

Samoa

Background

The island state of Samoa is located in the South West Pacific. It is divided into 2 states by the 171st meridian. To the West is Independent Samoa and to the East is the US territory of American Samoa.

Independent Samoa is comprised of two main Islands (Upolu and Savai'i) and two smaller islands (Manono and Apolima). Collectively the islands cover a total land area of 2934km². The capital city of Apia and the majority of commercial activity are based in Upolu. The remaining population lives in Savai'i, which is located 22km by sea from Upolu.

Both Upolu and Savai'i are volcanic, mountainous islands with central water catchment areas covered by tropical rainforest vegetation. The highest points are Mt Fito in Upolu at 1,158m Mt Silisili in Savai'i at 1858m.

Samoa's total estimated population is 161,000. Over a quarter live in the capital city of Apia, with approximately 75,000 living in 200 coastal villages in the island of Upolu. The remainder of the population live in Savai'i (~50,000) and the outer islands. Other than Apia, there are no significant commercial towns and the majority of the population lives in small villages of between 100 to 2000 people, relying on fishing and farming.

Water resources and supply

In the Global Water Supply and Sanitation Assessment in 2000, the coverage of the population in Samoa with access to an improved water supply was estimated at 63% for rural areas and 98% for urban areas.

Samoa is reliant on surface water and groundwater resources. The municipal area of Apia is dependent on surface water collected from a catchment area in the centre of Upolu Island. The remaining smaller villages are currently dependent on groundwater although proposed programmes for both Upolu and Savai'i will attempt to supplement scarce groundwater resources in the West of Upolu with surface water from the centre of the island.

The use of rainwater catchment systems is not common in Samoa. In the early 1990's UNDP promoted the use of rainwater for household consumption. However, in certain parts of the country communities refused to use the subsidised rainwater tanks, saying they disliked the taste of rainwater. In other parts of the country (Savai'i), the European Union (EU) has installed a large number of ferro-cement rainwater tanks, which have been accepted by the communities.

The Management of Samoa's water resources are currently fragmented and no agency has direct responsibility for water resource management. The Ministries involved in Water Resource Management include the Ministry of Agriculture, Forestry, Fisheries and Meteorology who are responsible for watershed management and hydrology, the Department of Health (DoH), responsible for monitoring water quality standards, the Samoa Water Authority (SWA) who are the national water service provider, and the Electric Power Co-operation (EPC) the biggest user of water for hydroelectricity generation.

Due to this fragmentation of responsibility, there is no regulation or control of private groundwater extraction within customary lands, and consequently limited information is available about exact quantities of surface or groundwater resources available.

In an attempt to achieve greater co-ordination, the Department of Lands, Surveys and Environment (DLSE) in collaboration with other key stakeholders, developed a National Water



Resources Policy (NWRP) in June 2001. The core focus of this policy was to improve knowledge of current water resources and to promote greater understanding of the importance of water conservation and water quality at National and community level. The initiative will be further supported by the European Union (EU) through regional workshops.

A part of NWRP is to ensure that deforestation is controlled within the water catchment area. The South Pacific Regional Environment Programme (SPREP) estimates that forest now accounts for only 37% of the land area compared to 57% in 1960. This increased deforestation in the catchment area has caused increased surface water run off, and a depletion of available surface/groundwater resources.

The important issues for the NWRP for water quality include the clearing of forests for agricultural practices resulting in the increased use of pesticides and fertilisers in the catchment area, and the possible nitrate contamination of drinking water and increased turbidity (TSS) caused by soil erosion and the increased surface run off particularly during the rainy season. This change in aesthetic quality of drinking water can result in communities drinking from polluted sources, and impacts on the ability to treat the water.

Currently, the municipal centre of Apia is served by treated surface water through a combination of in-house and yard connections. The surface water is abstracted from the catchment area of the central highlands of Upolu. It is then pumped to treatment plants at Alaoa, Malololelei and Fulusou where the water passes through three treatment processes; sedimentation, where raw water from reservoirs is pumped into sedimentation tanks with a retention time of 4 hours to reduce turbidity and TSS. It is then filtered through a roughing filter and slow sand filters to remove microbial contamination. However, the filtered material is removed by hand from the slow sand filters and dumped under uncontrolled conditions due to lack of funds. Finally the water is disinfected by UV light. In July 2001, SWA added chlorination with calcium hypochlorite as a final treatment phase before distribution.

The distribution network for the town has been designed to deliver 240 litres per capita, however some households consume more than 900 litres per person per day (lppd) and in some cases consumption rates reached more than 1900 lppd implying major losses through mains leakage or in-house wastage. A project began in 1999 to equip households with water meters and some 13,000 households of the 18,000 in Apia have been equipped with such meters resulting in a reduction in consumption from greater than 900 lppd to less than 350 lppd.

There are two major limitations facing the Apia distribution system, the ineffective treatment during rains due to increased deforestation in the catchment area resulting in high particle loadings, and the high consumption rates with the increased demand for water for rural water supply programmes, reducing the water available for Apia.

Rural areas of Samoa are primarily dependent on groundwater resources, abstracted from boreholes at below 80m by electric submersible pumps. In the west of Upolu, these groundwater resources are scarce and to supplement supply, the European Union is currently funding a program to divert surface water from the central catchment area to these rural villages.

The second island of Savai'i relies on groundwater extracted from boreholes, pumped into a reticulation system by submersible electric pumps and distributed by gravity through in-house connections. The SWA has proposed developing surface water resources on the island to supplement the groundwater supply.

In rural areas that are not served by a piped water supply, unprotected springs or river intakes are used as the principal drinking water source. It was noted that in Apia, customers who do not receive regular water supply often supplement their town supply with unprotected spring water.



Over the last 5 years there has been an increase in the number of households buying bottled water. There are currently 5 private companies bottling water (4 on Upolu and 1 in Savai'i) with one company estimating that they are supplying the equivalent of 20litres per family per month. Some limited water quality regulation of these companies is in place.

The present levels of coverage do not guarantee 100% reliability of service with households in low-pressure zones having intermittent supply with some households being without water for up to 12 hours. Where the supply is intermittent, piped water is often supplemented by untreated spring water by individual households. Households at end points of the distribution system receive low pressure, and treated water has until recently been diluted with raw water to boost supply.

In rural areas, the operation and maintenance of village reticulation systems is not well defined but SWA will assume greater responsibility for rural areas in the near future. Currently, there is little community involvement and supply and repair is intermittent, and where water is unavailable it has to be transported by local authorities in 200 litre drums.

SWA have recently initiated a cost recovery system in Apia and since the installation of water meters consumers have been paying approximately US\$3.5 per capita per month, equivalent to less than US\$0.03 per litre. Because of this low level of cost recovery, SWA does not generate sufficient revenue to cover system development or operation and maintenance. Many of the rural areas are dependent on piped water supply and bulk metering at the village level has been considered, however these voluntary contributions are currently minimal.

Samoa, like its neighbouring pacific islands, has a very low level of industrial and agricultural activity, but concerns remain over the potential effects of some chemical and biological pollutants in drinking water.

A survey to identify and quantify the volume of unwanted Persistent Organic Pollutants (POP's) and associated environmental contamination in Samoa identified that the level of chemical contamination is comparatively low and that chemical pollutants in drinking water are of less concern than microbial contamination associated with unsafe sanitation practices.

Sanitation practices in Samoa include on-site household faecal disposal that include pour flush, septic tank systems and pit latrines. The SWA has identified that sewerage is necessary for the 18,000 households of Apia due to presence of black and grey water overspill from septic tanks running into watercourses and recreational waters, and there are indications of eutrophication occurring in lagoons around Apia.

Currently, there is no standard septic tank design in Samoa. They are not lined to prevent subsurface pollution, and are not monitored by the EHU to ensure regular desludging. The tanks are emptied by private-public co-operation, which includes the Department of Lands Survey and Environment (DLSE) and the Ministry of Public Works, however the enforcement of quality control standards for emptying by the EHU is lacking. De-sludging often occurs prior to sludge maturity, and in some cases the holding capacity of septic tanks is insufficient and emptying is required daily.

The sludge is disposed of in two unlined pits at Tafa'igata 10km to the south west of Apia upstream of a number of production boreholes and testing for microbiological contamination, nitrate and nitrite levels in these boreholes are conducted on a regular basis. The estimated 740mt of nitrogen-based sludge produced annually is not being disposed of under controlled conditions and in areas outside of Apia sludge is removed manually and dumped in forested areas.



A waste characterisation study recorded that Samoa has a relatively low waste generation rate of 0.52kg/person/day with a bulk density of 350kg/m³ of which 59% were biodegradable materials and the remaining 41% predominantly paper, metal and plastic. The Department of Land Survey and Environment (DLSE) in partnership with a number of private sector groups, collect waste at household level, which is then disposed at the landfill site in Tafa'igata which began operation in 1993, is unlined, with limited covering activities.

A program has begun aimed at raising awareness of the importance of solid waste management as a major source of pollution, promoting household sorting and recycling of organic products and the drilling of a number of inspection boreholes close to the present landfill site to monitor COD/BOD and conductivity.

The uncontrolled dumping of solid waste raises concerns of possible chemical pollution of drinking water particularly from the leachate contamination of groundwater and surface water resources from the unlined landfill sites.

A high percentage of cultivated land in Samoa is used to grow subsistence crops such as taro, yams, bananas, pawpaws and breadfruit with coconut products being the only agricultural export accounting for 70% of exports. Despite this low level of export-driven agriculture the use of pesticides remains a concern, and the Ministry of Agriculture maintains a register of pesticides aimed at controlling the importation of both agricultural and household pesticides.

There is limited industrial activity in Samoa and the food and brewing industry accounts for a third of all industrial discharge, the remainder including printing, photo developing, cigarette manufacturing, fuels, gasses, lubricants and shoe manufacturers.

The wastewater discharged from Vialima Breweries is the major industrial waste discharge however the brewery has installed a treatment facility and adheres to the Coca-Cola standard for wastewater discharge.

Currently there is no effective form of medical waste disposal at Apia Hospital and of the 30 bins of medical waste collected per day, 25 are taken to Tafa'igata. The hospital incinerator is currently being re-habilitated. Medical waste in rural areas is buried and burnt, and an incinerator is currently being built for Savai'i hospital.

Unsafe faecal and waste disposal has resulted in an increase in water borne diseases with morbidity data from the Department of Health suggesting that there is an increasing trend in water borne diseases, particularly diarrhoeal diseases, gastro-enteritis, unclassified and infantile diarrhoea. Typhoid has also increased and is now endemic in certain areas of the country. The Preventive Health Department are currently investigating the cause of these typhoid outbreaks using questionnaires to establish the principal drinking water source and food sources 30 days prior to illness, however, to date, there is no conclusive evidence as to cause. Dengue Fever is also evident in Samoa.

Although mortality rates associated with waste related disease remains relatively low, rates of morbidity continue to remain high and the Department of Health have formed a Committee of Communicable Diseases with typhoid prevention as the primary issue.

Water quality surveillance and monitoring

An inter-Ministerial panel compiled the *Samoa Drinking Water Standards* with a final draft published in 1999 the objective being to raise awareness of the importance of water quality and to create a set of standards applicable to physical conditions in Samoa.

These Samoa Drinking Water Standards are significantly different from the WHO Guidelines for Drinking Water Quality in the requirements for indicator bacteria for microbiological



parameters. The reason for the difference is related to realistic levels of service provision and the perceived immunity of Samoans. It was noted that SWA and EHU stated that increased levels of *E.coli* was of limited concern due to the higher immunity of Samoans through long exposure to bacterial infections, however, acceptable levels of contamination are not dependent on immunity. There are other deviations in chemical standards outlined in the Samoan guidelines including a limited number of pesticides and arsenic.

Although the final draft of the Standards was written in 1999, to date the Cabinet has not legally mandated the Standards and they are considered as "Intermediate" standards and WHO Guidelines continue to be used.

The agencies responsible for water supply at the national (urban and rural) level include the Samoa Water Authority Environmental Business Unit (EBU) responsible for capital works systems, rehabilitation, operation and maintenance, management and cost recovery, and water quality. The Environmental Health Unit (EHU) of the Department of Preventative Health, Ministry of Health are responsible for water quality health education. The Ministry of Agriculture, Forestry, Fisheries and Meteorology are responsible for watershed management boreholes and siting. Policy is the responsibility of the Department of Lands Survey and Environment (DLSE) and private bottling companies (including Le Vai, Vailele and Vai Lata) are responsible for bottled water supply. A number of NGO's and United Nations Departments are also active in Samoa focussed on health education programmes.

There are currently two official drinking water quality monitoring programmes in Samoa. One operated by Samoa Water Authority (SWA) and the second by the Environmental Health Unit (EHU). There is also an independent Chemist who collaborates with both SWA and the EHU in the sampling and analysing of water from Le Vai Bottled Water Company.

Prior to formation of SWA in the mid 1990's, the EHU were responsible for the majority of sampling and water quality testing in Samoa. With the creation of SWA, it was verbally agreed that SWA as the service provider should monitor the water they are providing and the EHU should act as a surveillance agency that undertake random sampling to cross check results.

Following the publication of the first draft of the *Samoa Drinking Water Standards Manual* in March 1999, it was noted that sampling and monitoring laboratories will be approved and regulated, as necessary, by the Department of Health and that should a supplier fail to comply with the standards it must contact the Director General of Health within 24 hours of receiving results. Notifying the public of the unsafe water source is then the responsibility of the Ministry of Health.

The SWA has a team of water quality monitors that make up the Environmental Business Unit (EBU), a semi autonomous unit within SWA. They primarily collect samples from the Apia urban distribution system but also test selected boreholes in Savai'i and recently have begun to take samples from the private bottling companies and are promoting themselves as an independent unit that can also test private supplies. Currently they have been concerned only with collection and analyses of samples, both in the field and in a central laboratory.

Irregular and regular results are recorded and discussed with Managers and Engineers on a monthly basis. These results are then used by SWA to locate and improve potential areas of contamination within the distribution system, however no form of sanitary survey, health education or community development is undertaken by the EBU. The diagnosis of points of contamination and remedial action is the responsibility of the Engineering Works Department of SWA with the EBU having the sole responsibility for monitoring water quality.



The monthly report is discussed at the monthly Water Quality Committee meeting attended by all the key stakeholders in water quality and the SWA Board Meeting attended by Board Members including the Director General of Health, and other Departments

The Chief Health Inspector leads the Environmental Health Unit (EHU) within the Division of the Preventative Health Service. He manages a team of 17 people who are divided into five Programmes; Environmental Sanitation, Vector Control and Quarantine, Water/Food Safety and Quality Control, Occupational Health and Chemical Control and Rural Health in Savai'i

Currently, the EHU is doing a limited amount of work in the area of water quality surveillance with a greater focus being paid to food safety and quality control. Due to limited physical resources and lack of motivation house-to-house surveys are being done on an irregular basis and focus on a household level analysis such as condition of food preparation areas and general house condition. Standard sanitary survey forms for water supply are not used but a limited number of sanitary inspections are conducted at the household level. Water samples are taken on an irregular basis and results are questionable due to condition of testing facilities.

The major supplier of bottled water in Apia (Le Vai) has contracted an independent chemist to test their water quality at varied points of treatment on a weekly basis. Impartiality is maintained by crosschecking with the EBU and SWA. Results from this water quality testing are fed into the operation and maintenance of the treatment and bottling facility.

The major focus of the EBU of the Samoa Water Authority is on the Apia distribution system where it is currently taking approximately 50 samples per week from 10 fixed points in the distribution system, and testing for a number of microbiological, physical and chemical parameters.

A combination of field and laboratory testing is used depending on the parameter to be tested. For the physical parameters of conductivity, TDS, turbidity, pH and residual chlorine, field-testing equipment is used with samples returned to the laboratory to reconfirm turbidity, salinity, pH and iron. Equipment is available for BOD and COD testing but arsenic has not been tested.

The Department of Health has been testing water quality since 1949. It is scheduled to collect 10 samples per week but due to limited resources, often fewer samples are collected. For these samples, the EHU are responsible for collecting the samples and, in collaboration with laboratory technicians, undertake analysis of the samples. Over the last 5 to 10 years however, there has been a reduction in the number of samples collected due to restructuring in the sector with greater responsibility being passed to the SWA. Due to these limitations, it is estimated that the EHU is currently sampling a maximum of less than 10 samples per month and despite the presence of new field-testing kits, it is understood that a large number of samples are transported to the laboratory under uncontrolled conditions. In the rural areas, the EHU appear to have a systematic method of testing for samples, some are taken randomly and some at fixed points. The collection rate is less than that agreed in the *Samoa Drinking Water-Standards Manual 1999*.

There are three laboratories in Samoa that are undertaking drinking water quality testing. The Department of Health Laboratory is located in the Central Hospital in Apia. It was established in 1929 and is in need of rehabilitation. The Public Health Laboratory (which undertakes water quality testing) is a shared facility with the clinical laboratory and it has been noted that due to the poor sanitary conditions of the laboratory it is recommended that laboratory services be suspended. The staff are experienced but the laboratory itself was in an unsanitary condition and it was very difficult to locate equipment, media and data.

Samoa Water Authority Laboratory is located in the Environmental Business Unit of Samoa



Water Authority set up in 1996 when the Samoa Water Authority was formed. The laboratory has the capacity to undertake a range of biological, chemical and physical tests.

The EBU laboratory follows the US Environment Protection Agency (USEPA) approved standard operation procedures (SOP's) for all tests and a copy of these SOP's was available. The laboratory staff are highly efficient and motivated and their data is organised and recorded in the laboratory computer.

A small private laboratory is located in Le Vai Bottled Water Plant established in 1998 for in-house water quality monitoring and has the facility to conduct a limited number of microbiological, physical and chemical tests. The laboratory is well organised and attention to detail is paid in calibration of equipment.

No systematic form of sanitary surveys is currently being used, although the EHU undertakes house-to-house surveys with greater attention paid to food preparation and less to water sources. The SWA does not conduct any form of sanitary survey and water quality monitoring is done in isolation with results provided to assist engineers in improving facilities. As a result the effectiveness of the sampling without sanitary surveys is questionable.

The largest challenge facing Samoa in the sector of Water Quality surveillance is institutional. Currently, the service provider (Samoa Water Authority) is also the regulator. In order to maintain equilibrium between service provision and control, there is a need for an independent surveillance agency.

During meetings held with the various actors in the sector, there was an acknowledgement that an independent surveillance agency is required. As part of Samoa Water Board's master plan, the Environmental Business Unit (EBU) will, in time, become self-funded entity acting autonomously from SWA as a regulator. The first step to becoming independent is income generation and EBU currently advertise their services to carry out water quality testing for private consumers. The fees associated with these tests are to maintain the service.

However, the Department of Health is obligated to maintain standards of service provision in order to reduce the risk to public health and there is an argument for the Environmental Health Unit (EHU) of the DoH to become a more active regulator of the service provider, however they are unable to this with their current human and physical resources.

Furthermore, the Department of Land, Survey and Environment (DLSE) is proposing through the National Water Resource Policy to maintain appropriate water quality. To achieve this, greater co-ordination is required between the water catchment unit of the MoA, the service provider (SWA), the consumer (including EPC) and the water quality surveillance body. This will ensure that over-intensive agriculture is not depleting or polluting water resources.

Needs analysis

An independent water quality surveillance agency should be created that should be an agency that is not a service provider, but rather a monitor of service provision.

Following the recommendations of WHO a new management position should be created as Manager of the Environmental Health Service, who in collaboration with the Head of Preventative Health Services would be responsible for restructuring the EHU. It is recommended that new Job Descriptions be composed for all members of EHU and that performance be reviewed on a monthly basis with particular attention paid to laboratory staff.

It is important to maintain the current dynamism in the EBU by dividing responsibility for sampling and testing between the EBU and EHU. This could be done by zoning with high risk



areas with limited access to basic service provision covered by the EHU, and private customers with the ability pay covered by the EBU.

The creation of National Water Resource Policy (NWRP) by the Department of Lands, Survey and Environment should form a basis for future inter-departmental co-ordination in Integrated Water Resource Management whereby a full and comprehensive survey of water resources is conducted regarding quantity, quality, and coverage of water supply. It is recommended that all key players in the water sector should participate in the assessment to enable them to understand the linkages. With regard to the linkage of water quality and health statistics the establishment of a monthly Water Quality Committee meeting is the first step to information dissemination.

Current laboratory resources in the Department of Health are inadequate and it is proposed that in the interim that the EHU focus on field-testing rather than laboratory testing.

It is also recommended that legislation be followed up in Drinking Water Standards as since the publication of the final draft of the Samoa Drinking Water Standards no progress has been made to legally mandate them. The Public Health Act needs to be reviewed as to its applicability in relation to water quality surveillance as the mandating of the Drinking Water Standards and of the Public Health Act affords a legal backing to an independent water quality surveillance agency once formed.

Legislation towards the standardisation of septic tank design is required to avoid further surface and groundwater pollution and should be enforced by the EHU. A review of desludging practices in Apia is recommended, particularly in reference to collection and disposal. It is recommended that the pits be relocated and redesigned with adequate water quality monitoring facilities to measure levels of groundwater contamination from wastewater.

Training is required in the area of sanitary surveys and health education and their importance for water quality monitoring. This should be directed at the EHU, EBU and any agency involved in community health care

Laboratory testing procedures should be standardised to ensure uniformity of results and it is recommended that a committee be formed to compile a *DRAFT* Standard Operation Procedures Manual to accompany the Drinking Water Guidelines. It is recommended that a format for water quality testing is designed and used by all testing water.

It was recommended in the Pacific Water Association Meeting in 2000, that a regional laboratory is needed to test for chemical parameters that cannot be tested in each Island state. This would provide a more effective procedure for chemical analysis for the island States.

Reference

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