GUYANA

Source: esri

General

Guyana - officially the Co-operative Republic of Guyana - is a sovereign state on the northern mainland of South America. It is bordered by the Atlantic Ocean in the North, Brazil in the South and Southwest, Suriname in the East and Venezuela in the West. Guyana has an area of 21.5 Mha (million hectares) with in 2022 a population of 809,000, or 0.038 persons per ha (Wikipedia and United Nations, 2022).

Climate and geography

The local climate is tropical and generally hot and humid, though moderated by northeast winds along the coast. There are two rainy seasons, the first from May to mid-August, the second from mid-November to mid-January (source: Wikipedia).

The fertile coastal plain is a comparatively narrow, low-lying area, which consists of soft clayey soils, very gently sloping down to the sea. Along the shoreline the ground level varies mostly between 0.30 m-MSL (mean sea level) to 0.30-0.60 m+MSL, while high tide normally rises to about 1.50 m+MSL. Therefore, occupation and cultivation near the coast is only possible where there is a natural or man-made protection against the sea levels (Group Polder Development, 1982).

Rostain (2010) describes that thousands raised fields surrounded by ditches are located in the coastal zone of the Guianas (Figure 1). The first raised fields were made in 350 in Suriname by the Barrancoid builders of the Buckleburg mounds, and probably also in Guyana (Versteeg, 2008).

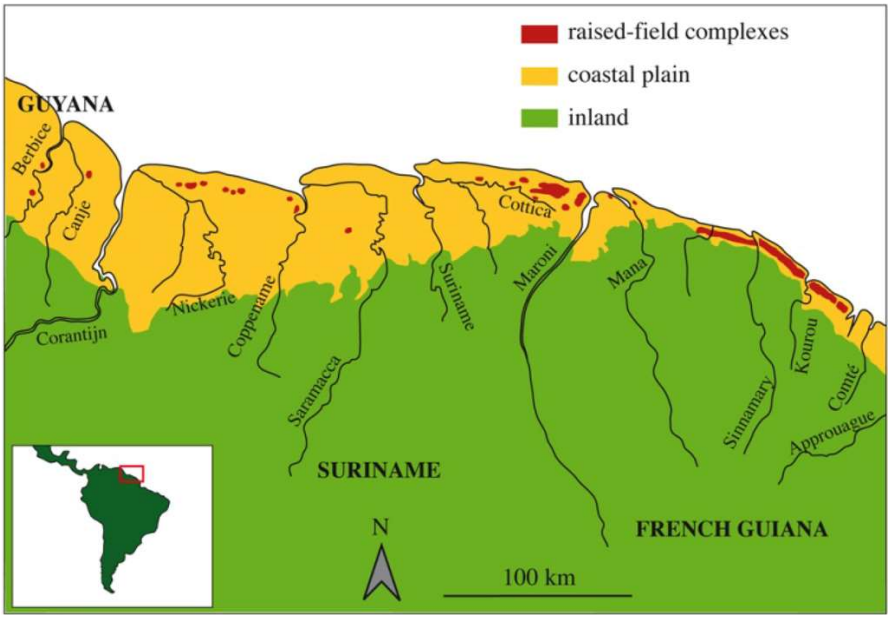

Figure 1. Map of the raised field complexes of the Guianas coast (Rostain, 2010)

However, most of the earthworks are associated with Arauquinoid sites in Guyana, Suriname, and French Guiana (Rostain, 1994). Artificial residential mounds are associated with raised field complexes in various countries of South America. Along the Guianas coast, Arauquinoid culture spread from the middle Orinoco to the coast of the Guianas (Rostain and Versteeg, 2004). Arauquinoid groups belong to a cultural continuum settled between Berbice River and Cayenne Island in eastern Guyana. The first Arauquinoid raised fields were made since 650, but between 1000 and 1450 they became common and spread almost everywhere along the coast up to Cayenne Island. They erected thousands of raised fields of various shapes, dug canals, ditches and pathways, and built artificial mounds to establish their villages.

The raised fields are classified on the basis of their size, shape and topographical location (Rostain, 2008). The last criterion is indicative of differences of adaptation to the hydrographical conditions and to the nature of the soil. Rostain (2010) distinguishes four types of raised fields. Only one of these types exist in Guyana. These are ridged fields. They are elongated and narrow, measuring between 1 and 3 m wide, 5 to 30 m long and 30 to 80 cm high. They take the shape of the slope between the sandy ridges and the swamp. Their distribution is related to the altitude and the water level. In eastern Guyana, 787 rectangular raised fields are distributed in a linear configuration. Their size ranges from 1.7 to 6.9 m wide, 5 to 8.2 m long and 50 to 170 cm high. They are associated with a residential mound along the Canje and the Berbice rivers (Plew, 2005).

All these earthworks changed the face of the coastal flooded savannas and their ecology. This represents a territory of approximately 600 km in length where the raised field technique was intensively used for almost a thousand years prior to the European conquest (Rostain, 2010).

Ehrenburg and Meyer (2015) describe that most plantations in Latin America were located on higher ground. Plantations on the coastal plains along the lower reaches of rivers and on the coast of Guyana and Suriname were polders with an advanced and multifunctional water management system, and therefore rare. The conditions were favourable due to the fertile clay soils, a warm and humid climate with a lot of precipitation during a large part of the year and the absence of storms and natural disasters. There were also unfavourable conditions: the poorly accessible mud coast, moist marshes with many mosquitoes, a high risk of disease, intrusion of salty seawater, an unstable coast and weak clay soils.

One of the most significant Dutch legacies in Guyana was the method of land management. Settlement and agriculture initially were limited to a belt of land extending 50 to 150 km upriver. The marshy coast did not appear conducive to European settlement. The prospect of large profits for tropical agricultural products, especially sugar, led to the reclamation of coastal lowlands in the second half of the 18th century. The Dutch were suited to this task, having originated the polder system. Using this system, the Dutch created a coastal plain that remains one of Guyana's most productive plantation areas. The polder system entailed the use of a coastal dike. This dike was supported by a back dike of the same length and two connecting side dikes, which formed a rectangular polder. The dikes kept the salt water out, and fresh water was managed by a network of canals that provided drainage, irrigation, and a system of transportation. The labour for the reclamation of Guyana's coast was provided by the Dutch colony's African slaves (Country Studies). Ehrenburg and Meyer (2015) show a map of 1796 made by the surveyor Jan Sabrier with the canals and polder plantations along the Demerara River (Figure 2). Not all the canals at this map have been made.

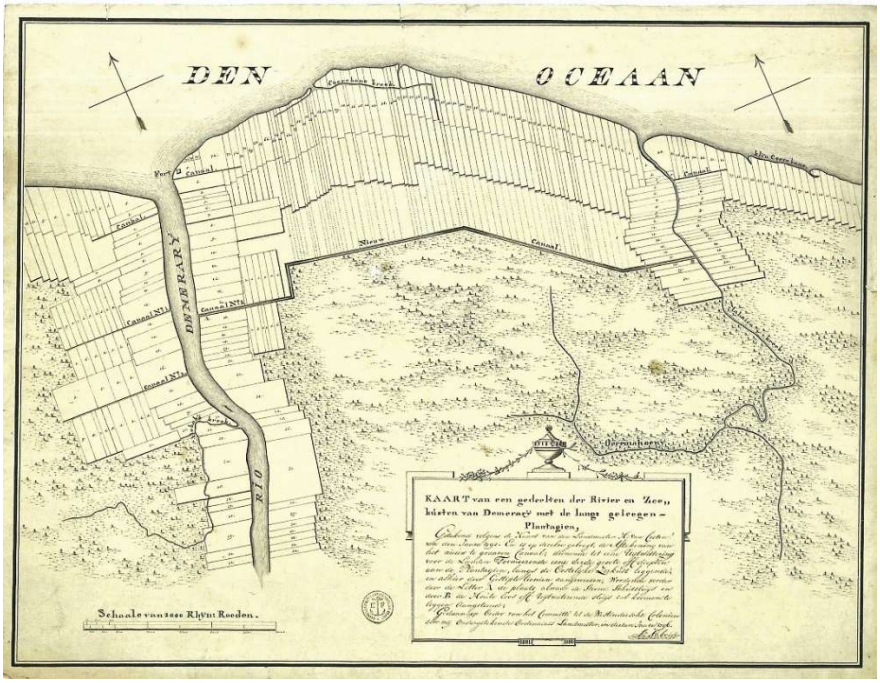

Figure 2. Map of 1796 by Jan Sabrier on canals and polder plantations along the Demerara River (Ehrenburg and Meyer, 2015)

The Group Polder Development (1982) describes that the early plantations were laid out perpendicular to the coast as comparatively narrow but deep plots, with drains in between them. Where no natural sand reefs existed, earth protection dikes were built parallel to the coastline. The dikes were protected by natural mangrove and gourida bush. Discharge sluices drained the excess water towards the sea.

Existing polders

The Group Polder Development (1982) identified two polders, Black Bush Polder and Ogle Estate. From newspaper articles it can be derived that at least part of Georgetown is located in a polder and that there is the Canal Number 2 Polder.

Black Bush Polder

The area where the Black Bush Polder is located is a coastal lowland that was waterlogged much of the year, and vegetation varied from thick bush with many trees, to open grasslands. The Black Bush Polder covers an area of 10,900 ha (Figure 3). The soil is suitable for rice growing. Before 1958 it was an undrained and uncultivated marsh.

Ogle Estate

The Ogle-estate concerns a polder, mainly used for the cultivation of sugarcane. This polder is 2,673 ha and drained by a tidal sluice and/or a pumping station.

Georgetown

Georgetown is located on Guyana's Atlantic coast on the east bank of Demerara River estuary. The terrain where the city is located is flat coastal plains. The city is surrounded by cane fields along with marshy swamps, and savannah lands on the East and South. The elevation of the land is one metre below the high tide level. Therefore the city is protected by a retaining wall known as the seawall to keep the ocean out and an innovative network of urban canals with culverts to drain the city of excess water (source: Wikipedia). It has also been reported that the surface level can be as low as 1.8 m-MSL.

Canal Number 2 Polder

This polder is mentioned in several newspaper articles. However, details on size and water management could not yet be found.

On Google Earth it can be observed that there should be more polder areas in Guyana.

General characteristics of the polders in Guyana are shown in Table II. Table III shows the characteristics of the water management and flood protection systems of the existing polders.

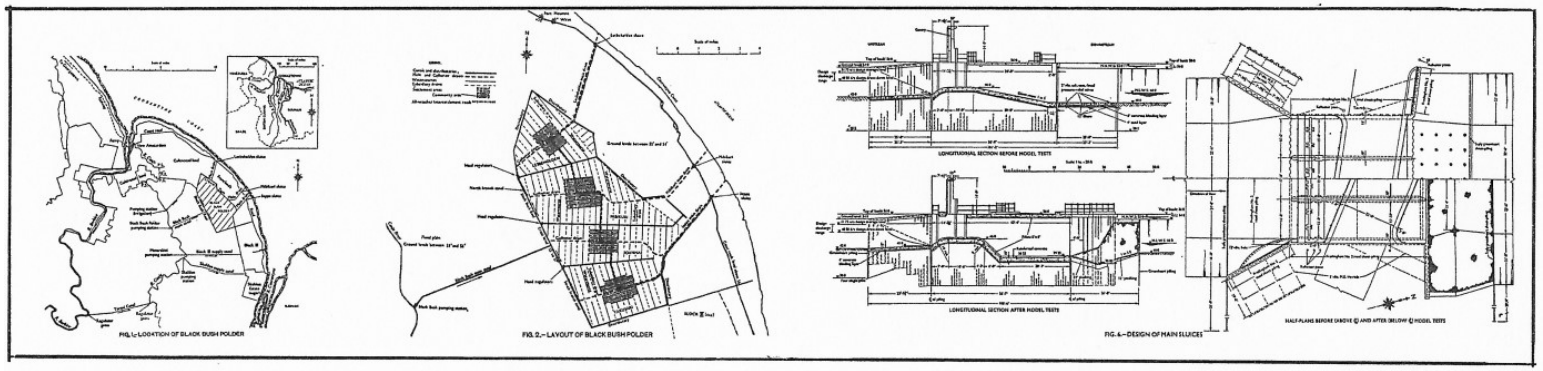

Figure 3. The lay out and sluices of the Black Bush Polder (Scott et al., 1960)

Design, construction, operation and maintenance

Scott *et al*. (1960) give a detailed description of the irrigation and drainage system of the Black Bush Polder. Typical cross-sections of the irrigation canals and drains are shown in Figure 4. The discharge of drainage water to the sea was done through tidal gates.

In the second half of the 19th century attempts have been made to construct permanent sea dikes. However, these dikes did not resist the erosion (Van Duivendijk and Pieters, 1983) (Figure 5).

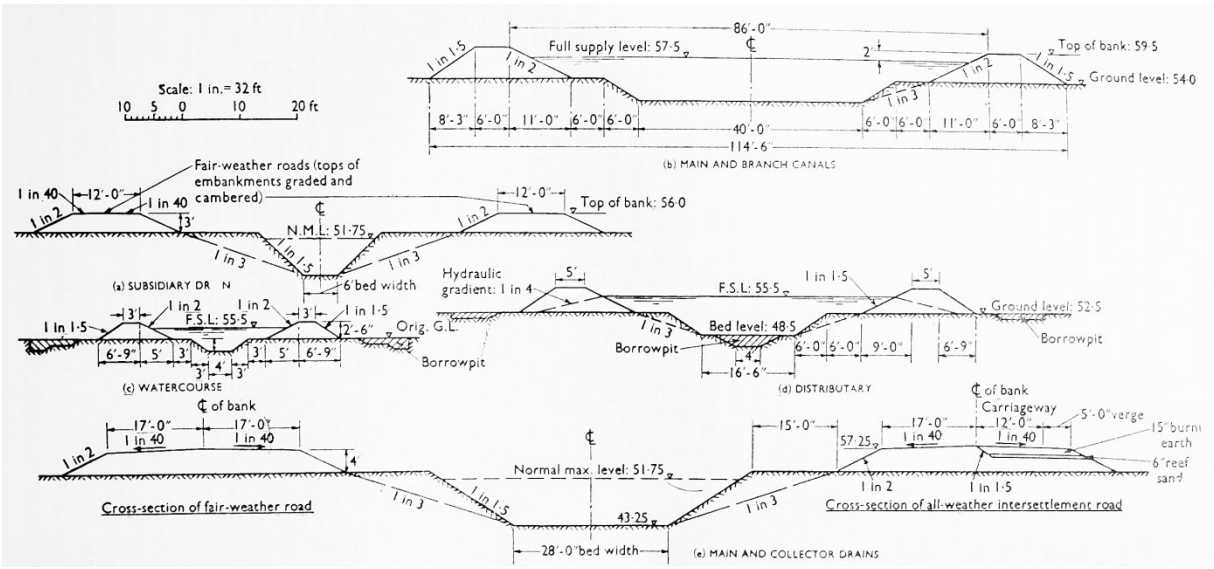

Figure 4. Typical cross-sections of the irrigation canals and drains in the Black Bush Polder (Scott et al., 1960)

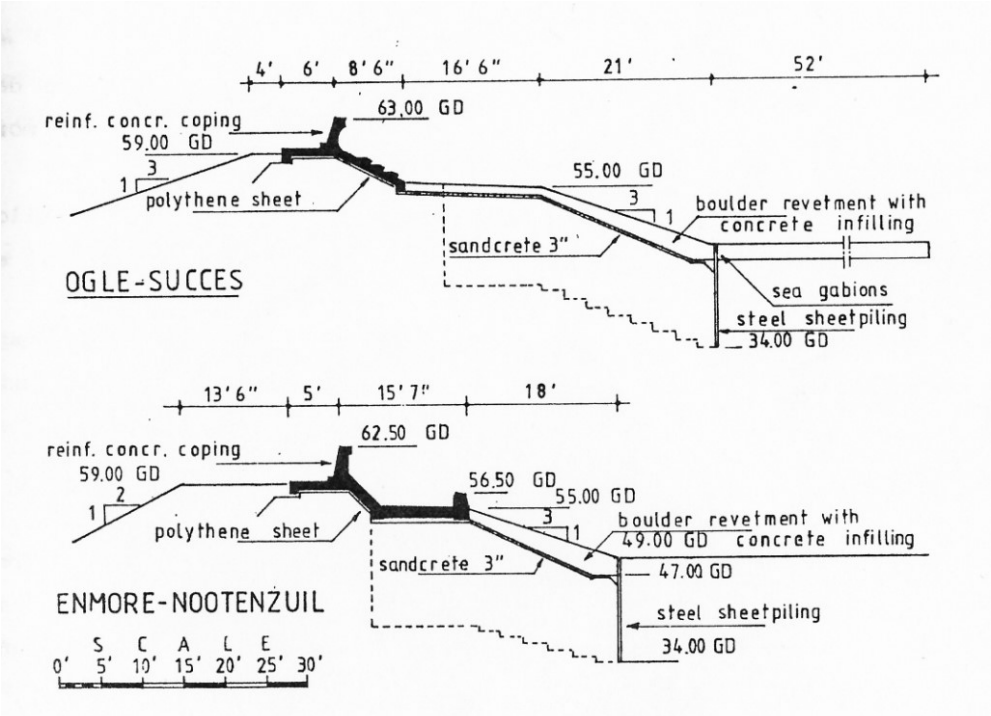

Figure 5. Types of sea defences prior to 1970 (Van Duivendijk and Pieters, 1983)

Van Duivendijk and Pieters (1983) also present a Table with the types and length of the existing sea defences (Table I). In addition, they present a schematic design for a new dike (Figure 6). The completion report of this project has been published by NEDECO (1977).

Table I. Classification of existing sea defences in Guyana (Van Duivendijk and Pieters, 1983)

Classification	Overall length in km	%
Natural sand reefs	77.3	24
Earth dikes without protection	168.6	53
Earth dikes with slope protection	4.3	1
Earth dikes protected at the toe, on the slopes and with copings	70.6	22
Total	321	100

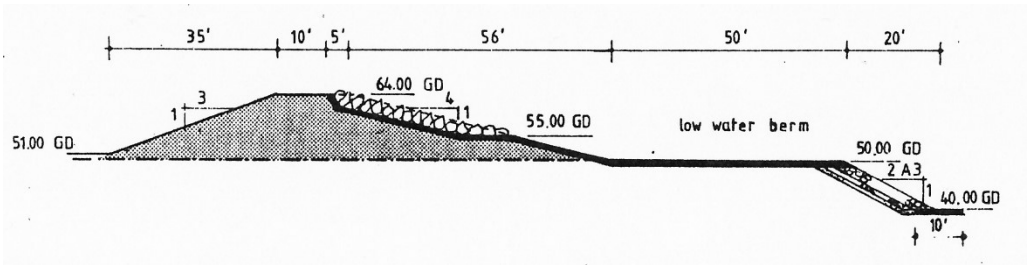

Figure 6. New design for a sea dike (Van Duivendijk and Pieters, 1983)

Proposed polders

No proposed polder has been identified.

Location of the polders in Guyana as shown on the World polder map

The location of the polders in Guyana is shown in Figure 7.

Figure 7. Location of the polders in Guyana (source: esri – Batavialand)

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Lelystad, April 2023

Table II. General characteristics of existing polders in Guyana

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Black Bush Polder	1959	10,900	RLL	6º 03' N	57º 17' W	4	Agriculture
Ogle Estate		2,673	RLL	6º 48' N	58º 04' W	4	Agriculture
Georgetown			RLL	6º 48' N	58º 09' W	4	Urban
Canal number two Polder			RLL	6º 48' N	58º 09' W	2	Agriculture
Total		13,473					

*) RLL = reclaimed low-lying land; LGS = land gained on the sea; DL = drained lake

Table III. Characteristics of the water management and flood protection system of existing polders in Guyana

Name	Design criteria in chance of occurrence/year						
	Water management						Flood protection
	Drainage					Irrigation	Rural and urban
	Type	Design criterion	Percentage of open water	Discharge capacity			
				m^3/s	mm/day		
Black Bush Polder	RLL						Overtopping 0.1 litre/per m/per s
Ogle Estate	RLL						
Georgetown	RLL						Overtopping 0.1 litre/per m/per s Outer slope 1:4, inner slope 1:3
Canal number two Polder	RLL						