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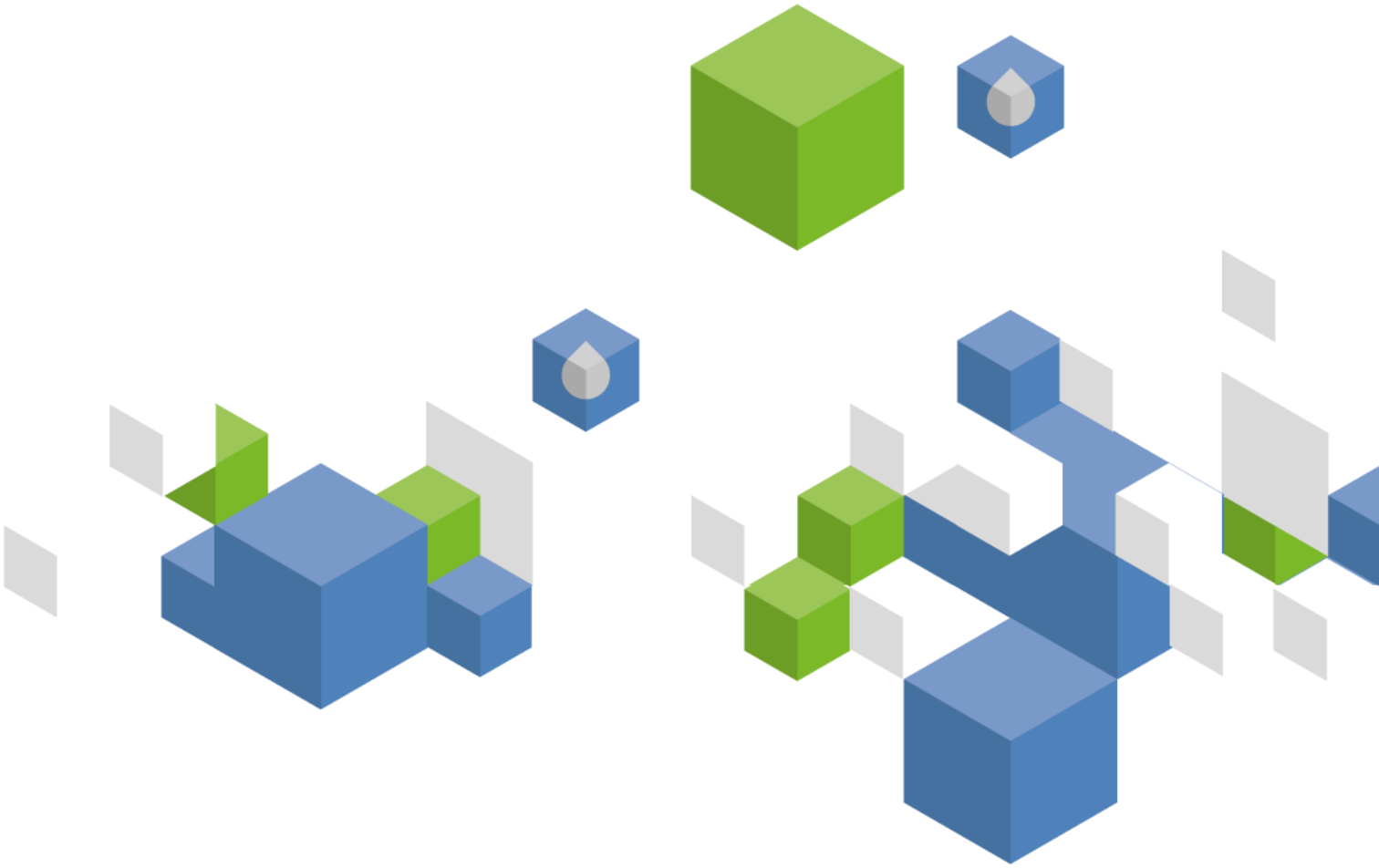

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Brunei Darussalam

GEOGRAPHY, CLIMATE AND POPULATION

Geography

Brunei Darussalam lies in Southeast Asia, on the northwest coast of the island shared with Indonesian Borneo and Sabah and Sarawak states of Malaysia. It is bordered on the landward side by Sarawak. The country is composed of two enclaves separated from each other by the valley of the Limbang River in Sarawak. Brunei Darussalam is divided into four districts having an area of 5 770 km^2 (Table 1).

TABLE 1
Basic statistics and population

Physical areas			
Area of the country	2009	577 000	ha
Cultivated area (arable land and area under permanent crops)	2009	8 000	ha
• as % of the total area of the country	2009	1.4	%
• arable land (annual crops + temp fallow + temp. meadows)	2009	3 000	ha
• area under permanent crops	2009	5 000	ha
Population			
Total population	2009	392 000	inhabitants
• of which rural	2009	25	%
Population density	2009	68	inhabitants/km^2
Economically active population	2009	187 000	inhabitants
• as % of total population	2009	48	%
• female	2009	44	%
• male	2009	56	%
Population economically active in agriculture	2009	1 000	inhabitants
• as % of total economically active population	2009	0.5	%
• female	2009	0	%
• male	2009	100	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2006	11 471	million US$/yr
• value added in agriculture (% of GDP)	2007	0.7	%
• GDP per capita	2006	31 002	US$/yr
Human Development Index (highest = 1)	2010	0.805	
Access to improved drinking water sources			
Total population		-	%
Urban population		-	%
Rural population		-	%

The districts of Brunei-Muara, Tutong and Belait, which form the larger western portion, are dominated by hilly lowlands, swampy plains and alluvial valleys. Mountainous terrain abounds in the eastern district of Temburong. The highest elevation is Bukit Pagon, at 1 850 m.

The cultivable area is estimated as 13 000 ha, which is about 2.5 percent of the total land area. In 2009, the cultivated area was an estimated 8 000 ha, about 61.5 percent of the cultivable area. About 5 000 ha were under permanent crops, the remaining 3 000 ha being under annual cultivation. In 1997, the cultivated area was estimated as 6 000 ha, of which 4 000 ha was for permanent and 2 000 ha annual crops.

FIGURE 1
Map of Brunei Darussalam

BRUNEI DARUSSALAM

FAO - AQUASTAT, 2011

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Climate

Brunei Darussalam has a tropical climate characterized by high rainfall and temperatures throughout the year. Climatic variations follow the influence of the monsoon winds. The northeast monsoon blows from December to March, while the southeast monsoon occurs around June to October.

The total average annual precipitation is an estimated 2 722 mm. There are two rainy seasons: from September to January and from May to July.

The temperature is relatively uniform throughout the year, with an annual average of 27.9°C, ranging from 23.8 to 32.1°C. The drought months of March and April are the warmest. Owing to high temperatures and rainfall, humidity is high throughout the year with an average of 82 percent.

Population

In 2009, Brunei Darussalam had a population of 392 000, about 25 percent of which lived in rural areas (Table 1). In 1999, the population was 320 000, thus the annual population growth rate during the period 1999-2009 is estimated as 2.1 percent. In 1996, the district of Brunei-Muara, which includes the capital, Bandar Seri Begawan, had the largest population with 201 100 inhabitants, while Temburong district in the east was sparsely populated with a total of 8 700. The average population density is 68 inhabitants/km^2.

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2009, the total economically active population was 187 000, or slightly more than 48 percent of the total population. In the agricultural sector the economically active population is an estimated 1 000 inhabitants, which is 0.5 percent of the total economically active population, of which 100 percent are male. In 2006, the gross domestic product (GDP) was US$ 11 471 million. In 2007, agriculture accounted for 0.69 percent of GDP.

Some 55 percent of the cultivated land is under ruminant livestock production with the rest being horticulture, mixed cropping and poultry farming. Crop production is dominated by horticulture, which includes the cultivation of vegetables, production of fruits, floriculture and ornamental plants. Vegetable growing is mainly concentrated on the urban fringes, while fruit orchards are scattered across the country. In 2003, almost 10 360 tonnes of mainly tropical leafy vegetables were produced. In the same year, crop production registered over 4 600 tonnes of fruits and nearly 547 tonnes of rice. Floriculture produces small quantities of orchid flowers and an assortment of tropical ornamental plants (MIPR, 2009).

Brunei Darussalam gives much importance to agriculture and agri-food development to ensure the security of food supply and enhance economic contributions to the GDP. Agricultural development is the main factor that sustains national food supply and agri-food production. For the past decade, there has been an impressive increase in the value of primary production from US$ 82.56 million in 1996 to US$ 158.98 million in 2005. In 2005, the livestock sector, including processed products, continued to dominate agricultural sector development with a market value of US$ 104.9 million. This is in comparison to the crop sector and its processed products, which had an output value of U$ 54.08 million, contributing about 66 percent from livestock and 34 percent from crops to the total agriculture output. Poultry, eggs and leafy vegetables are commodities that have attained self-sufficiency level (MIPR, 2009).

WATER RESOURCES

There are four main river basins in Brunei Darussalam: Temburong, Belait, Tutong and Brunei:

- The Temburong, which is the smallest of the rivers, drains a catchment area of about 430 km^2.
- The Belait is the largest basin, with an area of 2 700 km^2. The lower catchment is composed of an extensive area of peat swamp forest. The river narrows at the town of Kuala Belait and a sandbar restricts the discharge of water into the South China Sea. Some areas in the upper catchment have been cleared for agriculture.
- The Tutong basin, which is about 1 300 km^2, has a complex estuary system that has formed between two sand spits. Subject to fairly high tidal influence, its lower catchment is mainly floodplain. The upper catchment is jungle with patches of agriculture.
- The Brunei river flows into Brunei Bay. The upper reaches of the river are a major freshwater source particularly for the western part of the country.

In relation to the whole island, the runoff coefficient is estimated as 1.5 m/year corresponding to a surface flow of 8.5 km^3. Limited reserves of groundwater have been identified in the Liang and Seria areas of the Belait district and in the Berakas area of the Brunei-Muara district. The estimated safe yield is 17.3 million m^3/year. Also, in relation to the whole island, the total groundwater resources are estimated as 0.1 km^3/year, all being drained by the rivers. Internal renewable water resources are around 8.5 km^3 (Table 2).

TABLE 2
Water resources

Renewable freshwater resources			
Precipitation (long-term average)		2 722	mm/yr
		15 710	million m^3/yr
Internal renewable water resources (long-term average)		8 500	million m^3/yr
Total actual renewable water resources		8 500	million m^3/yr
Dependency ratio		0	%
Total actual renewable water resources per inhabitant	2009	21 684	m^3/yr
Total dam capacity	1995	45.1	million m^3

Brunei Darussalam has two dams that have a total storage capacity of just over 45 million m^3. The Tasek reservoir is used for water supply and has a total capacity of 13 000 m^3; its catchment area is 2.8 km^2. The Benutan dam, which is an impounded reservoir, used to regulate the Tutong river, has a total storage capacity of 45 million m³ and a catchment area of 28.6 km^2.

There is no hydropower dam, though one suitable site has been located within the National Forest Reserve of Temburong.

WATER USE

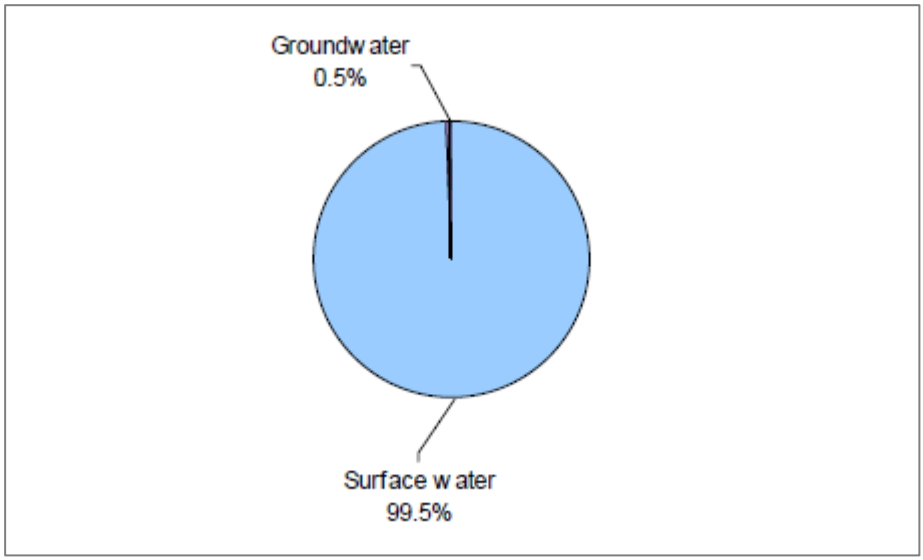
In 1994, total water withdrawal was approximately 92 million m^3 (Table 3). Urban water is supplied entirely from surface water. The major use of water in industrial processes is for the liquefied natural gas industry, which abstracts and treats its own water from the Belait river. Other industrial uses are on a smaller scale for timber and sawmills, dairy farms, soft-drink manufacture and workshops, which account for about 25 percent of overall water demand.

TABLE 3
Water use

Water withdrawal			
Total water withdrawal	1994	92	million m^3/yr
- irrigation + livestock		-	million m^3/yr
- municipalities		-	million m^3/yr
- industry		-	million m^3/yr
• per inhabitant	1994	326	m^3/yr
Surface water and groundwater withdrawal	1994	92	million m^3/yr
• as % of total actual renewable water resources	1994	1.08	%
Non-conventional sources of water			
Produced wastewater		-	million m^3/yr
Treated wastewater		-	million m^3/yr
Reused treated wastewater		-	million m^3/yr
Desalinated water produced		-	million m^3/yr
Reused agricultural drainage water		-	million m^3/yr

Initially, groundwater abstraction was undertaken in the 1950s for use by the oil and gas industries. This has been replaced by surface water resources. Groundwater abstraction, which accounts for 0.5 percent of total water supply, is currently limited to the local bottled water industry (Figure 2).

FIGURE 2
Water withdrawal by sector
Total 0.09159 km^3 in 1994



Drinking water is treated at six government treatment plants, which are located in different parts of the country (WHO, 2004).

IRRIGATION AND DRAINAGE

Evolution of irrigation development

All irrigation facilities were equipped in 1980. There are only small-scale irrigation schemes (up to 0.9 ha). In 1995, the area equipped for irrigation was 1 000 ha, all surface irrigation (Table 4). The existing infrastructure and facilities are being upgraded in rural areas, but the irrigated area has remained unchanged since 1980.

TABLE 4
Irrigation and drainage

Irrigation potential			-	ha
Irrigation				
1. Full control irrigation: equipped area		1995	1 000	ha
- surface irrigation		1995	1 000	ha
- sprinkler irrigation			-	ha
- localized irrigation			-	ha
• % of area irrigated from surface water		1995	100	%
• % of area irrigated from groundwater			-	%
• % of area irrigated from mixed surface water and groundwater			-	%
• % of area irrigated from non-conventional sources of water			-	%
• area equipped for full control irrigation actually irrigated			-	ha
- as % of full control area equipped			-	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)			-	ha
3. Spate irrigation			-	ha
Total area equipped for irrigation (1+2+3)		1995	**1 000**	**ha**
• as % of cultivated area		1995	17	%
• % of total area equipped for irrigation actually irrigated			-	%
• average increase per year over the last 14 years		1985-1995	0	%
• power irrigated area as % of total area equipped			-	%
4. Non-equipped cultivated wetlands and inland valley bottoms			-	ha
5. Non-equipped flood recession cropping area			-	ha
Total water-managed area (1+2+3+4+5)		**1995**	**1 000**	**ha**
• as % of cultivated area		1995	17	%
Full control irrigation schemes	**Criteria**			
Small-scale schemes	< 0.9 ha	1995	1 000	ha
Medium-scale schemes			-	ha
large-scale schemes	> 0.9 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			-	ha
• Annual crops: total			-	ha
- Rice		1997	375	ha
- Other annual crops			-	ha
• Permanent crops: total			-	ha
- Other perennial crops			-	ha
Irrigated cropping intensity (on full control area equipped)			-	%
Drainage - Environment				
Total drained area			-	ha
- part of the area equipped for irrigation drained			-	ha
- other drained area (cultivated non-irrigated)			-	ha
• drained area as % of cultivated area			-	%
Flood-protected areas			-	ha
Area salinized by irrigation			-	ha
Population affected by water-related diseases			-	inhabitants

Of the total irrigated area of 1 000 ha, 48 percent is irrigated only in the first season, 37 percent only in the second season and 15 percent is a continuously irrigated area.

The Ministry of Industry and Primary Resources (MIPR) is currently working to improve the irrigation system to address farmers' needs for rice planting (Goh De No et al., 2009).

Role of irrigation in agricultural production, the economy and society

In 1997, the major irrigated crops were rice, vegetables and fruits. Rice is grown on 375 ha. The figures for rice show that the country is able to meet only 3.6 percent of the total demand of 27 500 tonnes/year. Lack of labour is the main constraint to the country's agricultural development.

Status and evolution of drainage systems

MIPR is working towards improving the irrigation system, as it is recognized as one of the major issues. Dykes and drainage systems have already been introduced to improve the water flow into and out of the fields (Goh De No et al., 2009).

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

Institutions

The main institutions related to water management are:

- The Ministry of Industry and Primary Resources (MIPR) is responsible for facilitating and developing industries and primary resources for local markets and export.
- The Department of Agriculture at the MIPR is responsible for irrigation and drainage as well as water and electricity supplies. It actively promotes the development of various agricultural commodities and facilitates the outsourcing of raw materials and food supply.
- The Technical Services Division of the MIPR is responsible for coordination and facilitation of agricultural infrastructure development in the Agricultural Development Area (ADA land) and Department of Agriculture premises. The responsibilities cover mechanical and agricultural engineering support, development and maintenance of agricultural infrastructure such as buildings, access and farm roads and irrigation and drainage systems, the supply of main electrical and domestic water requirements.
- The Departments of Water Services and of Public Works and the Ministry of Development are responsible for monitoring treated water at treatment plants, storage points and end-points.
- The Department of Health Services audits the quality of water at the treatment plant and end-points.

Water management

Efforts have been made to diversify the economy and to shift from the country's current heavy dependence on oil and gas towards a more independent agriculture sector. The first of the Government's four major objectives for agriculture is to enhance the domestic production of rice, vegetables, poultry and livestock. The Government is stimulating greater interest in agriculture by establishing model farms, and by providing training, advice and support.

The Government supports the development of agro-industries through provision of various kinds of agricultural infrastructure. In this context, the Department of Agriculture has spent a large sum of money on farm roads, irrigation and drainage infrastructure as well as on the supply of water and electricity to help entrepreneurs develop their farmlands. The Department is also actively involved in facilitating inflow of technology and provides various kinds of technical services to boost the productivity and quality of domestic agriculture.

ENVIRONMENT AND HEALTH

As stated above, Brunei Darussalam has excellent facilities for the treatment of its drinking water. In addition, Brunei Shell Petroleum (BSP) and Brunei Shell's Liquefied Natural Gas (LNG) manage two

other facilities privately. There are also bottled water factories using advanced technology to produce purified water.

Monitoring of treated water at treatment plants, storage points and end-points is carried out daily by the Departments of Water Services and of Public Works, and by the Ministry of Development. In addition, the Department of Health Services audits the quality of water at the treatment plant and end-points.

Brunei Darussalam was declared malaria-free in 1987 by the World Health Organization. Seventeen new cases were reported in 2003 but they were all imported. Malaria vigilance activities continue to be maintained and are carried out by the Department of Health Services. Water supply and sanitation-related diseases such as diarrhoeal diseases, hepatitis, cholera and typhoid occur in Brunei Darussalam (WHO, 2004).

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

The future direction of the Department of Agriculture is to strengthen the primary production sectors and to develop the agri-food processing industry by creating a macro-business environment that is attractive to investors. The Department is committed to reforming itself so that it can better serve the needs of the agricultural sector, which includes the water sector.

The Department of Agriculture is currently working on improving system implementation in the department. This includes reassessing agricultural policies, supportive programmes, marketing system, legislation and other matters that affect the progress of this new initiative.

MAIN SOURCES OF INFORMATION

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