice by hurricanes in the 20th century prompting the relocation of the capital to Belmopan City.

Hydrography

The abundance of rain in Belize and the low coastal topography has favored the formation of an important network of waterways and water bodies. These provide the national population with drinking water, building aggregate, destinations for recreation and tourism, fish and wildlife, and a place for daily domestic activities. There are 16 major watersheds and numerous smaller ones that deliver freshwater, sediment, and nutrients to the Caribbean Sea. Four of the 16 watersheds are shared with Guatemala, and one (Rio Hondo) has major portions draining both Guatemala and Mexico. Although the Rio Hondo watershed dwarfs the rest of Belize’s rivers in terms of catchment area (15,075.5 km^2), only 18% of this occurs in Belize. The Belize River (total area 9,434 km^2; 69% in Belize) occupies substantially more of Belize’s land mass and dominates the central portion of the country[8].

Northern Belize is characterized by wetlands that tend to occur in crustal slumps within the north-northeast trending fault zones that occur there, or within karstic depressions[9]. Topography of the northern coastal plain is relatively flat and most of the freshwater wetlands occur at or below five meters above sea level. Most of these systems are spring-fed and many are perennially waterlogged, with water fluctuations of about 1 m in conjunction with the seasons[10]. Many of the wetlands of northern Belize occur as expansive lagoon systems containing multiple habitat types (e.g., swamp forests, herbaceous marshes, and open water areas). The most notable among these is Crooked Tree Lagoon, a 165 km^2 wetland complex connected to the Belize River via two streams[11]. Other substantial wetlands include New River Lagoon, Progresso Lagoon, Cox Lagoon, and Pulltrouser Swamp. Several freshwater wetlands also occur in southern Belize. There, recent tectonic movement along fault lines has back-tilted the continental crust to form a number of swamps[12]—most notably the Sarstoon-Temash delta, and Aguacaliente Swamp, a 35 km^2 wetland surrounded by tropical wet broadleaf forest.

Ecosystems and land cover

Belize occurs in the Mesoamerican biodiversity hotspot, a region characterized by exceptional levels of endemism and high levels of habitat loss[13]. A great variety of terrestrial, marine, and freshwater ecosystems are represented in Belize (Figure 1; Table 1). Eighty-five terrestrial ecosystems[14], 15 marine ecosystems[15], and 43 different riverine ecosystems[16] have been

[7] NHC 2008
[8] Lee et al. 1995
[9] Pope and Dahlin 1989
[10] Seimens 1978
[11] Zisman 1996
[12] King et al. 1986
[13] CI 2007
[14] Meerman and Sabido 2001, 2004
[15] CZMI 1997
[16] Esselman et al. 2005

classified in the country. Lakes and lagoons are as yet unclassified. When the most recent nationwide ecosystem classification was done (2004), approximately 15,867 km^2 or 69% of Belize's land area was under some form of forest cover[14], though this number is certainly lower today. In the coastal zone, seagrass habitats are the most prevalent ecosystem, followed by deep water systems, sand- and silt-bottom habitats, and coral reefs[15] (Table 1). Despite the fact that coral reefs and their associated habitats only comprise about 6% of the coastal zone, they are disproportionately important for their high levels of biodiversity[17], and the tourism and fisheries economies that they support. Coral reef systems are also highly vulnerable to the consequences of global change from increased temperatures, damage from severe storm events, and ocean acidification from increased levels of dissolved CO_2[17]. Several severe coral bleaching events have been documented from Belize waters in the past decade as a result of temperature stresses to these ecosystems[18].

Table 1. Broad ecosystem classes for terrestrial[14] and marine[15] habitat types. Note that the marine figures do not take into account deep water pelagic figures beyond the Mesoamerican Barrier Reef.

Ecosystem class	%	km^2
Terrestrial		
Lowland broadleaf forest and shrubland	51.4	11,803
Agriculture, all subclasses	16.7	3,835
Submontane and montane broadleaf forest	10.0	2,296
Lowland savanna including pine savanna	8.8	2,021
Mangrove and littoral forest	4.2	964
Submontane pine forest	2.1	482
Water	2.1	482
Wetland	1.9	436
Lowland pine forest	1.4	321
Coastal savanna (marine salt marsh)	1.1	253
Urban	0.5	115
Marine		
Seagrass habitats	44.2	4152
Deep water	35.1	3294
Sand/silt with sparse algae	11.8	1105
Coral reefs and associated habitats	6.2	586
Unclassified	2.4	227
Shallow gorgonian beds	0.4	33

II. Population profile

Distribution of the population

In 2007, the population of Belize was estimated to be 311,480 persons[19] (Figure 3), up from 240,204 persons at the time of the last full census (2000)[20]. The population is growing at about 3.3% per year, a rate that, if sustained, would cause Belize to double its population in 21 years. However, population models predict slower growth to approximately 499,835 persons in 2050[21]. High growth rates can be attributed to elevated fertility rates (3.6 children/woman) and high

[17] Hughes et al. 2003
[18] McField 2001
[19] SIB 2007a
[20] CSO 2005
[21] SIB 2007b

levels of immigration. From 2000 to 2004, 8,829 individuals were granted citizenship or permanent residency in Belize, a number that accounts for approximately 27% of total growth during this period. The birth countries of the new citizens were mainly Guatemala (30%), El Salvador (19%), and China (16%)[20]. Despite the small but rapidly growing population, Belize still enjoys the lowest population density in Central America (~12.3 persons/km^2), with large areas of the country essentially uninhabited and existing in a wilderness state.

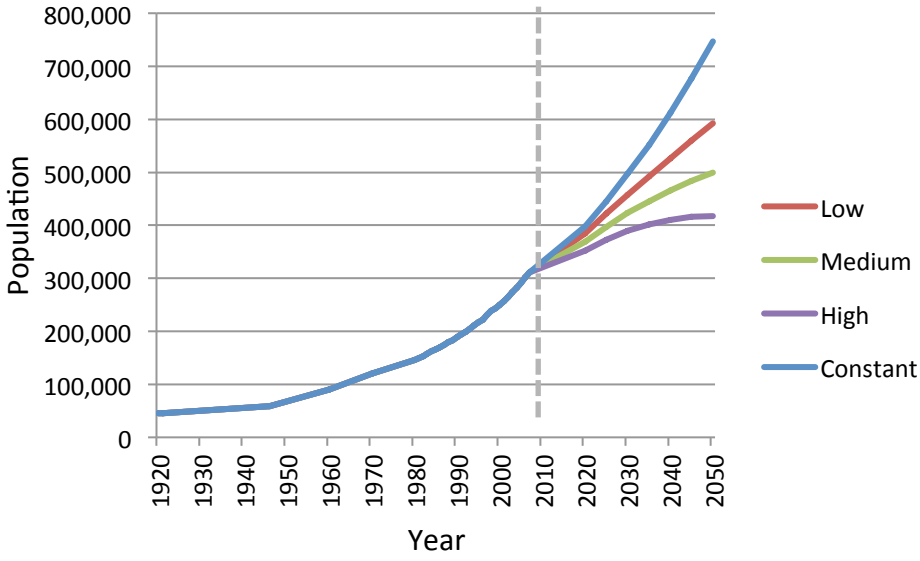

Figure 3. Belize population from 1920 to 2007 (vertical gray line), and predicted population from 2008-2050 under four different growth scenarios. Constant growth holds all demographic factors equal to today, and low, medium, and high scenarios, represent increasing deviation of crude birth and death rates from current values. The High scenario assumes that both crude birth and death rates decline relatively strongly in the future[19,21].

Belize is demographically young, with 39% of the population below the age of 15 years, and 4 % over 65. Fertility rates are high but falling—from 7 children/woman in the 1960s to 5 children/women in the mid-1980s to 3 children/woman in 2006. The infant mortality rate is still unacceptably high (19.6 per 1000 births in 2006) and varies across the country, reflecting disparities in living conditions and services. In 1992, infant mortality in the Toledo District was more than twice that of the nation. By 2006, the ratio had improved but still remained high (1.4 to 1)[22]. Belize has a falling death rate (7.8/1000 in 1969 to 4.7/1000 in 2005) and falling infant mortality rate (51.2/1000 in 1960 to 16.3/1000 in 2005). In 2005, life expectancy for males was 69 years and for females, 74 years[23].

For its size, the population of Belize is ethnically diverse, with the majority group being Mestizo (50.7% in 2006), followed by Creole (26.9%), Maya (8.9%), Garifuna (6.1%), East Indian (3.1%), Mennonite (1.9%), and small but growing percentages of Chinese, North American, and British immigrants (CSO 2005). The Mestizo majority is a relatively recent occurrence. During colonial days through 1991, Creoles were the ethnic majority, a shift driven by the recent influx of Central American immigrants.

[22] MoH 2007
[23] World Bank 2008

Though English is the official language of Belize, the primary language of its citizens varies geographically by ethnic group. In the north (Corozal and Orange Walk Districts) and west (Cayo District), it is predominantly Mestizo and Spanish speaking, with some Yucatec Maya. In the Belize District, it is English-speaking Creole. All four of these districts have Mennonite communities, which form a distinct German-speaking cultural element. In the south, the population in the Stann Creek District is split evenly between Garifuna, who speak their own language, and Spanish-speaking Mestizo, while 65% of the inhabitants of the Toledo District are Maya and speak either Kekchi or Mopan mayan[20].

The Belize population is statistically split almost equally between urban and rural dwellers, with more urban dwellers in the two most populous districts (Belize and Cayo), and an abundance of rural dwellers in all of the remaining districts (Figure 4). The largest urban center is Belize City, a low lying coastal city with a population of about 60,000 people. A number of other large population centers (San Pedro, Corozal, Dangriga, and Punta Gorda) and many villages are also located on the coast, making approximately 40% of the population highly vulnerable to hurricanes and rises in sea level[20].

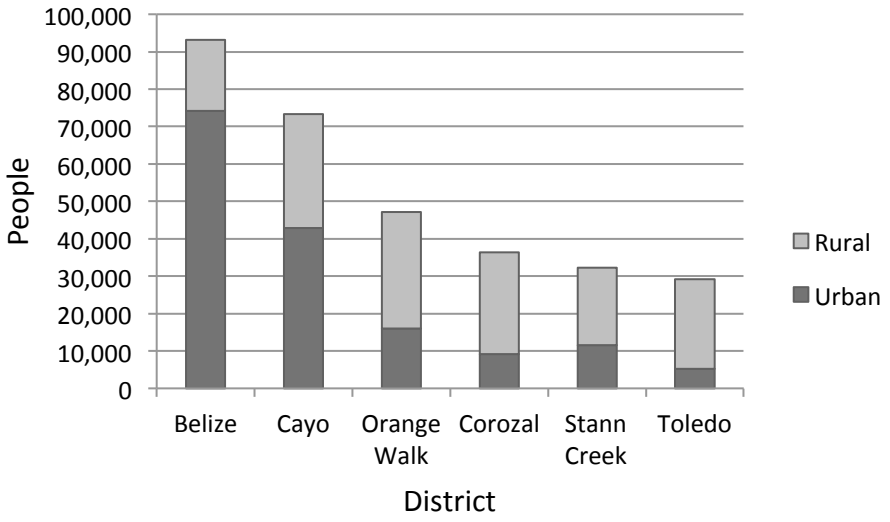

Figure 4. Total population of rural and urban dwellers in the 6 districts of Belize in 2007. The Belize District, where Belize City is located, is by far the most urban, whereas the Toledo District in deep southern Belize has the most rural population[19].

In 2007, the labor force (i.e. those in, available for, or seeking employment) stood at 122,439 people or 39% of the population—64% of them male[24]. The total unemployment rate was 12%, and mean income (in 2005) was US$385 per month[20]. On a national basis, 33.5% of the population is poor and 10.8% is extremely poor or indigent (i.e. their level of income was not high enough to enable them to satisfy their basic food requirements). Poverty rates are highest in the Toledo district, where 79% of the population is poor, and lowest in the Belize District (24.8%). The rate of poverty in Orange Walk and Stann Creek are slightly above the national rate, and the Corozal and Cayo districts join Belize as the districts with the lowest poverty levels[25].

[24] SIB 2007d
[25] NHDAC 2004

Belize has a good health care network, high levels of child immunization, and clean water, but is also experiencing a rise in infectious diseases. The Belizean population is served by seven government hospitals, four private hospitals, and a network of 40 health centers and 44 rural health posts. In addition, mobile clinics move from village to village and account for about 40% of primary health care. In 2004, there was 98.8% coverage of adequate and safe potable water supplies in urban areas, falling to 95.4% in the countryside[22], but only 50% of the population had improved sanitation facilities (23% of rural homes were on septic systems), and 44% were using pit latrines[20] (2000 statistics).

Infectious diseases are a public health concern in Belize. Malaria had been thought to be controlled but increased dramatically during the 1990s, peaking at 10,311 cases in 1994. Since this time malaria control measures have reduced the incidence of the disease to just over 1,000 cases per year from 2000-2004[20] and down to 844 in 2006[25]. There have been no cases of Cholera reported in the 21st century, but dengue is considered a threat during the rainy season, and sporadic outbreaks of diarrhea are also a problem. Belize has one of the highest HIV rates in the Caribbean and Latin America at 3.3%[20]. The highest prevalence is found in Belize City, followed by Dangriga. Belize has reported almost 4,000 HIV and AIDS cases since the first case was detected in 1986, and the epidemic continues to rise with around 450 new cases of HIV/AIDS reported every year[26]. Recent information from the Ministry of Health indicates that a large number of women are contracting HIV, and national authorities believe that the epidemic may be understated because of social stigma against getting tested[26].

III. Institutional structure

State structure

Belize is a sovereign state governed under the principles of parliamentary democracy based on the Westminster model. The 1981 constitution provides for a Governor-General who must be a citizen of Belize, but who is appointed by the Queen of England to be her representative. Joining the Governor-General, the executive branch of the government is formed by the Prime Minister and Cabinet, which is drawn from the National Assembly. The National Assembly forms a bicameral legislature comprising a 31-member elected House of Representatives and a 12-member appointed Senate. The judiciary is comprised of a Supreme Court and Court of Appeals, both located in Belize, and a Privy Council which consists of members of the British House of Lords[27]. As a signatory to the Treaty of Chaguaramas, which established the Caribbean Community Single Market and Economy (CSME), Belize also recognizes the authority of the Caribbean Court of Justice to interpret and apply the treaty relevant to trade relations[28].

There are six administrative districts (Corozal, Orange Walk, Belize, Cayo, Stann Creek, and Toledo, Figure 1), and a number of towns and villages. The administrative affairs of these communities are conducted by a combination of city, town and village councils. Belize City has a nine-member elected council, whereas Belmopan City and the town and village councils have seven-member elected councils.

[26] UNAIDS/WHO 2006
[27] GoB 2006
[28] CCJ 2003

The country is a member of the United Nations, the Commonwealth of Nations, the Organization of American States, the Non-Aligned Movement, the Caribbean Community, the Association of Caribbean States, and the Central American Integration System.

Climate related institutions

The National Meteorological Service is the principal advisor and negotiator for the government on climate change matters. The Chief Meteorologist is the Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC), which was ratified by Belize in 1994. Belize became a signatory to the Kyoto Protocol in 2003, and since this time has established a designated national authority to certify Clean Development Mechanism (CDM) projects, and is in the process of creating national regulations. Toward this end, a National CDM Committee has been assembled with technical experts from six Ministries, civil society, and the Belize Trade and Investment Development Organization (Beltraide)[29]. A delegation from Belize attended the December 2007 UN Climate Change Conference in Bali.

The Belize Forest Department is the agency responsible for management and protection of areas designated as Forest Reserves and Protected Areas. This agency is an essential partner to any implementation of forestry projects related to Clean Development Mechanisms, or their equivalent in the 'post-Kyoto' era.

The Caribbean Community Climate Change Centre (CCCCC) coordinates the Caribbean region's response to climate change from its headquarters in Belmopan City. The CCCCC officially opened in August 2005 as a node for information on climate change issues and on the region's response to managing and adapting to climate change. In this role, the Centre is recognized by the UNFCCC, the United Nations Environment Programme (UNEP), and other international agencies as the focal point for climate change issues in the Caribbean[30].

IV. Education and research

Education

All children between the ages of six and fourteen years receive compulsory basic education in Belize[31]. Students under the age of 6 may attend one of 118 pre-schools distributed throughout the country, as did about 9% of the under-6 population in 2004-2005[20]. Net primary school enrollment reflects the mandatory education law, with a large majority (86%) of children between 6 and 14 attending one of the 288 primary schools. Primary school completion rates have hovered around 70% for the last 5 years[32]. Education beyond the age of 14 is voluntary, and approximately 40% of children attend one of 50 secondary schools throughout the country[32]. An additional 2% attend one of several vocational schools[20]. The male-to-female ratio for secondary school is approximately 0.92:1, and greater than 3:1 for vocational school. In the last five years, slightly more than 4,000 Belizeans per year (about 3% of the population over 20 years old) have been enrolled in some form of tertiary education[20].

Several institutions of higher education are found in Belize, which offer Associates, Bachelors, Masters, and Doctor of Medicine degrees. The state-sponsored University of Belize (UB) is the largest university in Belize with campuses in Belize City, Belmopan, Central Farm, and Punta Gorda. UB endeavors to prepare its students to contribute to sustainable development of the nation and offers degrees in a wide range of subjects including natural sciences, language,

[29] NMS 2008
[30] CCCCC 2007
[31] MoES 2001
[32] SIB 2007c

mathematics, information technology, business, and nursing. Galen University is one of few schools in Belize that offer graduate and professional degrees in business, arts and sciences, and education in addition to their undergraduate programs. The Central America Health Sciences University (CAHSU) Belize Medical College in Belmopan was founded in 1996 and confers Doctor of Medicine degrees to its students.

Climate Monitoring and Research

The National Meteorological Service (NMS) is responsible for management of long-term hydrological and meteorological data, daily forecasting for agricultural, tourism and forestry management, and for issuing warnings to safeguard life and property. To fulfill these goals, it maintains a network of 41 hydrological and 34 meteorological observing stations, an upper air observing station and a Synoptic Forecasting Office equipped with telecommunication equipment and workstations, WEFAX satellite receiving equipment and a 10 cm weather radar. The Chief Meteorologist is responsible for coordinating research activities for preparation of National Communications to the UNFCCC including research on greenhouse gas emissions and risk assessments. In this capacity, the NMS has facilitated vulnerability assessments on staple crop yields, coastal vulnerability to sea level rise, and water resources[29].

Belize has participated in research and capacity building activities to assist with adaptation to climate change. In the Caribbean Planning for Adaptation to Climate Change (CPACC) project, Belize installed a tide gage, assessed coastal zone resources, designed a coral reef monitoring program to detect climate change impacts, and drafted an adaptation policy for Belize response to climate change[33]. CPACC, which ended in 2000, was followed by the Mainstream Adaptation to Climate Change (MACC) project which focused on the water resource management in an agricultural watershed, installed an additional tide gage, and set up a station to separate the effects of land movement from sea level rise. MACC ended in 2008.

Other climate change research has been conducted by independent researchers from universities and NGOs. This research spans a range of topics including carbon sequestration by tropical forests, sea level rise, responses of mangroves to climate change, seagrass sensitivity to environmental variation, and coral bleaching. In the mid-1990s, a Belize NGO, Programme for Belize, implemented the Rio Bravo Carbon Sequestration Pilot Project with funding from six North American energy companies. This pilot project has since been complemented by remote sensing analyses designed to estimate above ground carbon stocks. This research has estimated that mean carbon stocks in northwestern Belize forests equal 13.1 Mg/ha[34].

Toscano and Macintyre (2003) used C14 dating of corals and mangrove peat from sites in Belize and elsewhere to estimate sea level rise in the Western Atlantic. They found average rates of rise of 0.93 mm per year for the past 2,000 years.

Several authors have investigated the role and response of mangroves to climate change. These studies have shown that mangroves are sensitive to several variables predicted to change as climate changes (insolation, sedimentation, and water depth), and that these crucial coastal forests may not persist in the face of rapid climate change[35]. Another study of mangroves showed that reduced growth with increasing water depth will offset or balance the increases in growth predicted as a result of elevated atmospheric CO_2 concentrations[36]. The

[33] CPACC 2002
[34] Brown et al. 2005
[35] Ellison and Farnsworth 1996
[36] Ellison and Farnsworth 1997

protective capacity of mangroves for coastlines during catastrophic storms has been convincingly demonstrated in Belize[37], and mangrove destruction has been implicated degradation of seagrass habitats[38].

A number of studies have investigated coral bleaching and recovery. Several of these documented an extensive coral bleaching event that occurred in 1998 in which 70 - 90% of the corals along the Mesoamerican Barrier Reef bleached as a result of elevated water temperatures[39][40][41][42]. Aronson et al. (2005) showed that the decline of coral reefs since 1980 is the result of disease outbreaks, bleaching episodes, and hurricanes, and ruled out the alternative hypothesis that corals have been declining for more than a century. Castillo and Helmuth (2005) have detailed the physiological responses of corals to thermal stress, finding that acclimation to warm temperatures prior to temperature spikes reduces stress in corals, and Rotjan et al. (2006) found that chronic grazing of corals by parrotfishes can exacerbate the influence of environmental stressors like heat.

V. Housing Stock

During the last national census (2000), 51,945 houses were enumerated throughout the country. Just over half of these were located in rural areas. A large majority of households (44%) were home to five or more persons. Most houses had two (36%) or three (25%) bedrooms, and were relatively new—42% built since 1990. On a national basis (urban and rural combined), the statistically most common house is a cement-floored structure, with wood outer walls (44% of homes), and a sheet metal roof (80% of homes). Almost 80% of households are powered with electricity from a public generator, though kerosene lamps are still common in some rural areas. It is also still common to find dirt floors and thatched roofs in rural areas[20]. The general tendency historically is for families to upgrade their thatch or wooden homes to more permanent cement structures, a progression that requires greater investment but improves hurricane preparedness.

There is a sharp division between urban and rural homes in their drinking water source and sanitation facilities. In urban areas, 38% of homes receive their water from a public source piped into their dwelling, and an additional 28% use purified (bottled) water. This contrasts with rural areas where most drinking water (37%) comes from a private rainwater catchment vat or a well. Five percent, or about 1300 rural households still rely on rivers, streams, ponds, or springs for their drinking water[20]. These statistics suggest that a large number of Belizean rural households that depend on rainwater or runoff may be vulnerable to drought and changes in the quality of surface and ground waters, which would reduce water security.

The differences in toilet facilities perhaps reveal the strongest difference between houses in rural and urban areas. In urban areas, most households (47%) have toilets that run to a septic tank in their yard, and many households (30%) are also connected to a sewer system. By contrast, in rural areas, about 70% of households use some type of latrine, 22% have septic systems, and 6% have no toilet facilities at all[20].

[37] Granek and Ruttenberg 2007
[38] Short et al. 2006
[39] Mumby 1999
[40] Kramer and Kramer 2000
[41] McField 2001
[42] Aronson et al. 2002

VI. Economic profile

Generalities

From the early colonial history of Belize until the mid-20th century the Belize economy was dominated by forestry activities, but depletion of mahogany stocks and diversification of economic development led to a shift toward export agriculture. Cane sugar has been a strong segment of the economy since the decline of the mahogany industry, and subsequent expansion of citrus and banana industries also took place. Today these crops remain a mainstay of the economy, but service industry related to tourism has become one of the strongest sectors of the economy. Belize has slowly diversified its economy over time, with substantial aquaculture and manufacturing industries, and more recently, a small but lucrative petroleum industry.

Belize's currency (Belize dollars, BZD) has been pegged to the US dollar since 1976 at a ratio of 2-to-1 (BZD-to-US$). As a result Belize has achieved generally satisfactory macroeconomic outcomes—inflation has been relatively low and stable, growth has been above the regional average, and exports have performed well[43].

Recent growth

As of 2006, the GDP at current market prices was US$1,213.65 million (mn), with a per capita GDP of approximately US$3,896 mn[44]. GDP growth during the nineties averaged 4.6%, and notwithstanding three natural disasters and the September 11 attack, growth between 2000 and 2006 averaged 6.5%. The service and wholesale/retail trade sectors contribute most significantly to GDP (20% and 14.5% respectively in 2006), followed by manufacturing (10.6%), transport and communication (10.4%), government services (9.8%), and agriculture and forestry (9.1%)[44] (Figure 5). Tourism is a large contributor to both the service and wholesale/retail trade sectors. In 2006, tourist arrivals totaled 903,000 and tourist receipts amounted to US$199 mn, or about 16% of the GDP[32].

Belize imports one and a half times more goods than it exports. In 2006, goods valued at US$660 mn were imported, while US$427 mn were exported. The top imports were machine and transportation equipment (17%), fuels and lubricants (16%), manufactured goods (12%), and food (9%). The United States is the source of 39% of goods entering the country, and another 20% come from Central America. Agricultural products comprise the majority of export earnings in Belize (Table 2). Citrus concentrate was the most valuable export commodity for Belize in 2006 (US$54.5 mn), followed by cane sugar (US$50.5 mn), and bananas (US$25.3 mn). Petroleum (US$44.3 mn) and marine products (US$43.0 mn) also contributed substantially to export earnings[32]. The United States was the main recipient of Belizean exports (42%) in 2006, followed by the United Kingdom (17%). Between 2003 and 2006 the balance of trade deficit ranged from US$173 mn to US$231 mn with an average of US$199 mn[32].

[43] IMF 2006
[44] CBB 2006

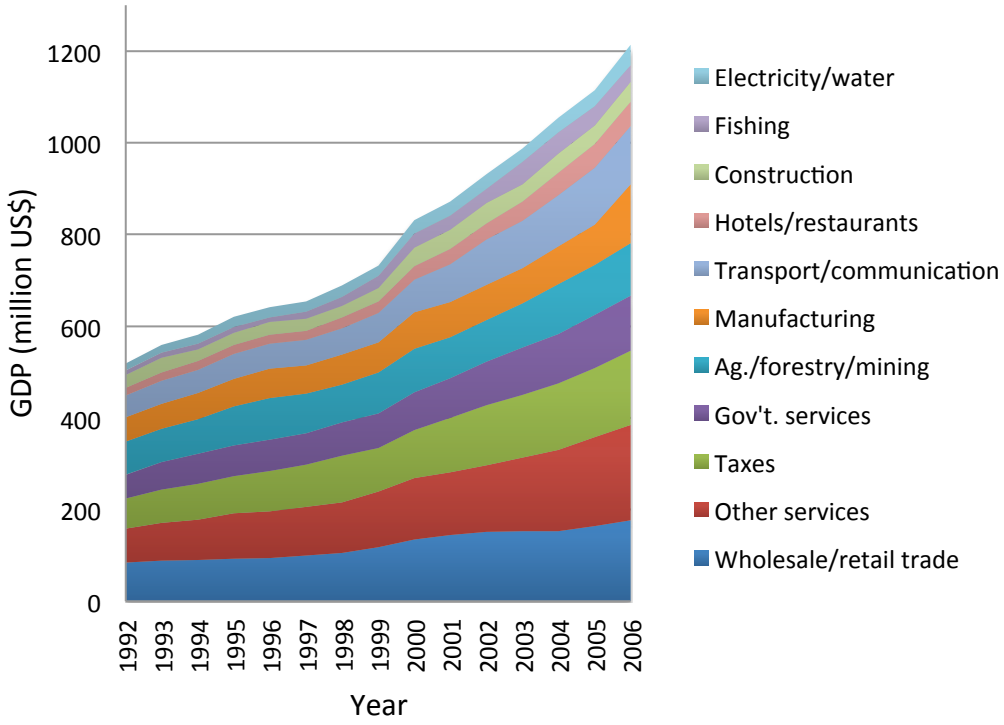

Figure 5. GDP by industry and total GDP for the period from 1992 to 2006[44].

Table 2. Gross domestic product (million US$) of different agriculture crops, marine products (including aquaculture), petroleum, and timber[20,32].

Product (mn US$)	2003	2004	2005	2006
Citrus Concentrate	39.05	40.30	53.60	54.50
Oranges	1.20	1.40	1.75	1.45
Citrus Juice	0.95	1.65	0.40	0.05
Sugar	35.60	40.75	34.95	50.05
Molasses	1.25	0.90	1.40	2.10
Banana	26.30	26.20	24.95	25.30
Livestock production	19.55	20.90	N/A	N/A
Papayas	8.40	11.40	13.45	15.50
Black Eye Peas	1.70	1.20	1.85	1.70
Red Kidney Beans	0.85	1.20	2.60	0.95
Petroleum	0	0	0	44.25
Timber	1.80	1.50	1.30	0.65
Garments	15.45	18.40	17.30	18.30
Marine Products	55.10	53.80	49.05	43.0

Belize's sugar and banana industries have long benefited from preferential market access, but this access is being weakened by deepening global trade liberalization. Preferential access to the EU market has afforded Belize growers significantly higher export prices. However, ongoing reforms in the EU trade regimes for bananas and sugar are eroding these prices, thus having economic and social consequences for Belize. An IMF assessment of the economic

implications of the expected decline in trade preferences predicted negative effects on the trade balance, economic growth and, to a lesser extent, the fiscal balance of Belize. Medium term scenarios predict that loss of preferential agreements will lead to a lower GDP growth of ¼% through 2010 and moderate declines in export receipts for bananas and sugar[43].

Recent developments

In 1998, the then newly elected government enacted aggressive policies to stimulate economic activity, which led to large fiscal and current account deficits fueled by foreign borrowing. As debt service costs rose, access to voluntary financing fell and borrowing costs increased sharply. As a result, Belize's sovereign credit ratings, which help determine the country's access to international capital markets, dropped in early years of the new millennium. At this time the IMF cautioned that the macroeconomic policies were overly expansionary and could threaten the country's currency peg[45]. In response, the government began to implement a stabilization program in the 2005/06 budget by raising taxes, cutting expenditures, and tightening monetary conditions. These moves helped reduce the central government deficit from 8½% of GDP in FY2004/05 to 3 percent in FY2005/06. In 2006, the government made a debt exchange offer to its creditors which would convert eligible debt instruments into new bonds that would start to amortize in 2019. A majority of Belize's creditors accepted the debt exchange in February 2007, which led to a decrease in the debt service burden and an upgrade of sovereign debt ratings[45].

The extraction of petroleum from an estimated 10 mn barrel reserve in western Belize commenced in December 2005. In 2006, approximately 811,199 barrels of crude oil were extracted from this location, 80% of which was exported to the US. The geology of Belize suggests a high probability for the existence of more oil deposits, which if located and exploited, could lead to a shift in the economic base of Belize over a relatively short time span[46]. There are currently 6 companies with production sharing agreements with the Belize government exploring the country for oil[47].

VII. Energy profile

Regulatory structure

The Public Utilities Commission (PUC) is the government body whose role it is "to regulate the electricity, water, and telecommunications sectors in Belize to efficiently provide the highest quality services at affordable rates, ensuring the viability and sustainability of each sector"[48]. In this capacity, the PUC is instrumental in regulating the energy industry in Belize, and for formulating and implementing energy policies.

It is an important time for Belize with regard to energy sector development. With a burgeoning population, growing service and industrial sectors, and a rapidly increasing demand for electricity—9% per annum[49]—Belize must develop the energy sector wisely to facilitate sustainable national development and a clean environment. Recognizing this, the PUC undertook a one year project entitled Formulation of a National Energy Plan for Belize in 2003, which recommended that Belize develop a comprehensive National Energy Policy and Implementation Plan. In 2004, the Government of Belize endorsed the PUC to lead the

[45] El-Masry 2007
[46] CDB 2007
[47] MNREI 2002
[48] PUC 2001
[49] LC 2003

formulation of a National Energy Plan for Belize, an effort that is currently in the planning stages.

Energy supply and demand

Belize acquires its energy from four main sources: imported fossil fuels (66%), biomass (26%), hydro (3%), and imported electricity (5%) (Figure 6). Belize currently imports nearly 100% of fossil fuels used, although the further development of the oil industry may lead this to change. The main petroleum based sub-products—gasoline, kerosene and diesel—are supplied by three retailers. Gasoline is used mostly in the transport sub-sector, diesel in both the transport and electricity sub-sectors and kerosene is used in the aviation industry and for lighting. The liquid propane gas (LPG; butane/propane) market has four main importers. Retail (pump) prices in both the petroleum and LPG industries are regulated by Government of Belize[49].

In the electricity sub-sector, about 50% of the electricity produced is imported from Mexico. Hydropower (25%), diesel (20%), and combustion of sugar cane waste biomass (5%) fill the other half of electricity supply (Figure 6). Belize's demand for electricity is growing very quickly. In 2002, aggregate peak demand was 54MW and 273 Gwh were sold to consumers that year. In 2010 peak demand is expected to reach 96MW and 523 Gwh are expected to be sold (Table 3; LC 2003). Of electricity sold by BEL, 56% is for residential application, 31% for commercial application, 8% for street lights, and 5% for industrial application[49].

Belize Electricity Limited (BEL) is the main commercial provider. This company dominates the distribution/transmission market and is required by law to provide transmission facilities to any generator capable of paying its fees.

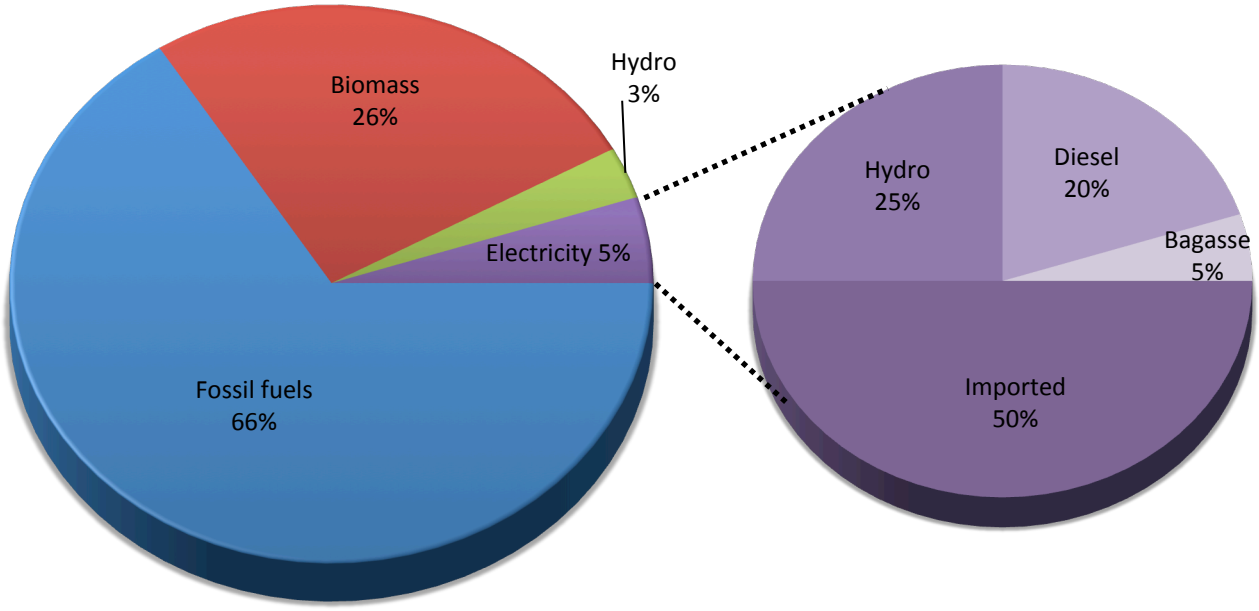

Figure 6. Total energy (left) and electricity (right) supply for Belize (LC 2003).

Table 3. Energy sales and forecasts for demand (2008-2010)[50].

Year	Total Sales (GWhs)	Total System Growth (%)	Grid Sales (GWhs)	Grid Generation (GWhs)	Grid Peak (MW)
2000	229.4	14.96	214.4	245.4	40.9
2001	256.6	11.88	242.5	277.3	46.2
2002	273.4	6.56	263.0	293.1	47.8
2003	298.0	9.00	295.2	329.0	54.3
2004	321.3	7.81	318.1	354.5	58.5
2005	349.4	8.73	349.4	389.4	64.2
2006	379.6	8.65	379.6	423.1	69.8
2007	411.9	8.52	411.9	459.1	75.7
2008	446.6	8.43	446.6	497.8	82.1
2009	483.8	8.33	483.8	539.3	89.0
2010	523.6	8.22	523.6	583.6	96.3

The future

A PUC-sponsored energy sector diagnostic report[49] emphasized the importance of energy security for Belize, citing the heavy reliance of imported fossil fuels as a factor that creates vulnerability. The report states that "the best Belize can aspire to, in order to improve energy security is to reduce the dependency on imports in the electricity sub-sector, practice energy conservation and review the possibility of biofuels to ameliorate the extreme dependence in the transport sub-sector"[49]. The report also urged Belize to take part in the Plan Puebla-Panama Initiative for Energy Integration, a project aimed at unifying Central American countries' electricity grids to reduce costs and the frequency of power disruptions. The first stage of the project is the Sistema de Interconexion Electrica para America Central (SIEPAC), which includes installation of a 195 km, 230kV power transmission line between Guatemala and Belize City[51].

To date, Belize has made significant progress in reducing its dependency on imports in the electricity sub-sector through addition of hydro power and biomass-to-energy capacity. In 2005, the Belize Electricity Company Limited (BECOL) completed the construction of the Chalillo Dam, which has a generating capacity of 7 MW, but also serves as a water storage facility that increases the annual generation of the Mollejon hydroelectric dam downstream from 80 GW to more than 160 GW[49]. The Vaca Hydroelectric dam (under construction) will have an installed capacity of 18 MW[52]. In 2004, BEL signed an agreement with Belize Cogeneration Energy Limited (BELCOGEN), a subsidiary of Belize Sugar Industries Ltd., to buy electricity from a 31.5 MW bagasse-fired plant that is now under construction and due to come online in 2009. In a final recent step toward energy independence, BEL signed an agreement with Belize Aquaculture Ltd. to supply up to 15 MW of power generated from high efficiency engines that run on heavy fuel oil or diesel at prices competitive to those of electricity from Mexico. This plant will also come online in 2009[53].

Renewable energy technologies have historically been used both in small, isolated applications and power plants in Belize. Currently, hydroelectricity, stand alone solar photovoltaics (PV),

[50] BEL 2001
[51] PUC 2003
[52] PUC 2007a
[53] BEL 2008

small wind electricity generation, solar thermal, hybrid systems (diesel/PV or diesel/wind), biomass cogeneration and biogas are all being used at some scale in Belize. It has been estimated that Belize can add 20 MW of electricity from wind, and expand solar in off-grid applications. Aside from the dams mentioned above, thirteen additional hydropower development locations have been identified in Belize in a recent national assessment, opening the door for further development of hydropower[54].

VIII. Transport and telecommunications

Transport

Belize's transportation infrastructure includes approximately 3,909 km of unimproved dirt roads, 2,542 km of paved or improved dirt side roads, and 541 km of paved 2-lane highways[55]. There are also two international airports, ten local airports that serve the domestic airline industry, and a number of private airstrips. Three commercial ports in Belize can accommodate large ocean freighters (Belize City, Commerce Bight, and Big Creek), and smaller water craft are commonly used to carry people to the islands in the coastal zone.

Five large commercial airlines, one regional airline, and two domestic airlines operate flights to, from, and within Belize. This number is likely to grow, as direct flights from Europe begin as a result of recent upgrades to Phillip Goldson International Airport in Belize City. The number of arrivals in Belize has risen steadily through time, except for a several year lull following the 2001 terrorist attacks on the World Trade Center. Total passenger traffic on airplanes in and out of Belize in 2004 was 464,001. Total aircraft movements in Belize equaled 47,354, of which civilian services (both international and domestic) accounted for 92%, military flights for 5%, and private aircraft for 3%[20].

The number of licensed motor vehicles in Belize has increased by about 9% per year between 2000 and 2004, with a total of 48,300 vehicles registered in 2004. The majority of these (84%) were private passenger vehicles, mostly pick-up trucks and cars (29% and 25% respectively), followed by freight vehicles (9%), and public service vehicles (7%)[20]. No statistics are available about the breakdown of fuel types used by vehicles, though diesel is the cheapest fuel source and thus a very common engine choice for private and freight vehicles. Belize depends heavily on ship transport for many of its imported and exported goods. A total of 261 ships (217 foreign owned, with about half from China) fly under the Belizean flag[56]. In 2006, Port of Belize Ltd. reported 243 ship calls at its Belize City and Commerce Bight ports[57]. Between 1995 and 2000 the number of registered passenger boats (running gas or diesel outboard engines) grew 27% annually, from 278 in 1995 to 727 in 2000[49].

Telecommunications

Two companies provide telecommunications services to Belize: Belize Telemedia Ltd. (BTL) and Smart/Speednet. BTL enjoyed a monopoly until 2004, and still dominates the telecommunications market as the main service provider of stationary and mobile telephones and internet. Smart/Speednet began operations in 2004 and offers mobile phone service, fixed cellular service, and wireless internet.

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[54] Soubrier 2006
[55] TNC 2006
[56] CIA 2007
[57] Port of Belize 2005

Like many places in the world, telephone usage in Belize has seen a shift in recent years away from stationary land lines to mobile cellular telephones (Figure 7). In 2005, mobile phones outnumbered landlines by about 3 to 1, even though landlines had outnumbered cellular phones as recently as 2001[58]. Internet usage has also risen quickly, with the majority of customers still operating with dial-up connections, but with high speed DSL drawing more and more customers since first being offered by BTL in 2004[58].

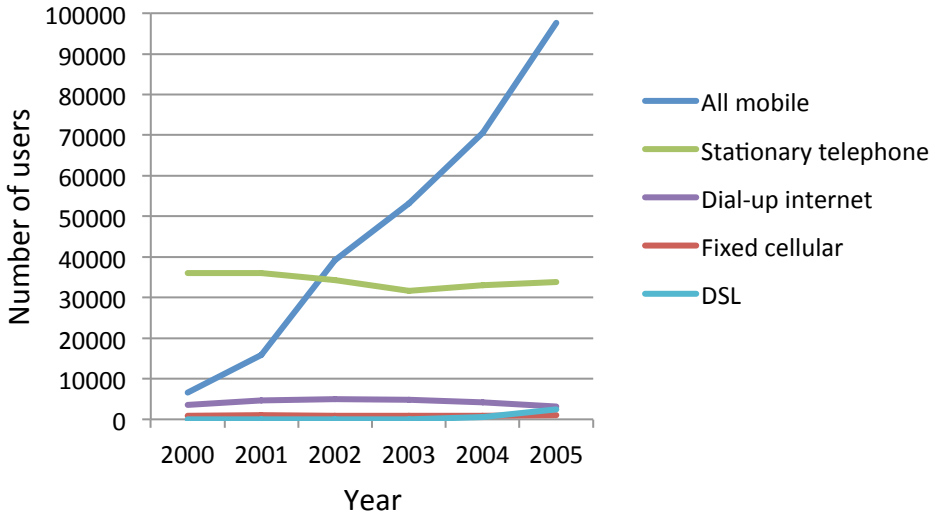

Figure 7. Number of users of different telecommunications services between 2000 and 2005[58].

IX. Waste

The Solid Waste Management Authority (SWMA) was established by the Solid Waste Management Authority Act of 1991. The SWMA is the organization responsible for waste collection and disposal services in Belize. The SWMA coordinator works closely with the Department of the Environment (DOE)–the agency responsible for prevention and control of pollution by coordinating all activities related to the discharge of wastes into the environment.

In the most recent technical assessment of Belize's waste stream[59], it was estimated that Belize generated 112,000 tons of domestic solid waste, or about 1.32 kg/person/day. About half of this is domestic waste from the major urban centers of the country (Table 3). About 60% of this consisted of organic material and the remaining 40% was comprised of equal percentages of metals, glass, plastic, paper and other waste[60]. The majority of Belizean households (51%) dispose of their waste through municipal collection services which exist in all major urban centers in Belize. An additional 33% of households burn their waste, and the rest either carry it themselves to a public dumping area (8%), dump it in their own yard (4%), or bury it (2%)[20]. Burning of waste is a preferred disposal technique in rural areas.

During the period 1995-2000, industrial waste generated was estimated to be between 400 and 650 thousand metric tons, primarily from agricultural activities[59]. Solid waste from these industries is mostly organics (60%) and consists of rejected fruits from the banana industry,

[58] PUC 2007b
[59] Stantec 1999
[60] Stantec 2000

citrus rinds from the production of juice concentrate, and bagasse, the fiber left from sugar cane processing. Bananas are disposed of in approved sites near the farms, citrus rinds are composted, and about half of all bagasse is burnt for the production of energy, a figure that will increase as the new biomass-to-energy plants becomes operational in 2009. Another waste product is shrimp heads that are usually buried for decomposition[61].

There are no sanitary landfills with adequate environmental protection measures operating in Belize. Disposal sites for waste collected in all cities and towns consist of open dumps that lack technical and environmental controls, adequate equipment, and sufficient cover material[61]. The largest disposal site is located at the edge of Belize City in what is a low lying mangrove area with a high water table, which receives the majority of Belize City's solid waste stream, which equaled over 81 tons per day in 2000[20]. Other, sometimes impromptu, waste disposal sites are dispersed throughout the mainland and on the offshore islands near centers of population. Fires are common at most disposal sites and leachates are assumed to escape into the local water table.

Belize developed a Solid Waste Management Plan in 2001. The plan proposes:

- A regional sanitary landfill in a central location with a 25-year capacity
- Modified landfills at existing sites in Orange Walk and Corozal
- New modified landfills in Placencia, Dangriga and Punta Gorda
- Transfer stations along the Western corridor
- Closure of the landfills on Caye Caulker and San Pedro and movement of their waste to the central sanitary landfill
- Development of a collection system to provide service to small villages and rural residents along the three main highways corridors.

This plan remains in a pre-implementation state.

Table 3. Solid waste generated in different municipalities in 2000[20].

Municipality	Tons per day	Tons per annum	Kg/capita/ day
Corozal	12.82	4,680	1.50
Orange Walk	17.44	6,365	1.27
Belize City	81.56	29,770	1.54
San Ignacio	19.46	7,104	1.32
Benque Viejo	5.70	2,080	1.13
Belmopan City	9.62	3,510	1.18
Dangriga	8.55	3,120	0.95
Punta Gorda	4.27	1,560	0.99
San Pedro	10.68	3,900	2.18
Total	170.11	62,089	1.32

Information on liquid waste and sludge is very limited. In terms of human liquid waste, about 15% of all households are connected to a sewer system, and an additional 35% use septic systems. The households connected to sewer systems are located in Belmopan, Belize City and San Pedro. Volumes of sewage generated are unavailable. The waste stream from a

[61] PAHO 2003

septic leach field may enrich groundwater with nutrients. In densely settled areas on porous soil, this may cause groundwater contamination, but is as yet unmeasured in Belize.

X. Agriculture

The conditions for agriculture vary widely in Belize from swampy lowlands in the north to very wet alluvial floodplains in the south. All areas exhibit strong dry-wet seasonality. Cultivated land amounts to about 3,835 km^2 or 17% of the national land area[14]. The majority of land used for agriculture (37%) has been classified as shifting cultivation and unimproved pasture, followed closely by mechanized agriculture of corn, beans, and rice (34%) practiced primarily by Mennonites[14] (Figure 8).The remaining 29% in comprised of general agriculture, mango and citrus plantations, banana and papaya farms, and fish or shrimp ponds.

The most economically important crops are citrus products, which combined earned US$56 mn in 2006, sugar/molasses (US$52.15 mn), and bananas (US$25.3 mn). Individually, these all compare favorably with other high value non-agricultural exports (Table 2), but erosion of preferential trade agreements may deter future growth. Livestock production is valued at about US$20 mn per year, predominately from production of poultry/eggs, beef, and pork[32].

Commercial agricultural crop production through time reveals that sugar cane is the most productive crop by biomass. Sugar production increased through the late 1980's then leveled off in the mid-1990s. Oranges and banana's are also productive crops that have increased through time, as has chicken and shrimp production[20], though the latter has leveled and decreased in recent years in response to the closure of a major producer[62] (Figure 8).

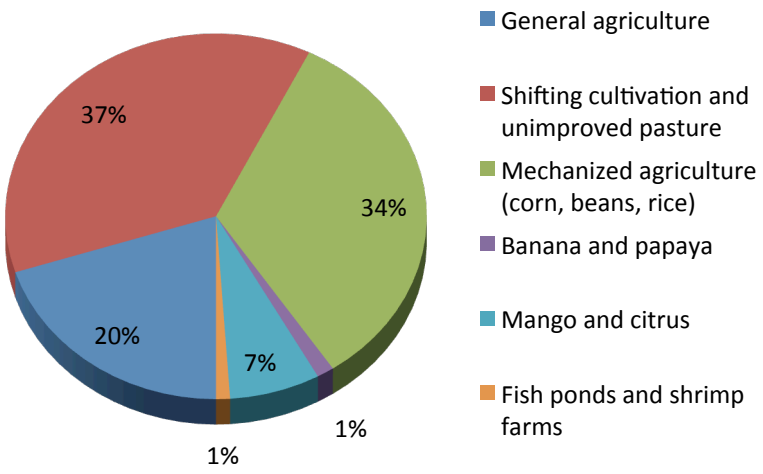

Figure 8. Percentages of agricultural land in different agricultural cover types[14]. The general agriculture category is a catch-all grouping for agricultural types that could not be classified effectively from the satellite imagery used.

Livestock production is a relatively modest industry in Belize with the exception of chicken, a major staple for the population. No estimates are available for the number of cattle, pigs, and chickens that exist in the country, but statistics on animals brought to market are kept. The

[62] SIB 2007e

number of cattle brought to market each year has increased steadily from 7,459 animals in 1988 to 13,020 in 2004. Pig production grew only modestly in this period from 8,160 to 14,325 and chickens from 2,831 to 8,039. These numbers only reflect animals killed commercially. Production of livestock on small farms is not included[20].

Milpa, or slash and burn, agriculture is an important form of agriculture that utilizes a large proportion of the 37% of land area used for shifting cultivation and unimproved pasture. This form of agriculture is practiced widely among Maya and Mestizo families in rural areas for subsistence production of corn, and some commercial production of beans or vegetables.

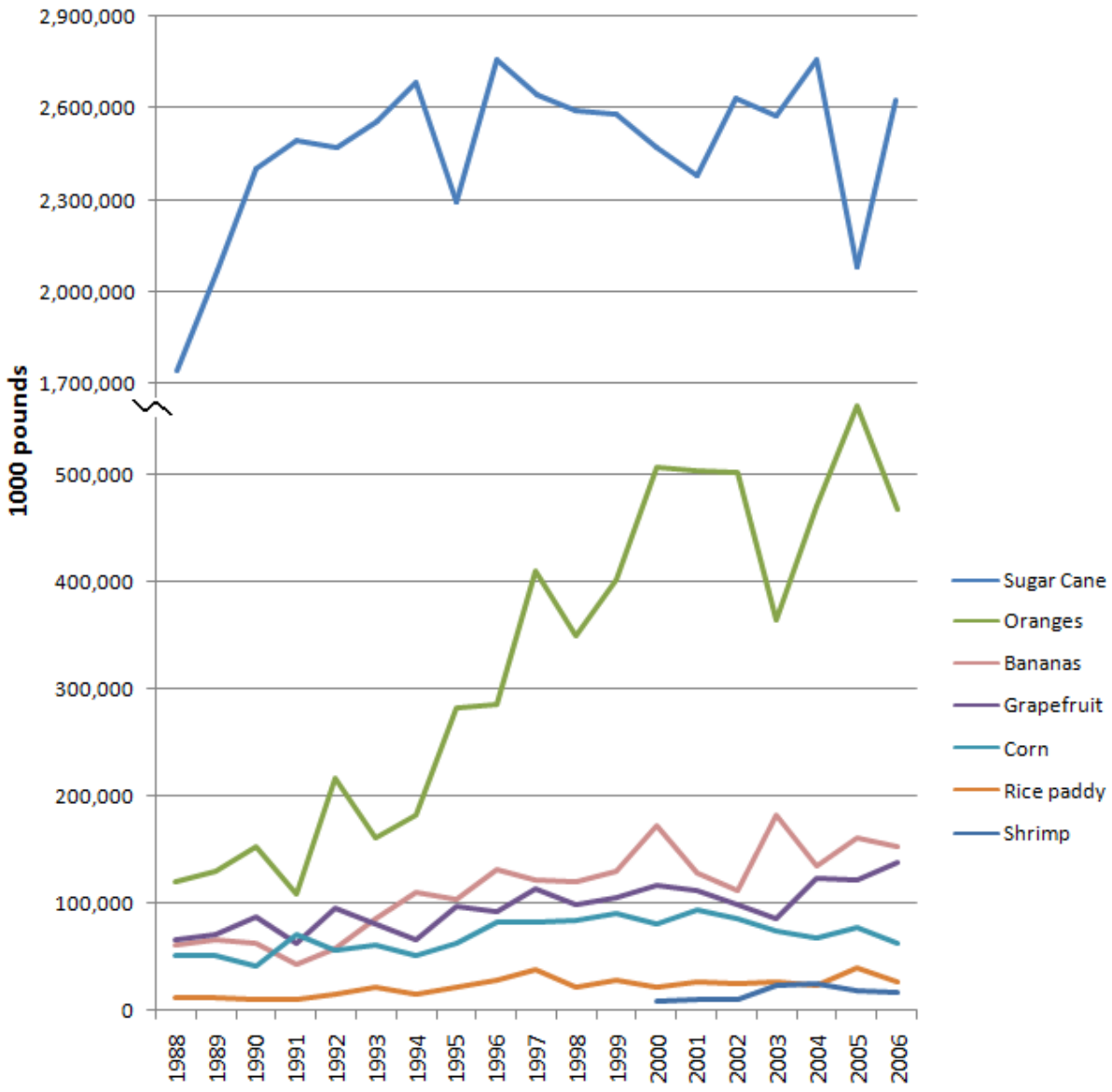

Figure 9. Agricultural production from 1988 to 2006 measured in standardized units of 1000 lbs.[20,62]

XI. Forestry

Forested area and production forestry

The colony British Honduras was founded on forestry—logwood, mahogany, cedar, and chicle (a natural chewing gum base)—but the sector declined by the mid-1900s because of unsustainable stock management, and because a synthetic gum base replaced chicle. While a small industry around timber still exists, it contributes very little to GDP (Table 2). The Forest Department within the Ministry of Natural Resources and Environment is the agency responsible for management of all forest reserves and most terrestrial protected areas (except archeological reserves), with more limited authority over private forested lands.

At the time of the last inventory, total forest area in Belize was 15,867 km^2, which is equivalent to 69% of the country[14], though it is likely that the current percentage of forested land is closer to 61% (Percival Cho, Forest Officer, personal communication). Forest cover is changing due to extensive export agricultural development as well as small areas of slash and burn agriculture[63]. While 1990-2000 deforestation rates for Central America were 1.2% per year, the deforestation rate in Belize during this period (2.3% per year) exhibited much higher rates of loss[64]. Approximately 80% of the lost area was broadleaf forest (620 km^2). The remaining 20% were secondary forest (100 km^2), coniferous forest (34 km^2), riverine vegetation and bamboo (16 km^2) and mangroves (11 km^2). Deforestation is very common along river courses where agricultural conditions (soils and access to water in the dry season) are best. DiFiore (2001) recorded a 22% (72 km^2) loss of forest cover from 1989 to 2001 in the riparian corridor along the Belize River—a forest conversion rate of 2% per year. This trend is likely to hold for other floodplain forests in Belize.

A number of mills currently operate throughout the country, mostly focusing on production of pine lumber and secondary hardwood lumber (Table 4). The Forest Department grants logging concessions within Forest Reserves to local and international logging companies. Recently, in an effort to promote sustainable management of timber resources, the Forest Department began granting long-term (40-year) management concessions. These concessions are managed by stricter standards that regulate rotation periods, utilizing area control, and improved harvesting practices.

Table 4. Cubic feet of timber harvested from the top four species from 1999 to 2004[20].

Species	1999	2000	2001	2002	2003	2004
Pine	833.0	710.2	1,404.4	1,410.6	21.9	1,689.6
Mahogany	140.3	81.3	126.8	134.2	137.8	868.1
Santa Maria	160.2	86.8	218.6	93.4	133.1	904.9
Yemeri	191.6	109.7	110.3	142.8	20.5	418.3

Teak is the only significant plantation tree used in Belize. It is estimated that there are over 5,000 acres of plantations present in Belize, in small scattered plots of a few acres to a couple of hundred acres. No known mahogany plantations exist, but mahogany line planting for forest enrichment has occurred in several places around the country, though in quantities far less than teak (Percival Cho, Forest Officer, personal communication).

[63] White et al. 1996
[64] FAO 2001

Approximately 80 km^2 of Belize's economically important Caribbean pine (*Pinus caribaea*) forests were decimated by an infestation of the southern pine bark beetle (*Dendroctonus frontalis*) between 1999 and 2001. Only 4 km^2 of Caribbean pine have been replanted since that time as part of restoration efforts (Percival Cho, Forest Officer, personal communication).

Protected areas

Belize has an impressive national protected area system that protects about 36% of its terrestrial and 13% of its marine area[65]. The protected areas system is comprised of a number of different types of conservation reserves, multi-use forest reserves, marine reserves, and archaeological sites (Figure 10). Coordinating management of these areas involves a complex regulatory structure with multiple agencies and many stakeholders, including the Forest Department, Fisheries Department, and Department of Archaeology (each within a different Ministry of government), in combination with non-governmental organization partners.

In 2005, a comprehensive National Protected Areas Policy and Systems Plan was completed with high level representation from relevant agencies to "ensure that the potential contribution of the protected areas system to national development and poverty alleviation is maximized, thereby putting it on a sound and rational footing"[65]. Major results of this process include:

1. *Formulation of a comprehensive protective area policy* that creates a policy framework in which the plan will be implemented.
2. *A protected area system assessment and analysis* that evaluates the adequacy and coherency of the network and makes recommendations for maximizing these.
3. *Management procedures and sustainable use* recommendations that address shared governance of the network and supporting legal instruments.
4. *Strengthened management and monitoring* procedures for building capacity, information driven decision making, and financing.

Both the Policy and Plan were endorsed by the Government of Belize to set the stage for implementation. Recommendations of the National Protected Area Plan are currently being implemented over a 6-year time period[65]. It is anticipated that at the end of the process the protected area system will be consolidated and managed in a streamlined manner to better meet the economic needs of the nation while maintaining its functionality as a place where biological diversity and ecosystem services can continue to function unhindered.

Forest management and climate change

The Bali Action Plan is one of the tangible results of the 3-14 December 2007 UN Climate Change Conference in Bali. The action plan calls for consideration of "policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries"[66]. So called 'reducing emissions from deforestation and degradation (REDD)' activities hold much promise for Belize, because of the significant carbon sinks present. Belize, via its representatives to the COP, plans to actively pursue benefits from receipt of payments for averting forest loss and managing forests for carbon fixation. Application of sustainable forest management practices, in particular, can enhance Belize's potential as a carbon sink. Belize is also well-positioned as a non-Annex I signatory to the Kyoto Protocol to participate in activities under the Clean Development Mechanism.

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[65] Meerman and Wilson 2005
[66] COP 2007

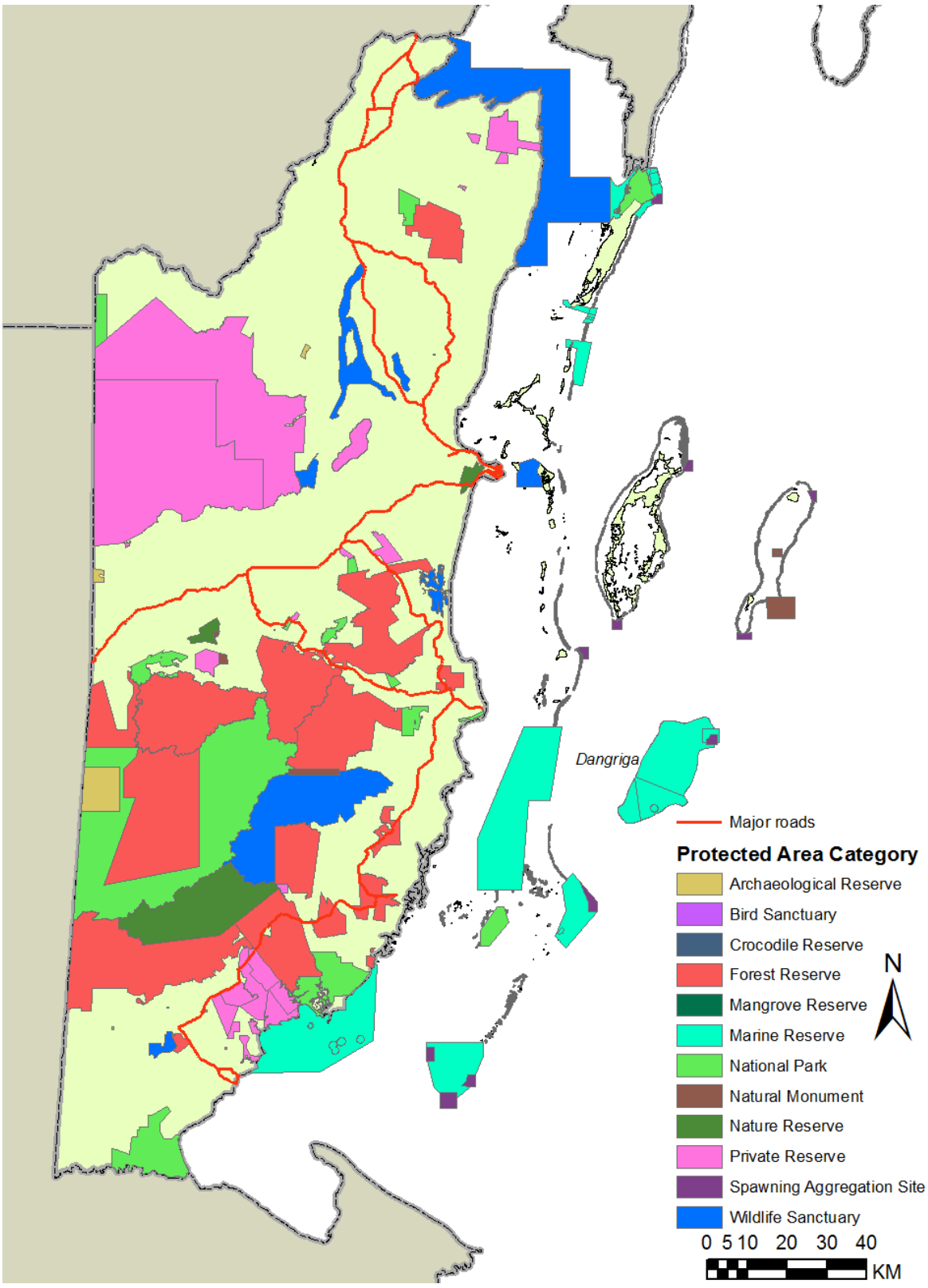

Figure 10. Belize has an extensive system of many protected areas that is currently being consolidated from the many reserve types shown here to larger reserves with multiple zones in each.

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