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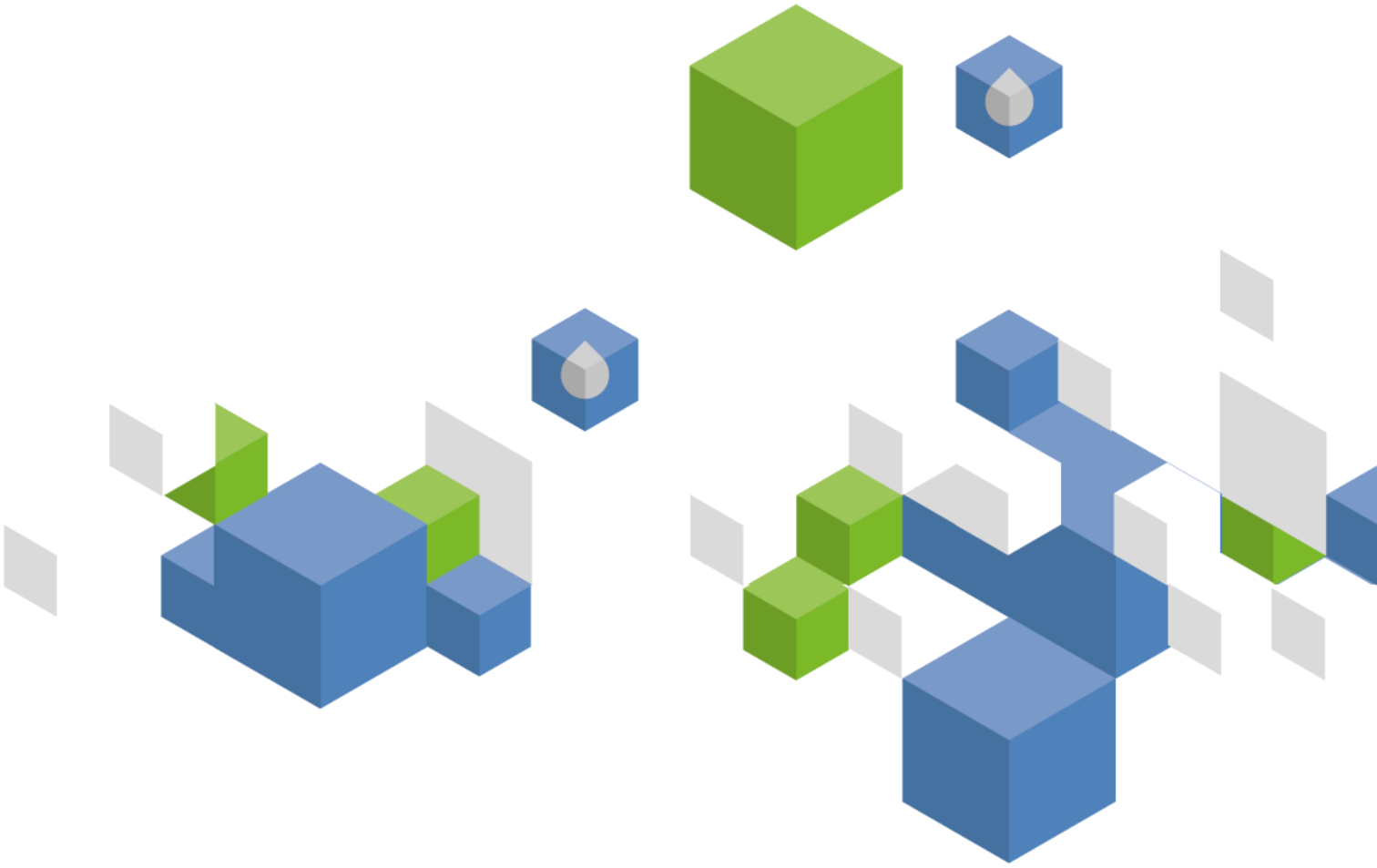

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Suriname

GEOGRAPHY, CLIMATE AND POPULATION

Geography

Suriname, located on the northeastern coast of South America, lies between latitudes 2°N and 6°N and between longitudes 54°W and 58°W. It is bordered by the Atlantic Ocean to the north, French Guiana to the east, Brazil to the south and Guyana to the west. The country has an area of 163 820 km^2, of which around 80 percent is covered with tropical rain forests. Only 1.5 million ha are considered suitable for agriculture. In 2012, the total cultivated area was estimated at 66 000 ha, of which 60 000 ha were annual crops, with rice being dominant, and 6 000 ha permanent crops, with bananas, sugarcane, coconut, citrus and palm oil trees being the major crops (Table 1). For administrative purposes, the country is divided into ten districts. The capital is Paramaribo.

TABLE 1
Basic statistics and population

Physical areas:			
Area of the country	2012	16 382 000	ha
Agricultural land (permanent meadows and pasture + cultivated land)	2012	83 000	ha
• As % of the total area of the country	2012	0.5	%
• Permanent meadows and pasture	2012	17 000	ha
• Cultivated area (arable land + area under permanent crops)	2012	66 000	ha
- As % of the total area of the country	2012	0.4	%
- Arable land (temp. crops + temp. fallow + temp. meadows)	2012	60 000	ha
- Area under permanent crops	2012	6 000	ha
Population:			
Total population	2013	539 000	inhabitants
- Of which rural	2013	29	%
Population density	2013	3	inhabitants/km^2
Population economically active	2013	203 000	inhabitants
• As % of total population	2013	38	%
• Female	2013	37	%
• Male	2013	63	%
Population economically active in agriculture	2013	33 000	inhabitants
• As % of total economically active population	2013	16	%
• Female	2013	24	%
• Male	2013	76	%
Economy and development:			
Gross Domestic Product (GDP) (current US$)	2012	4 738	million US$/year
• Value added in agriculture (% of GDP)	2011	10	%
• GDP per capita	2012	8 873	US$/year
Human Development Index (highest = 1)	2013	0.705	-
Gender Inequality Index (equality = 0, inequality = 1)	2013	0.463	-
Access to improved drinking water sources:			
Total population	2012	95	%
Urban population	2012	98	%
Rural population	2012	88	%

FIGURE 1
Map of Suriname

SURINAME

FAO - AQUASTAT, 2015

Suriname can be divided into four major ecological zones:

- The *Young Coastal Plain*, about 16 260 km^2, consists of clay flats at sea level, covered in the estuarine zone with mangrove forests, coastal lagoons and brackish swamps. It includes the delta systems which extend along the entire coast between the border river Maroni in the east and the border river Corentyne in the west. The width of the Young Coastal Plain varies from 8 km in the east to 50 km in the west.
- The *Old Coastal Plain*, about 4 310 km^2, consists of remnants of 4 to 10 m high sandy ridges and clay islands, both covered with rain forests. These higher elements are surrounded by clay and peat soils, both at sea level, which are covered with freshwater swamps, swamp wood and swamp forests.
- The *Savannah or Zanderij Belt*, about 8 780 km^2, lies 10 to 100 m above sea level and consists of rolling and dissected plains, characterized by unbleached loams and coarse white sands, both of continental origin. The vegetation consists of rain forests, xerophytic forests and, to a lesser extent, open savannahs.
- The *Residual Uplands* (interior), cover four-fifths of the land surface, or 134 470 km^2. This area is part of the Guyana Shield, with hills and mountains up to 1 230 m above sea level, and is mainly covered with undisturbed rain forests.

Climate

Suriname has a tropical climate. The populated area in the north has four seasons: a minor rainy season from early December to early February, a minor dry season from early February to late April, a major rainy season from late April to mid-August and a major dry season from mid-August to early December. Daytime temperatures in Paramaribo range between 23°C and 31°C, with an annual average temperature of 27°C. The range in average temperatures between the warmest month, September, and the coldest month, January, is only 2°C.

Rainfall is highest in the central and southeastern parts of the country. The average annual rainfall varies from 1 450 mm in Coronie district in the north to 3 000 mm at Tafelberg (Table Mountain) in the centre of the country in Sipaliwini district. It is 2 200 mm in Paramarino. The relative humidity is very high, from 70 to 90 percent. Suriname suffers the effects of *El Niño*, a current of warm water that periodically flows along the western coast of South America.

Population

Suriname's population is 539 000 inhabitants in 2013, of which 29 percent are rural, while 34 percent were rural in 1993. The average density is estimated at 3 inhabitants/km², but about 95 percent of the country's population live in the coastal plain, with the capital Paramaribo as the main urban centre where approximately 70 percent of the population are concentrated. The *Residual Uplands* are sparsely populated, with just 5 percent of the total population. Ninety percent of the country is uninhabited. During the period 2003-2013 the annual population growth rate was estimated at 1.0 percent.

In 2012, 95 percent of the population had access to improved water sources (98 and 88 percent in urban and rural areas respectively). Sanitation coverage accounted for 80 percent (88 and 61 percent in urban and rural areas respectively).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2012, Suriname's GDP was $US4 738 million of which the agriculture sector accounted for 10 percent. Agriculture is the primary source of livelihood in the rural areas.

In 2013, the total economically active population is 203 000, or 38 percent of the total population. The economically active population in agriculture is estimated at 33 000 (16 percent of the total active population), of which 24 percent is female.

Suriname has many natural resources, fertile land and abundant freshwater resources that provide a solid base for the economic development of the country (USACE, 2001).

The main economic activities are mining (bauxite and gold), agriculture, oil industry and fisheries, all concentrated along the coast. Within the agricultural sector, rice is the most important covering about 55 000 ha, followed by sugarcane on about 3 000 ha and bananas on about 2 000 ha. During the 1980s, the country experienced political and economic problems as a result of the decrease on prices of bauxite and aluminium and the suspension of development aid from The Netherlands. In 1995, Suriname was admitted to CARICOM but to participate in the market it must produce competitive goods (USACE, 2001).

WATER RESOURCES

Surface water and groundwater resources

Annual average rainfall in Suriname is 2 331 mm or 382 km^3/year in the country's territory. Water resources are abundant. Internal Renewable Water Resources (IRWR) are about 99 km^3/year, which is equal to the flows of the internal rivers and an estimated 50 percent of the flows each of the border river with Guyana and the border river with French Guiana (Table 2 and Table 3).

TABLE 2
Major river basins of Suriname, from east to west (Source: SWRIS 2013)

River basin	Catchment area (km^2)	Average discharge (m^3/s)	Average discharge (km^3/year)	IRWR (km^3/year)
Maroni (border with French Guiana) *	68 700	1 780	56	28
Commewijne-Cottica	6 600	120	4	4
Suriname	16 500	426	13	13
Saramacca	9 000	225	7	7
Coppename	21 700	500	16	16
Nickerie	10 100	178	6	6
Corentyne (border with Guyana) *	67 600	1 570	50	25
Total	**200 200**	**4 799**	**152**	**99**

** The catchment area and average discharge include the parts of the neighbouring countries*

TABLE 3
Renewable water resources

Renewable freshwater resources:			
Precipitation (long-term average)	-	2 331	mm/year
	-	381 864	million m^3/year
Internal renewable water resources (long-term average)	-	99 000	million m^3/year
Total renewable water resources	-	99 000	million m^3/year
Dependency ratio	-	0	%
Total renewable water resources per inhabitant	2013	183 673	m^3/year
Total dam capacity	2010	20 000	million m^3

The Corentyne (Corantijn) river is the border river with Guyana, from its source till the sea. The total flow is estimated at 50 km^3/year. It is considered that the entire flow of this river is generated both in Guyana (50 percent) and in Suriname (50 percent) and therefore is part of the IRWR of each country and is not considered to be a border river. The same is the case for the Maroni (Marowijne) river in the east, being the border river with French Guiana from its source till the sea, with a total flow estimated at 56 km^3/year (Table 2). In addition to the Maroni and Corentyne rivers, there are five other major rivers draining northward towards the Atlantic Ocean from east to west: Commewijne, Suriname, Saramacca, Coppename and Nickerie. The main characteristics of these rivers are detailed in Table 2. To the south, the border with Brazil coincides with the watershed boundary between the catchments of the Amazon and the catchments of some Surinamese rivers. No rivers cross into or out of Suriname.

Lakes and dams

Nani lake, located in the Nickerie District, is the only natural fresh water lake.

Total dam capacity is estimated at around 20 km^3 in 2010. Brokopondo lake, also called Blommestein lake receiving the name of the engineer who constructed it, is a reservoir of 20 km^3 created by damming the Suriname river. It's the largest lake in the country covering an area of 1 560 km^2. The reservoir was created by constructing the Afobaka dam across the Suriname river between 1961 and 1964. In 1981, the Afaboka dam provided 30 percent of total energy requirement for Paramaribo (USACE, 2001).

Many exhausted bauxite mines have turned into small lakes. Topibo Lake is a large lake complex at the old mining complex near Paranam (USACE, 2001).

Swamps cover about 60 percent of the Coastal Plain and are characterized by stagnant water, dense tropical forest and large amounts of decaying vegetation. In a 10 km wide strip along the coast, the swamps contain brackish to saline water (USACE, 2001).

International water issues

The Amazon Cooperation Treaty (TCA) was signed in 1978 by Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela and entered into force for Brazil in 1980. The basic scope of the TCA is to promote the harmonious development of the Amazon, in order to allow an equitable distribution of the benefits, to improve the quality of living of its peoples and to achieve the full incorporation of their Amazon territories to the respective domestic economies. In 1995, the countries members of the TCA created the Amazon Cooperation Treaty Organization (ACTO) to strengthen the implementation of the Treaty. From a hydrographic point of view Suriname is not part of the Regional Amazon System because its territory is not part of the Amazon Basin. However, Suriname belongs to the Amazon Cooperation Treaty (ACT) because of vegetation, more specifically the tropical rain forest ecosystem in and around the Amazon Basin.

In 1971 Suriname signed the international Ramsar Convention on Wetlands of International Importance (IDB/GOS, 2010).

WATER USE

In 2006, total water withdrawal was estimated at 615.9 million m^3, of which 70 percent was for agricultural purposes, 8 percent for municipal and 22 percent for industrial purposes (Table 4 and Figure 2). Surface water is used for agricultural and industrial purposes. The urban and coastal rural areas use groundwater for their water supply because of its higher quality, but saltwater intrusion in the wells due to over pumping is increasing. Most of the rural interior areas use rain water collection or surface water for their water supply (IDB/GOS, 2010; USACE, 2001) (Figure 3).

TABLE 4
Water use

Water withdrawal:			
Total water withdrawal	2006	615.9	million m^3/year
- Agriculture (Irrigation + Livestock + Aquaculture)	2006	431.1	million m^3/year
- Municipalities	2006	49.3	million m^3/year
- Industry	2006	135.5	million m^3/year
• Per inhabitant	2006	1 220	m^3/year
Surface water and groundwater withdrawal (primary and secondary)	2006	615.9	million m^3/year
• As % of total renewable water resources	2006	0.6	%
Non-conventional sources of water:			
Produced municipal wastewater	-	-	million m^3/year
Treated municipal wastewater	-	-	million m^3/year
Direct use of treated municipal wastewater	-	-	million m^3/year
Direct use of agricultural drainage water	-	-	million m^3/year
Desalinated water produced	-	-	million m^3/year

FIGURE 2
Water withdrawal by sector
Total 615.9 million m^3 in 2006

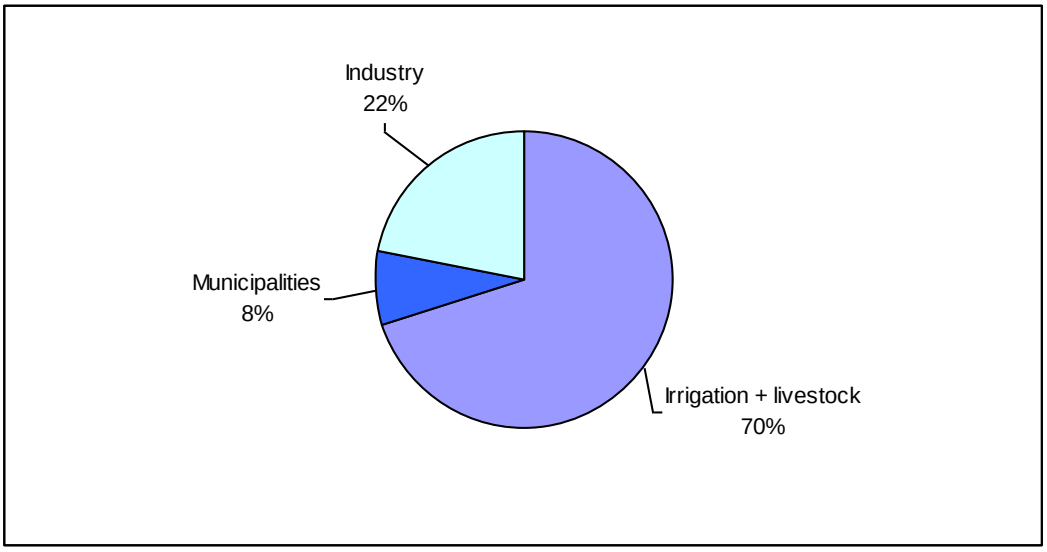
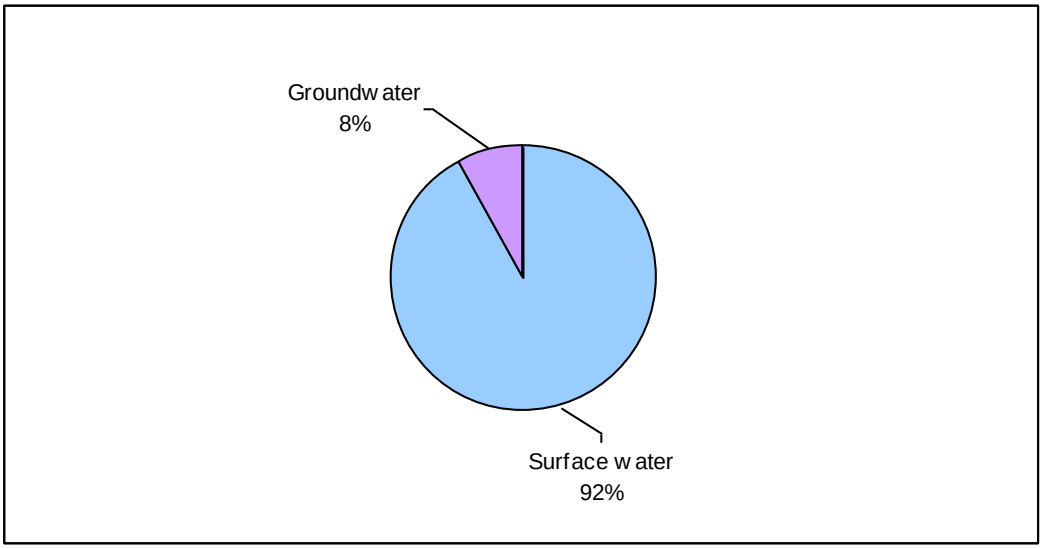


FIGURE 3
Water withdrawal by source
Total 615.9 million m^3 in 2006



IRRIGATION AND DRAINAGE DEVELOPMENT

Evolution of irrigation development

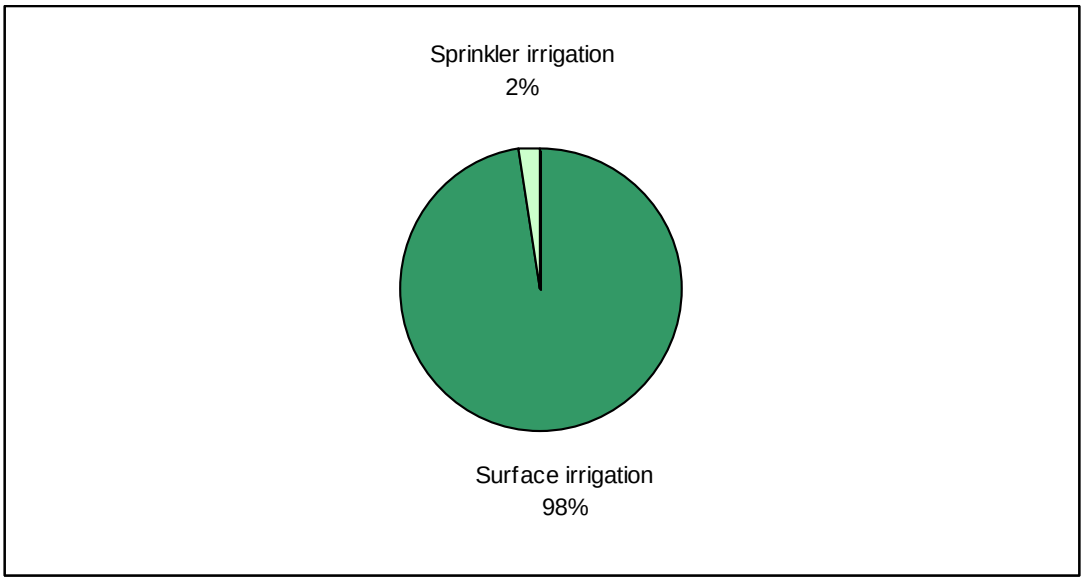
Virtually all economic developments of significance have taken place in the. In the 17th Century, Dutch settlers introduced practices for reclamation of tidal flood lands, converting large areas of the coastal plain into polders suitable for the establishment of plantations for the production of products such as cotton, cocoa, coffee and sugar. The design of water management systems that facilitated the economic utilization of the tidal movements for agricultural production constituted a prime concern in the spatial layout of the polders, established in the form of rectangles with an area of 50 to 1 000 ha. In the course of the 17-18th centuries, about 1 000 polders of this type were built.

After the abolition of slavery in 1863, the human resources demand for plantation-production was met by labourers contracted in China, India and Indonesia that were entitled to obtain small plots of farmland. The replacement of the liberated slaves by Asian labourers led to the introduction of rice cultivation into the economic production structure of Suriname.

By 1950 large-scale mechanized rice farming based on river diversion irrigation was introduced, with the execution of the Wageningen mechanized rice production development scheme in Nickerie district, subsequently followed by the gradual expansion of irrigated farmland on both sides of the Nickerie river to a total of approximately 51 178 ha by 1998. In 2011, the area equipped for irrigation is estimated at 57 000 ha (Table 5). Drainage is considered the main problem with irrigation in Suriname (USACE, 2001).

The major irrigation technique is surface irrigation. Of the irrigated total area of 2 000 ha of bananas, 1 100 ha use sprinkler irrigation systems. The other 900 ha use surface systems. Irrigation for bananas varies, depending upon the weather. Much less irrigation is used in areas where rainfall is more evenly distributed (USACE, 2001). A very small number of farmers use localized irrigation (Figure 4).

FIGURE 4
Irrigation techniques on area equipped for full control irrigation
Total 57 000 ha in 2011



Only surface water is used for irrigation water, obtained from swamps and rivers. Brackish water is used for aquaculture, for cultivating shrimp, fish, etc. (USACE, 2001).

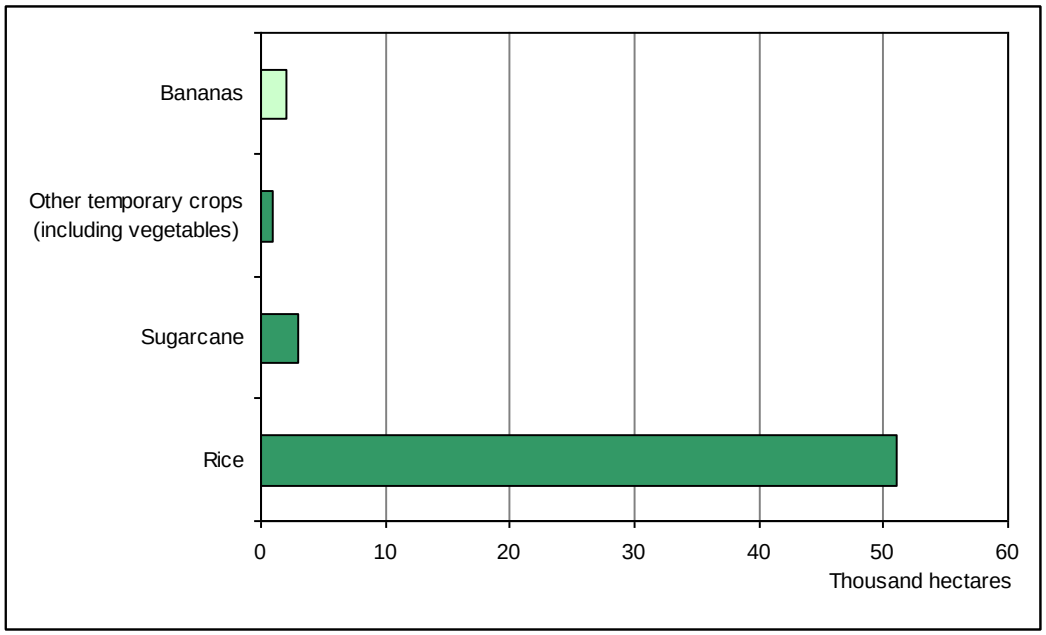
TABLE 5
Irrigation and drainage

Irrigation potential		-	-	ha
Irrigation:				
1. Full control irrigation: equipped area		2011	57 000	ha
- Surface irrigation			-	ha
- Sprinkler irrigation		2001	1 100	ha
- Localized irrigation		-	-	ha
• Area equipped for full control irrigation actually irrigated		2011	57 000	ha
- As % of area equipped for full control irrigation		2011	100	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	-	ha
3. Spate irrigation		-	-	ha
Total area equipped for irrigation (1+2+3)		**2011**	**57 000**	**ha**
• As % of cultivated area		2011	85	%
• % of area irrigated from surface water		2011	100	%
• % of area irrigated from groundwater		2011	0	%
• % of area irrigated from mixed surface water and groundwater		-	-	%
• % of area irrigated from non-conventional sources of water		-	-	%
• Area equipped for irrigation actually irrigated		2011	57 000	ha
- As % of total area equipped for irrigation		2011	100	%
• Average increase per year		-	-	%
• Power irrigated area as % of total area equipped for irrigation		-	-	%
4. Non-equipped cultivated wetlands and inland valley bottoms		-	-	ha
5. Non-equipped flood recession cropping area		-	-	ha
Total agricultural water managed area (1+2+3+4+5)		**2011**	**57 000**	**ha**
• As % of cultivated area		2011	85	%
Size of full control irrigation schemes:	**Criteria**:			
Small schemes	< - ha	-	-	ha
Medium schemes	> - ha and < - ha	-	-	ha
large schemes	> - ha	-	-	ha
Total number of households in irrigation		-	-	
Irrigated crops in full control irrigation schemes:				
Total irrigated grain production				metric tons
• As % of total grain production				%
Harvested crops:				
Total harvested irrigated cropped area		2011	57 000	ha
• Temporary crops: total		2011	55 000	ha
- Rice		2011	51 000	ha
- Sugarcane		2011	3 000	ha
- Other temporary crops (including vegetables)		2011	1 000	ha
• Permanent crops: total		2011	2 000	ha
- Bananas		2011	2 000	ha
Irrigated cropping intensity (on full control area actually irrigated)		2011	100	%
Drainage - Environment:				
Total cultivated area drained		-	-	ha
• Non-irrigated cultivated area drained		-	-	ha
• Area equipped for irrigation drained		-	-	ha
- As % of total area equipped for irrigation		-	-	%
Area salinized by irrigation		-	-	ha
Area waterlogged by irrigation		-	-	ha

Role of irrigation in agricultural production, economy and society

In 2011, total harvested irrigated cropped area was estimated at 57 000 ha. Rice accounts for 51 000 ha or 89 percent of the harvested irrigated cropped area, sugarcane for 3 000 ha, bananas for 2 000 ha and vegetables and other crops for around 1 000 ha (Table 5 and Figure 5). Except for bananas, fruit trees do not require irrigation. Rice is mainly cultivated in the northwestern part of Suriname.

FIGURE 5
Irrigated crops on area equipped for full control irrigation
Total harvested area 57 000 ha in 2006 (cropping intensity on actually irrigated area: 100%)



Women and irrigation

One of the main problems found by women in agricultural production are the poor drainage and irrigation systems. Other important problems reported are unavailability of inputs, high cost of packaging, plant and animal diseases and natural disasters (Defares, 1996).

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The following governmental and non-governmental agencies are responsible for water-related issues in Suriname (SWRIS, 2013):

- The Ministry of Natural Resources is in charge of the development, management and engineering of all natural resources including water. The Water Supply Company (SWM) of the Ministry is responsible for producing and distributing drinking water in the coastal area and the hinterland. It is also responsible for technical training and the design and maintenance of water supply projects.
- The Ministry of Agriculture, Animal Husbandry and Fisheries is in charge of irrigation and drainage management.
- The Ministry of Public Works is in charge of roads and public drainage and sewerage systems. The Hydraulic Research Division (WLA) of the Ministry promotes the optimal utilization, management and protection of water resources. It is the principal agency in the country that collects and publishes hydrologic, hydraulic and water quality data and information and conducts investigation and research. The Meteorological Service Suriname (MDS) of the Ministry maintains a national meteorological databank.
- Other ministries with responsibilities related to water resources are: the Ministry of Public Health, the Ministry of Labour, Technological Development and Environment, the Ministry of Transport, Communication and Tourism and the Ministry of Regional Development.
- The National Institute for Environment and Development in Suriname (NIMOS), established in 1998, is responsible to initiate the development of a national, legal and institutional framework

for environmental policy and management in the interest of sustainable development in Suriname.

- The District Water Board Multipurpose Corentyne Project (OW-MCP) is in charge of managing the pumps at Wakay, cleaning the Corentyne canal and re-establishing district water boards in the rice areas.
- The Anton de Kom University of Suriname is in charge of education and research through the departments of Infrastructure (IS), Environmental Sciences (MW), National Zoological Collection – CMO (NZCS) and the Hydraulic Laboratory (WBL).
- The Suriname Order of Consulting Engineers (ORIS) provides engineering services in the fields of, among others, water resources studies, irrigation and drainage works, water supply and sewerage, identification of pre-feasibility and feasibility studies, supervision during construction of works, recommendations on maintenance, operation and legislation, and support for education and training.

Water management

In the 1994-1998 Multi-annual Development Plan, the revitalization of agriculture was emphasised through rehabilitation and modernization of the agricultural sector, modernization of agro-industries, improvement in traditional export production and expansion of non-traditional agro-cultural production. In addition to the above, the 1996-2001 Agricultural Policy Document mentions certain policy measures, notably: removal of subsidies, privatization, incentives for export and domestic food production and improvement of physical infrastructure.

The Multi-Purpose Corentyne Project in Nickerie district included the construction of a 66 km irrigation canal to bring water to existing and projected new areas to produce rice and raise cropping intensity from 1.22 to 1.90. Vegetables, perennial fruit crops and pastures are mainly rainfed, although modern irrigation and drainage systems would be needed to make production less dependent on rainfall.

The Suriname Water Resources Information System (SWRIS) Project has improved water resources management in the country. In addition to the online information system, the project has developed a water video, a collection of hydro-meteorological field data, awareness programmes about water resources for primary and secondary schools, training, and academic courses. The goal is to increase awareness of freshwater resources and to promote and foster human resources development in IWRM in Suriname (GWP, 2013).

The potable water supply system in Greater Paramaribo is characterized by inadequate production capacity, unreliable supply, restrictions on housing, old and inadequate production and transmission and distribution infrastructure. The Government of Suriname and the Inter-American Development Bank are preparing a new operation Water Supply Infrastructure Rehabilitation (IDB/GOS, 2010).

In 2009 the new Water Supply Master Plan for Suriname was approved (IDB/GOS, 2010).

Finances

At present, there is no fee for irrigation, but there are proposals to start charging farmers for using surface water, which will control the use of water and reduce the waste of water.

Policies and legislation

Currently, there is no legislation in Suriname on water or environment, and therefore no formal environmental permits are issued. A national water law has been in draft since 1984.

A set of regulations on groundwater protection areas was drafted in 2007, but there was no further development of this draft regulation.

NIMOS has prepared a guideline based on World Bank guidelines for Environmental Impact Assessments, using similar categories and terminologies as the World Bank.

ENVIRONMENT AND HEALTH

Surface water quality in urban and rural areas is under severe stress due to poor sanitary practices and agricultural, industrial and mining activities. Mercury contamination from gold mining is a major environmental concern in the Interior of Suriname (USACE, 2001). Saltwater intrusion in coastal areas and in some wells is increasing due to over-pumping.

In the coastal area including Paramaribo the drainage of storm water represents a serious problem during the wet seasons, as these areas are very flat and low lying, resulting in frequent flooding. In many occasions the faecal waste is dispersed through the floodwater into the environment. In the wet season, the incidence of diarrhoea increases in the marginal urban areas. In past decades some measures in Paramaribo were taken to minimize the flooding, such as the implementation of several projects to improve discharge capacity (pumping stations and open canals with large storage), improved mechanical equipment for the maintenance of open canals and ditches, and the cleaning up of sewer pipes. A detailed investigation and programme for restoration of the sewer system is needed. Greater Paramaribo has 25 sluices and pumping stations. Some of the pumping stations are in disrepair further reducing effective service (USACE, 2001).

El Niño causes floods in several areas, wastewater and storm water drainage systems, agricultural devastation, epidemic problems (dengue and malaria), and increase in sea level causing coastal erosion.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

Recent international trends such as incentives to avoid carbon emissions from deforestation (REDD+) or the exclusion of deforestation-related goods from supply chains suggest Suriname is in extraordinary position to greatly benefit from becoming a leader in deforestation-free agriculture.

The provision of water for the rice sector requires government investment. The irrigation system in Suriname requires resources for its administration, operation and maintenance. It is important to design management systems and even set a fee on the provision of this service to increase the efficiency of the system and improve its performance.

Productivity levels have a large impact on the demand for land from the rice sector. If rice productivity stagnates at current levels (± 4.2 tons/ha), high production targets would mean that the rice production area would need to increase by more than 20 000 hectares by 2022. On the other hand an accelerated productivity increase combined with modest increases in production targets would mean that 10 000 ha could be liberated from rice production. If productivity increase keeps pace with production targets, 15 000 ha could be available for other crops after meeting production targets from the rice sector. This area is three times as large as the area currently occupied by vegetables and fruit crops in Suriname. Economic returns from these crops are on average ten times higher than returns from rice production (IIS, 2012).

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