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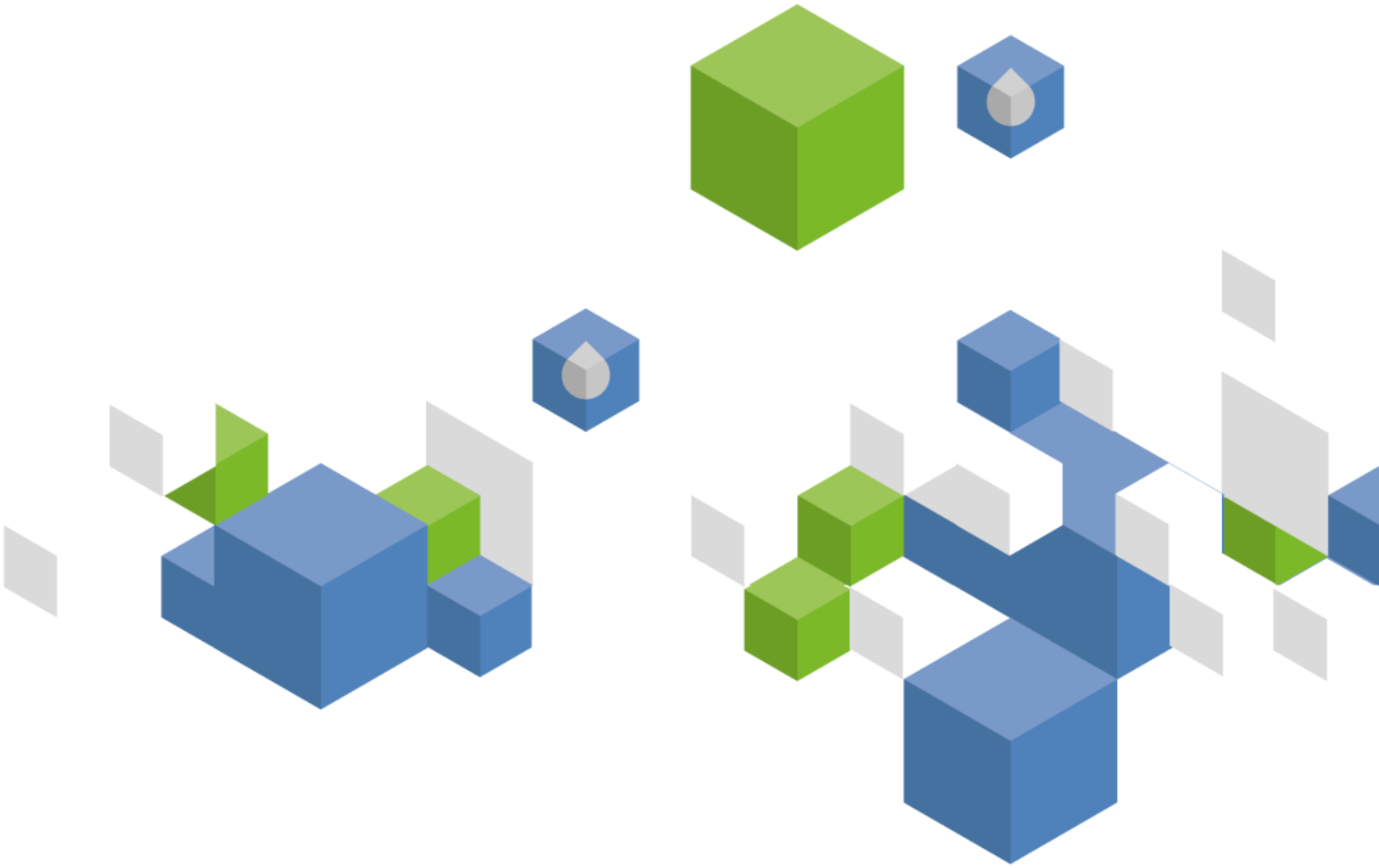

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Timor-Leste

GEOGRAPHY, CLIMATE AND POPULATION

Geography

Timor-Leste is a country in maritime Southeast Asia, covering a total area of 14 870 km^2 (Table 1). It is located northwest of Australia in the Lesser Sunda Islands at the eastern end of the Indonesian archipelago. It includes the eastern half of the island of Timor, the Oecussi (Ambeno) region on the northwest portion of the island of Timor, and the islands of Pulau Atauro and Pulau Jaco. The topography consists of a narrow plain around the coast and a central mountain range dominating the country.

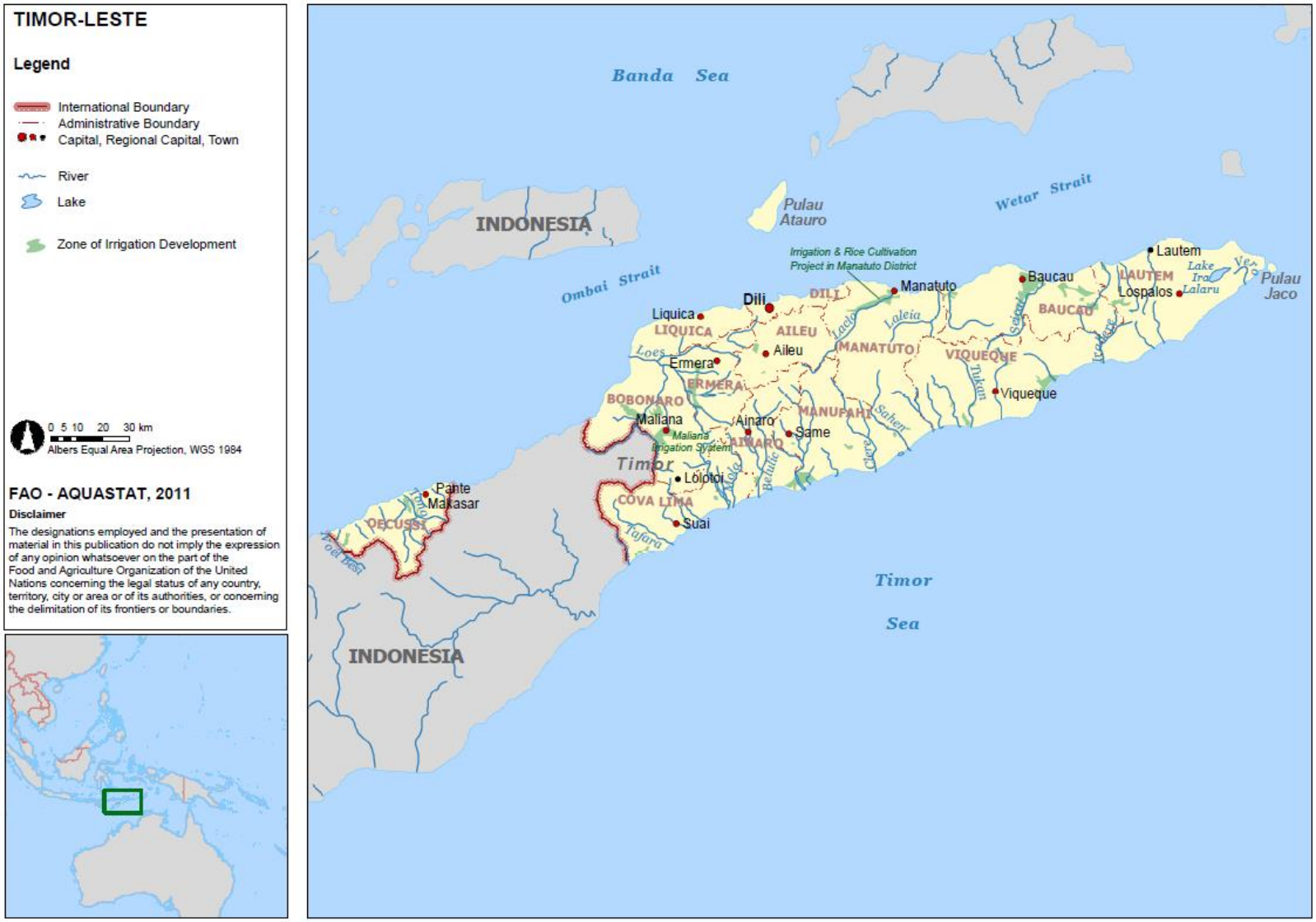
TABLE 1
Basic statistics and population

Physical areas			
Area of the country	2009	1 487 000	ha
Cultivated area (arable land and area under permanent crops)	2009	225 000	ha
• as % of the total area of the country	2009	15	%
• arable land (annual crops + temp fallow + temp meadows)	2009	165 000	ha
• area under permanent crops	2009	60 000	ha
Population			
Total population	2009	1 100 000	inhabitants
• of which rural	2009	72	%
Population density	2009	74	inhabitants/km^2
Economically active population	2009	432 000	inhabitants
• as % of total population	2009	39	%
• female	2009	41	%
• male	2009	59	%
Population economically active in agriculture	2009	344 000	inhabitants
• as % of total economically active population	2009	80	%
• female	2009	45	%
• male	2009	55	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2009	558	million US$/yr
• value added in agriculture (% of GDP)	2001	25.4	%
• GDP per capita	2009	507	US$/yr
Human Development Index (highest = 1)	2010	0.502	
Access to improved drinking water sources			
Total population	2008	69	%
Urban population	2008	86	%
Rural population	2008	63	%

The country is divided into 13 districts: Aileu, Ainaro, Baucau, Bobonaro (Maliana), Cova-Lima (Suai), Dili, Ermera (Gleno), Lautem (Los Palos), Liquica, Manatuto, Manufahi (Same), Oecussi (Ambeno), Viqueque. The name of the district capital is the same as the name in seven of the districts, for the other six the name of the district capital is in brackets.

The total cultivated area in 2009 was an estimated 225 000 ha of which 165 000 ha for annual crops and 60 000 ha for permanent crops.

FIGURE 1
Map of Timor-Leste



Climate

The climate of Timor-Leste is characterized by extreme conditions. In the north of the island there is little or no rain for almost eight months of the year. The island has a monsoon climate, typical for the Asian tropics. From December to March northwest to southwest winds prevail, bringing the principal wet season for the year to most parts of the island. From May until October southeast to northeast winds prevail, bringing mostly dry conditions, except on the south coast and the southern slopes where the wet season persists until July. Average annual rainfall is around 1 500 mm, varying from 565 mm at Manatuto along the north coast to 2 837 mm at Lolotai in the central-western mountains. As is common in most tropical locations, extremely heavy rainfall occasionally occurs in Timor-Leste during relatively short time intervals.

There is little temperature variation on either a diurnal or a seasonal basis. Temperature variations mainly occur with altitude. Average annual temperatures decrease from 27 ºC at sea level to 24 ºC at 500 m; 21 ºC at 1 000 m; 18ºC at 1 500 m and 14ºC at 2 000 m. Relative humidity varies between 70 and 80 percent, which makes the climate humid in general, but pleasant (MAFF, 2004).

Population

In 2009, the total population was almost 1.1 million, of which around 72 percent lived in rural areas (Table 1). The average population density is about74 inhabitants/km^2. Annual average growth rate during the period 1999-2009 was 2.9 percent.

In 2008, access to improved drinking water sources reached 69 percent (86 and 63 percent for the urban and rural population respectively), while access to improved sanitation accounted for 50 percent (76 and 40 percent for the urban and rural population respectively).

ECONOMY, AGRICULTURE AND FOOD SECURITY

The total population economically active in agriculture in 2009 was an estimated 344 000 inhabitants, amounting to 80 percent of the economically active population. Women are about 45 percent of the economically active population in agriculture. In 2009, the gross domestic product (GDP) was US$ 558 million. In 2001, agriculture accounted for 25.4 percent of the GDP. Agriculture in Timor-Leste is the most important economic sector.

Agriculture is the main activity in Timor-Leste, providing subsistence to about 80 percent of the population. It also generates an average of 90 percent of the exports, mainly coffee. Most farmers practice subsistence farming, planting and harvesting what they need for a simple life-style, collecting wild foods and traditional medicines, and the animals are very much left free to grow and reproduce. There are almost no large-scale farms except for missions.

In the first three-quarters of the last century, the Portuguese Agronomic (or Agriculture) Mission tried to stimulate food production (rice) on the coastal plains, leaving the mountains for coffee. The coffee production system provides a three-layer sustainable ecosystem composed of shade trees which are usually a legume, coffee plants, and grasses. These protect the soil, provide income and employment.

A government priority is to obtain food security for the entire country. The Agriculture Rehabilitation Programme is trying to restore the rice irrigation schemes and rural roads, and Cooperativa Café Timor and others have been sponsoring the rebirth of the coffee sector (Fontes, 2004).

The principal staple crops are rice and maize, with estimated production areas of 38 000 ha for rice and 120 000 ha for maize. However, land suitable for rice production is limited and maize is more widely grown in the uplands including hillsides. As agriculture is dependent on gravity irrigation, irrigation water in many of the irrigated rice areas is available only when the river water level has increased to the level of the intake of the irrigation systems.

Other food crops grown in Timor-Leste include cassava, sweet potato, taro, bananas, squash, kidney beans, soybeans, mungbean, peanut and white potato. Almost every household grows cassava. Together with sweet potato and taro, it provides the source of calorific energy when rice or maize have run out. Cassava and sweet potato grown on about 55 000 ha and 32 000 ha respectively.

Most common commercial crops are Arabica coffee, chimeri (candlenut tree), vanilla and coconut. Coffee is grown largely at high elevations in the districts of Liquica, Ermera, Ainaro, Bobonaro and Aileu.

Cropping systems vary depending on topography, elevation, and rainfall pattern. One or two crops of rice dominate the cropping system in the irrigated or rainfed areas of the northern lowlands. Where no irrigation water is available and topographic and hydrologic conditions do not permit growing of flooded rice, maize or peanut followed by cassava, sweet potato, or beans are commonly grown. Cropping systems on the northern slopes include single or two crops of flooded rice, maize followed by cassava, sweet potato or pumpkin, or mixed cropping of maize, cassava, kidney beans or peanut, and sweet potato. In the northern and southern highlands, households still grow rice in small areas supplied by communal systems, maize, cassava, sweet potato, beans, and kantas. On the southern slopes, farmers grow maize followed by cassava or mixed cropping of maize with cassava, sweet potato, and peanut but because of the relatively longer wet period, cropping systems are usually of longer duration (MAFF, 2004).

WATER RESOURCES

Timor-Leste has been broadly divided into twelve ‘Hydrologic Units’, which are groupings of climatologically and physiographically similar and adjacent river basins. Each of these hydrologic units comprise a number of rivers, 29 main river systems in total, of which 12 in the north and 17 in the south. All rivers are generally short and fast-flowing (AWRF, 2006). Table 2 presents the units with the corresponding area in the country. The total length of the rivers is about 4 286 km with a total river surface area of around 18 342 ha (La’o Hamutuk, 2010).

TABLE 2
Hydrologic units in Timor-Leste

Name of unit	Area (km^2)	As % of country
Loes	2 184	14.7
Laclo	2 024	13.6
Clere and Belulic	1 917	12.9
Irabere	1 614	10.9
Mola and Tafara	1 533	10.3
Seical	1 510	10.2
Tukan and Sahen	1 375	9.2
Laleia	1 006	6.8
Lifau and Tono Besi	812	5.5
Vero	744	5.0
Atauro Island	140	0.9
Jaco Island	11	0.1
Total	**14 870**	**100.0**

The largest river system is Loes river system with a total area of 2 184 km^2 (covering almost 15 percent of the country). It is also the longest river (80 km long), followed by the Laclo river system and the Clere and Belulic river system with 2 024 km^2 and 1 917 km^2 respectively. Given the temporal variations in rainfall and the low capacity of upland areas to hold water, very few rivers flow all year round, most being ephemeral but generally with significant underbed flows in the lower reaches (AWRF, 2006).

Internal renewable surface water resources are about 8.129 km^3/year and groundwater resources at 0.886 km^3/year. An estimated 0.8 km^3/year or 90 percent returns to the rivers as base flow and may be considered to be the overlap between surface water and groundwater. Therefore, total internal renewable water resources (IRWR) are estimated as 8.215 km^3/year (8.129+0.886-0.8) (Table 3). The sustainable yield of the aquifers, which can be considered to be the exploitable groundwater, is around 0.266 km^3/year (AWRF, 2006).

TABLE 3
Water resources

Renewable freshwater resources			
Precipitation (long-term average)	-	1 500	mm/yr
	-	22 300	million m^3/yr
Internal renewable water resources (long-term average)	-	8 215	million m^3/yr
Total actual renewable water resources	-	8 215	million m^3/yr
Dependency ratio	-	0	%
Total actual renewable water resources per inhabitant	2009	7 468	m^3/yr
Total dam capacity	-	-	million m^3

Some river basins are shared with Indonesia in the border area and Oecussi district. About 9 percent of the Loes river basin, 20 percent of the Tono river basin and 60 percent of the Noel Besi river basin lie in Indonesia, the latter two being in Oecussi district. However, no information on the amount of water crossing the borders is available.

There are several water resources that can be potentially used on a large scale in districts of Manatuto and Aileu where the watershed contains a fairly spacious catchment area, which results in a relatively high water availability. In these regions, multipurpose dams could be built to fulfil raw water and electricity (hydropower) needs. Several locations have been identified where hydropower dams can be built. One of the assessed locations is in Daisoli region.

Timor-Leste has only one large freshwater lake, Lake Ira Lalaru, a large, shallow, seasonally fluctuating lake, which has formed in the lowest part of the Fuiloro plateau, covering between 10 and 55 km^2 depending on the season. Lake Ira Lalaro has a catchment area of 406 km^2, but apart from very heavy rainfall events the catchment characteristically produces little runoff as the lake is situated in a limestone karstic area. While several small watercourses drain into the lake none of these are perennial (AWRF, 2006).

According to the Strategic Development Plan, some dams are planned for construction before 2015: Comoro dam in Dili, Laclo and Sahen dams in Manatuto, Irabele dam in Viqueque, and Caraulun dam in Manufahi (La'o Hamutuk, 2010).

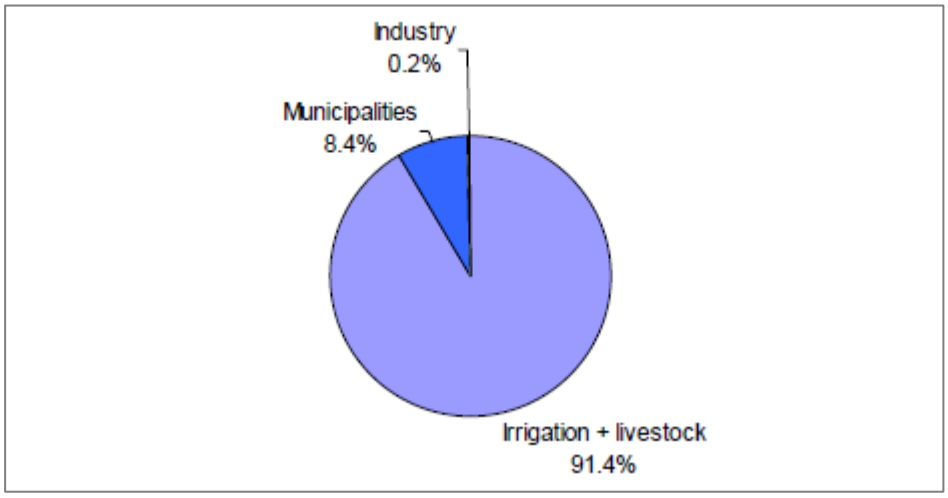
WATER USE

Total water withdrawal in 2004 was an estimated 1 172 million m^3, of which 1 071 million m^3 (91.4 percent) for agriculture, 99 million m^3 (8.4 percent) for municipalities, and 2 million m^3 (0.2 percent) for industry (Table 4 and Figure 2).

TABLE 4
Water use

Water withdrawal			
Total water withdrawal	2004	1 172	million m^3/yr
- irrigation + livestock	2004	1 071	million m^3/yr
- municipalities	2004	99	million m^3/yr
- industry	2004	2	million m^3/yr
• per inhabitant	2004	1 203	m^3/yr
Surface water and groundwater withdrawal	2004	1 172	million m^3/yr
• as % of total actual renewable water resources	2004	14.27	%
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

FIGURE 2
Water withdrawal by sector
Total 1.172 km^3 in 2004



There has been little development of hydropower, there are only a few micro-hydropower plants, one of which is the micro-hydropower plant in Gariuai with a capacity of 325 KW (La'o Hamutuk, 2010).

IRRIGATION AND DRAINAGE

Evolution of irrigation development

Following an overwhelming vote for independence from Indonesia in an United Nations-backed plebiscite in August 1999, pro-Jakarta militias destroyed most of the infrastructure including irrigation and water supply systems. A country that was in ruins is slowly rebuilding itself with international help. Since October 1999, the United Nations Development Programme (UNDP) has been playing a key role in the irrigation sector. In a rapid response to a potential food crisis resulting from lack of cultivation during the rice planting season in Manatuto, 80 km east of Dili, UNDP designed an irrigation project to rehabilitate the damaged rice watering systems. This enabled farmers to restart rice cultivation. The rehabilitation work also provided employment and modern technology for rice cultivation was passed onto farmers (UNDP, 2000).

Before the destruction in 1999, the total design irrigation area in Timor-Leste was an estimated 72 159 ha covering more than 427 schemes. In 2002 only 34 649 ha or 48 percent was left, of which 5 384 ha are technical schemes, 7 770 ha semi-technical schemes and 21 495 ha traditional schemes

(Table 5 and Table 6). MAFF is also transferring the irrigation schemes to community-based management.

TABLE 5
Irrigation and drainage

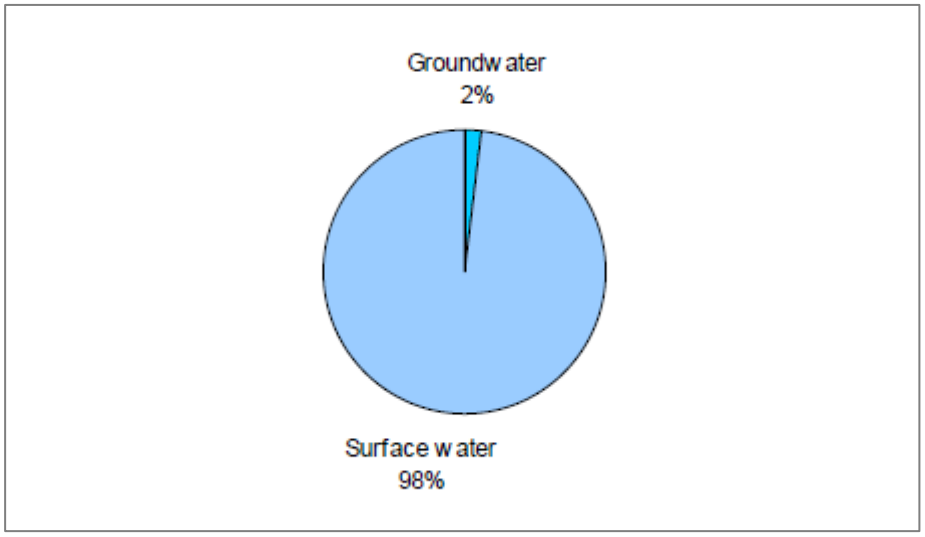
Irrigation potential			-	ha
Irrigation				
1. Full control irrigation: equipped area		2002	34 649	ha
- surface irrigation			-	ha
- sprinkler irrigation			-	ha
- localized irrigation			-	ha
• % of area irrigated from surface water		2002	98	%
• % of area irrigated from groundwater		2002	2	%
• % of area irrigated from mixed surface water and groundwater			-	%
• % of area irrigated from mixed non-conventional sources of water			-	%
• area equipped for full control irrigation actually irrigated		2002	28 907	ha
- as % of full control area equipped		2002	83.4	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		2002	0	ha
3. Spate irrigation		2002	0	ha
Total area equipped for irrigation (1+2+3)		**2002**	**34 649**	**ha**
• as % of cultivated area		2002	16	%
• % of total area equipped for irrigation actually irrigated		2002	83.4	%
• average increase per year over the last - years			-	%
• power irrigated area as % of total area equipped			-	%
4. Non-equipped cultivated wetlands and inland valley bottoms		2002	0	ha
5. Non-equipped flood recession cropping area		2002	0	ha
Total water-managed area (1+2+3+4+5)		**2002**	**34 649**	**ha**
• as % of cultivated area		2002	16	%
Full control irrigation schemes	**Criteria**			
Small-scale schemes	< ha		-	ha
Medium-scale schemes			-	ha
large-scale 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			-	ha
• Annual crops: total			-	ha
- Rice			-	ha
- Maize			-	ha
- Other annual crops			-	ha
• Permanent crops: total			-	ha
- Other perennial crops			-	ha
Irrigated cropping intensity (on full control actually irrigated area)			-	%
Drainage - Environment				
Total drained area			-	ha
- part of the area equipped for irrigation drained			-	ha
- other drained area (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

TABLE 6
Irrigation schemes and irrigation areas, March 2002 (ADB, 2002)

	Number of schemes	Pre-1999 design area (ha)	Area currently functioning (ha)	Percentage functional (%)
Technical schemes	24	10 587	5 384	51
Semi-technical schemes	58	18 320	7 770	42
Traditional schemes	345	43 252	21 495	50
TOTAL	427	72 159	34 649	48

This will be a long task involving significant cultural change and the irrigators are only slowly starting to take over themselves, since all operation and maintenance before was done by the Indonesian administration. Irrigation demand is presently low because of the lack of commodity marketing arrangements, conveyance systems and infrastructure, which makes internal transport highly costly (ADB, 2002). Based on national reports, and the situation in neighbouring Indonesia, the area irrigated by groundwater is about 2 percent of the total area equipped for irrigation (Figure 3).

FIGURE 3
Source of irrigation water on area equipped for full control irrigation
Total 34 649 ha in 2002



The Japan International Cooperation Agency (JICA) implemented the Irrigation and Rice Cultivation Project in Manatuto District (06/2005-03/2010). This was to improve productivity of rice on approximately 505 ha of the irrigated area. The objectives of the project was to improve the existing irrigated rice farming system on around 505 ha and establish a functional water Uuser association (WUA) (JICA, 2008).

JICA has supported the Rehabilitation and Improvement of Maliana I Irrigation System Project (02/2008-11/2008). This aimed to distribute a stable supply of irrigation water to Maliana I Irrigation area. This was accomplished by rehabilitating the Maliana I intake weir and irrigation canals and constructing related facilities. The project expected to increase the amount of water taken from Bulobo river and to expand the irrigation area from 600 ha to 1 050 ha to increase rice production (JICA, 2008).

Role of irrigation in agricultural production, the economy and society

Rice is the key food and cash crop. The major impediments to rice cultivation are the shortage of irrigation water and the lack of cattle and tractors to speed up cultivation. The main rice crop in Timor-Leste is grown in the wet season from November to March (UNDP, 2000).

Less than 20 percent of the irrigated rice areas produce a second crop of rice within the year. Yield per hectare is low compared to other rice-growing countries in Asia, largely because of poor application of

improved technologies including use of quality seeds, fertilizer, and sometimes the limited supply of irrigation water. Because of high cost, among other reasons, farmers do not normally use fertilizer to produce rice. Use of poor quality seeds, poor soil conditions, drought, and occasionally pests and diseases are the usual causes of low maize yields. About 81 percent of households grow maize (MAFF, 2004).

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

Institutions

In mid-2001 a proposal to establish a single agency with responsibility for water resources was not accepted. The present arrangements are therefore built around a requirement for coordination among agencies, without any main body or specific coordinating mechanism in place (ADB, 2002).

The main institutions related to water and agriculture are:

- Ministry of Agriculture, Forestry and Fisheries (MAFF): Mainly responsible for policy formulation, economic coordination and planning concerning food grain, other agricultural crops and livestock. It contains the Irrigation Division.
- Ministry of Development: Responsible for national policy programmes and plans regarding environment, pollution, ecology.
- National Directorate of Environmental Services (DNSMA in Portuguese): Responsible for pollution control, environmental policy, impact assessments, monitoring and awareness raising, and biodiversity. It is contained in the Secretariat for Environment Coordination, Territorial Ordering and Physical Development.
- Ministry of Natural Resources, Minerals and Energy Policy (MNRMEP): The role of this new ministry, as stated in the 2005/2006 budget papers, is to manage the natural resources of Timor-Leste efficiently and in a consistent and an environmentally acceptable way (AWRF, 2006).

Water management

Water resources in Timor-Leste are optimally managed (La'o Hamutuk, 2010).

WaterAid has worked in Timor-Leste since 2005 helping the country's poorest people gain access to safe, sustainable water supplies and sanitation (Water Aid Australia, 2010).

In 2008, the Ministry of Agriculture, Forestry and Fisheries (MAFF) sought to appoint an Irrigation Consultant to assist the Irrigation Division to identify the required action to repair and maintain selected irrigation schemes and provide technical advice on planned rebuilding of other irrigation schemes (DebNetJobs, 2008).

According to the Strategic Development Plan, presented in 2010, the framework and policy direction of the development of the water resources must be gradually implemented as follows:

a. Short-term (2010-2015): Formulation of a policy to preserve the water cycle balance. The short-term purpose and objectives are to protect the hydrology cycle to safeguard the natural conservation balance, especially forest, river, watershed, sea and coastal area conservation. Ongoing development must consider the environmental conservation factor.
b. Mid-term (2015-2020): Utilization of water resources to meet the water demand of the society and to fulfill the energy demand. The mid-term purpose and objectives are to exploit water resources with appropriate technological use such as barrages and hydropower, with the intention of fulfilling water and energy demand of the society as the number of population grows.

c. Long-term (>2020): Reduction of the dependency on diesel power generators, to be replaced using hydropower. The long-term purpose and objectives are to reduce the burden of diesel power generator use, since it is uneconomical and environmentally unfriendly for natural conservation.

Finances

The agricultural and rural sectors were severely disrupted owing to the civil disturbances in 1999 when the previous Indonesian system of highly subsidised support was withdrawn and a great deal of physical damage inflicted on the people, infrastructure and rural market systems. The donor community, through the World Bank, established the Trust Fund for Timor-Leste to provide financial means to rehabilitate many structures and mechanisms that were damaged or destroyed during the last months of occupation. In the agricultural sector, funds were channelled through the MAFF-managed Agricultural Rehabilitation Projects: ARP I, ARP II and ARP III. ARP I started in August 2000, which was completed in September 2002, including the rehabilitation of small irrigation schemes.

ARP II started in October 2001 and was completed in December 2004, continuing the restoration of agriculture assets, irrigation infrastructure and restoration of vaccination services with the general objective of improving the food security of rural families and increasing agricultural production in selected areas. ARP III began in April 2004 and was finished in 2007, the objective was to strengthen the capacity of MAFF and its development partners and assist rural communities sustainably increase their production and income (MAFF, 2004).

Policies and legislation

The current limited demand for water development lends weight to the view that comprehensive and sophisticated policies are not warranted. However, the water and sanitation and the irrigation agencies all perceive the need for a water resources policy from their perspective (ADB, 2002).

ENVIRONMENT AND HEALTH

Timor-Leste, thanks to its agricultural economy and the absence of large population centres, does not suffer from the problems of industrialization. It will, nevertheless, suffer from global climate change. There are other environmental problems that can affect its future. Soil erosion, caused by both high rainfall (it rains more than 1 750 mm/year on 65 percent of the island) and by the great slope of the mountain areas, can be serious. Itinerant agriculture, deforestation and the subsequent loss of vegetation may have consequences that are difficult to reverse and may cause a reduction in crop production. On the positive side, farmers hardly ever use agrochemicals, which means that the farm produce can almost all be classified as organically grown (MAFF, 2004).

The rains can bring with them large-scale flooding that washes pollution into the waterways. This water quality is often poor. The climate is favourable to mosquitoes, and the poor sanitation in the cities means that malaria is one of the major causes of death, which impacts economic and educational development. WaterAid Australia's programme aims to deliver sustainable, community-managed water and sanitation services to rural communities in Aileu district as well as health and hygiene education in Aileu, Baucau, Manatuto and Lautem districts (Water Aid Australia, 2010).

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

According to the Strategic Development Plan (2010-2020), the work plan related to agricultural water management includes:

- preparing hydrology and climatology data that has already been measured;
- making an inventory of the operational state of water infrastructure;
- reviewing of every watershed;
- increasing the capacity of clean water availability;
- increasing the number of irrigated areas in conjunction with the increase of raw water sources;
- renovating existing barrages to enhance performance and establishing new reservoirs in areas to meet the demands for drinking and irrigation water;
- improving and expanding flood control check dams; and
- establishing multipurpose dams to meet clean water, irrigation and power plant demand.

With the growing economic needs of the people, it will be necessary to move beyond the existing crops. It is felt that the production of higher value crops (cashew nuts, mangos, spices, vanilla, restoration of sandalwood, pineapples, passion fruit, guavas, cut flowers) associated with processing (roasting of nuts, mango pulp, guava jam, passion fruit concentrate) are the next stage in the development of the agriculture sector (Fontes, 2004).

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