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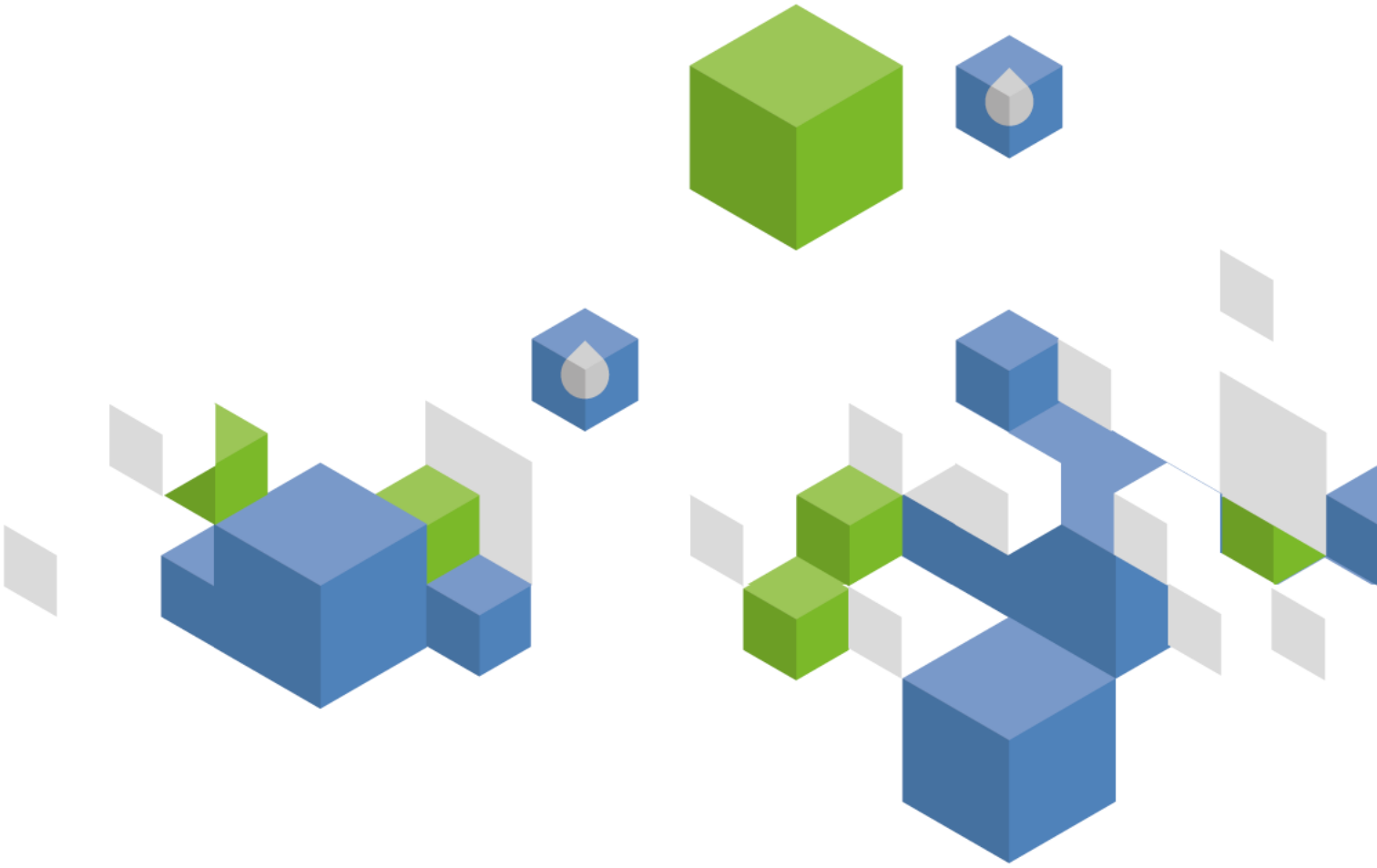

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Samoa

GEOGRAPHY, CLIMATE AND POPULATION

Geography

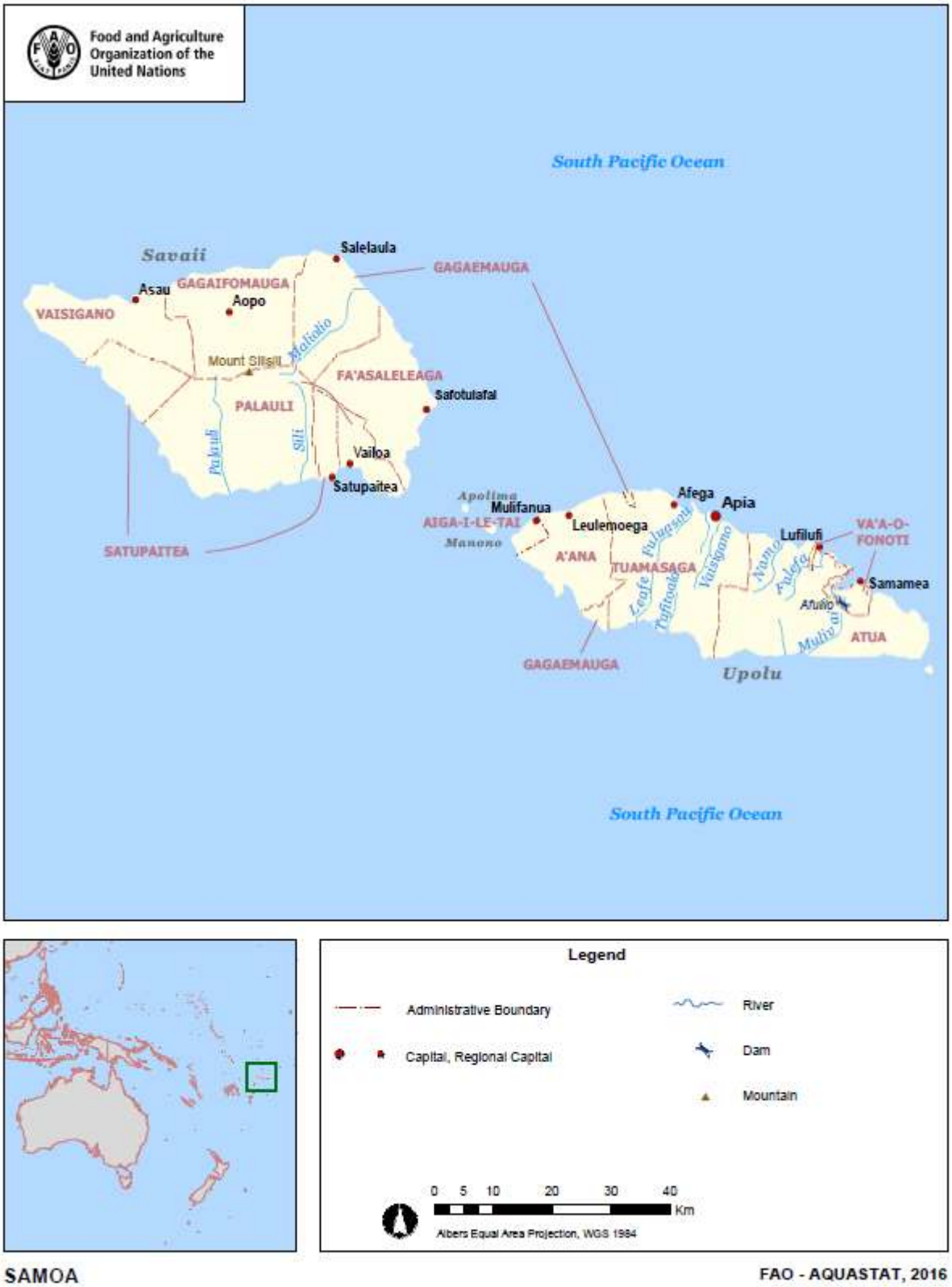
Samoa is a country in the South Pacific Ocean, to the northeast of Fiji, with a total area of 2 840 km^2. The country comprises two major islands, Savai'i and Upolu, eight smaller islands, plus some uninhabited islets. For administrative purposes, the country is divided into 11 districts. The capital city is Apia, located on Upolu island.

The agricultural area, which is the sum of arable land, permanent crops and permanent meadows and pasture, is estimated at 35 000 ha, which is 12 percent of the total area of the country. In 2013, the total physical cultivated area was estimated at 30 000 ha, of which 27 percent (8 000 ha) consisted of temporary crops and 73 percent (22 000 ha) of permanent crops (Table 1).

TABLE 1
Basic statistics and population

Physical areas:			
Area of the country	2013	284 000	ha
Agricultural land (permanent meadows and pasture + cultivated land)	2013	35 000	ha
• As % of the total area of the country	2013	12	%
• Permanent meadows and pasture	2013	5 000	ha
• Cultivated area (arable land + area under permanent crops)	2013	30 000	ha
- As % of the total area of the country	2013	11	%
- Arable land (temp. crops + temp. fallow + temp. meadows)	2013	8 000	ha
- Area under permanent crops	2013	22 000	ha
Population:			
Total population	2015	193 200	inhabitants
- Of which rural	2015	81	%
Population density	2015	68	inhabitants/km^2
Economy and development:			
Gross Domestic Product (GDP) (current US$)	2014	801	million US$/year
• Value added in agriculture (% of GDP)	2013	10	%
• GDP per capita	2014	4 170	US$/year
Human Development Index (highest = 1)	2014	0.702	-
Gender Inequality Index (equality = 0, inequality = 1)	2014	0.457	-
Access to improved drinking water sources:			
Total population	2015	99	%
Urban population	2015	98	%
Rural population	2015	99	%

FIGURE 1
Map of Samoa



SAMOA **FAO - AQUASTAT, 2016**

The topography of both Upolu and Savai'i island is rugged and mountainous, with about 40 and 50 percent of their territory respectively characterized by steep slopes descending from volcanic crests. The interior of both islands is covered with forests and contain volcanic peaks. The Upolu crestal ridge rises to 1 100 m, whereas Savai'i has more and younger volcanic cones with the highest peak reaching 1 848 m at Mount Silisili. The islands generally have a narrow coastal plain (SOPAC, 2007).

Climate

The climate of Samoa is tropical with abundant rainfall. The average daily temperature range is from 22º C to 30ºC varying only 1-2º C between the seasons due to its equatorial location. There are two major distinguishable seasons. The hot and wet season extends from November through April, while the cooler and drier season runs from May to October during which period the climate is pleasant because of fresh trade winds. The annual rainfall averages 2 880 mm (Table 2), varying from 2 000 mm in the north-west parts of the main islands to over 6 000 mm in the highlands of Savai'i with about 75 percent of the precipitation occurring during November-January. Humidity averages 80 Percent (SPC, 2012; SBS, 2012; SOPAC, 2007).

Population

In 2015, the total population was about 193 200, of which around 81 percent was rural (Table 1). About three quarters of the population live on the main island of Upolu. Population density is 68 inhabitants/km^2. Besides Upolu and Savai'i islands, only Manono and Apolima islands are inhabited. The average annual population growth rate in the 2005-2015 period was 0.7 percent.

In 2014, the Human Development Index (HDI) ranks Samoa 105 among 188 countries, while the Gender Inequality Index (GII) ranks it 97 among 155 countries, for which information was available. Life expectancy is 73 years and the under-five mortality is 18 per 1000 births, both progressing from 67 years and 27 per 1000 in the 1990s. With no significant distinction between boys and girls, around 95 percent of the children in 2013 are enrolled in primary education and 80 percent in secondary education (World Bank, 2015). In 2015, 99 percent of the population had access to improved water sources (98 and 99 percent in urban and rural areas respectively) and 92 percent of the total population had access to improved sanitation (93 and 91 percent in urban and rural areas respectively) (JMP, 2015).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2014, the gross domestic product (GDP) was US$ 801 million and agriculture accounted for 10 percent of GDP, while in 1994 it accounted for 23 percent.

The economy of Samoa has traditionally been dependent on development aid, family remittances from overseas, tourism, agriculture, and fishing (World Bank, 2016). The current Strategy for the Development of Samoa (SDS) 2012-2016 and the Agriculture Sector Plan (ASP) 2012-2016 set out goals and strategies for the re-invigoration of the agricultural sector both for local food security and for exports. Agriculture in the country has evolved from subsistence to semi-subsistence and commercialization, due to the demands of a growing population, the continuing shift to a cash-based economy, and technologies (MNRE, 2013).

WATER RESOURCES

Surface water and groundwater resources

Surface water and groundwater sources exist across most of Samoa, although their distribution is not uniform. The older volcanic terrain of the Fagaloa and Salani volcanics have a clay cover that results in impermeable strata, and therefore surface runoff. These older volcanics and associated surface water courses are mostly located on the eastern and southern halves of both the Upolu and Savai'i islands. The younger volcanics of the Mulifanua, Lefaga, Puapua and Aopo lave flows have little or no soil cover

and allow the infiltration of nearly all rainfall. These lavas are highly permeable, allowing also rapid groundwater flow to the sea. These younger volcanics are along the north-west Upolu and Savai'i regions and coincide with the dominant distribution of coastal springs and good groundwater sources (MNRE, 2013; SOPAC, 2007).

Upolu island has about 15 more or less perennial rivers, while Savai'i island has about 4 perennial rivers (MNRE, 2013). River flow is good during the wet season whereas in the dry season, ephemeral rivers and streams begin to dry up and perennial river systems experience low flows (MNRE, 2013).

Rainwater harvesting has only been reported to be practiced to any extent in the Falealupo Peninsula of north-west Savaii, where a combination of the highly permeable Puapua volcanics and the relatively isolated geographic peninsula appear to result in saline groundwater and no surface water courses, giving the local populace no alternative but to use rainwater harvesting. This has been practiced since 1993. There is no known use of non-conventional sources of water in the country (SOPAC, 2007).

Lakes and dams

There are some crater lakes in Samoa. Lake Lanoto'o on Upolu island is the largest lake in the country (MNRE, 2013).

There are five hydropower schemes operating in the country at Afulilo, Lalomauga, Samasoni, Faleolefee and Alaoa. The latter three schemes abstract water from within the Vaisigano catchment. The Afulilo scheme includes the only dam in the country with a total capacity of 10 million m^3, and stores water from a number of streams above the Vaipu wetland (Table 2). The five power stations provide about 40 percent of the annual national energy demand, varying from 70 percent in the wet season to only 20 percent in the dry season (MNRE, 2013).

TABLE 2
Renewable water resources

Renewable freshwater resources:			
Precipitation (long-term average)	-	2 880	mm/year
	-	8 179	million m^3/year
Internal renewable water resources (long-term average)	-	-	million m^3/year
Total renewable water resources	-	-	million m^3/year
Dependency ratio	-	0	%
Total renewable water resources per inhabitant	-	-	m^3/year
Total dam capacity	2013	10	million m^3

Water use

In 2007, surface water provided approximately 65 percent and groundwater 35 percent of the total water withdrawal in Samoa. Most of water withdrawal and supply are operated by the Samoa Water Authority (SWA), some by independent water schemes in villages. In 2007, SWA operated 38 surface water intakes used for public water supply, 36 in Upolu (including 4 springs) and 2 in Savai'i, and 40 borehole supplies, 20 each on Savai'i and Upolu. In addition, there are 19 independent water schemes in Upolu and 5 in Savai'i. Water supply in northern, eastern and southern Upolu and eastern Savai'i is from surface water intakes, whereas that for western Upolu and rest of Savaii is from groundwater.

The urban water supply for greater Apia is supplied almost entirely from surface water intakes from the Vaisigano and Fuluasou rivers. Commercial and industrial uses are limited in Samoa, and rely for the most part on the urban water supply. The largest commercial activities are the brewery, coconut factory and approximately seven bottled water companies. Tourism in Samoa is growing and contributes to heavy water demand and high wastewater production, thus putting pressure on the water availability. Tourism relies also on the urban water supply (SOPAC, 2007; SPC, 2012).

SWA has responsibility for providing water services in rural areas, though coverage is not widespread and infrastructure is poorly maintained and users are reluctant to pay for the low levels of service they receive. Outside of these areas water is accessed through village operated and independent schemes or small household scale sources. In rural communities where there is no access to piped water, the most common water supply is untreated groundwater and surface water sources where available (ISF-UTS, 2011).
There is hardly any irrigated agriculture in Samoa, almost all is rainfed. However the Penina golf course has an irrigation system, fed from a borehole, but no information on water withdrawal for this is available. Surface water is also used for power generation (SOPAC, 2007).

Rainwater catchment systems are less common in Samoa than in the other Pacific Island countries, and some communities have reportedly refused to use subsidized rainwater tanks citing to dislike the taste. Rainwater harvesting is only practiced widely in the Falealupo Peninsula and in otherwise isolated and rural households (SOPAC, 2007; IFS-UTS, 2011).

Water shortages are reported during the dry season, especially during extended dry periods associated with the El Nino/Southern Oscillation (ENSO), in the Apia area on Upolu served by surface water intakes and in the Falealupo Peninsula on Savai'i where groundwater is often brackish saline and the population relies upon rainwater harvesting (SOPAC, 2007). There is an increase in the development of groundwater resources to supplement surface water supplies in the country. SWA, some major hotels, and beverages and water bottling companies, as well as other large establishments have constructed their own production boreholes to provide reliable water services, especially during the dry season when river and stream flows are low (MNRE, 2013).

IRRIGATION AND DRAINAGE

Evolution of irrigation development

Irrigation areas in Samoa are very small. Small-scale irrigation needs are supplied by gravity from the numerous streams found on both main islands, but no information on exact areas is available.

Women and irrigation

The Ministry of Women, Community and Social Development (MWCSD) is the government department formally responsible for the rights and representation of women, as well as the mechanism by which the government coordinates and works with the traditional governance structure of the village communities (SOPAC, 2007).

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

Institutions

The most important institutions involved in water resources management are:

- The Ministry of Natural Resources and Environment (MNRE), which leads the management of Samoa's environment and natural resources, working in partnership with a number of resource management Boards (Land, PUMA, Forestry, Spatial Information and Water) to advise, inform and support community and government decision-making and deliver services to the people and communities. MNRE also works with ministries, non-governmental organizations (NGOs) and the private sector. The role of MNRE is to make sure that the environment and human health are protected, and that natural resources and services are as sustainable as possible and contribute to economic growth.
- The Water Resources Division (WRD) within the MNRE is responsible for ensuring community access to water of suitable quality and appropriate quantities to meet all reasonable health, environmental and economic development needs (MNRE, 2016).

- The Samoa Water Authority (SWA) is the major water service provider in Samoa and it is committed to providing safe and good quality water and wastewater services for Samoa as a whole (SWA, 2015).
- The Samoa Water Resources Board (SWRB), stablished by the Water Resources Management Act 2008 advises the government on any matter affecting the quantity and quality of the water resourcse, promotes coordination amongst government agencies, and ensures that there is effective monitoring of the water resources and dissemination of information.
- The Independent Water Schemes Association, established in 2007, manages and maintains independent and community water and sanitation schemes outside SWA areas in conjunction with government and NGO partners. This association has been supported by the EU-WSSP program since 2009 (IFS-UTS, 2011).

The Pacific Islands Applied Geoscience Commission (SOPAC) is an intergovernmental, regional organization including 18 Pacific island countries and territories, as well as Australia and New Zealand. SOPAC's work is carried out through its Secretariat, based in Suva. While the initial focus of its work was on marine mapping and geosciences, during recent years other scopes such as hazard assessment and risk management, environmental vulnerability, oceanography, energy, water and sanitation have been included.

Water management

The Water for Life initiative of the MNRE is an ongoing process to stimulate the development of Samoa's Water and Sanitation sector. The Water for Life Sector Plan 2012-2016 envisages the following sectoral objectives:

- Strengthen the water sector governance framework to guide and sustain sector developments
- Improve watershed management and reliability of water resources data through integrated water resource management (IWRM)
- Increase access and improve provision of reliable, clean and affordable water supplies
- Improve surveillance of drinking water quality and water-borne diseases
- Increase access to basic sanitation, improved wastewater systems and improved hygiene practice
- Strengthen effectiveness of flood mitigation measures to reduce incidence and magnitude of flooding in the Apia urban area
- Strengthen the community engagement in water resources management

The Water Sector Support Programme (WSSP), funded in 2005 and financed by the European Union, was successful in creating a comprehensive and coherent framework for the development and evolution of the water sector. Amongst others, the programme has financed the rehabilitation of some rural schemes (MNRE, 2016).

In 2007, SOPAC implemented the sustainable integrated water resources and wastewater management project in Pacific Island countries, of which Samoa is a beneficiary. The project was funded by the Global Environmental Facility (GEF). The Apia catchment area was considered an appropriate pilot in this project (MNRE, 2016; SOPAC, 2007b).

The Pacific Hydrological Cycle Observing System (HYCOS), funded in 2008 by the EU-Water Facility (EU-WF), provided training and support to MNRE-WRD, over a three-year period, with the re-establishment of surface water hydrological stations to help establish a programme of sustainable water resources monitoring in Samoa (MNRE, 2016; SPC, 2012).

Finances

Major investments in rural water supply and sanitation schemes were planned for 2008-2011 by the Asian Development Bank (ADB) and European Union (EU).

In 2010, SWA was able to cover its operation and maintenance costs from water sales (ISF-UTS, 2011).

Policies and legislation

The Samoa Water Resources Management Act 2008 (revised edition in 2014) makes provision for the management, conservation and use of water resources in Samoa including coastal waters where freshwater accumulates or discharges and is mixed with seawater. The Act sets out the principles of sustainable management of water resources, defines rights to control and manage water resources, regulates the taking and use of water, establishes the Samoa Water Resources Board, provides for the protection of the catchment areas, provides for community involvement in water resources management and defines offences. MNRE shall implement this Act and manage the water resource in accordance with principles set out in this Act (FAO, 2014).

ENVIRONMENT AND HEALTH

Regular monitoring of rivers and streams for parameters including flow rates, temperature, turbidity, pH and dissolved oxygen (DO) is ongoing under the WRD of MNRE. Available processed data indicates that river flow rates are highly dependent on seasonal fluctuations in precipitation making it highly vulnerable to climate change and climate variability. Already, there is an emerging declining trend in river flow rates in the main rivers of Samoa with economic implications.

River and stream water quality is not a major issue based on indicators of turbidity, pH and dissolved oxygen, but there are reported incidences of high E.coli counts in water springs of several villages. Direct waste disposal into rivers and streams, especially in rivers in the urban setting, has contributed to a lot of pollution to the coastal areas and is now being targeted by the rehabilitation efforts of the WRD (MNRE, 2013).

Sanitation in Samoa is almost completely managed through individual septic systems. Approximately three quarters of the households in Apia are connected to septic tanks, but many of these are overflowing and thus leaking black and grey water into groundwater or surface streams (IFS-UTS, 2011).

Samoa experiences both floods and drought. Flooding often occurs during the wet season (November-April), following prolonged or intensive rainfall events, and can cause devastation in urban areas (MNRE, 2013). El Niño related dry periods can cause urban water supply problems in Apia. Even where rainfall is reduced for a relatively short period, impacts can be felt due to limited catchment and reservoir storage (SPC, 2012).

Salinization is known to occur at some boreholes in Savai'i, although this is generally thought to be due to over-pumping of an individual borehole rather than to saline water intrusion (over-abstraction from the aquifer as a whole). The Falealupo Peninsula is an exception, which might be prone to saline water intrusion (SOPAC, 2007).

Deforestation caused by agricultural clearing and commercial logging has changed the vegetation cover in Samoa. At present, the low volumes extracted in the few remaining logging activities are indicative of the largely depleted nature of Samoa's native forests (MNRE, 2013).

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

The largest immediate threats to Samoa's natural resources, including water, are extreme events associated with climate change and climate variability, such as cyclones, floods and droughts. Other threats exist, such as amongst others waste proliferation, poor sanitation systems, unsustainable exploitation of resources and poorly planned development initiatives. However, these threats are more manageable with timely and effective interventions (MNRE, 2013).

Water demand is increasing with population wealth, urbanization and an increase in major developments, including tourism. Despite considerable effort in water demand management measures, including metering, leakage detection and repair, tariff incentives and conservation awareness campaigns, per capita consumption of water are predicted to rise. Samoa recognizes the benefits of adopting more integrated water resources management approaches (SOPAC, 2007).

The potential for increased hydroelectric power generation or irrigation will directly compete with more traditional uses (SPC, 2012).

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