

# **Annex A(3)**

***Analytical Evidence to Support Guyana's Green State Development Strategy: Vision 2040***

***Sustainable Management of Natural Resources***

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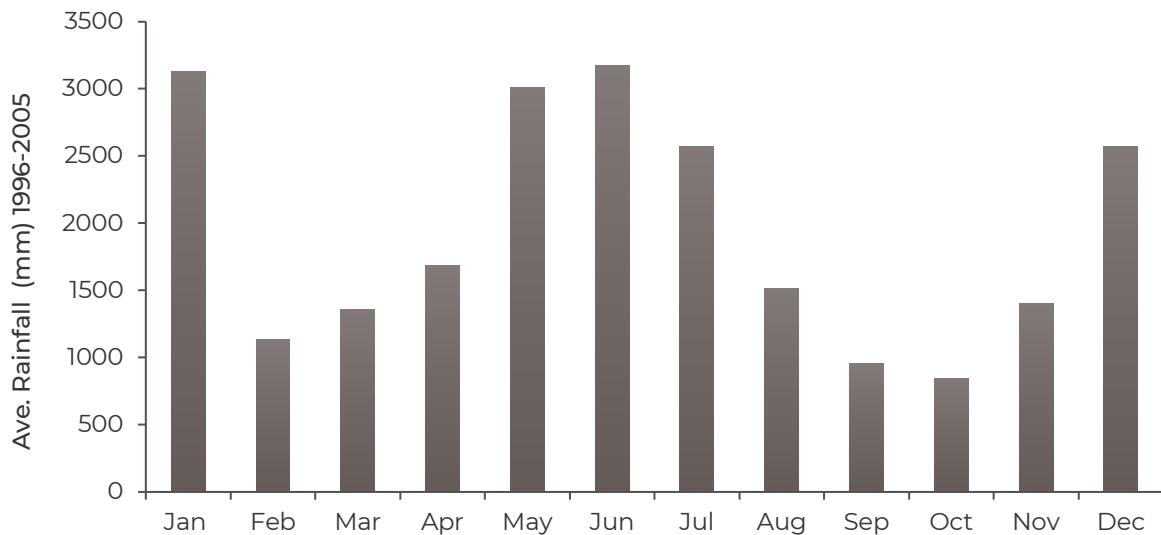
## A 3 Climate and Weather

### A 3.1 Climatic Zone and Weather Patterns

Guyana is situated at latitude 5° north and 59° west longitude and therefore, in the wet, hot and humid tropics just above the equator. This location ensures that temperatures are high and consistent year-round, averaging 26°-28° Celsius, with night time temperatures varying between 22°-24° Celsius. The hot, humid climate is moderated by the northeast Trade Winds along the coastal plain, which in hotter months can record 30° Celsius temperatures. The upland, forested areas can be cooler with temperatures ranging between, 20°-23° Celsius<sup>1</sup>.

Guyana's weather is affected by the migration patterns of the Inter-Tropical Convergence Zone (ITCZ), a massive system of weather located over the Atlantic Ocean, as well as by easterly and tropical waves moving west across the Atlantic from Africa.<sup>2</sup> The ITCZ migrates between latitudes 2° – 5° N in March and 12° – 15° N in September with high pressure systems and drier air that influence the double rainy and dry seasons. There are two main rainfall zones i) the northern coastal area sub-zone moderated by maritime influences and two seasonal rainfall peaks; and ii) the more continental sub-zone of the Rupununi Savannas in the southwest with its one wet and one dry season (Figures 1 and 2).

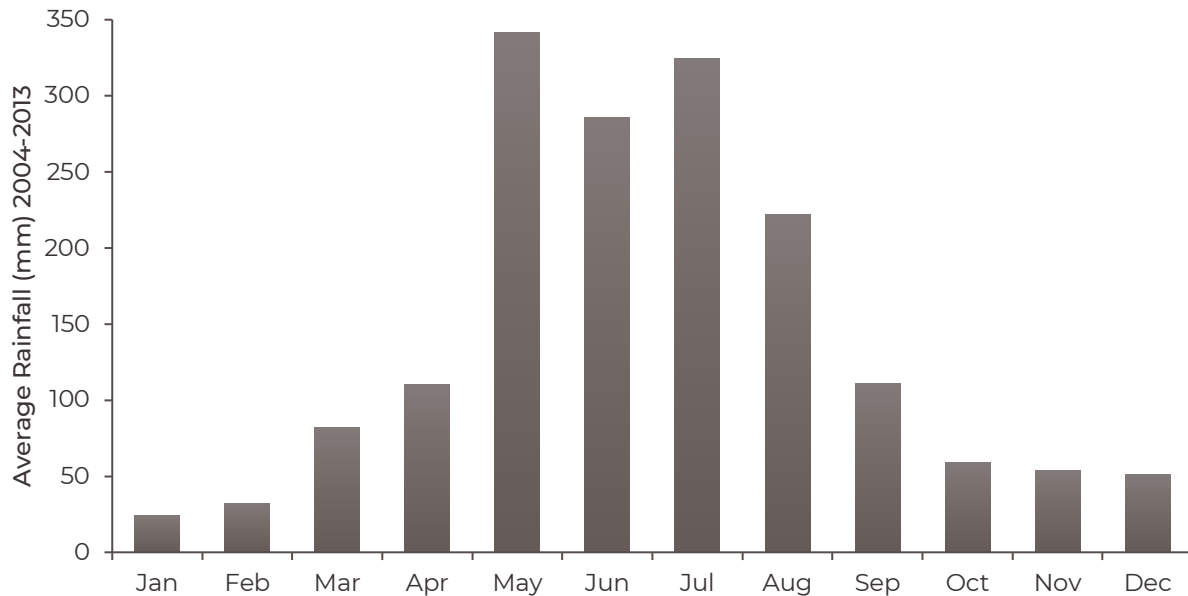
**Figure 1: Bimodal pattern of rainfall for the wet marine sub-climate**



Source: Monthly rainfall tables 1996-2014 for Guyana

<sup>1</sup> Guyana Second National Communication to the UNFCCC

<sup>2</sup> Hydrometeorological Service of Guyana of the Ministry of Agriculture.

**Figure 2: Unimodal pattern of rainfall of the continental sub-climate (Rupununi Region)**

Source: Ballyram et al (2014)C

The westerly movement of tropical waves can bring disruptive weather and high rainfall conditions (e.g. during hurricane season in the Caribbean). Guyana's weather is also affected by periodic episodes of the El Niño-Southern Oscillation (ENSO) weather system off the west (Pacific) coast of South America and the counter-cycles of La Niña that bring drier and wetter conditions, respectively.

With its two rainy seasons (from November to January and May to July) and two dry seasons (September-October and February-March), rainfall amounts average 1,890mm per year, which is among the highest in the Caribbean. Across the country rainfall duration and intensity varies slightly, with wetter western areas (Regions 1 and 7) especially near Kaieteur Falls, and drier areas along the eastern boundary with Suriname (Regions 5 & 6) and near Lethem (Region 9). Guyana's agricultural activities are largely influenced by the country's spatial and temporal rainfall patterns.

Climate and weather conditions are monitored by the Hydrometeorological Service of Guyana<sup>3</sup> through its network of weather monitoring stations across the country. The densest network of stations is clustered along the coastal plain, while other weather monitoring stations and equipment are arrayed across all regions, with Regions 6 and 9 having the lowest number of monitoring stations. The Hydrometeorological Service is an agency of the Ministry of Agriculture and was established not only to measure, monitor, compile and disseminate weather data but also monthly climate data and bulletins to farmers. It also builds capacity for the collection of national weather data.

<sup>3</sup> The Hydrometeorological Service of Guyana is mandated by the Water and Sewage Act 2002, Chapter 30:01 Part III, to i) collect, process, archive and make available, data on the weather, climate change and oceanography; and ii) to establish, manage and operate national systems, to monitor the availability, quality and use of surface water and ground water. See: <http://hydromet.gov.gy>.

In comparison to its CARICOM neighbours, the number of sunshine hours is not very high because of high cloud cover, with the lowest (5-6 hours) in May-June coinciding with the very wet rainy season and the highest number of sunshine hours (8 hours) from August-October. Guyana also lies outside (south) of the hurricane belt in the Caribbean. Whilst it is very rare for hurricanes to migrate as far south as Guyana, there have been the rare occasion where Trinidad & Tobago at 10° north latitude has been affected by hurricane weather.

### A 3.2 Natural Hazards and Climate Change

The *Second National Communication to the UNFCCC* (2<sup>nd</sup> Communication<sup>4</sup>) reports that since 1960, Guyana has experienced an increase in air temperature and decreased precipitation, with similar projections for the future. Rainfall and climate models run for Regions 5, 6 and 10 (years 2040-2069) indicate increases in temperatures that, according to the projections, could lead to higher evapotranspiration, and when combined with lower rainfall, could also result in increased water deficits with consequences for agriculture, domestic and industrial water use. While there are regional variations, the report concludes that Guyana will experience increases in temperature and increased rainfall in rainy seasons and less precipitation in months where water deficits are already experienced.

Guyana's low-lying coastal plain – in parts, lying about 1.5m below the mean high-water mark – is also likely to be threatened by climate-induced sea-level rise. The models predict that by 2031 sea-levels could increase by 26 cm, and in 2071 by 51 cm. Significantly, by 2031 storm surges could result in a 2.94 cm sea-level rise (in a moderate scenario), and up to 5.94 cm (in a catastrophic scenario)<sup>5</sup>.

These models serve as important early warning signals for preparing the majority of the population (90%) that reside on the coastal plain, and the extensive agricultural and infrastructural systems and related investments. These predictions at their worst, have the potential of severely disrupting livelihoods and activities, changing ecosystems and natural resources such as freshwater and groundwater, and having huge cost implications for climate-related mitigation and adaptation.

The extensive system of north-draining rivers also makes Guyana vulnerable to flooding especially along the coastal plain and in lowland areas. In 2005, Guyana experienced one of its worst flooding events. Torrential rains began December 24 2004 and continued through January 31, 2005. By mid-January, the monthly average rainfall (178mm) had been exceeded by seven times the amount from almost continuous rainfall especially along the coastal plain.

Georgetown remained under water for several days and over 290,000 people (39% of the population) were affected and relocated to shelters and higher ground, as Regions 3, 4 & 5 were declared a disaster zone. Water overtopped the conservancy dykes to the north of Georgetown and in some areas the dykes were breached. For persons trapped in their homes they were exposed to major health risks e.g. leptospirosis, dengue, salmonella, hepatitis, caused by poor sanitation, waste and vector proliferation in the flood waters. Cost estimates for the effects of the 2005 floods amounted to 60% of Guyana's GDP.

<sup>4</sup> *ibid.*

<sup>5</sup> *ibid.*



The *Second Communication* also identified available **short-term** adaptation options as:

- The formulation and implementation of land-use planning policies to address people and settlements and agricultural lands at risk to inundation, deriving from sea-level rise and storm surges.
- Fortification of sea and river defences in accordance with sea-level rise in vulnerable areas.
- Implementation of early warning systems in the event of storm surges.
- The building of shelters on higher ground either on the coast (Enmore, Mahaicony) or inland (Linden), to house people in the event of inundation due to storm surges.

Recommendations for **long term** adaptation include:

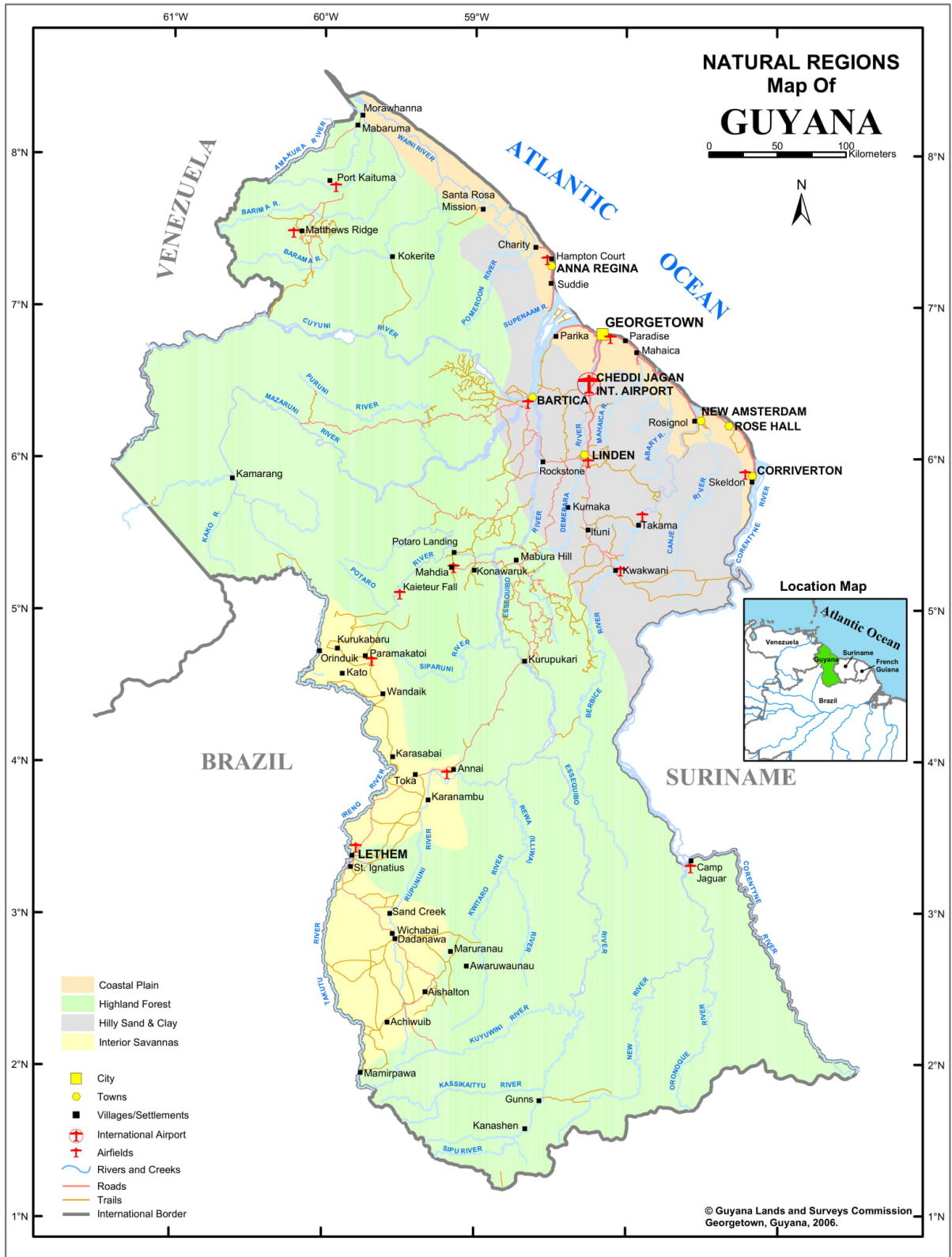
- More stringent building legislation and a limit to development work along the coastal plain encouraging a retreat to higher elevations and decentralization of economic activities and services.
- Additional studies and evaluation of agricultural lands, coastal aquifers, drainage and irrigation systems to understand their characteristics in relation to the vulnerabilities of the coastal plain.
- Policies to encourage and/or incentivize the relocation of population, infrastructure and services away from the vulnerable areas of the coastal plain.

## A 3.3 Physiography

### A 3.3.1 NATURAL REGIONS

Guyana has four natural regions (Map 1) namely i) Coastal Plains; ii) Hilly Sand and Clay Regions; iii) the Interior Savannahs and; iv) the Forested Highlands. These were described differently in the seminal mapping work conducted by FAO (1966) as five physiographic regions: i) the coastal plains; ii) the interior alluvial plains and low-lying lands; iii) the White Sand Plateau and older pediplains; iv) the crystalline shield uplands; and v) the highlands, mountains and plateaux.

Map 1: Natural Regions of Guyana



Source: Guyana Lands and Surveys Commission

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### A 3.3.2 GEOLOGY

Guyana is located on the northern part of the “Guiana Shield” of the Amazonian craton (i.e. part of the earth’s crust) of South America. The term “Guianas” (an indigenous word meaning land of waters) includes Guyana, Suriname and French Guiana, but also parts of eastern Venezuela and northern Brazil, areas that broadly define the extent of the “Guiana Shield”. The area comprises three geomorphic zones from south to north: low mountains of the Precambrian Guiana Shield (highest point located at Mt. Roraima in Brazil at 2,772 m); a lower region of hilly savannas; and the alluvial plain along the coast.

The Guiana Shield is underlain by some of the oldest granitic rock formations on the South American continent, dating to almost two billion years ago (late Precambrian era in geologic time). They comprise metamorphosed volcanics e.g. granites, gneisses and are also remnants of Gondwana, the supercontinent that once joined South America to western Africa. The Mesozoic period (about 240 million years ago) marked the time when the South American continent broke away from the African continent and began its westward migration to its location today, as the underlying tectonic plates spread apart in the Atlantic rift zone.

The Shield slopes up towards highlands that broadly span western Guyana/eastern Venezuela and northern Brazil encompassing the Pakaraima and Kanuku Mountains (the Guiana Highlands). These mountains form important headwaters for the Mazaruni and other tributaries to the east and south that flow into the Essequibo, and the Berbice and Corentyne rivers. Notably, these mountains are ‘table-top’ formations known by their indigenous names “tepui” and represent sandstone structures uplifted from millions of years ago during an era of intense tectonic (faulting) activity.

Mesozoic-era tectonic activity resulted in the metamorphosis of sedimentary strata creating “metasediments” and “metavolcanics” e.g. the greenstone belts, which contain abundant deposits of gold, manganese, uranium, copper and other minerals. Younger, overlying rocks comprise inter-woven layers of sandstones, quartzites, shales and conglomerates intruded by sills of younger “mafics” i.e. intrusive volcanic rocks from later volcanic activity.

During late Mesozoic times (Cretaceous age, 145 million years ago) tectonic rifting also gradually formed the Takutu Graben in the lower Rupununi area that is correlated with the offshore Guyana-Suriname basin, the site of recent major oil and gas finds. The Takutu Graben or basin (in the vicinity of Lethem) is also thought to potentially comprise oil and gas bearing strata. The basin is surrounded by faults through which were uplifted the older Pakaraima mountains with sedimentary conglomerates in the north, and the Kanuku mountains of metamorphic rocks mixed with igneous granite and doleritic intrusive rocks in the south.

The central highland areas of the Pakaraimas are also the source of Guyana’s most famous Kaieteur Falls located on the Potaro River, which is the world’s largest single-drop waterfall (from fault activity), and part of the Kaieteur Falls National Park. The Falls have a height of 226 m and the water cascades over sandstone cliffs.

The Proto-Berbice river, probably the ancestor of the Orinoco river in Venezuela and the Rio Branco in Brazil, from Mesozoic to Quaternary times, created expansive flood plains and deltaic deposits as they drained towards the east, emptying at coastal locations near today’s Berbice and Corentyne Rivers and into the Atlantic Ocean, and creating near- and offshore shelf areas. These flow patterns established expansive coastal plains depositing vast layers of

conglomeratic, sandy and clayey strata that progressed and regressed with changes in marine sea level and tectonic uplift from the Mesozoic to more recent geologic times.

The North Rupununi savannah overlies the Takutu basin and has volcanic lava flows interspersed with sedimentary rocks reflecting a major episodic period during the Jurassic period (~200 million years ago), with frequent interruption of sedimentation. Toucan Hills are an outcrop of lava flows in the south. The South Rupununi is geologically different, comprising rocks associated with the Kanuku mountains.

Deposits of bauxite occur in a continuous narrow belt – varying from 30km-100km wide – located about 100km inland from the coast stretching from Pomeroun in the northwest near Charity, south then east towards the Corentyne River at Apura. The towns of Bartica, Linden and Kwakwani are located within this belt. The bauxite deposits lie mainly upon the weathered clays (laterites with high iron and aluminium content) of a late Tertiary peneplain (Pliocene era, 1-5 million years ago) comprising deltaic clays, sands and lignite of the Berbice (White Sand) Formation.

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### A 3.3.3 SOILS

The UN FAO mapped and produced a soils map for Guyana in the mid-1960s, providing the first classification of soil types in Guyana. The National Agricultural Research and Extension Institute (NAREI) of the Ministry of Agriculture reclassified the soil types adopting the US Department of Agriculture's classification system. There are 5 distinct groups of soils<sup>6</sup>, described below and according to their locations and classifications in Table 1.

#### A 3.3.3.1 Coastal Plain soils

The most fertile soils are found on the Coastal Plain especially between and along the Essequibo to Corentyne river courses. These soils are generally silty and clayey loams developed from a mix of fluvial deposits. Units nearer the coast have higher fertility. The main limitation is drainage and a few units can even have high salinity and toxicity. There are also the 'pegasse' soils units that are typical of coastal area back swamps typically found west of the Pomeroun, with high levels of peat and organic matter with interlayers of clay. These are very acid soils with low fertility and high toxicity. This Coastal Plain soil group also contains other units near the Berbice and Demerara rivers that are slightly better drained clays/silty clays that with managed inputs could be made suitable for agriculture.

#### Interior Alluvial Plain soils

These are typically found on the Rupununi savannahs but are also common on alluvial plains, in the Pakaraima plateau, along the major rivers and in low-lying areas. These are hydromorphic soils with very poor drainage and of low fertility. Where the soils are found in the North Rupununi they are very poorly drained silty loams and clays that can be flooded for 3-4 months of the year. The vegetation is typically a mix of forest and savannah types.

#### A 3.3.3.2 The White Sand Plateau and Older Pediplains soils

These soils were developed from old deltaic and continental deposits and many are red-yellow latosols with a high content of iron and aluminium oxides, and sandy regosols derived from

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<sup>6</sup> See National Land Use Plan, 2013.

minerals and unconsolidated materials. The soil unit extends inland from the Coastal Plain and predominate in central regions and in the upper regions of the Essequibo river in the south. These soils are very well drained, of low fertility and depending upon slope characteristics, can be subject to erosion.

#### A 3.3.3.3 Crystalline Shield upland soils

These soils are developed from the older crystalline metamorphic rocks of the Guiana Shield and occur mainly in the northwest, near the Mazaruni river and the Pakaraima mountains. Some units tend to be clayey with others gravelly, well drained and of low fertility with a high potential for erosion if the forest cover is removed. In areas with more favourable slopes, agriculture may be possible but with sound soil management and conservation practices.

#### A 3.3.3.4 Highlands, Mountains and Plateaux soils

These are found in the Pakaraima, Kanuku and Acarai mountain areas and comprise deep and shallow soils. The deeper units derived from alkaline igneous rock are well drained clayey loams and of variable fertility. Other units are typically colluvium, that is, gravelly soils developed from scree slopes or that accumulate at the slope base. These soils also have high erosion potential are well drained and of variable fertility.

Most soil groups in Guyana have low to high infertility, moderate to high drainage and/or are subject to erosion especially when occurring in hilly, mountainous regions. Where deeper soil units occur on gentler slopes, agriculture is possible with careful land management. Soils of the Coastal Plain by comparison, are very fertile but require high levels of land management.

The various soil types of Guyana serve as substrates for a range of vegetation types and there appears to be strong correlation between soil properties and the distribution of vegetation.

**Table 1: Spatial Distribution of major soil classes according to the natural geomorphic regions.**

Geomorphological region	Geographic locations	Major soil types
Highland Regions	<ul style="list-style-type: none"> <li>Western Guyana</li> <li>Pakaraima Mountains</li> <li>Foothills of Kanuku Mountains</li> <li>Roraima area</li> </ul>	Cambisols
Upland and Hilly Regions	<ul style="list-style-type: none"> <li>Kurupukari</li> <li>Mabura Hill</li> <li>Entire forestry zone</li> </ul>	Ferralsols
	<ul style="list-style-type: none"> <li>Soesdyke</li> <li>Intermediate Savannas</li> <li>Mabura Hill</li> </ul>	Arenosols
	<ul style="list-style-type: none"> <li>Linden-Wismar</li> <li>Kwakwani-Berbice</li> </ul>	Laterites as Calcine bauxite
Coastal Regions	<ul style="list-style-type: none"> <li>Entire coastal zone</li> <li>Swamps</li> </ul>	Anthrosols; Gleysols; Fluvisols; Histosols

Source: FAO Classification Scheme by Geo-regions of Guyana (modified after Hammond, 2005)

Land capability describes a soil classification system that is based on the limitation of the soil type for agriculture. A Land Capability Classification was developed by the FAO (1966) for Guyana. It was later reclassified for soil conditions that assumed the provision of drainage, and for others that included the transportation cost of fertilizers.<sup>7</sup> The size of areas occupied by the major land capability classes of Guyana are shown in Table 2 below:

**Table 2: Land Capability Classes of Guyana**

Capability Classes	Description	Hectares	Percentage
Class I-II	Good to moderate agricultural land	3,327,395	15.8
Class III	Poor agricultural lands	8,227,247	39.0
Class III	Poor agricultural lands with fertiliser potentials	2,980,836	14.1
Class IV	Non-agricultural land	6,566,984	31.1
<b>Total</b>		<b>21,102,462</b>	<b>100.0</b>

Source: National Land Use Plan, 2013

The Ministry of Agriculture estimates that there are 1.74 million hectares of land currently under agricultural production, but due to poor drainage and irrigation facilities, only about 11 percent or 200,000 hectares are effectively utilised.<sup>8</sup> Agriculture on coastal plain soils has good potential for agriculture but is constrained mainly by poor drainage, while maintenance of soil fertility (particularly phosphorus and pH levels) and associated transportation costs are the major hurdles to overcome in the Hinterlands. Based on the information in Table 2, while only 15 percent of the country's land area is well suited for agricultural production, a further 53 percent requires advanced management inputs and/or conservation practices. The abundance of capable lands presents the country with good opportunities to expand its agricultural economy.

## A 3.4 Natural Resources

### A 3.4.1 LAND

#### A 3.4.1.1 Policy, Tenure and Rights

Guyana occupies a total surface area of 353,210 km<sup>2</sup> comprising a landmass of 214,970 km<sup>2</sup> and a maritime area<sup>9</sup> of 138,240 km<sup>2</sup>. Land tenure is categorised as public-, private- and Amerindian lands. Public land i.e. State Land and government land, comprises all land that is not owned privately or by Amerindian communities. The main agencies administering Public lands are the Guyana Lands and Surveys Commission (GL&SC), the Guyana Forestry Commission (GFC), the Guyana Geology and Mines Commission (GGMC) and the Mahaica-Mahaicony Abari

<sup>7</sup> "National Land Use Plan", Guyana Lands & Survey Commission, 2013.

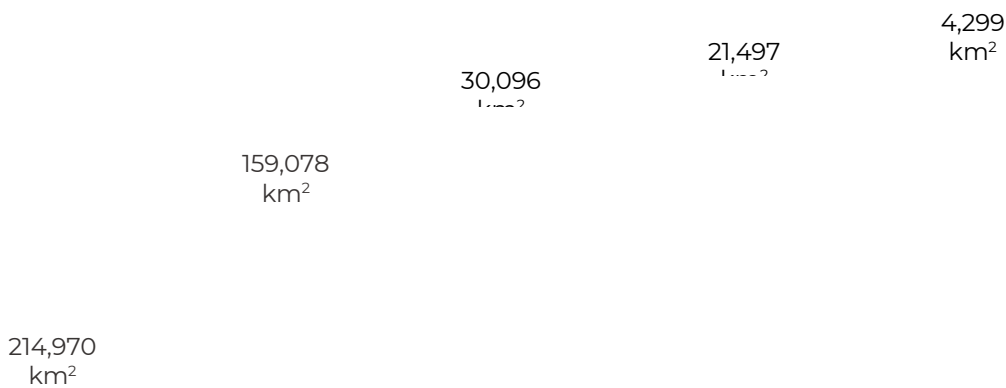
<sup>8</sup> Ministry of Agriculture, 2013.

<sup>9</sup> Government of Guyana- Ministry of Agriculture: Marine Fisheries Management Plan 2013-2018

Agricultural Development Authority (MMA-ADA). Established in 1978, the MMA-ADA was conceived as a project executing agency to oversee the construction of drainage and irrigation works in Region 5. The agency is responsible for providing drainage and irrigation services for agricultural development, and administration of all state and government lands, between the Berbice and Mahaica rivers.

Two leasehold systems exist: i) the 'Transport Index' based on Roman Dutch Law and ii) the "Index of land transfer of title," based on the Torrens System derived from English Law. The two systems in the way lands are transfer. That is, the transfer of Transported land from one entity to another must be done through the Court, while transfers of titles do not. Most of the land in municipalities of Georgetown and New Amsterdam are transported lands as is the case for a few parcels of agricultural land on the Coast<sup>10</sup>.

**Figure 3: Guyana land distribution**



*Data Source: Guyana Lands and Surveys Commission*

State Lands comprise 74% of Public lands (Figure 3). The Guyana Lands and Surveys Commission has jurisdiction over State Lands, which are used for agriculture in general. The Mahaica Mahaicony Abary-Agricultural Development Authority also allocates and administers lands for rice and livestock in Region 5, while the Guyana Forestry Commission and the Guyana Geology & Mines Commission administer leases for logging and mining, respectively. Conflict arises when these agency leases are issued for the same parcel of land for different purposes (i.e. agriculture, logging and mining) and is one of the major reasons for land use conflicts and environmental degradation in Guyana. State lands occupied by the municipalities are controlled by the Municipal Council, and those allocated as Protected Areas are managed by the Protected Areas Commission (PAC).

<sup>10</sup> National Land Use Plan, 2013.



Government Lands comprise 3% of Public land. These purchased by Government or granted for development of hospitals, schools, administrative buildings, recreational parks, public spaces and other types of land development schemes. This scenario allows Municipalities to control parcels of both State and Government lands.

Private land officially comprises 10 percent of all lands, but the National Land Use Plan regards this as an overestimate with the figure closer to 1%. These are former State lands held by private or corporate interests. The administration of Private Land is carried out by the Land Registry under the Office of the Attorney General.

Lands belonging to Indigenous Peoples are sometimes called Villages and Communities. A "Community" refers to those that have not received individual title to the lands that they occupy. A "Village" refers to lands owned communally under title granted to a Village Council. According to the National Land Use Plan, villages account for about 15%, approximately 32,265 km<sup>2</sup>, of Guyana's total land size. The village has all rights of use to the land, except for mineral rights for large scale mining. However, they have the right of veto over medium and small-scale mining. All villages have usufruct rights for fishing, hunting, logging, small-medium scale mining and other activities, but if they wish to commercially log forest resources, they are encouraged to apply for a State Forest Permit (SFP) from the GFC and prepare a forest management plan.

Since 1969 Indigenous Peoples living in Guyana have been making efforts to receive legal recognition for the lands they occupy and use. An Amerindian Land Commission established by the Government of that time recommended amendments to the Amerindian Act (1951). In 1976 the Act was amended and allowed for the granting of land titles to Indigenous communities. In the same year, 64 Indigenous communities, followed by another 10 in 1991, received legal recognition of the lands they occupy and use. The 10 Absolute Grants given in 1991 were issued under the State Lands Act. At this stage, lands granted to Indigenous Peoples represented approximately 6 percent of the country's land area.<sup>11</sup> The Amerindian Act (1976) was further revised in 2006 and provided for an additional 23 communities to become legal guardians of their lands through the issuance of Absolute Titles by what is now the Ministry of Indigenous Peoples' Affairs (MOIPA). By 2011, there were 112 Indigenous communities inclusive of satellite communities and settlements. At that time, there were 95 Titled Villages occupying a total of 3.2 M ha of land, which is just about 15% of all lands.<sup>12</sup> At present, there are 316 Amerindian communities, with 154 being Titled Villages and 162 are satellite communities.<sup>13</sup> The increase in acreage of lands legally owned by Indigenous Peoples is driven by the revised Amerindian Act (2006) which allows Indigenous Peoples to apply for extensions to lands already issued to them. Another factor is the GOG's commitment to address all Amerindian land titling issues by 2015. Prior to the Guyana REDD+ Investment Fund (GRIF), the costs of fulfilling this objective was prohibitive.<sup>14</sup> Furthermore, increases in the Indigenous population will drive an increase in demand for homesteads and farming grounds by residents. One of the land management constraints faced by Titled communities is the absence of demarcated

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<sup>11</sup>

<sup>12</sup> Guyana National Land Use Plan, 2013

<sup>13</sup> Patricia Fredericks ca. Anil Roberts (pers.comm.)

<sup>14</sup> UNDP 2012: Amerindian Land Titling Project



boundaries which leads to illegal encroachment by non-residents, squatters, miners and other persons seeking new economic opportunities.

#### A 3.4.1.2 Land Use Types

Lands in Guyana are subjected to a wide range of uses (e.g. forestry, agriculture, mineral mining, sand mining, housing development, biodiversity conservation, and petroleum exploration and extraction) and are administered by multiple agencies. This situation leads to conflicts and environmental degradation. Sustainable management of terrestrial ecosystems will require an understanding of the social and economic drivers of unsustainable land use. One of the main economic drivers is market demand and prices for commodities such as gold and timber. This leads to unsustainable land use and conflicts, especially in situations where there are multiple users of the same parcel of land.

*Forest Land:* Forest is the largest land cover type in Guyana – occupying 18.47M ha i.e. 87% of the country's total land mass.<sup>15</sup> Uses of forested areas include logging, mining, agriculture, settlements, and infrastructure, research, tourism, training, bioprospecting, conservation, wildlife management, climate regulation and cultural practices. The State Forest Estate, which is administered by the Guyana Forestry Commission (GFC) comprises 12.8 million hectares (70 percent of the country's total forested area) and the remaining 5.5 million hectares is owned and administered by Indigenous Villages (i.e. Titled Lands) and the Guyana Lands and Survey Commission (Table 3 and Map 2). With the exception of Mahaica-Berbice, the State Forest Estate is spread across all administrative regions with the East-Berbice Corentyne and Cuyuni-Mazaruni regions having the largest endowment.

The GFC administers lands under State Forests and issues leases for either production, research or reserve purposes (Map2). The different types of forestry lease arrangements depend upon size of area requested by the concessionaire, the nature and the duration of the operation. These are:

- i. State Forest Permits (SFPs) are issued for a period of two years for areas less than or equal to 8,000ha. These small-sized concessions include Community Forest Management Agreements. Presently, there are 76 Community Forestry Organisations (CFOs) with user rights to 128 concessions totalling 508,372 hectares of forest lands distributed across the country. Current membership of Community Forestry Programmes is about 1,689 members whose livelihoods are being enhanced while providing employment for over 3,600 other persons working as machine operators, drivers, etc. (Benn, unpubl.). The highest number of Community Forest Organisations (CFOs) exists in Region 10, followed by Regions 2 and 6.

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<sup>15</sup> Guyana REDD+ Monitoring, Reporting and Verification System. Interim Measures Report Year 6: January 2015 – December 2016 (Version 1)

**Table 3: Spatial Distribution of State Forests**

Region	Region Name	Hectares	%
1	Barima/Waini	1,614,281.68	12.55
2	Pomeroon/Supenaam	298,600.44	2.32
3	Essequibo Is./W. Demerara	216,136.35	1.68
4	Demerara/Mahaica	1,099.37	0.01
6	East Berbice/Corentyne	3,222,480.29	25.05
7	Cuyuni/Mazaruni	2,883,225.07	22.41
8	Potaro/Siparuni	904,449.73	7.03
9	Upper Takutu/Upper Essequibo	2,326,642.80	18.08
10	Upper Demerara/Berbice	1,352,264.72	10.51
<b>Non-Coverage</b>		<b>46,110.15</b>	<b>0.36</b>
<b>Total State Forest</b>		<b>12,865,290.60</b>	<b>100.00</b>

Source: Guyana Forestry Commission

- ii. State Forest Exploratory Permits (SFEPs) allow potential concessionaires to secure the land for two years to conduct baseline studies and to decide if it is feasible to invest into the sector. A SFEP is a pre-requirement for any large concession and cannot be renewed. The applicant is required to pay a non-refundable fee of US\$20,000 and develop a Forest Resources Management Plan (FRMP) within the duration of the SFEP i.e. if they decide to proceed with the extraction of timber from the concession. SFEPs do not permit commercial extraction, but the applicant is allowed to remove specified kinds and quantities of forest produce to recover no more than 25 percent of the expenses incurred during the exploratory phase.
- iii. Wood Cutting Leases (WCLs) are granted for up to 10 years for areas between 8,000-24,000ha;
- iv. Timber Sales Agreements (TSAs) granted for areas larger than 24,000 ha for 10-25 years; Recipients of TSA/ WCL are required to satisfactorily complete an Environmental and Social Impact Assessment (ESIA), a Forest Inventory, and a Business Plan within three (3) years of submitting their applications to the GFC. All leases are renewable subject to compliance with the terms of the agreement. State Forest Exploratory Permits (SFEPs) are also granted for 3 years and is the precursor to a TSA and WCLAs of May 2016, a total of 602 leases<sup>16</sup> equivalent to approximately 7.2Mha or 57.32 percent of State

<sup>16</sup> UNDP 2016: State of the Environmental Report. Guyana.

Forest or approximately 33 percent of the country's total land area were issued for timber production (Table 4).

**Table 4: Showing Allocation of State Forest**

Classifications	Amount	Area (hectares)	% State Forest
<b>Production Lands</b>			
State Forest Authorisations (SFA)	568	2,045,211	16
State Forest Exploratory Permit (SFEP)	6	570,302	5
Wood Cutting Lease (WCL)	1	21,268	0.17
Timber Sales Agreement (TSA)	27	4,527,345	36
Production Areas Allocated as at end of May 2016	602	7,164,126	57.3
<b>Forest Reserves</b>			
GFC Forestry Reserves	11	17,797.40	
Amount of State Forest Unallocated		5,412,077	43.2
Total State Forest Estate		12,576,203	

Source: UNDP 2016 (see footnote #16)

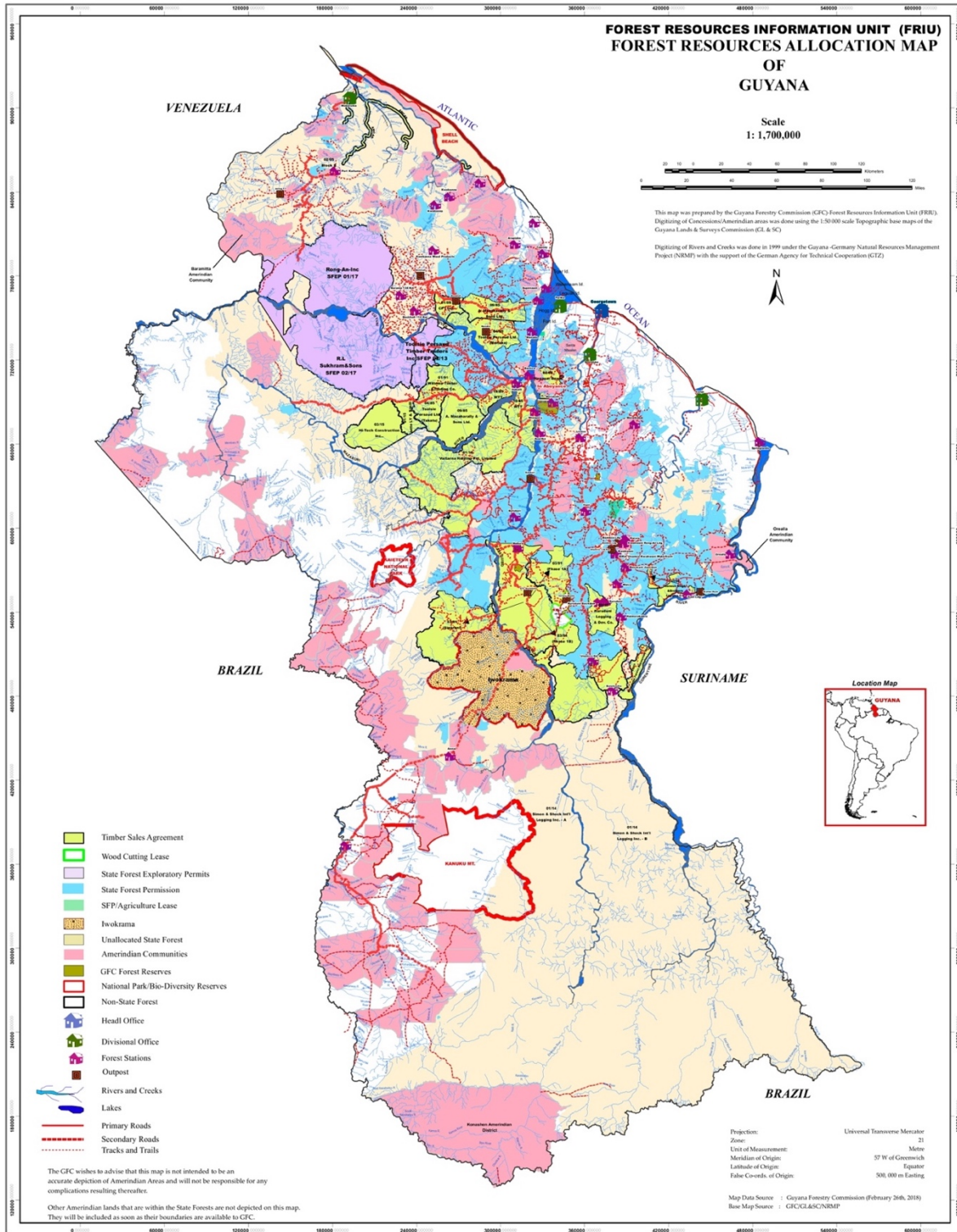
*Mining Lands:* GGMC has mapped and divided the entire country into six mining districts (Map 3) based on location and availability of minerals, and issues different mining leases depending upon the scale of the operation and whether the concessionaire is prospecting or actually mining. The types of mining leases are:

- Small Scale: Land Claim – 457.5 x 244m or 11.16 hectares (27.58 acres or 1 mile of river. These can only be issued to Guyanese by birth and/or naturalization.
- Medium Scale: Prospecting Permit – 61 - 486 hectares (150-1,200 acres) that can be renewed annually and converted to a Mining Permit with a duration of up to 25 years;
- Large Scale: Prospecting License - 202 - 5,180 hectares (500 - 12,000 acres), renewable annually and eligible for conversion to a Mining Permit for 25 years. Large scale aerial geological and geophysical surveys which are usually undertaken by large foreign companies will require a Reconnaissance and Survey Permit.

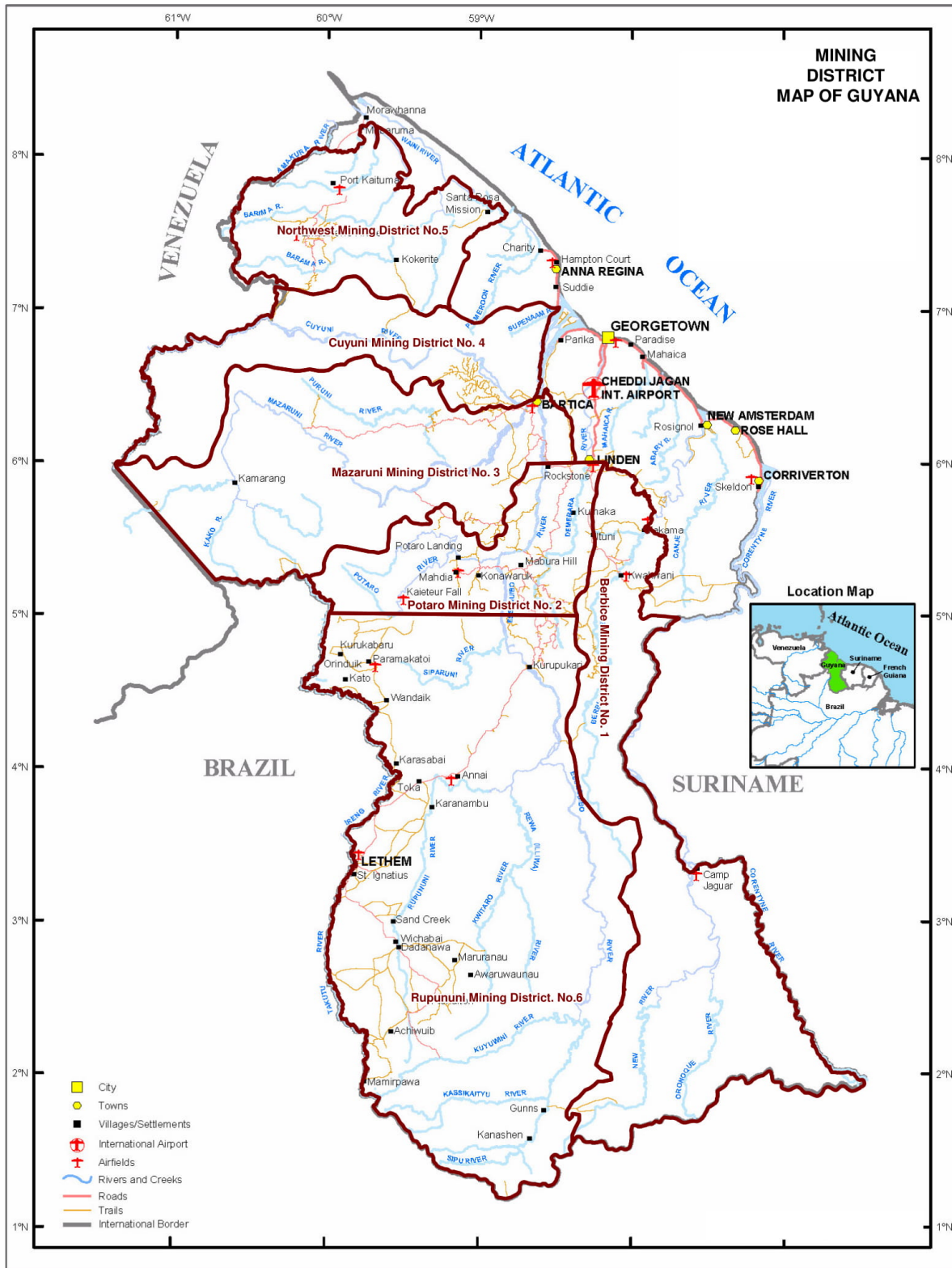
During the period 2010-2011, a total of 22,566 permits were issued for a total area of 9,400,859 ha (approximately 44 percent of the national land area) for different types of mining lease/permit arrangements. However, many of these claims were not actually utilised, and in many instances, the allocated mining permits overlap with logging leases.<sup>17</sup>

<sup>17</sup> National Land Use Plan, 2013

Map 2: Forest Allocation Map



Map 3: Mining Districts of Guyana

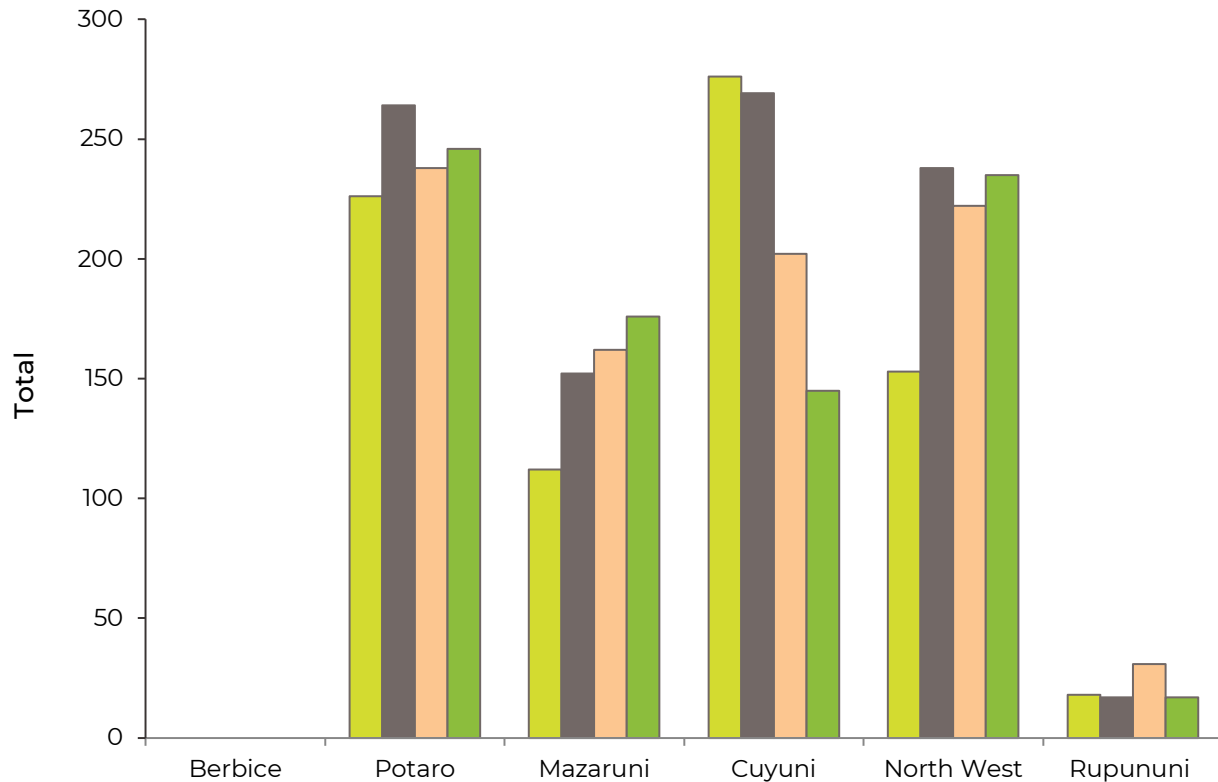


Source: Guyana Lands and Surveys Commission



Between 2005-2007, the Mazaruni-Potaro and Cuyuni area accounted for more than 87 percent of all licensed gold dredging operations,<sup>18</sup> but by 2015 the number of dredges monitored by the GGMC in the North-west District outnumbered that in Mazaruni area (Figure 4).<sup>19</sup>

**Figure 4: Dredges monitored in 2015**



Source: GGMC Annual Draft Annual Report, 2015

Bauxite and sand mining (silica) and stone quarrying are other forms of mining in Guyana. Information emerging from the GGMC shows that at the end of 2015 there were 70 active sand mining sites, 26 of which were located in areas within the Hilly and Sandy belt along the Soesdyke-Linden, and five active stone quarries dispersed throughout the Essequibo Region.<sup>20</sup>

Agricultural Lands. Except for agricultural lands in the MMA-ADA Project, the GLSC administers state land for agriculture and issues leases from as low as 5 hectares for periods as long as 50 years. Additionally, the GLSC has also earmarked a total of 536,400 hectares for development to attract investors under its Capital Budget Programme. Under this programme, leases for land from 1,500 hectares in size will be issued in Regions 6, 7, 9 and 10 (Table 5).<sup>21</sup> The MMA-ADA leases lands for agriculture within the MMA-ADA Project Area. Agricultural leases are issued with stipulations that include Right to Mortgage, Right to

<sup>18</sup> GGMC Annual Report, 2007

<sup>19</sup> GGMC Draft Annual Report 2015

<sup>20</sup> *ibid*

<sup>21</sup> National Land Use Plan, 2013

Transfer and Right of Refusal. The Right to Mortgage presents the lessee with an opportunity for loans and thereby creates opportunities to increase their production capital.

**Table 5: Lands Earmarked for Guyana Lands and Surveys Commission**  
*Capital Budget Project*

Regions	Locations	Hectares
6	Mara-Canje Backlands	201,558
7	Along the Bartica-Potaro Road	1,510
9		16,754
10	Moblissa-Watoka	12,141
10	Intermediate Savannahs	304,505
<b>Total</b>		<b>536,468</b>

Source: Guyana Lands and Surveys Commission, 2013

Land for Road Developments: Road access is an essential requirement for promoting trade and socio-economic development in Guyana. The national road network (paved or unpaved) was designed to connect the Hinterland with Coastal Regions, and in some instances, transboundary connections. Total network of roads (i.e. declared/undeclared, paved/unpaved, trails, etc.) is estimated at 7,970 kilometres.<sup>22</sup> However, the “national public” road network ranges between 2,600 to 4,000 kilometres,<sup>23</sup> that is, for declared and undeclared public roads. The national road network density is estimated at 3.5km/1000 persons,<sup>24</sup> but this estimate might be inaccurate due to an absence of data and lack of advanced data basing mechanisms.

One of the main aims of the Green State Development Strategy: Vision 2040 is to improve connectivity via roads between the Hinterland and Coastal Regions. Progress in this regard includes the recently declared 114 kilometres (approximately 71 miles) of fair-weather road along difficult terrain from Meritzero to Monkey Mountain to connect Regions 8 and 9 via the Georgetown to Lethem Road. This connection will open new opportunities and marketing alternatives for residents of Regions 7 and 8, who can now either market their produce at Lethem, Linden or Georgetown.

Roads, especially those in the hinterland will catalyze negative environmental and socio-economic impacts which must be monitored for Guyana to truly realize all the objectives of the Green State Development Strategy: Vision 2040Ro.

<sup>22</sup> NDS, 2000

<sup>23</sup> MOIPA, pers. comm

<sup>24</sup> MOIPA, pers. comm

The Georgetown to Lethem Road (Map 4) is the one of the GOG's highest priority and most important in terms of poverty alleviation and national development.<sup>25</sup>

It complements the Initiative for the Integration of Regional Infrastructure in South America (IISRA) road network being developed to strengthen markets and improve trade among countries on the South American continent. Exports of produce from northern Brazil follow a corridor that begins in Manaus and/or Boa Vista and ends at the Venezuelan port of Puerto la Cruz (Map 5). The Georgetown-Lethem Road will shorten the routes from Manaus and Boa Vista by 29 and 45 percent, respectively and will also reduce shipping costs.

The Georgetown-Lethem Road passes through at least three Administrative Regions in the Hinterland, cuts through the Iwokrama International Reserve, bisects the lands of Amerindian communities, and will impact the lives of more than 25,000 residents in Region 9.

Land for Protected Areas (PAs) is another land use type of importance to Guyana. PAs allow for the maintenance of healthy ecosystems for the provision of essential ecosystems goods and services. To date, there are five legally recognised PAs occupying a total of 1.8 M ha equivalent to 8.3 percent of the country's landscape (Table 6).<sup>26</sup>

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<sup>25</sup> CI-Guyana, 2009

<sup>26</sup> PAC



Map 4: Alignment of Georgetown-Lethem Road



Source: Conservation International

Map 5: Northern Brazilian Atlantic Road Route via IISRA



Source:

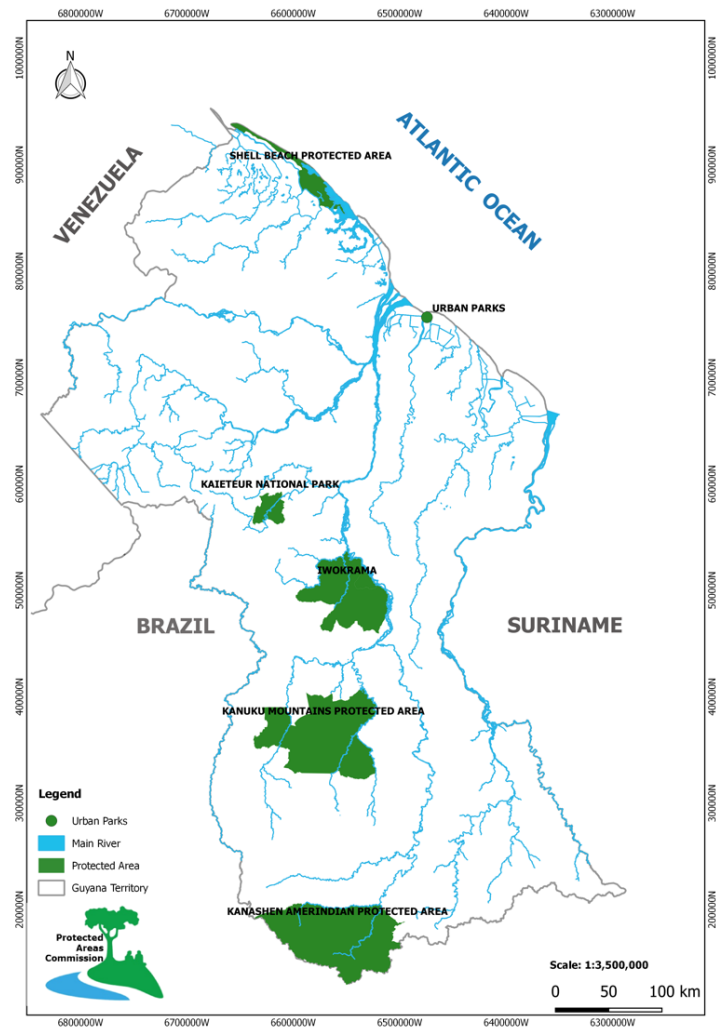
Table 6: Sizes of Protected Areas and the proportion of Guyana occupied by all Protected Areas

Protected Areas (PAs)	Size (in hectares)	% of Guyana
Kaieteur National Park	62,700	0.29
Kanuku Mountains Protected Area	611,000	2.84
Shell Beach Protected Area	123,055	0.57
Iwokrama Protected Area	371,000	1.73
Sub-total National Parks	1,167,755	5.43
Kanashen Community Owned Conservation Area	625,000	2.91
<b>Total</b>	<b>1,792,755</b>	<b>8.34</b>

Source: Protected Areas Commission



Map 6: Protected Areas in Guyana



Source: Protected Areas Commission

Other places earmarked for conservation management are as shown in Map 6a. Guyana's policy objective is to achieve the UNCBD target of having at least 17 percent of the country's land and inland water under some form of protection by 2020. The GOG's stated intent is to set aside another 2 million hectares for conservation. This will increase the proportion of land area under protection to 17.6 percent.

## A 3.5 Freshwater

### A 3.5.1 OVERVIEW

Guyana is endowed with enormous hydrological resources - surface and groundwater - that are used for domestic and commercial purposes. Surface water is usually extracted from rivers and creeks for domestic and other purposes. The Guyana Water Incorporated (GWI) has 4 active extraction sites in selected rivers of Region 7 and 10. Those of Region 10 are: i) One in the Demerara River to supply water to West Watooka and McKenzie municipalities; ii) another site in the Demerara River for residents of Christiansburg and surrounding areas, and iii) the

Dakouria Creek which serve residents of Wismar, Block 22, Half-Mile and Blue Berry Hill. About 5 million litres of freshwater is taken daily from each of these three extraction sites to supply about 9,000 persons in the Region with water for domestic and semi-commercial uses for example, car-wash bays.<sup>27</sup> At Bartica, in Region 7 there is a single extraction point in the Mazaruni River that provides about 2.5 million litres to residents of the area. The GWI is currently undertaking feasibility studies in Region 7 for the identification of new sites to replace the one in the Mazaruni River because of mining and the risk of mercury contamination.<sup>28</sup>

### A 3.5.2 SURFACE WATER

This includes freshwater from the internal network of rivers and creeks, man-made conservancies and wetland areas. During the rainy seasons (May-June) and especially in situations of high tides many of the rivers and creeks overflow their banks to produce permanent and semi-permanent lakes/ponds identified as natural wetlands that offer regulatory, and provisioning and cultural services. Though many have the potential to become RAMSAR sites, Guyana is the only Amazonian country not party to the Convention. Other than these naturally flooded areas, there are four man-made Conservancies located behind the Coast. These structures were designed and constructed to provide freshwater for agricultural and household needs of Coastal communities.

### A 3.5.3 GROUND WATER

The [groundwater](#) system comprises three coastal [aquifers](#), namely i) the Upper Sand developed in 1831 and closed in 1931 because of its shallowness, and high iron and saline content;<sup>29</sup> ii) the A Sand developed in 1931 to replace the Upper Sands and; iii) the B Sand opened in 1962. The latter two aquifers are the main sources of potable drinking water, and they occupy a total sub-surface area of approximately 20,000 km<sup>2</sup>, extending about 250 km along the Atlantic coast and 40 to 150 km inland.

There are also small to large inland aquifer systems located in the Hinterland Regions. These are: i) the White Sands Plateau in the vicinity of Linden; ii) the Takutu Sandstone Formation of the northern Rupununi Savannah; iii) the metamorphic rocks of the Barima-Mazaruni Supergroup that underlays the Kanuku Mountains; and iv) the Merume Mountains in the western parts of the country. These provide groundwater from depths ranging between 10 metres to 300 metres. Additionally, in northwest regions along the Waini River there is an aquifer system with large quantities of brackish to saline water at depths between 3 and 30 metres. Unfortunately, this aquifer is unfit for use due to saline contamination and sea water infiltration during high tides.<sup>30</sup>

<sup>27</sup> A. Roberts, pers.comm.

<sup>28</sup> *ibid*

<sup>29</sup>

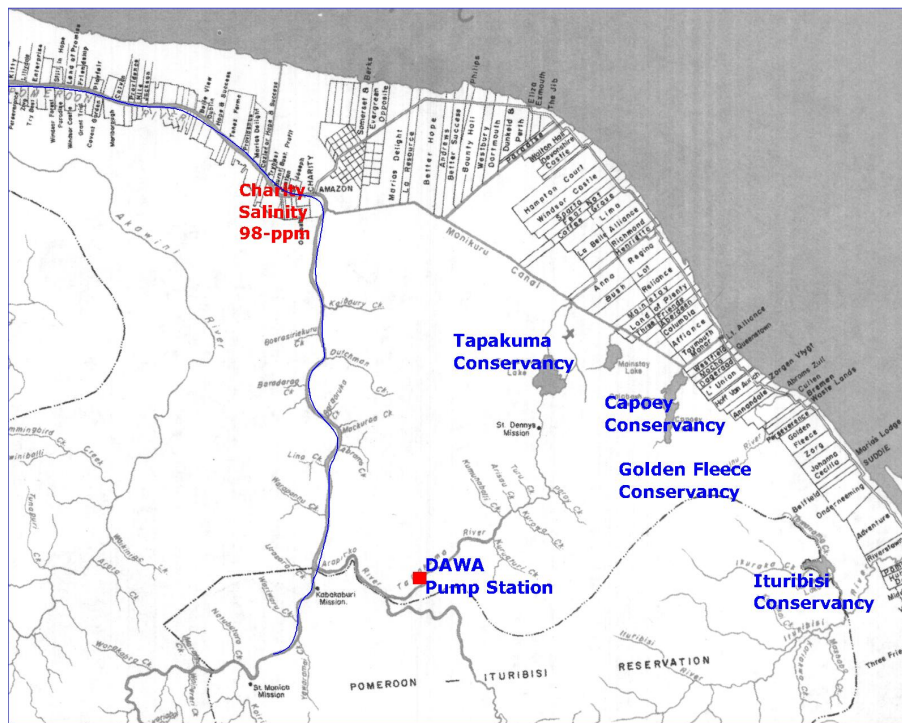
<sup>30</sup> US Corp of Engineers, 1998:

## A 3.5.4 WATER CONSERVANCIES

Seven water conservancies were constructed along the Coastal Plain to provide water for agricultural and domestic purposes as well as drainage for flood control through a network of canals.<sup>31</sup> The conservancies are shallow reservoirs of varying sizes and receive freshwater supplies from upland creeks and streams, mainly from the Hilly and Sandy physiographic region. Four of these water management structures exist in Region 2 and one in each of the Regions 3, 4, and 5. Those in Region 2 are the Ituribisi, Tapakuma, Capoey and Golden Fleece (Map 1). Collectively, these structures provide irrigation water and flood control to over 25,000 acres of rice lands, 380 acres of cash crops and the populated centres of the Region.<sup>32</sup> The largest of these is the Tapakuma Conservancy, which has an area of 140 km<sup>2</sup> with a reservoir capacity of 18.1 cubic hectometer (hm<sup>3</sup>). It became operational in 1974 to provide irrigation for 15,000 acres of rice lands in the Region.

The Tapakuma Conservancy receives irrigation water from the Tapakuma River by artificial means i.e. of pumps at the Dawa Pumping Station, and during the rainy season excess water is released through the Cozier Canal located at the north boundary of the dam crest, near the Pomeroun River.<sup>33</sup>

Map 7 : Water Conservancies in Pomeroun-Supenaam



Source: National Drainage and Irrigation Authority

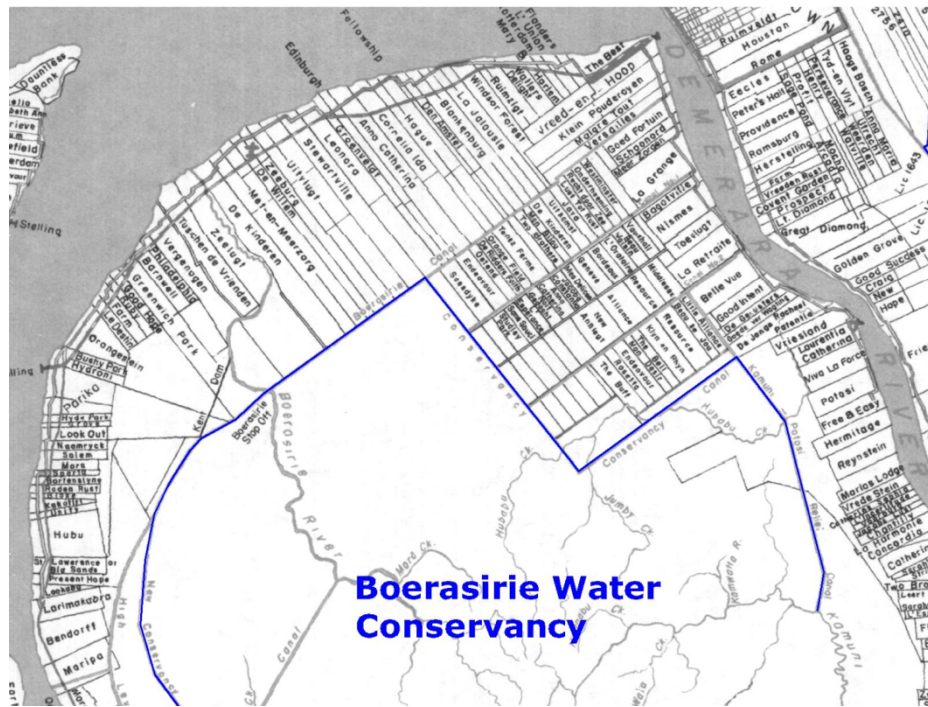
<sup>31</sup> T. Inniss, pers. Comm.

<sup>32</sup> *ibid*

<sup>33</sup> WWF 2012 Biodiversity of Wetlands Report

The West Demerara Water Conservancy (WDWC) aka the Boerasarie Conservancy (Map 8) spans an area of almost 100 square miles. It was constructed in the 1950's to provide flood control and irrigation to 525,757 acres of sugar cultivation and another 40,848 acres for the cultivation of rice and other crops in Region 3. It has a capacity of 165 hm<sup>3</sup> with a reservoir area of 235km<sup>2</sup>. Flooding is controlled by drainage through the Essequibo and Bonasika Rivers.<sup>34</sup>

**Map 8: Boerasarie Water Conservancy in Essequibo Islands-West Demerara**



Source: National Drainage and Irrigation Authority

The East Demerara Water Conservancy (EDWC) located above 15 miles south of the coastal foreshore between the Mahaica and Demerara Rivers (Map 9) in Region 4. It was constructed in 1878 to prevent floods in the wet season and to store water in dry seasons. The EDWC is perhaps the most important of all conservancies in Guyana. The catchment area of 518km<sup>2</sup> is bordered by a northern dam 72 km long that aligns parallel to the Atlantic Ocean.<sup>35</sup> This reservoir has a capacity of 340hm<sup>3</sup> with a maximum storage level of 57.5 Georgetown Datum (GD). It provides irrigation water to thousands of acres of rice, sugar and other crops cultivated in the Region. The Conservancy is also one of the primary sources of domestic water supplies to some parts of Georgetown. Due to its low-lying topography excess water can only be removed by motorized pumps or by gravity flow at low tide through its main drainage canals (e.g. Kofi, Cuhna, Dutch Four Canals) into the Atlantic Ocean. In response to the floods of 2005, and to reduce the danger of future overtopping and breaches, the design of the Conservancy was

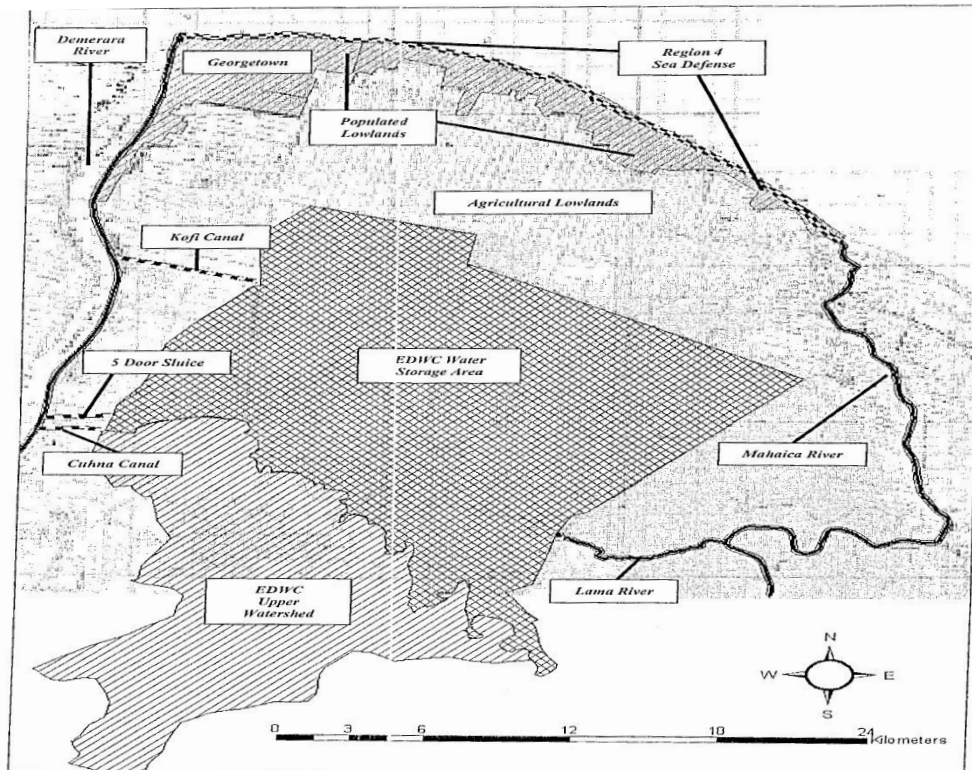
<sup>34</sup> WWF 2012 Biodiversity of Wetlands Report

<sup>35</sup> WWF 2012 Biodiversity of Wetlands Report



adapted to include 10.3km long canal, a three-door head regulator at the conservancy end of the channel and an eight-door outfall sluice into the Atlantic Ocean.<sup>36</sup>

**Map 9: East Demerara Water Conservancy in Essequibo Islands-West Demerara**



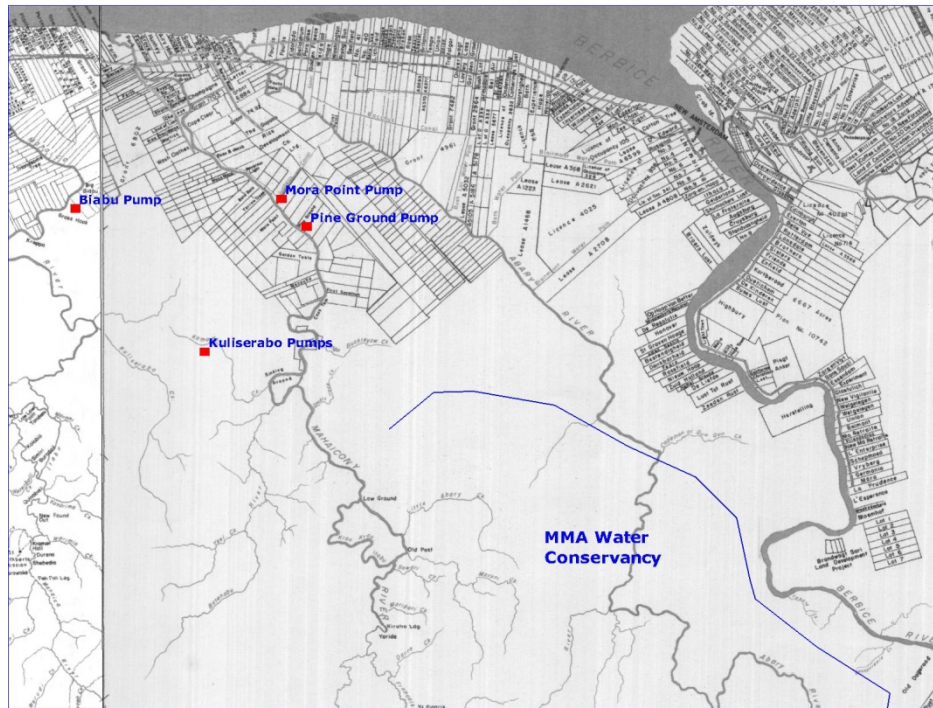
Source: National Drainage and Irrigation Authority

The Mahaica, Mahaicony Abari Conservancy in Region 5 was constructed in 1985 by partially damming a floodplain area lying between the Mahaicony and Berbice Rivers (Map 10). It is the largest of all conservancies with a capacity of 609 cubic hectometer ( $\text{hm}^3$ ) and a reservoir area of 808  $\text{km}^2$ . The Conservancy represents Phases 1 and 4 of the Mahaica, Mahaicony Agricultural Development Project which was established to allow for increase agricultural production in the Region 5. Phases 2 and 3, when completed, will complement the Project which is designed to provide drainage and irrigation to over 450,000 acres of agricultural lands lying between the Mahaicony and Berbice Rivers. At present, the MMA/ADA supports almost 50 % of the national rice production, about 30-35% of all livestock (most cattle) production and 10-15% of national sugar production.<sup>37</sup>

<sup>36</sup> T. Inniss, pers.comm.

<sup>37</sup> *ibid*

Map 10: Mahaica/Mahaicony/Abary Water Conservancy



Source: National Drainage and Irrigation Authority

### A 3.5.5 WATER DEMAND AND AVAILABILITY

The annual per capita water availability is 314,963 cubic metres, indicating that Guyana is enormously rich in freshwater resources.<sup>38</sup> In 2012 the UNDP<sup>39</sup> estimated the total water withdrawal by all sectors to be around 1,444 m<sup>3</sup>. Agricultural production withdrew an estimated 94.1% of the national total for irrigation, which is provided by 485 km of main canals and 1,100 km of secondary canals and the four artificial conservancies. About 4.2% of the national total was withdrawn by GWI to meet the domestic needs of the Municipalities, while the industrial sector withdrew about 1.4% but it is not sure if the water withdrawal from mining was considered.<sup>40</sup>

#### A 3.5.5.1 Potable Water Supply

The potable water is extracted from either the ground water aquifers or the Conservancies. GWI developed and manages a total of 230 groundwater wells and 25 operating water treatment for the provision of safe water across the Regions of Guyana.<sup>41</sup> Demerara-Mahaica and Upper Takutu-Upper Essequibo have the greatest amount of groundwater wells, while there aren't any water treatment plants in Barima-Waina and Cuyuni-Mazaruni.

<sup>38</sup> GLSC 2013

<sup>39</sup> UN 2012

<sup>40</sup> UN 2012

<sup>41</sup> A. Roberts, pers. comm



In addition to the wells sunk by the GWI, a number of indigenous communities in Hinterland Regions have also constructed their own wells. These hand-dug wells are located in areas of inland aquifers (for example, in the regions of Potaro-Siparuni and Upper Takutu-Upper Essequibo) and were sunk by local residents. These wells although shallow (less than 90 metres or 30 feet deep) allow for about 71 percent of communities in these two Regions to have access to potable water.<sup>42</sup>

Water rights in Guyana are vested in the State - Section 36 of the National Constitution provides for the State to protect and rationally utilise its water resources. The State's rights to the water resources was reinforced by Section 18 of the Water and Sewerage Act (2002) - "the ownership of all water resources and the rights to use, abstract, manage and control the flow of water is vested in the State." However, in Guyana, water is administered by several institutions, many with overlapping responsibilities. These include:

#### A 3.5.5.2 The Guyana Water Incorporated (GWI)

GWI was established in 2002 under the Ministry of Housing and Water, now renamed the Ministry of Communities, as a GOG-owned Public Corporation recognized by the Water and Sewerage Act (2002) as the public supplier of potable water for domestic, industrial and commercial purposes. The mission of GWI is to "*deliver safe, adequate and affordable water and to ensure sewerage systems for improved public health and sustainable development.*" The GWI is therefore not only responsible for potable water supply but also has a role in sewerage disposal.<sup>43</sup>

#### A 3.5.5.3 Hydrometeorological Services

Another agency mandated for water management under the Water and Sewerage Act (2002) is the Hydrometeorological Services - an arm of the Ministry of Agriculture (MOA), with general responsibilities that include monitoring the availability and quality of ground and surface water resources, managing the licensing system for ground and surface water, observing, archiving and understanding weather and climate, and providing meteorological, hydrological and oceanographic services to the country.<sup>44</sup> These two organizations are governed by one piece of Legislation but have different reporting responsibilities i.e. the Hydrometeorological Service reports to the MOA, the GWI is answerable to the MOC.

#### A 3.5.5.4 National Drainage and Irrigation Authority (NDIA)

Established in 2006 by the NDIA is the country's focal point on all public matters dealing with the management, improvement, extension and provision of drainage, irrigation and flood control infrastructure and services. The NDIA is the arm of the MOA responsible for water resources management and planning primarily for agricultural purposes.<sup>45</sup>

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<sup>42</sup> Government of Guyana: 2013: Guyana's Report for the 3rd International Conference for Small Island Developing States (SIDs). GOG, Georgetown. Guyana

<sup>43</sup> Water and Sewerage Act 2002: Chp 30:01

<sup>44</sup> *ibid*

<sup>45</sup> NDIA Act 2006

#### A 3.5.5.5 The Mahaica, Mahaicony, Abary-Agricultural Development Authority (MMA-ADA)

The MMA-ADA is a water-control agricultural development project established by the MMA-ADA Act of 1977 to improve the farming lands situated between the Mahaicony and Berbice Rivers. Under the Act, the functions of the Authority include amongst others, to plan, approve and undertake drainage and irrigation (D&I) systems in the project area. Furthermore, except for sewerage works, the MMA-ADA Act gives the Authority the right to exercise control and management over water for D&I in the project area.<sup>46</sup>

#### A 3.5.5.6 Amerindian Village Councils

Amerindian communities receive their water supplies either from nearby rivers and creeks or from the shallow wells dug on Village lands. Part IV of the Water and Sewerage Act 2002 stipulates that any person with the intent to create and use a “bore hole” for water extraction should first inform and seek permission from the HydroMet Service. However, this does not apply to Amerindian Villages. Section 14.(1) of the Amerindian Act 2006 permits Village Councils to make village rules governing the control, maintenance, protection and use of water supplies, including the construction and regulation of wells owned by the Village. This allows Amerindian Villages to sink wells and extract ground water free of charge.

#### A 3.5.5.7 Water Users Associations (WUAs)

Water Users Associations (WUAs) are community-based NGOs comprising mainly of farmers and other stakeholders who pay for a service.

Though the right to water is vested in the State, there isn't any State entity (parent-body) with overarching responsibilities for the management and use of water in the country. Section 3 of the Water and Sewerage Act 2002 provides for the establishment of a National Water Council to be the parent-body for water management. To date, this remains non-existent. The Act mandates the NWC to advise the Minister of Communities on the development and implementation of national water policies to ensure equitable distribution of water across the country, to be responsible for advising government agencies on the incorporation of the water policy into their activities and work programmes; and to oversee the management and coordination of a national water policy.<sup>47</sup> The apparent overlap in responsibilities and lack of clarity on the hierarchy of water extraction and management can be attributed to the absence of the NWC and its associated National Water Use Policy.

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### A 3.5.6 WATER SECURITY AND MANAGEMENT

#### A 3.5.6.1 Limited Management of the national aquifer system

There is a lack of a systematic monitoring programme to regularly collect qualitative and quantitative data, including information on recharge rates of the underground aquifer

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<sup>46</sup> MMA-ADA Act Chp: 69:11;

<sup>47</sup> Water and Sewerage Act 2002: Chp. 30:01

system.<sup>48</sup> Regular monitoring is now more important since the pressure head of the A Sand Aquifer is reported to have fallen by 20 metres.<sup>49</sup>

#### A 3.5.6.2 Sea (salt) Water contamination

The high levels of extraction from coastal aquifers for domestic water supply renders these aquifers vulnerable to the effects of saltwater intrusion especially during high tides. Sea level rise due to climate change is predicted to aggravate this situation.

#### A 3.5.6.3 Poorly maintained Drainage and Irrigation (D&I) Systems

Most of the country's D&I systems are not regularly maintained and are inadequate for the irrigation needs. Due to poor maintenance many of these structures became incapable of draining low-lying areas especially during abnormal high tides or heavy rains thereby resulting in flooding, which is a major concern of coastal Regions 3, 5 and 6.

#### A 3.5.6.4 Water Pollution

Improper solid waste management and chemical pollution from mining (e.g. mercury) and agriculture (e.g. pesticides and nitrate-based fertilisers) affects the quality of surface water available for human consumption, and present health risks to communities. Mercury pollution from mining is of major concern particularly for the Amerindian communities of the Hinterlands. It is expected that this issue will soon be resolved as the Ministry of Natural Resources that monitors and regulates mining, is moving to ban the use of mercury in the mining sector from 2020.

The continued use of septic tanks and pit latrines in municipalities and villages is also a threat to groundwater, especially during high rainfall events and floods. Some areas of the Georgetown are serviced by an inefficient sewerage system to remove waste water, and the discharge of untreated solid waste at the mouth of the Demerara remains as the approved method of sewerage disposal.<sup>50</sup> The practice of discharging sewerage into waterways is common in a few Hinterland Regions, particularly Region 1. A few Coastal communities in Regions 3 and 5 are also dumping sewerage and other forms of solid waste into adjacent waterways.

#### A 3.5.6.5 Absence of an Integrated Water Use Policy

This policy has been in draft for some time, with consequences for the establishment of the proposed National Water Council (NWC). The council will, when established, comprise a wide cross section of water users and administrators, working to ensure an integrated approach to water security and management. This envisages horizontal collaboration on water resources management (surface and sub-surface) between, Guyana Forestry Commission, Guyana Geology and Mines Commission, Guyana Water Incorporated, National Drainage and Irrigation Authority, Water Users Association, etc. The absence of a National Water Council and an Integrated Water Management Resources Policy is partially responsible for the absence of an integrated approach to water security and management

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<sup>48</sup> MSEG #2 Report

<sup>49</sup> GLSC 2013

<sup>50</sup> PAHO (GUYANA) 2016

A 3.5.6.6 Increases in the Critical Demand for water

While it is necessary to ensure that the entire nation has access to safe water for human consumption, it is also important for the country to establish national and sub-national estimates on the critical demand of freshwater. Mining and rice coupled with the creation of towns and urban expansion is expected to raise the threshold for the critical demand of freshwater.

A 3.5.6.7 Illegal activities

At present, the GWI does not have the capacity (i.e. modern technology) for increased surveillance to deter destruction of its water distribution system by illegal water users.<sup>51</sup> The breaking of mains by domestic water users in municipalities and towns, and for “gold wash-down” by illegal miners in some parts of Region 8 reduces the quantity and quality of available water. Furthermore, the country’s borders are conducive to the intrusion of foreign nationals who construct illegal reservoirs to establish fish farms in the Hinterland Regions. These illegal infrastructure cause blockages and affect the natural hydrology of the area which disrupts the availability of surface water to communities downstream.

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## A 3.6 Biodiversity

### A 3.6.1 OVERVIEW

Guyana's vision for biodiversity as reported in the National Biodiversity Strategy and Action Plan (NBSAP 2012-2020) is that "by 2030, biodiversity is sustainably utilized, managed and mainstreamed into all sectors contributing to the advancement of Guyana's bio-security, and socio-economic and low carbon development." To fulfil this vision, the nation aims at having its biodiversity valued, effectively conserved, protected and restored where appropriate, delivering significant benefits and contributing to climate change mitigation and adaptation in a way that is acceptable nationally and globally. This vision and goal are in line with those of the Framework for the Green State Development Strategy and highlights the importance of biodiversity to Guyana's development.

### A 3.6.2 POLICY AND LEGISLATIVE FRAMEWORK

The duties and obligations of the State and its citizens towards biodiversity management are enshrined in the Guyana Constitution where Article 36 states that "the well-being for the nation depends upon preserving clean air, fertile soils, pure water and the rich diversity of plants, animals and eco-systems". To advance on the Constitution and demonstrate to the world that it's serious about managing biodiversity, Guyana became a signatory and/or ratified a number of Multi-national Environmental Agreements (MEAs). Those specific to biodiversity are as follows:

*United Nations Convention on Biological Diversity (UNCBD):* Guyana become a signatory to the UNCBD in 1992 and ratified it two years later. The UNCBD, created in 1992 at the Earth Summit in Rio, is the international binding Agreement for use and conservation of biodiversity by parties of the Convention. The three main goals of the Convention are: i) the conservation of biological diversity; ii) the sustainable use of its components and, iii) the fair and equitable sharing of benefits from the use of genetic resources.<sup>52</sup> The UNCBD is the medium for signatories to receive incentives for conservation and sustainable use of biodiversity from other nations signed on to the Convention.

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<sup>52</sup> [www.cbd.org](http://www.cbd.org)

*REDD+ Agreement:* Reduced Emissions from Deforestation and Forest Degradation (REDD+) is an international mechanism that encourages developing countries to receive financial support to reduce greenhouse gas emissions and regulate global climate through the conservation of forests and biodiversity and sustainable management of forests, which enhances of forest carbon stocks.

The main purpose of REDD+ is to mitigate global climate change, whilst providing socio-economic benefits (for example, improved livelihoods, stronger forest governance) to participating countries. Guyana's participation in the REDD+ programme was driven by the desire for a strategy that will allow for forest protection while simultaneously enhancing the contributions of forestry to national development. Under the Agreement, the Government of the Kingdom of Norway committed to provide Guyana with US\$250 million in support of its avoided deforestation efforts over a five-year period commencing in 2009. Though the Agreement is a forest-based one, it stipulates for protected areas to be created and established in close collaboration with indigenous communities.<sup>53</sup> The Agreement expired in 2015 and both countries have signaled their intentions to seek a renewal as Guyana is yet to implement all the benchmarks.

Guyana is also a signatory to a few Treaties restricted to Caribbean and Latin American countries. These are: i) Caribbean Planning for the Adaptation to Climate Change; ii) Caribbean Regional Environmental Programme; iii) Latin American Network for Technical Cooperation in National Parks, Protected Areas and Wildlife; and iv) the Guiana Shield Initiative.<sup>54</sup>

Since signing the UNCBD, Guyana's commitment to sustainable use of biodiversity

### Box 1: Nine Strategic Objectives of the National Biodiversity Strategy and Action Plan 2012-2020

**SO1:** Improve the status of biodiversity by conserving ecosystems, species and genetic diversity and by restoring biodiversity and ecosystem services in degraded areas.

**SO2:** Promote the conservation, sustainable use and value of biodiversity into key productive sectors used for growth, expansion and diversification of the economy.

**SO3:** Expand and improve awareness, appreciation and communication on biodiversity and ecosystems.

**SO4:** Improve national implementation, monitoring and reporting for Multilateral Environmental Agreements (MEAs) and other bilateral commitments.

**SO5:** Create stronger and wider national, regional and international partnerships that contribute to achieving the goal and objectives of this Plan.

**SO6:** Consolidate/harmonize policy, legal, regulatory, and administrative frameworks that support the sustainable use, protection and management of biodiversity resources.

**SO7:** Improve substantially biodiversity monitoring at the national level and within key productive sectors.

**SO8:** Strengthen the knowledge base and capacity for conservation, management and sustainable use of biodiversity.

**SO9:** Secure adequate resources from national, regional and international sources for the implementation of the Plan.

<sup>53</sup> Jake Bicknell et al 2017: Designing protected area networks that translate international conservation commitments into national action

<sup>54</sup> Guyana's National Biodiversity Strategy and Action Plan 2012-2020

was further reinforced by the enactment of a number of legislations and the development of a series of related policies, strategies, and action plans. The national legislations related to biodiversity include: (i) Environmental Protection Act (1996); ii) Protected Areas Act (2011); iii) Fisheries Act (2002); iv) Wildlife Conservation and Management Act (2016); v) Wildlife Act (2002); vi) the Wild Birds Protection Act, (1990); and iv) Plant Protection Act 1919. The Environmental Protection Act, the Protected Area Act and the Wildlife Conservation and Management Act gave rise to the three foremost institutions responsible for managing Guyana's biodiversity. These are:

- Environmental Protection Agency (EPA): The EPA was established in 1996 by the EPA Act (1996) with the mandate to manage, conserve, protect and improve the environment. The Agency is the national focal point for the Global Environmental Facility, the UNCBD, the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, and the Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Area.
- Protected Area Commission (PAC): The PAC was established under the Protected Area Act 2011 to provide for the establishment of a national protected areas system for the protection and conservation of biodiversity and ecosystem services for sustainable development.
- The Wildlife Conservation Management Commission (WCMC): was established under the WCMC Act 2016. Functions of the Commission include: i) providing effective management of wildlife so as to ensure its conservation, and sustainable use; ii) granting of licenses, permits and certificates in respect of activities related to wildlife and monitor for compliance; iii) coordinate, in consultation with stakeholders, the establishment and maintenance of wildlife conservation and management plans and programmes; and iv) advise the Minister on actions to be taken for the implementation and enforcement of the First, Second and Third Schedules of the CITES Convention.

Other national institutions with mandates related to biodiversity include: i) Department of Environment (via the Ministry of Presidency) ii) Guyana Forestry Commission (via the Ministry of Natural Resources); iii) Fisheries Department and Guyana Livestock Development Authority (via Ministry of Agriculture); (v) Guyana Forestry Commission; vi) Integrated Coastal Zone Management Committee; vii) Mangrove Action Committee; viii) National Mangrove Management Unit; ix) the National Coordinating Committee on Biosafety and Biosecurity; and x) the REDD+ Secretariat.

One of the main responsibilities of the Department of Environment is to integrate the activities of the non-extractive agencies, i.e. Environmental Protection Agency, Protected Areas Commission, and the Wildlife Conservation and Management Commission into a single coordinating framework. The Ministry of Natural Resources coordinates the extractive sectors (e.g. forestry and mining), except for fisheries.

The management of biodiversity in Guyana is also guided by a number of national and sectoral policies, action plans and regulations. These include:

- *National Biodiversity Action Plans (NBAP)*: Under Article 26 of the UNCBD, Guyana along with other signatories, is required to prepare and submit NBAPs. To date, five NBAPs have been prepared and submitted for the periods 1994-1999; 2000-2003; 2004-2006; 2007-2010 and 2011- 2014. The fifth NBAP covered the period 2011 to 2014. It described the actions taken by Guyana to conserve and sustainably manage its diversity to achieve the UNCBD strategic goals including the Aichi Biodiversity Targets. The UNCBD guidelines stipulated for the report to consist of three parts: i) Updates on biodiversity status, trends, threats and implications for human well-being; ii) a National Biodiversity Strategy and Action Plan (NBSAP) for mainstreaming of biodiversity; and iii) a description of progress towards the 2015 and 2020 Aichi biodiversity Targets as well as those of the Millennium Development Goals (MDGs). In order to enhance effectiveness of implementation, the GOC in 2014 made a decision for the NBAP to be revised and updated to a National Biodiversity Strategy and Action Plan (NBSAP 2012-2020).
- *National Biodiversity Strategy and Action Plan (NBSAP) 2012-2020*: The NBSAP 2012-2020 outlines the vision, roles, duties and obligations of the country to protect, and equitably share the benefits arising from the use of biodiversity. The NBSAP also provides guidance on the actions required for sustainable utilization and conservation of biodiversity, outlines the national priorities and the strategic objectives to be achieved, and identifies the partners that contribute or support Guyana to meet its national biodiversity targets while simultaneously honouring its obligations to the UNCBD. The NBSAP 2012-2020 has nine Strategic Objectives (SO) and Priority Actions (See Text Box 1) that collectively reflect a low emission development pathway, mainstreaming of biodiversity in important Sectors such as forestry, mining and agriculture, and provides for improved data collection for effective monitoring and management of natural resources, and improve the implementation of related Conventions and Protocols.
- *Policy on Access to Genetic Resources and Fair and Equitable Sharing of Benefits Arising from their Utilization (2007)*: The general objective of this Policy is to guide the conservation and sustainable use of biological resources for poverty reduction, sustainable livelihoods, health, and cultural practices. It provides guidelines for Guyana as both a provider of genetic resources and a user of genetic materials originating from elsewhere. It is the basis for equitable sharing of socio-economic benefits from the nation's genetic resources.
- *Biotechnology, Biosafety and Biosecurity Policy (2007)*: This policy aims at controlling Genetically Modified Organisms (GMO) and Living Modified Organisms (LMO) to avoid adverse effects on the conservation and sustainable use of biological diversity in Guyana. In addition to GMOs and LMOs, the policy also targets all elements of genetic materials used in genetic manipulation, as well as, laboratory and field applications of biotechnology within Guyana.
- *National Forest Policy (2017)*: The overall objective of the Policy is for “the conservation, protection, and utilisation of the state’s forest, by ensuring it’s social, economic, and environmental attributes and benefits are sustained and enhanced for the benefit of current and future generations of Guyanese, whilst at the same time fulfilling Guyana’s



commitments under international agreements and conventions.” The policy aims at achieving four specific objectives: I) deriving economic benefits from the forest; II) conserving, protecting and sustaining the forest; III) governing the forest; and IV) building capacity for effective forest management. Guidelines and priorities for biodiversity management are provided under specific objectives I, II and III, but more so under II, which outlines numerous measures for the protection, conservation and restoration of biodiversity and ecological integrity as a component of sustainable forest management.

- *Low Carbon Development Policy (LCDS):* Guyana’s LCDS was first prepared in 2009 and revised in 2010 and 2013. The LCDS presented Guyana’s vision and plan for the country’s forest to be protected and maintained to reduce global carbon emissions while at the same time attracting resources for development that would put Guyana onto a low carbon growth path.<sup>55</sup> The three main components of the LCDS were: i) investment in low carbon economic infrastructure; ii) investment and employment in low carbon economic sectors; and, iii) investment in communities and human capital. The Low Carbon Development Strategy emerged from the REDD+ Agreement between the GOG and the Kingdom of Norway, whereby the latter agreed to provide the former with financial support to reduce greenhouse gas emissions and protect global climate through the sustainable management of forest carbon stocks and the conservation of biodiversity.

Other plans and strategies include: i) National Environmental Action Plan (2001-2005); ii) National Forest Plan (2011); iii) National Protected Areas System Plan (2013-2015); iv) National Land Use Plan (2013); v) National Mangrove Management Action Plan (revised in 2010); vii) Integrated Coastal Zone Management Action Plan (2000); and viii) National Marine Fisheries Management Plan (2013-2018); ix) National Strategy for the Conservation and Sustainable Use of Guyana’s Biodiversity (1997); x) National Protected Areas Strategy (2002); and recently, the Framework Document for the Guyana Green State Development Strategy (2017).

### A 3.6.3 STATUS

Guyana is part of the Guiana Shield Region which forms part of the Amazon Biome. The Amazon Biome, spanning 6.7 million km<sup>2</sup>, is the single largest remaining tropical rainforest in the world and is home to at least 10% of the world’s known biodiversity. Guyana’s geographic location and its proximity to the Amazon Region has allowed it to be one of the most species rich places in Guiana Shield. Supporting almost 81% of all birds, 80% of all mammals and 60% of all reptiles discovered in the Guiana Shield. Though there are many species not yet discovered, knowledge of the country’s biodiversity as at 2010 is as shown in Table 7 below:

<sup>55</sup> Guyana’s Fifth National Report to the Convention on Biological Diversity

**Table 7: Number of Biological Species Found in Guyana**

	Taxonomic Group					
	Plants	Birds	Fishes	Mammals	Reptiles	Amphibians
<b>Suriname **</b>	~ 5,100	715	318	192	175	102
<b>Guyana*</b>	~8,000	814	467	225 (104 are non-volant)	179	130
<b>All of Guiana Shield</b>	tbd	1004 <sup>a</sup>	tbd	282 <sup>a</sup>	295 <sup>a</sup>	269 <sup>a</sup>

Source: \* Guyana Fifth National Report CBD, 2014; \*\* Suriname's Fourth National Report to CBD 2012; Checklist of the Terrestrial Vertebrates of the Guiana Shield, 2005

Other forms of biodiversity known to occur in the country includes approximately 1,200 species of fungi, 33 bacterial species, 13 types of nematodes, 44 algae, 17 mollusc and 30 viruses.<sup>56</sup> Guyana's species richness is not only attributed to its close proximity to the Amazon Biome, but is also influenced by the variation of natural habitats that comprises the country's six major ecosystems. Except for coastal and marine areas, 70 percent of Guyana's ecosystems are relatively intact. These ecosystems are discussed below.

#### A 3.6.4 COASTAL AND MARINE ECOSYSTEMS

Guyana is located between the estuaries of the Amazon and Orinoco Rivers, and soil profile of country's coastline was influenced by the deposition of unconsolidated clay and silts by the Amazon and Orinoco River as well as the inland rivers e.g. the Essequibo and Corentyne. The continuous deposition of silt resulted in the coastal waters being persistently brown and turbid. Guyana's coast is basically a marine inter-tidal mudflat, intersected by sand and shell beaches, and mangrove forests. It lies 2m below sea-level at high tides and is vulnerable to flooding. The early colonists built dykes, dams and kokers to protect the coast from the sea. This has resulted in Guyana's Coastal Plain being one of the most heavily populated agricultural zones along the entire coastal seashore of the Guiana Shield. Nevertheless, the sandy beaches of the north-western section of Guyana's coast serve as nesting and foraging grounds for migratory species, including the Scarlet Ibis (*Eudocimus ruber*), four endangered marine species e.g. the Leatherback, (*Demochelys coriacea*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*), and the Green turtle (*Chelonia mydas*); dolphins (*Sotalia spp.*)<sup>57</sup>

The GOG has declared this area (Shell Beach Protected Area) as a protected area to be managed under the National Protected Area System. The vegetation type along the Coast is predominantly mangroves: the black mangrove (*Avicennia germinans*), red mangrove

<sup>56</sup> EPA, 2014

<sup>57</sup> Guyana National biodiversity Strategy and Action Plan, 2014

(*Rhizophora mangle*) and white mangrove (*Laguncularia racemosa*).<sup>58</sup> The mangrove forests serve as buffer and natural defence against flooding from high tides and sea-level rise, sequester approximately 17 metric tonnes of carbon annually,<sup>59</sup> trap sediments, and provide breeding grounds and sanctuaries for wildlife. The coastal nearshore aquatic ecosystem is a main fishing ground for commercial species such as the bangamary (*Macrodon ancyclostodon*) white belly shrimp (*Nematopalaemon schmitti*) and crabs e.g. blueback (*Callinectes bocourti*) and bunderi (*Cardiosoma guanhami*). The coastal mangroves and nearshore ecosystems are threatened by fishing, tanning and bricking making industries.

Guyana's marine area commences 22km from the shoreline, where brackish coastal waters meet oceanic waters and extends to the boundaries of the exclusive economic zone (EEZ). The ocean waters are clearer and may be richer in benthic biomass and biodiversity than coastal waters. Important commercial species of the marine ecosystem include the gill backer (*Sciades spp.*), red snapper (*Lutjanus purpureus*) and tuna. Red snapper is a highly marketable species and is subjected to significant amounts of illegal and unlicensed fishing (IUU). Guyana is yet to fully exploit the high value species (e.g. tuna) of its deep-sea fisheries.

The offshore marine area is also rich in oil and gas, and commercial extraction bring additional threats to the ecosystem. Unless efforts are made to increase knowledge on the coastal and marine habits it will be difficult to manage the current and future threats.

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<sup>58</sup> Bovell, O. 2011: Code of Practice for Mangrove Harvesting. GFC, EU. Guyana.

<sup>59</sup> NMMU, 2010

## A 3.6.5 FOREST ECOSYSTEMS

Guyana's total forested area is estimated at 18.47 million hectares i.e. 87 percent of the country's total land area,<sup>60</sup> and stores about 5 gigatonnes CO<sub>2</sub> equivalent in its above ground biomass. The State Forest Estate, which is administered by the Guyana Forestry Commission comprises of 12.8 million hectares (70 percent of the country's total forested area) and the remaining 5.5 million hectares is owned and administered by Amerindian communities (i.e. Titled Lands) and the Guyana Lands and Survey Commission.<sup>61</sup> Current knowledge informs that Guyana has 8,000 identified plants species, including 1,182 native tree species.<sup>62</sup>

Though richer in plant species than temperate countries, the forest in Guyana has less species than the forests in the eastern and central Amazon.<sup>63</sup> However, many of the floral species are either endemic to the country or locally and/or globally threatened. These include endemic timber species such as Greenheart (*Chlorocardium rodiei*), Purpleheart (*Peltogyne venosa*),<sup>64</sup> Wamara (*Swartzia leiocalycina*) and Clump Wallaba (*Dicymbe altosonii*), the critically endangered (CE) Sarebereballi (*Vouacapoua americana*), the endangered (En) Silverballi (*Aniba rosaedora*).

The Pakaraima Mountains in Guyana has the highest level of plant endemism in the country, followed by the upper Mazaruni-Kako-Roraima area where high concentrations of endemic species are known to occur. The Mazaruni-Kako-Roraima area is ranked the second most important area for plant endemism in Guyana. The white sands of the Hilly Sand and Clay Region also support high levels of floral endemism.<sup>65</sup>

The forests of Guyana are also niche refugia for many globally endangered faunal species such as the Giant River Otter (*Pteronura brasiliensis*) and Tapir (*Tapirus terrestris*), both of which are also officially gazetted<sup>66</sup> as locally threatened species. The tapir is a prime game species hunted for food /or wild meat trade by local communities.

**Box 2: The Proto-Berbice River**

The proto-Berbice was a large northeast flowing river that drained the central areas of the Guiana Shield and exited at the Atlantic coast in the vicinity of present-day towns of New Amsterdam in Guyana and Nickerie in Suriname. Later on, the lower proto-Berbice eventually shifted away the present day Berbice River and joined onto the Essequibo River as evidenced by the sharp elbow curve at its confluence with the Rupununi River.

Source: deSouza, L; Armbruster, W and D.C. Werneke (2012)

<sup>60</sup> Guyana REDD+ Monitoring, Reporting and Verification System. Interim Measures Report Year 6: January 2015 – December 2016 (Version 1)

<sup>61</sup> National Land Use Plan, 2013

<sup>62</sup> Guyana's Fifth National Report on Biodiversity

<sup>63</sup> ter Steege et al 2000

<sup>64</sup> Biodiversity, REDD+ and the Georgetown-Lethem Road Paper

<sup>65</sup> Guyana's National Biodiversity Strategy and Action Plan 2012-2020

<sup>66</sup> Guyana Official Gazette, 1999

### A 3.6.6 SAVANNAH ECOSYSTEMS

Savannahs occupy approximately 8% of the country's land area and are located in the southwest i.e. the Rupununi Savannahs, northeast in the Hilly and Sandy Region (Intermediate Savannahs) and in the Pakaraima Mountains in the north western part of the country. The southern Rupununi Savannah is the largest, and the savannah in the Pakaraima Mountains is the only upland savannah known in the Guiana Shield. The flat grassland Savannah of the Rupununi is dominated by *Trachypogon spp* of grasses interspersed with shrub and woody species such as Sand paper tree (*Curatella Americana*) and *Byrsomima crassifolia*. The six major rivers (Essequibo, Rewa, Siparuni, Takutu, Burro-Burro and Rupununi Rivers) passing through the Rupununi show differences in water colour ranging from black, white and clear. The Rupununi Savannahs has a hydrological regime that has over geologic time has influenced Guyana's species richness and diversity and its landscapes particularly the Rupununi savannahs.<sup>67</sup>

Due to its location within the Takutu rift Basin, the North Rupununi Savannah lies within the ancestral pathway of the Proto-Berbice River which, during the Cenozoic era (65M years ago) drained east from the uplands of Venezuela and northern Brazil (Guiana Shield). It flowed past the Pakaraima and Kanuku Mountains along the Takutu rift basin and floodplains between the current Essequibo and Berbice rivers, emptying into the Atlantic (See text Box 2) near Berbice. This ancient river deposited gravels, sand and clay formations as far as the Guyana basin offshore in the Atlantic.

Today, the Rupununi River which has its source in the Kanuku Mountains and other tributaries of the Essequibo river, greatly influence the hydrology of the savannahs. Almost every rainy season these river systems overflow their banks. Flood levels can range between 2m – 25m depending on the intensity of the rainy season and often intermix and transform the dry savannahs into a flooded wetland ecosystem that can last up to six months. This allows the North Amazon basin rivers (via the Branco-Ireng-Takutu Rivers) to interconnect with the rivers of the upper Essequibo basin. During this time, the flooded North Rupununi Savannah serves as spawning grounds for huge populations of migratory fish species arriving with the floodwaters in Brazil into the Takutu basin. The flow of floodwaters also generates a migration of micro and macrofaunal associated with this dynamic ecosystem that are also fed and supported by this complex ecosystem.<sup>68</sup>

This facilitates the inter-breeding of Amazonian species with species from the Guiana Shield, thereby enhancing genetic pools and biodiversity. This seasonal hydrological process also drives the high species diversity found in the Rupununi Savannahs, making it richer in vertebrates than many other ecologically important places in the world (Table 8). The spawning grounds and nurseries created by the seasonal flooding is also important to food security (availability) for neighbouring Indigenous communities, and essential natural ecological processes such as predation, reproduction and competition.<sup>69</sup>

<sup>67</sup> Watkins, D; Oxford, P and R. Bish: 2010: Rupununi – Rediscovering a lost world.

<sup>68</sup> Descriptions of the ecosystem and its dynamic hydrological regimes are described in the work of WWF-Guianas and have been shared with the GSDS Coordination Office.

<sup>69</sup> deSouza, L; Armbruster, W and D.C. Werneke (2012): The influence of the Rupununi portal on the distribution of fresh water fish, in the Rupununi District; Guyana

**Table 8: Comparison of Numbers of Vertebrate Species of Renowned Ecological Habitats**

Taxon	Manu (Peru)	Pantanal (Brazil)	Okavango (Botswana)	Rupununi Savannahs
Birds	>850	390	444	643
Fishes	>210	>410	71	263
Mammals	200	130	122	>191
Reptiles	68	40	64	>103
Amphibians	140	96	33	>67
Size of Area	18,811 km <sup>2</sup>	160,000 km <sup>2</sup>	28,000 km <sup>2</sup>	32,880 km <sup>2</sup>
<b>Total Number of Vertebrates</b>	<b>&gt;1,468</b>	<b>919</b>	<b>734</b>	<b>1,414</b>

Source: Watkins, D; Oxford, P and R. Bish: 2010: Rupununi – Rediscovering a lost world.

The Takutu Basin also has petroleum formed as the result of the deposition of organic materials over millions of years ago. Gold deposits are reported to be the vicinity of the Kanuku<sup>70</sup> (e.g. Mapari area) and Marudi Mountains. Unregulated and careless mining will threaten the quality of water for residents and biodiversity of the area. At present, there are also expressions of interest for large-scale commercial agriculture in the Rupununi. In this regard, it's worthy to note that the soil-substrates in this ecological important area are old, leached, heavily weathered and oligotrophic. Large-scale agriculture will require heavy applications of soil ameliorants which can have downstream effects on water quality and the welfare of residents when leached into nearby streams. In some places there are sandy-clay soils that become compacted and impermeable during rainy seasons resulting in water-logged conditions. The fragile but ecological important south-western Savannahs is probably best suited for biological conservation and high value-low impact economic activities such as ecotourism.

### A 3.6.7 AQUATIC ECOSYSTEMS

#### A 3.6.7.1 Waterways

The internal network of waterways (rivers, creeks) occupies about 18,120 km<sup>2</sup> or 8.4 percent of the country's land area. These include the three major drainage channels of the Berbice, Demerara and Essequibo Rivers, their tributaries and the many other small dissecting creeks and streams. Most of the rivers flow in a northern direction and empties into the Atlantic Ocean, but some rivers particularly those originating from the western parts of the country, flow eastern into the Essequibo River. The freshwater ecosystems support a vast array of biodiversity including 476 freshwater fish species of which about 83 species are endemic. In some parts of the country these rivers and creeks are subjected to intense human activities, for example, mining, agriculture and sport fishing. The Essequibo River watershed which occupies about 55 percent of the national land area is the country's main source of water and the third largest source in South America. It consists of two segments that meet in the north-

<sup>70</sup> deSouza, L; Armbruster, W and D.C. Werneke (2012): The influence of the Rupununi portal on the distribution of fresh water fish, in the Rupununi District; Guyana

central part of the country. The northern segment flows eastward from Venezuela via the Cuyuni River, and from the Pakaraimas through the Mazaruni River.<sup>71</sup> This northern half is extremely impacted by gold mining activities, which impacts the habitats of many endemic fish species locked-in by steep cataracts and falls along of the Mazaruni and Cuyuni Rivers. The southern segment flows southwards from the Acarai, Wassarai, Kamao, Amuku and Kanuku Mountain Ranges and across lowland forest and savannahs.<sup>72</sup> Unlike the northern half, the southern segment originates from Guyana's largest biodiversity conservation zone. Drainage is also aided by the watersheds of the Demerara, Berbice and Barima-Waini Rivers, plus 16 or more rivers and creeks (e.g. Pomeroon and Moruca rivers, and Abary, Mahaica and Mahaicony Creeks) dissecting the Coastal Plains. A few trans-boundary watersheds complement the country's drainage systems. These include the Rio Negro and Rio Branco which assist to drain the Rupununi Region (south-western Guyana) through connections with the Takutu River. Additionally, the Corentyne River (between Guyana and Suriname) has its source in the Acarai Mountains and helps to the drain the south-eastern parts of Guyana through connections to the New River.

#### A 3.6.7.2 Wetlands

At least 22 naturally occurring wetlands are recognised in Guyana. Nineteen of these were identified and studied by WWF in 2012. The majority of the wetlands are in Regions 1 and 9. These wetlands provide regulatory, provisioning and cultural services. For instance, wetlands help to recharge groundwater supplies, serve a source of irrigation water, provide opportunities for ecotourism, and provide *refugia*, feeding grounds and migratory routes for many species of local biodiversity. Lake Mainstay and the North Rupununi Wetlands are renowned for recreational activities. The North Rupununi wetland is the centre of the seasonal hydrological process between the Guiana Shield and Amazonian Region described in the previous section. Current and perceived threats to the Guyana's wetlands include invasive species such as water hyacinth (*Eichhornia crassipes*), water withdrawal and pollution as a result of agricultural expansion (e.g. rice) and mining, and illegal hunting and fishing. Guyana is yet to become a signatory to the RAMSAR Convention for protection of wetlands.

### A 3.6.8 CONSERVING BIODIVERSITY

#### A 3.6.8.1 Introduction

Endemism is the main criteria for identification of sites as Critical Natural Habitats (CNH) and/or Important Bird Areas (IBA). Though the locations of all CNHs and IBAs are not yet known, ten areas covering a total of 366,600 hectares (1.7% of the country) have been proposed as important areas for birdlife – five of these sites are located in the Rupununi Region.<sup>73</sup> Another area with habitats critical for species protection and conservation is the North Rupununi. Protected areas under the Guyana NPAS covers approximately 1.8million hectares and represents five vegetation types – mangrove, marsh forest, mixed lowland forest and white sand forest in southern Guyana. Large areas of grasslands, highlands and wetlands

<sup>71</sup> Hammond, D. 2005: Tropical Forest of the Guiana Shield. Ancient Forest in a Modern World. CABI Publishing Co.

<sup>72</sup> Hammond, D. 2005: Tropical Forest of the Guiana Shield. Ancient Forest in a Modern World. CABI Publishing Co.

<sup>73</sup> Important Bird Areas of the Americas. Priority Sites for Biodiversity Conservation. 2009

are not yet covered.<sup>74</sup> Therefore, it would be important to plan for the 2 million hectares to be set aside to include for example, the Rupununi Savannahs as an area of ecological importance.

#### A 3.6.8.2 Benefits of Conserving Biodiversity

Guyana's biodiversity and ecosystem services provide both global and local benefits, including climate regulation, provisioning of fresh water, and opportunities for economic development in agriculture, forestry and fisheries, particularly in hinterland communities.<sup>75</sup> With more than 87 percent of the country covered with forests and low levels of deforestation, Guyana forest plays an important role in climate regulation and assist in addressing the global problem of climate change. The GOG has already received climate-related compensation for maintaining its forest cover. In 2009, the country entered into a REDD+ Agreement with the Kingdom of Norway. Under the MOU, Norway agreed to provide US \$250 million in support of Guyana's effort to maintain annual deforestation at a rate lower than 0.056%.

Nationally, Guyana's biodiversity provides goods and services which are important to the economic development of the country. In 2013, at least 93% of the value of foreign exchange earnings to the national economy came from the use of natural resources, including biodiversity and ecosystem services.<sup>76</sup> The sources of these benefits include amongst others:

- *Timber and Non-Timber Forest Products:* During the period 2007 to 2016, the average annual contribution of forest produce to the nation's GDP has been estimated at 3.25 percent. Over the same period export earnings averaged US\$47.5M, with 2007 being the most profitable year (Table 9).
- *Fisheries:* Guyana's fisheries consist of marine and inland components. Fisheries in Guyana takes place within a multi-sectoral context and is affected by activities of other sectors such as: mining; tourism; health and nutrition; infrastructure; and petroleum sectors. The fisheries are a major source of protein for Guyanese. In 2013 Guyana had a per capita fish consumption of 54kg, which at that time was the highest for the entire Caribbean Region.<sup>77</sup> Marine fish species regularly harvested are sea bob (*Xiphopenaeus kroyeri*), penaeid shrimp (*Penaeus brasiliensis*), and red snapper (*Lutjanus campechanus*).<sup>78</sup> Species of importance to inland fisheries include Tilapia (*Tilapia spp.*), Tambaqui (*Colossoma macropomum.*), Hassar (*Hoplosternum spp.*) and lukanani (*Cichla spp.*).
- *Ecotourism:* Guyana's best tourism product is based on the country's wildlife and intact natural ecosystems. Therefore, astute management of species and ecosystem are important for the country's tourism products. Tourism for Guyana continues to be a viable economic activity for the country as well as for Indigenous communities. In 2014, Guyana was singled-out as a must-see place on the planet for eco-tourists wishing to experience

<sup>74</sup> Jake Bicknell et al 2017: Designing protected area networks that translate international conservation commitments into national action. Biol. Conservation 214 (2017).

<sup>75</sup> Guyana's Fifth National Report to the UN Convention on Biological Diversity

<sup>76</sup> Guyana's national Biodiversity Strategy and Action Plan 2012-2020

<sup>77</sup> EPA 2015: Guyana's Fifth National Report to the CBD

<sup>78</sup> Government of Guyana-Ministry of Agriculture: National Fisheries Management Plan 2013-2018



intact rain forest ecosystems.<sup>79</sup> Between 2004 and 2014, tourism earned GY380 billion dollars. The nationally recognised ecotourism sites of Guyana include Kaieteur and Orinduik Falls (Potaro-Siparuni), Rupununi Savannahs and the Kanuku Mountains (Upper Takutu-Upper Essequibo), Bartica and Marshall Falls (Cuyuni-Mazaruni) and the Shell Beach Protected Area (Barima-Waini).

The Rupununi Region houses a number of species of flora and fauna and is one of the most attractive tourist sites in Guyana.<sup>80</sup> Many Indigenous communities, for example Rewa, Surama, Annai, Kumu, Nappi, Karanambo (Upper Takutu-Upper Essequibo) and Capoey, Mainstay (Pomeroon-Supenaam) are also engaged in ecotourism as a business. The ecotourism enterprise at Surama provides direct benefits to more than 75% of people living in the village. Additionally, Rewa Village Eco-tourism project commissioned in 2005, relies on the biodiversity and ecosystems of the upper Rewa River as their tourism product. Recently, it was reported that the project earned over G\$77 million<sup>81</sup> in revenue for the Village, which has a population of around 300 persons. Guyana's biodiversity is of immense socio-economic importance, and will need to be managed sustainably to prevent losses and disruption of the ecosystem services, which will consequently have negative impacts on the national economy and quality of life for hinterland and Indigenous communities.

- *REDD+ Payments:* Guyana's species and ecosystems are important to nature, economic development and human well-being. The country's abundance of relatively intact forests contributes to global climate regulation, and the GOG has already received climate-related compensation for maintaining its forest cover. In 2009, the country entered into a REDD+ Agreement with the Kingdom of Norway. Under the MOU, Norway agreed to provide US \$250 million in support of Guyana's effort to maintain annual deforestation at a rate lower than 0.056%.

**Table 9: Forestry Sector Contribution to GDP (2006- 2016)**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
<b>GDP***</b>	3.37	3.31	3.52	3.57	2.98	2.70	2.85	4.14	3.64	2.39	3.25
<b>Export Earnings (US\$M)+++</b>	61.5	56.7	45.5	49.1	40.6	40.07	39.6	54.18	45.6	41.9	47.5

Source: \*\*\*Bank of Guyana, +++Guyana Forestry Commission

- *Wildlife & Habitats:* Guyana is home to some of the rarest and largest wildlife and habitats in the world. There are at least nine faunal giants existing in the country, namely: the Giant River Otter (*Pteronura brasiliensis*); the Giant River Turtle (*Podocnemis expansa*); the Giant Anteater (*Myrmecophaga tridactyla*); the Black Caiman (*Melanosuchus niger*); the Arapaima (*Arapaima gigas*) the largest freshwater fish; the Jaguar (*Panthera onca*) – the largest feline in the Americas, the Giant Spider (*Theraphosa blondi*) acclaimed as the

<sup>79</sup> Guyana National Biodiversity Strategy and Action Plan 2012-2020

<sup>80</sup> Ibid

<sup>81</sup> Kaieteur News May 2018

world's largest spider; the Giant Anaconda (*Eunectes murinus*) renowned as the largest snake in the world; and the Harpy Eagle (*Harpia harpyja*) –the world's largest raptor. Also known to exist in the country are the rare Guianan Cock-of-the-Rock bird (*Rupicola rupicola*), the Emerald Tree Boa (*Corallus caninus*), and the Blue Poison Frog (*Dendrobates azureus*).

Compared to its CARICOM neighbours, Guyana has the larger expanse of intact forests, much more freshwater (including 32 major rivers) and waterfalls (about 70) and a much higher diversity of flora and fauna.

With its diversity of ecosystems, Guyana has the potential to attract eco-tourists, adventurers, researchers and students. Tourism will add value to forest utilisation and promote the country's natural and cultural heritage while earning foreign exchange and promoting employment. Combined with the Iwokrama Conservation Area, Guyana's relatively intact ecosystems also provides opportunities for international researchers to test and develop new methods and techniques for sustainable management of the multitude of resources and biological diversity in the Tropical Forests of the world.

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#### A 3.6.9 THREATS TO GUYANA'S BIODIVERSITY AND ECOSYSTEMS

Threats to Guyana's biodiversity include: i) climate change; ii) land degradation; iii) overfishing; iv) depletion of the mangrove forests; and v) deforestation due to expansion of extractive industries and infrastructural development.

##### A 3.6.9.1 Climate Change

With the onset of climate change, Guyana will likely experience sea-level rise and storm surges on the Coastal Plain, increases in temperature, and decreased mean annual rainfall.<sup>82</sup> Sea level rise and increases in storm surge will increase erosion of the coastal seashore and destroy the mangrove forests, which are the natural sea-defences against the Atlantic Ocean.

Furthermore, disruption of the coastal and nearshore habitats due to sea level rise will result in lower fisheries production and loss of revenue. Reduced rainfall and increased temperatures will result in drought and wildfires causing destruction of forests, savannahs and Amerindian farms, and health risks associated with the shortage of potable water. Habitat fragmentation resulting from climate change will present Guyana with challenges for conservation and sustainable management of its biodiversity.

##### A 3.6.9.2 Land degradation

Land degradation negatively affects the ecological functions of soils, water, and physiology of plants and animals. Given the importance of biodiversity to the provision of ecosystem services, land degradation leads to losses in environmental, social, economic and non-material benefits critical for national development. Natural ecosystems that are potentially vulnerable to land degradation include the gold mining areas of the upper Mazaruni and Cuyuni Rivers, the Hilly Clay and Sandy Region subjected to forestry, agriculture and silica mining, and the entire Rupununi Region. It is estimated that at least 150,000 to 160,000 hectares of lands in

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<sup>82</sup> Guyana 5<sup>th</sup> National Report to the Convention on Biological Diversity

Guyana are degraded annually. This can be prevented with the development and institutionalization of the required policy mechanisms for integrated land use. Areas most vulnerable to land degradation are those places where mining and forestry overlaps.<sup>83</sup>

#### A 3.6.9.3 Destruction of Mangroves and Deforestation

The coastal mangroves have been severely depleted due to damage by human use, rise in sea level, and increased wave force. In 1992 the total area of mangrove forests in Guyana was estimated at 80,432 hectares<sup>84</sup> and by 2017 the total coverage was decreased to 22,632.4 hectares.<sup>85</sup> Mining, forestry, agriculture and infrastructural (e.g. roads and hydropower dams) development are the main causes of forest destruction. Between the period 1990 – 2016, the national rate of deforestation was highest in (0.079%) in 2012 before declining to 0.05 % in 2016. During this period, mining accounted for almost 72% of the total area converted from forest to non-forest, forestry 15%, agriculture 6.7% and infrastructure a meagre 2.3%.<sup>86</sup>

While Guyana has been able to maintain historical low rates of deforestation the situation is likely to change with new and upgraded hinterlands roads identified in the national transportation strategy. The upgrade of the Georgetown to Lethem road, a segment of the IIRSA, which passes through the hinterland region, is by itself projected to trigger settlement and agricultural development that will be responsible for an annual deforestation rate of 0.5 percent by 2040.<sup>87</sup> The ecological impacts of new and upgraded roads can be prevented with the implementation of effective monitoring programmes along the corridor of all hinterland roads. This will require the expansion of the Community-based Monitoring, Reporting and Verification programme into communities along these roads.

#### A 3.6.9.4 Overfishing

A 6.5% decline in fish catch in 2013 was attributed to overfishing.<sup>88</sup> The use of inappropriate gear which results in excessive by-catch is also a threat to the marine fisheries. Fisher folks have reported significant declines in catch per unit effort (longer trips and longer nets for the same catch), suggesting that many or most of the marine fisheries stocks are being depleted.<sup>89</sup>

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<sup>83</sup> *ibid*

<sup>84</sup> <http://www.mangrovesgy.org/home/index.php/2014-04-27-16-39-08/conservation-status-of-mangroves>

<sup>85</sup> Jaikishun S, Ansari AA, DaSilva P, Hosen A. 2017. Carbon storage potential of mangrove forest in Guyana. *Bonorowo Wetlands* 7: 43-54.

<sup>86</sup> Guyana Forestry Commission Sector Information Report. Annual Review 2017

<sup>87</sup> Biodiversity Mainstreaming Through Avoided Deforestation- Guyana case Study. 2007

<sup>88</sup> *ibid*

<sup>89</sup> Government of Guyana-Ministry of Agriculture: National Fisheries Management Plan 2013-2018

## A 3.7 Forests and Vegetation

### A 3.7.1 OVERVIEW

Guyana's total forested area is estimated at 18.47 million hectares, i.e., 87% of the country's total land area,<sup>90</sup> and stores about 5 gigatons CO<sub>2</sub> equivalent in its above ground biomass. The State Forest Estate, which is administered by the Guyana Forestry Commission (GFC) comprises of 12.8 million hectares (70 percent of the country's total forested area) and the remaining 5.5 million hectares is owned and administered by Indigenous communities (i.e., Titled Lands) and the Guyana Lands and Survey Commission (GLSC).<sup>91</sup>

The country's forested ecosystems are of importance at local, national and international levels. Locally, the forests provide socio-cultural and economic benefits to hinterland and indigenous communities who are highly dependent upon the nearby ecosystem goods and services. The forests also provide opportunities for activities such as recreation, scientific research and education. Globally, because of its relatively intactness, the forests have an important role in the combat against climate change.

Current knowledge informs that Guyana has 8,000 identified plants species, including 1,182 native tree species,<sup>92</sup> and three coastal mangrove species. Though rich in plant species when compared to temperate countries, the forest in Guyana has less species than the forests in the eastern and central Amazon.<sup>93</sup> The forests of inland areas are broadly divided into Mixed Forests on Brown Sands (Ferralsols) and Dry Forest on White Sands (Arenosols). Many of the floral species are either endemic to the country or locally and/or globally threatened. These include endemic timber species such as Greenheart (*Chlorocardium rodiei*), Purpleheart (*Peltogyne venosa*), Wamara (*Swartzia leiocalycina*) and Clump Wallaba (*Dicycme altosonii*), the critically endangered (CE) Sarebereballi (*Vouacapoua americana*), the endangered (En) Silverballi (*Aniba rosaedora*). The Pakaraima Mountains in Guyana has the highest level of plant endemism in the country, followed by the upper Mazaruni-Kako-Roraima area where high concentrations of endemic species are known to occur.

The forests of the Pakaraima Mountains, the Mazaruni-Kata-Roraima<sup>94</sup> and the white sands of the Hilly and sandy Regions support the highest levels of floral endemism in Guyana.

The forest of Guyana are also habitats for many faunal species, many of which are locally, nationally and globally important. For instance, the globally Endangered Giant River Otter (*Pteronura brasiliensis*) and Tapir (*Tapirus terrestris*), are both officially gazetted<sup>95</sup> as locally threatened species. The tapir is a prime game species hunted for food /or wild meat trade by local communities.

<sup>90</sup> Guyana REDD+ Monitoring, Reporting and Verification System. Interim Measures Report Year 6: January 2015 – December 2016 (Version 1)

<sup>91</sup> National Land Use Plan, 2013

<sup>92</sup> Guyana's Fifth National Report on Biodiversity

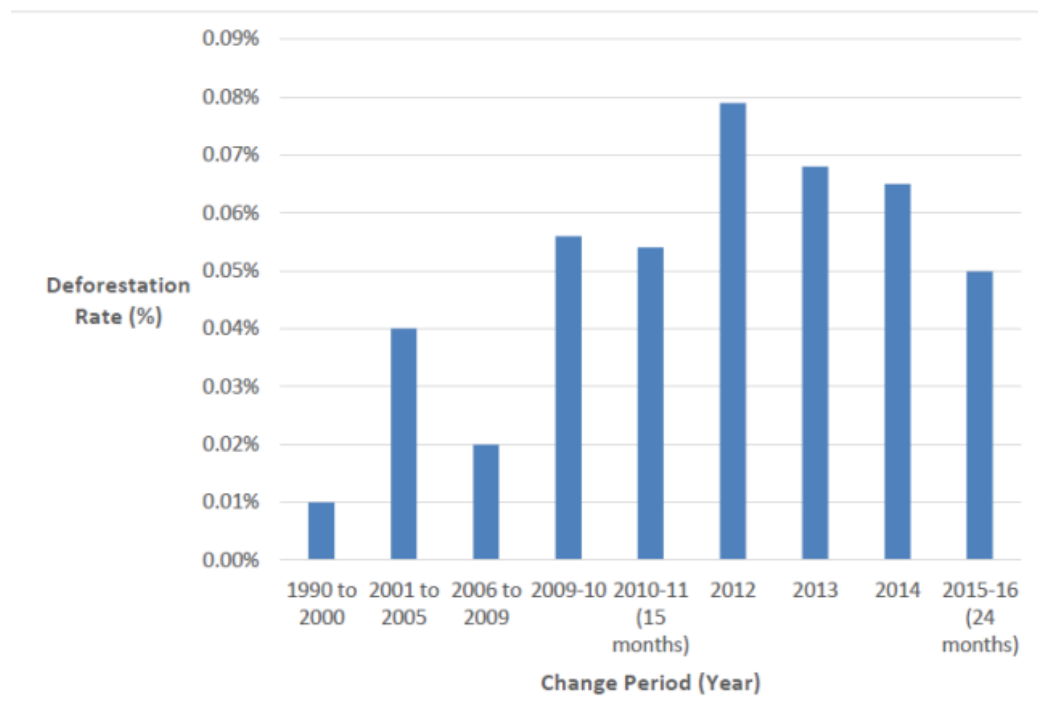
<sup>93</sup> ter Steege et al 2000

<sup>95</sup> Guyana Official Gazette, 1999

### A 3.7.2 FOREST COVER

Guyana has always maintained a historical low deforestation rate, ranging between 0.01 and 0.079 percent annually (Figure 5). The country is classified as a High Forest Low Deforestation (HFLD) nation<sup>96</sup> i.e., countries with more than 50 percent forest cover and an average annual deforestation rate less than the global average of 0.22%. Over time, the forest cover changed in small increments as people sought new fortunes in forestry, agriculture, mining and housing. A few Indigenous communities were also seeking extensions to their Titled lands. During the period 1990 – 2016 the total area converted from forest to non-forest was estimated to be 142,401 hectares and the rate of deforestation was at its highest (0.079%) in 2012 before steadily declining to 0.05 % in 2016.<sup>97</sup>

Figure 5: Annual Rate of Deforestation by Period 1990 to 2016



Source: Guyana Forestry Commission

## A 3.8 Coastal and Marine Ecosystems

### A 3.8.1 NEARSHORE AREAS

The coastal waters of Guyana are persistently brown in colour from the silt deposited by river flow from inland rivers and from external sources such as the Orinoco and Amazon Rivers of Venezuela and Brazil, respectively.<sup>98</sup> The coastal zone comprises marine inter-tidal mudflats,

<sup>96</sup> Fonseca et al 2007

<sup>97</sup> Guyana REDD+ Monitoring, Reporting and Verification System. Interim Measures Report Year 6: January 2015 – December 2016 (Version 1)

<sup>98</sup> Fisheries Management Plan

intersected by sand and shell beaches, and mangrove forests fringing brackish lagoons and swamps.

The sandy beaches provide important nesting and foraging grounds for migratory species, including the Scarlet Ibis (*Eudocimus ruber*), four endangered marine species e.g. the Leatherback, (*Demochelys coriacea*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*), and the Green turtle (*Chelonia mydas*); birds e.g. parrots, macaws, herons and egrets; and dolphins (*Sotalia spp.*).<sup>99</sup>

The coastal and nearshore ecosystem is also home to many of Guyana's commercial "fish" species including the bangamary (*Macrodon ancyclodon*), the Guyana seatrout (*Cynoscion virecens*), prawns (*Penaeus spp.*), seabob (*Xiphopenaeus kroyeri*), the whitebelly shrimp (*Nematopalaemon schmitti*) and crabs e.g. blueback (*Callinectes bocourti*), the bunderi (*Cardiosoma guanhami*) and the red sheriga (*Portunus rufiremus*);<sup>100</sup> mackerels i.e. the kingfish (*Scomboromorus cavalia*) and Spanish mackerel (*S. brasiliensis*).

The mangrove forests of the coastal ecosystem are also an important buffer and natural defence against flooding from high tides and sea-level rise. Tree main species of mangroves predominate in Guyana: the black mangrove (*Avicennia germinans*), the red mangrove (*Rhizophora mangle*) and the white mangrove (*Laguncularia racemosa*).<sup>101</sup> These mangroves sequester approximately 17 metric tonnes of carbon annually<sup>102</sup>, serve as breeding grounds and sanctuaries for numerous aquatic, avian and wildlife species and serve as sediments traps. Additionally, mangrove forests are harvested to support the local tanning industry, provide fuel wood for brick making and poles for setting of seines.

### A 3.8.2 MARINE AREAS

Guyana's marine area commences 22km from the shoreline, where brackish coastal waters meet oceanic waters and extends to the boundaries of the exclusive economic zone (EEZ). The ocean waters are clearer and may be richer in benthic biomass and biodiversity than coastal waters. Important commercial species of the marine ecosystem include the gill backer (*Sciades spp.*) and red snapper (*Lutjanus purpureus*). The latter is a highly marketable species and is affected by significant amounts of illegal and unlicensed fishing.<sup>103</sup>

The offshore marine area is now of significant interest for its petroleum blocks licensed to international oil and gas companies for oil and gas exploration and production. With the recent discoveries of significant oil and gas resources, this adds to other potential marine ecosystem threats in the area such as over-harvesting and illegal fishing.

<sup>99</sup> Guyana National biodiversity Strategy and Action Plan, 2014

<sup>100</sup> <http://www.fao.org/fish/guyprofile>

<sup>101</sup> Bovell, 2011

<sup>102</sup> NMMU, 2010

<sup>103</sup> ibid

## A 3.9 Aquatic Ecosystems

### A 3.9.1 WATERWAYS

The internal network of waterways (rivers, creeks) occupies about 18,120 km<sup>2</sup> or 8.4 percent of the country's land area. These include the three major drainage channels of the Berbice, Demerara and Essequibo Rivers, their tributaries and the many other small dissecting creeks and streams. Most of the rivers flow in a northern direction and empties into the Atlantic Ocean, but some rivers particularly those originating from the western parts of the country, flow eastern into the Essequibo River. The Essequibo River watershed which occupies about 55 percent of the national land area is the country's main source of water and the third largest source in South America.

Drainage is also provided by the watershed of the Demerara, Berbice and Barima-Waini Rivers, plus the 16 or more rivers and creeks (e.g. Pomeroon and Moruca rivers, and Abary, Mahaica and Mahaicony Creeks) dissecting the Coastal Plains. A few trans-boundary watersheds complement the country's drainage systems. These include, the Rio Negro (a tributary of the Amazon River) which assists to drain the Rupununi Region (south-western Guyana) through connections with the Takatu River. Additionally, the Corentyne River (between Guyana and Suriname) has its source in the Acarai Mountains and helps to the drain the south-eastern parts of Guyana through connections to the New River.

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Additionally, during the wet seasons the banks of the Rupununi River overflow and intermix with waters from the Rio Branco in neighbouring Brazil to facilitate evolutionary processes between Guiana Shield and Amazonian species. Current and perceived threats to the wetlands include invasive species such as water hyacinth (*Eichhornia crassipes*), water withdrawal and pollution from agricultural expansion (e.g. rice) and mining, and illegal hunting and fishing.

## A 3.10 Key Issues and Constraints

Historically, Guyana's natural resources (land, forests, gold and other minerals, ecosystem services) have played significant roles in the country's development. Given the contributions of these resources as raw materials for manufacturing/value-adding, trade, and socio-economic development, natural resource use and management (including petroleum and natural gas) is an important element in the transition to a green state. However, there are few constraints to the sustainable use and management of natural resources. A brief description of the key constraints is as follows:

A 3.10.1 ABSENCE OF A NATIONAL LAND USE POLICY AND PLANNING UNIT

The absence of a comprehensive National Land Use Policy, and Planning System is one of the main reasons for land use conflicts. The activities of the land administration agencies (i.e. GLSC, GGMC, GFC, MMA-ADA, MOIPA) are not conducive to integrated land management and social cohesion. Each of these entities issue land leases for different purposes and will do so without consulting or collaborating with each other. In many instances, the GFC, GGMC and GLSC will lease the same parcel of land to different concessionaires for logging, mining and agriculture, respectively.

The sector-focused approach and lack of coordination are barriers to cohesiveness and integrated land management for sustainable development. There is need for land administration (for all lands, including those under the EEZ) to be under the jurisdiction of a single agency (most likely the GLSC), which will be responsible for planning and allocation of parcels to the various entities (e.g. CHPA, GFC, GGMC, etc.) depending upon their needs and spatial limitations. The absence of such an overarching land management unit is also responsible for lands not being put to optimal use. For example, the Ministry of Communities via the Central Housing and Planning Authority (CH&PA) has been allocating house-lots on arable agricultural lands of the Coastal Plain thereby reducing the amount of fertile lands available for agricultural production.

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A 3.10.3 LANDLORDISM

Landlords are lessees who receive land from the State for mining (GGMC), logging (GFC) or agriculture (GLSC), and sublet it at high prices to persons seeking new opportunities in mining, logging or agriculture. The practice appears to be more common and widespread in the mining sector. The tenants being aware that the land is temporally leased to them would try to get the most out of it in a short period of time and leave when done. On the other hand, landlords do not return the land to the State but keep it to sublet to another tenant. This



causes exhausted lands, particularly, mined-out sites to be subjected to re-utilization without being given sufficient time to rejuvenate. In most cases, the end result is degradation and unproductive land use as there isn't any legislation or incentives compelling tenants to undertake reparatory works before leaving the area. There is need for regulations or stricter monitoring to deter the practice of landlordism in the natural resources sector.

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#### A 3.10.4 ILLEGAL EXTRACTION AND TRADE IN WILDLIFE

Sustainable management of Guyana's wildlife is constrained by the illegal wildlife trade. The cash economy of the Indigenous communities is not well developed, and unemployment and poverty are widespread in the Hinterland Regions. As a result, residents are inclined to be engaged in wildlife trading and/or fishing at semi-commercial scales without the guidance of species-specific management plans. Furthermore, the country's borders are not well monitored. This allows foreign nationals from neighbouring countries or even further away to enter in the country to illegally extract and export wild life.

Overharvest and illegal, unreported and unlicensed (IUU) fishing in the maritime zone also inhibit sustainable management of the country marine fisheries. The current decline in fish catch and landings is attributed to both overharvest and IUU. It is alleged that even licensed fishing boats may engage in illegal sale while at sea. IUU presents difficulties in sustainable management of the fish stocks. It causes lower landings relative to the actual catch to be reported, and this makes it impossible to accurately estimate Catch Per Unit Effort (CPUE). Inaccurate stock assessments due to false declarations will inhibit effective management of the fisheries resource.

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#### A 3.10.5 RELATIVELY POOR SOILS

Most soils in Guyana are either well drained with low fertility (e.g. Arenosols, Ferralsols, Cambisols, Laterites of the Hinterland) or are high-moderately fertile with poor drainage. Soils on coastal plain have good potential for agriculture but is constrained by poor drainage, while aluminium toxicity, low pH and low availability of nutrients restrict the productivity of hinterland soils. Therefore, sustainable land management and low-emission agriculture will be constraint by the need for either fertiliser applications and/or mechanized irrigation and drainage.