### **SURINAM**



Source: esri

#### General

Surinam - officially known as the Republic of Surinam - is a sovereign state on the north-eastern Atlantic coast of South America. It is bordered by the Atlantic Ocean in the North, French Guiana in the East, Guyana in the West and Brazil in the South. It is the smallest country in South America. Surinam has an area of 16.4 Mha (million hectares) with, in 2022, a population of 0.62 million, or 0.04 persons per ha (Wikipedia and United Nations, 2022).

## **Climate and geography**

Lying 2 to 5° north of the equator, Surinam has a very hot and wet tropical climate, and temperatures do not vary much throughout the year. Its average temperature ranges from 29 to 34 °C. Average relative humidity is between 80 and 90%. There are two wet seasons, from April to August and from November to February. There are also two dry seasons, from August to November and from February to April (source: Wikipedia).

The Group Polder Development (1982) describes that Surinam has a rather flat coastal plain, which stretches all along the East-West, about 40 km wide in the East and 120 km in the West. It consists mainly of marine, heavily textured clay deposits. This can be illustrated by a map of Netherlands Guiana of 1700 (Figure 1) (source: Wikimedia). The schematised geological situation of the coastal plain is shown in Figure 2 (Da Costa, 1983).



Figure 1. Netherlands Guiana around 1700 (nl.wikimedia.org)

Rostain (2010) describes that the first raised fields were made in Surinam by the Barrancoid, builders of the Buckleburg mounds in 350, and probably also in western Guyana (Versteeg, 2008). However, most of the earthworks are associated with Arauquinoid sites in Guyana, Surinam and

French Guiana (Rostain, 1994). Along the Guianas coast, Arauquinoid culture spread from the middle Orinoco to the coast of the Guianas (Rostain and Versteeg, 2004). The first Arauquinoid raised fields were made from 650, but they became common and spread almost everywhere along the coast up to Cayenne Island between 1000 and 1450. Arauquinoid groups belong to a cultural continuum settled between Berbice River in the east of Guyana and Cayenne Island in French Guiana. The territory of the Arauquinoid communities extended to cover a region some 210 km long and 25 km wide where the raised field technique was intensively used for almost a thousand years prior to the European conquest. They erected thousands of raised fields of various shapes, dug canals, ditches, and pathways, and built artificial mounds to establish their villages (Figures 3 and 4). All these earthworks changed forever the face of the coastal flooded savannas and their ecology. In Surinam raised fields were found in Surinam in 1956 by Dost, who has described them (Geijskes, 1964 and Boomert, 1976).



Figure 2. Schematised geological situation of the coastal plain of Surinam (Da Costa, 1983)



Figure 3. Map of the raised field complexes of the Guianas coast (Rostain, 2010)

Artificial residential mounds were associated with raised field complexes in various countries of South America. In the Llanos of Apure, in Venezuela, several Arauquinoid mounds and raised fields have been found. In western Surinam and eastern Guyana, between the Berbice and the Coppename rivers, sandy ridges were absent, so Hertenrits people had to build rounded clay mounds above the water level to erect their villages. At least eight mounds were erected on a landscape where fresh, brackish and salt waters met, but other possible artificial mounds have been reported in this area (Versteeg, 2008).



Figure 4. Hertenrits mound view from the raised fields, western Surinam coast (photo Geijskes, coll. Stichting Surinaams Museum) (Rostain, 2010)

At 200 to 320 m in diameter, 2.5 m high, and with a raised area estimated at 4 ha, Hertenrits is the largest of the six Arauquinoid mounds (Figure 5). The Hertenrits mound was occupied during a long period between 650 and 1250, being built progressively, layer by layer (Versteeg, 2008). The area around the mounds was inundated with fresh water at the end of the wet season. Some water courses were adapted to connect them or to improve natural drainage. A ditch of 20 - 100 m wide surrounds the Hertenrits mound. Mounds were built up from circa 600 layer by layer from the clay immediately around the mound. Five wharves of 20 m long and at least 1 m deep were disposed on the periphery to receive canoes. Two smaller satellite mounds were built diametrically opposite, equidistant from Hertenrits: Wageningen-1 is 4 km to the East and Wageningen-3 is 3 km to the West. Raised fields were built between the mounds. They were rectangular or elongated, distributed in irregular and scattered groups of mainly 2 to 10 - 15 plots. Shallow seasonally inundated canals run radially, connecting the Hertenrits mound to raised fields and to the two other mounds. These canals were used as pathways during the dry season and as waterways during the rainy season, strongly suggesting that the three mounds were occupied at the same time. The inhabitants of Hertenrits organized and managed their territory in a precise and specific manner.

The raised fields are classified on the basis of their size, shape and topographical location (Rostain, 2008a). 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 of which two - regular and irregular ones - were also identified in Surinam:

- *ridged fields in the three Guianas.* They are elongated and narrow, measuring between 1 and 3 m in width, 5 to 30 m in length and 30 to 80 cm in height. 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. On the western coast of Surinam, irregular raised fields are located near the residential mounds. They are distributed arbitrarily or arranged in groups of 2 to 10 or 15. They are oval shaped, measuring between 3 and 6.5 m wide, 8 to 140 m long, with an average of 4–5 × 20–30 m (Boomert, 1980);
- *large raised fields range in size from 2 to 5 m diameter and from 30 to 100 cm height.* These raised fields, generally round in shape, are found in eastern Surinam and around Kourou and

Sinnamary, but they are more square or rectangular near Cayenne Island. On the eastern coast and in some areas of the western coast of Surinam, the regular raised fields are rounded-off rectangular or square shapes (Boomert, 1980). Their size ranges from 3 to 4 m wide, 4 to 30 m long and 50 to 100 cm high. These large raised fields are located in the most flooded areas and their sizes are smaller in the deepest swamps.



Figure 5. Human modifications in the Hertenrits surroundings with the three residential mounds (Rostain, 2010, redrawn after Boomert, 1980)

A special find in the swamp near Prins Bernhard Polder, west of the raised fields areas in west Surinam, can be associated with raised fields and to Arauquinoid people. It is a shovel of hardwood (apparently green ebony, Bignonaceae, *Tabebuia serratifolia*), 72 cm long, with a flattened, curved end and a broken cylindrical handle (Figure 6). This tool, probably used to make or to maintain earthworks, yielded a Late Arauquinoid dating of 1240–1280 (Versteeg, 2003).

In 1745, Father Gumilla met Otomac Indians who built raised fields with wooden shovels in the Venezuelan Llanos. Similar shovels still exist in some Indian groups such as Ashluslay in Paraguay. In Africa, the Floup from Senegal use a similar wooden shovel, the *kayendo*, to cut quadrangular blocks in the clay (Rostain, 2008b). The block is extracted by pressure of the *kayendo* against the thigh (Figure 6). Archaeological excavations have shown that the Hertenrits mound was built by the piling up of rectangular blocks, probably made with the same type of wooden shovel.

Ditches were made to improve water control. Belt ditches are small and curved waterlines 1-2 m in width, perpendicular to the direction in which the water naturally flows. They enclose some groups of raised fields. They are relatively narrow at their extremities and generally form a pond at the centre. These ditches functioned to prevent too much water near the raised fields during the rainy season. They also most likely served as water reserves during the dry season.



Figure 6. (a) Arauquinoid wooden shovel found near Prins Bernhard Polder (photo and drawing Rostain, 2010). (b) Kayendo from Senegal used to build raised fields by Floup group (photos Montoroi).

Canals were straight and regular, larger than the belt ditches. They were about 2 m wide and could have a length of 150 m. They were used for the drainage of excess water and, perhaps, as water tanks or fishponds. Some of them were exceptionally long and could serve for canoe travel. For example, there were two long canals near the Mana River (Cornette, 1987). One of them was about 2 km long, 3 m deep, 4 m wide at the bottom and 21 m wide at the top. The Kali'na Indians of the Awala village mention that these canals served in the past to connect the settlements of the lower Mana River. Similar long canals are also found in Surinam, running perpendicularly from a sand ridge and often connected to a raised fields complex (Boomert, 1976).

The Saramaka, a group of escaped slaves who were living along the Maroni River, sometimes build small and elongated raised fields as well (Rostain, 1995).

Rostain (2010) describes that along the Guianas coast, extensive colonial earthworks were generally built to improve cultivation conditions. The most impressive constructions made by Europeans were the polders. Dutchmen reclaimed thousands of hectares in Surinam. In 1668 there were 23 sugar plantations, by 1800 there were 641 plantations along the Para River and the downstream sections of the Surinam and Commewijne rivers. In the 1970s, 3,500 ha of rice polders were irrigated in the Coronie District, on the western coast (National Planning Office of Surinam and Regional Development and Physical Planning Department, 1998).

Rostain (2010) also describes that by using slave labour, Dutchmen built hundreds of hectares of polders along the Cottica River, east of Paramaribo. This is also mentioned by Ehrenburg and Meyer (2015) who describe that most of the plantations in Latin America are established on higher ground and that the plantations in the lowland areas along the lower reaches of rivers and on the coast of Suriname and Guyana were polders with an advanced and multifunctional water management system, and therefore rare. They further describe that polder development in Surinam started in the period 1675-1716 along the Commewijne and Cottica rivers. At a later stage polder development started at the isles in the Lower-Essequibo River and along the Demerara River.

Interesting is that Van Sommelsdijck initiated the construction of a pilot polder with a small sluice to proof that such a system would be effective.

Already in 1787 Blom describes how for the development of plantations in the coastal area of Surinam polders were constructed. In the dry season first the land where the dike had to be constructed was cleared. Thereafter a dike of clay was constructed in combination with a surrounding drain. He also mentions that peat could not be used for the dike. Then, within the polder the land was cleared and raised beds and drains were constructed. This was followed by the installation of a culvert with a flap gate at an appropriate place in the dike.

Ehrenburg en Meyer (2015) describe that 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. Ehrenburg and Meyer (2015) show in four maps the development of the polder plantations from 1735 till 1860 (Figure 7).



Figure 7. Development of the polder plantations in Surinam from 1735 till 1860 (Ehrenburg and Meyer, 2015)

In line with the description by Blom, Ehrenburg and Meyer (2015) give a detailed description of the infrastructure of the polder plantations. The construction of a plantation started with the excavation of drains along the sides and the backside. With the excavated soil small dikes were made. In this way most plantations had an area between 215 and 430 ha. During low tide the side drains drained the excess water to the rivers through an outlet sluice. Fresh water could be obtained from the upstream swamp by gravity as for example shown by Spier (1983) (Figure 8).



Figure 8. Gravity irrigation of polder plantations from upstream swamps (Spier, 1983)

An old map with the lay-out of a sugar cane plantation is shown in Figure 9. The schematic lay-out is shown in Figure 10 (Ehrenburg and Meyer, 2015).

The Group Polder Development (1982) describes that the large, flat, nearly treeless, uninhabited areas are very suitable for rice cultivation, while they have fertile clay soils and are in the vicinity of rivers with sufficient good quality water. They also describe that European settlers preferred settlement in the marshy downstream areas. The first polders were constructed for the cultivation of high price tropical crops, such as sugar cane, coffee and cotton. Thousands of rectangular polders, varying in size between 200 and 600 ha were constructed along the main rivers in the Guyanas, starting around 1950. In addition to rice there is some banana cultivation in the polders, mostly in the Western District of Nickerie.

The Ministry of Regional Development (2012) shows the names of the Water Authorities in Surinam. It looks like their responsibilities coincide with the boundaries of polders.



Figure 9. Old map with the lay out of a sugar cane plantation (Tropen museum H-3550) (Ehrenburg and Meyer, 2015)

# **Existing polders**

The Group Polder Development (1982) mentions the following polders in Surinam:

- in the Western District of Nickerie near Jaricaba two polders of 450 and 550 ha (Da Costa, 1983);
- in North-West Surinam the cultivated polder area was expanded from some 10,000 ha in 1950 to more than 40,000 ha in the early 1980s (Spier, 1983);
- by the 1980s it was expected that the total polder area in Nickerie would grow to 57,000 ha, involving the following projects:
  - \* Nanni Polder (9000 ha) (Sevenhuijsen, 1977);
  - \* Coronie Polder (2,000 ha);
  - \* Multi-purpose Corantijn Project (33,000 ha).
- a schematic lay out of the Europolder in Western Surinam as shown in Figure 11.



Figure 10. Schematic lay out of a sugar cane plantation (drawing Ehrenburg/Sunecon) (Ehrenburg and Meyer, 2015)



Figure 11. Euro Polder in Western Surinam

Sevenhuijsen (1977) presents the development of polders in the Nickerie District (Figure 12).

Da Costa (1983) mentions three polders of respectively 250, 310 and 480 ha in the District of Saramacca for banana cultivation.

In various other publications names and additional information on polders is given. General characteristics of the polders in Surinam are shown in Table I.



Figure 12. Development of polders in the Nickerie District (Sevenhuijsen, 1977)

# **Proposed polders**

Ritzema (1980) presents a pre-feasibility study on a possible extension of the S.M.L. Polder (Figure 13). A check on Google Earth shows that this extension most probably has not been made.



Figure 13. Map of the north-western Part of the Nickerie District (Ritzema, 1980)

#### Water management system

Da Costa (1983) mentions that all banana polder plantations had the same lay out. A main canal collects the water from the secondary drains or ditches and discharges it through a sluice - often combined with a pumping station - to a regional canal that is connected with a tidal river. Each ditch controls an independent hydrological unit called *kavel*, which is 6-9 ha and is fed by small canals of about 0.90 m deep and 6 m spacing, thus creating a cambered bed system. Each *kavel* consists of 100 - 150 6 m beds and alongside each *kavel* there is a clay road or dike, which can only be used in the dry season (Figure 14) (Da Costa, 1983).

Descriptions of the construction aspects of polders in Surinam are given by Van 't Leven (1983) and by Meyer (1983). They stated that from the 18<sup>th</sup> till the 20<sup>th</sup> century the construction of polders has been carried out with manual labour. In the 20<sup>th</sup> century mechanisation came in. They also stated that because of this more emphasis had to be put on water management than in the past. This implied that the works started with enclosure of the polder area to be sure that no water from outside could flow into the area. At the same time the works were carried out to drain the polder. This was implemented by making a controllable outlet to a natural drainage canal, or a river, or to an already existing drainage system with outlet sluices. In the new polder the drains were excavated first with a road alongside the drains. They further give a detailed description of the steps during the construction phase, which took at least four years (Van 't Leven, 1983; Meyer, 1983).





CS 2 : CROSS - SECTION BED / BEDDRAINS



Figure 14. Cross-sections of a kavel for banana plantations Da Costa (1983)

# Location of the polders in Surinam as shown on the World polder map

The locations of the polders in Surinam are shown in Figure 15.



Figure 15. Location of the polders in Surinam (source: esri – Batavialand)

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Bart Schultz

Lelystad, May 2023

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Paradise	1898	286	RLL	5° 54' N	56° 56' W	0	Rice
Longmay			RLL	5° 55' N	56° 56' W	0	Rice
Nieuw Waldeck	1903	156	RLL				Rice
Sawmill Kreek Polder	1909/1914	274	RLL	5° 57' N	57° 00' W	2	Rice
Hampton Court Polder	1910/1938	450	RLL	5° 51' N	56° 55' W	1	Rice
Extension Hampton Court Polder			RLL	5° 53' N	56° 56' W	1	Rice
Boonacker Polder	~1913	217	RLL	5° 54' N	56° 55' W	2	Rice
Van Drimmelen Polder	1914	550	RLL	5° 51' N	56° 55' W	1	Rice
Corantijn Polder	1919	1,011	RLL	5° 57' N	57° 02' W	2	Rice
Klein Henar Polder	1920	43	RLL	5° 51' N	56° 55' W	1	Rice
Margarethenburg (Van Dijk)	1934	~500	RLL	5° 57' N	57° 00' W	2	Rice
Clara Polder	1942	1,500	RLL	5° 51' N	56° 55' W	1	Rice
Van Petten Polder	1946		RLL	5° 56' N	57° 00' W	1	Rice
Prins Bernhard Polder	1950	200	RLL				Rice
Commissaris Simons Polder	1 <sup>st</sup> half 20 <sup>th</sup> century	460	RLL	5° 40' N	55° 04' W	5	
Johannis Polder	1 <sup>st</sup> half 20 <sup>th</sup> century	214	RLL				
Saramacca Polder	1 <sup>st</sup> half 20 <sup>th</sup> century	2,800	RLL	5° 48' N	55° 40' W	12	
Middenstands Polder	1961	1,431	RLL	5° 54' N	56° 47' W	1	Rice
Bruto Polder			RLL	5° 51' N	56° 55' W	1	Rice
Commewijne			RLL	5° 43' N	54° 52' W	5	
Coronie Polder		2,000	RLL	5° 37' N	56° 17' W	6	
Eerste Bacoven Polder			RLL	5° 49' N	56° 53' W	1	
Europolder-noord			RLL	5° 51' N	56° 55' W	1	Rice
Europolder-zuid			RLL	5° 51' N	56° 55' W	1	Rice
Groot Henar Polder			RLL	5° 51' N	56° 55' W	1	Rice
Nanni Polder		9,000	RLL	5° 51' N	56° 55' W	1	Rice
Other polders in North-West Surinam		17,160	RLL	5° 50' N	56° 56' W	1	Rice
Polder I near Jaricaba		450	RLL	5° 50' N	55° 24' W	4	Banana
Polder II near Jaricaba		550	RLL	5° 50' N	55° 22' W	4	Banana
Sub-total		38,752					

Table I. General characteristics of existing polders in Surinam

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

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Sub-total previous page		38,752					
Polder I in Saramacca District		250	RLL	5° 49' N	55° 37' W	7	Banana
Polder II in Saramacca District		310	RLL	5° 49' N	55° 37' W	7	Banana
Polder III in Saramacca District		480	RLL	5° 49' N	55° 37' W	7	Banana
Reeberg			RLL	5° 42' N	55° 17' W	7	
Sint-Jozef Polder			RLL				
Totness Polder			RLL	5° 52' N	56° 20' W	4	
Tweede Bacoven Polder			RLL	5° 49' N	56° 53' W	1	
Wageningen Polder		10,000	RLL	5° 50' N	56° 43' W	3	Rice
Wasima			RLL	5° 51' N	56° 55' W	1	
Total		49,792					

Table I. General characteristics of existing polders in Surinam (continued)