Water Supply and Sanitation Collaborative Council
Working Group on Water Demand Management and Conservation Workshop
Oslo, Norway, 28-30 April 1997

WATER DEMAND MANAGEMENT AND CONSERVATION IN THE PACIFIC REGION

June 1997 *SOPAC Miscellaneous Report 252*

Prepared by

Ed Burke
Water and Sanitation Program
SOPAC Secretariat
Suva, Fiji

This Activity was funded by the United Nations Development Programme

INTRODUCTION

The Pacific Ocean covers some 18 million km of about 36% of the Earth's surface. Scattered in the ocean between the coastline of the Americas and the land mass of Australasia and far East Asian countries are over 30,000 small islands and a number of larger islands, (>2000 km) which emerge from the sea floor. Approximately 1,000 of these islands are inhabited.

Developing Pacific Island countries (except for PNG) are mostly small in area and population. Many supporting thousands of people on land areas of tens of km. The nations are remote from each other and to other larger developed nations. The main groups of people are Melanesians, Micronesians and Polynesians. All nations have been influenced by various western nations. Many nations still have close links with the Commonwealth (including Australia and New Zealand), France and the USA.

The nations range in size from single island countries like Niue and Nauru to larger island nations such as Papua New Guinea, Solomon Islands, Vanuatu and Fiji. Widely scattered groups of coral atolls include Kiribati, Tuvalu, Tokelau and the Marshall Islands. Populations range from less than 10,000 in Niue, Nauru, Tokelau and Tuvalu to the highest populated developing country of PNG now approaching 4 million people.

WATER SOURCES IN THE PACIFIC

Water supply sources are from rainwater roof catchments, streams, rivers, springs groundwater wells and galleries, desalination and importing water by boat or truck in times of emergency.

Table 1 shows the major freshwater sources in Pacific island nations.

TABLE 1
MAJOR FRESHWATER SOURCE

COUNTRY	RAINCATCHMENT	SURFACE	GROUNDWATER	DESALINATION
A. Samoa			✓	
Cook Islands		✓	✓	
FSM	✓	✓	✓	
Fiji	✓	✓	✓	
Guam		✓	✓	
Kiribati			✓	
Marshall Islands	✓		✓	✓
New Caledonia		✓	✓	
Niue	✓		✓	
Nauru				✓
PNG		✓	✓	
Solomon Islands	✓	✓	✓	
Tonga	✓		✓	
Tuvalu	✓			
Vanuatu		✓	✓	
W. Samoa	✓	✓	✓	
Tokelau	✓		✓	
French Polynesia		✓	✓	

WATER DEMANDS

Water consumption varies from country to county depending on the freshwater source, the type of distribution system and the cost of water. For example, on the atoll of Funafuti in Tuvalu, the population solely relies on rainwater collected off roofs and stored in either private or government tanks. Thus their water consumption is related to the amount of storage available and the amount of rainfall. When family storage tanks are depleted they may buy water from the government storage tanks. Normally users of stored rainwater are good managers of their limited water resource knowing how and when to conserve water.

The extreme example is a community serviced by a surface water supplied through a high pressure pipe line and the users do not have to pay for the water. This situation is found in Apia, Western Samoa and Rarotonga in the Cook Islands. The average consumption rate in Apia is in the order of 650 l/c/d which includes system losses. With no incentive to conserve water, consumers tend to waste water leaving taps running and not repairing faulty plumbing.

Increasing pressure is being placed on the limited water resources of nations within the Pacific region both on water quantity and quality. This is due to development activities (tourism, mining, agriculture and forestry) increase in population and migration to urban areas. In the past the solution to deal with the need for more water was to construct a new intake, a new dam, or sink another borehole. However, new demand management and conservation methods must be used to optimise and rehabilitate existing water sources and delivery systems. Reducing unaccountable for water by 30% is the equivalent to the addition of a new water source by the same amount.

Table 2 shows the summary of survey results from 12 Pacific countries.

TABLE 2
SUMMARY OF SURVEY RESULTS

	Meters Installed	Water Charge (US$/m^3)	Conservation Awareness Programs	Water Losses %	Irrigation Usage	Reused Water	Leak Detection Program
A. Samoa	Yes since 1980 60% drop in demand	0.42 (includes charge for sewerage)	NO	25	NO	NO	YES 70 ⇨ 25
Cooks	Most commercial Few domestic	NO	NO	? ~ 70	YES	NO	NO
Kiribati	Yes since 1980	0.80 domestic 4.0 commercial	NO	25 distribution only	NO	NO	YES 60 ⇨ 25
Marshalls	96% metered 75% drop in demand	1.58 domestic 2.63 commercial	YES newspaper	? ~ 60	NO	NO	NO
N. Caledonia	Yes for 40 years	0.55	NO	20	NO	YES	NO

	Meters Installed	Water Charge (US$/m3)	Conservation Awareness Programs	Water Losses %	Irrigation Usage	Reused Water	Leak Detection Program
Tonga	Yes since 1970	0.93	YES radio	40 ⇨45	NO	NO	YES
Tuvalu	No rainwater storage only	YES ?	YES	?	NO	NO	NO
Vanuatu	Yes since 1994 7% drop in demand	0.39 to 0.59	NO	30	NO	NO	YES
W. Samoa	NO	NO	YES	? ~ 60	NO	NO	YES
Kosrae, FSM	NO	0.13 to 0.63	YES	~ 50	NO	NO	YES
Fiji	YES (urban only)	0.08 to 0.46	NO	30 ⇨ 45	Not from domestic	NO	NO
Solomon	YES	0.18 to 0.36	yes	? ~ 50	NO	NO	YES

CASE STUDY: RAROTONGA, COOK ISLANDS

I recently visited Rarotonga to undertake low flow-stream measurement and to advise on the existing water supply system that consists of a double ring main around the island supplied by twelve stream intakes.

The following Table shows the results of three estimates of the national demand of Rarotonga.

TABLE 3
ESTIMATES OF WATER USAGE (M³/DAY) ON RAROTONGA

USAGE	Binnie (1) 2000	WMI (2) 2000	Sakaru (3) 1992
Domestic	5,680 (8,100)	3,000	7,200
Industrial & Commercial	3,420 (4,200)	4,400	2,100
Agriculture	800 (2,900)	18,000	1,200
Unaccounted for Water	1,800 (2,800)	6,880	3,500
TOTAL	11,700 (18,000)	32,380	14,000

(1) Binnie & Partners, Water Resources and Water Supply of Rarotonga, June **1984** NOTE: Binnie provides two demand estimates; a "best estimate" and a "high estimate" which is in ()

(2) WMI & BURGEAP,Outline Scheme for Water Development and Management. October **1992**

(3) Sakaru Tsuchiya, Report on Rarotonga Water Supply Network Analysis, March **1992**

As can be seen from the above estimated water demands there is little comparison. There is over a 50% difference in Binnie's best and high estimates. In calculating domestic demand Sakaru uses 660 l/c/d, Binnie's uses 560 l/c/d and WMI uses 250 l/c/d while all figures are said to be based on water meter readings,

Water for agriculture varies as well. WMI allow for the irrigation of 900 ha at 20 m/ha/day whereas the others are much less. It is believed that the high domestic demand rates used by Binnie and Sakaru have a component of irrigation.

Unaccounted for water is another big unknown, mainly consisting reticulation losses and illegal connections. Binnie uses 15% while WMI and Sakaru assume 25% for unaccounted water. However night flow losses up to 70% were measured by both Binnie and WMI resulting from water wasted through leaky distribution pipes, leaky individual plumbing systems and taps not turned off. Unaccounted for losses in the order of 40-60% are normal in the Pacific island region.

It is interesting to note that if the water from all the stream flows, that was measured by the team during a dry period, was available for use (19,319 m/day) then both Binnie and Sakaru's demand estimates would be satisfied.

Any reduction in unaccounted for water losses would have direct impact on water resources making additional water for future growth and developments and/or for in-stream users. An example would be that if a water supply system provided 10,000 m/day and 50% of the water was unaccounted for then actual demand is only 5,000 m/day. If through leak detection, pipe line rehabilitation and water conservation education, the unaccounted for water is reduced to zero, then the potential capacity of the water supply is doubled. In reality there will always be unaccounted for water in any water supply system but the point is by minimising water losses the capacity of the water supply is increased.

The only reliable way to assess and control water usage is by universal water metering and a user pays system.

Dealing with water losses may be more economic than providing for additional water sources and/or constructing new storage reservoirs.

Universal Water Metering

The installation of bulk (reticulation system) and individual (all used connections) water meters are very beneficial to the operation, maintenance and water consumption of a water supply system. The main benefits are as follows:

- You know how much water is being supplied by each water source and flowing through the distribution system.
- You and each consumer know how much water is being used.
- You can assess where water losses occur in the system by monitoring water meters.
- You can develop a water charging system that encourages consumers to use water wisely.
- You can manage the water supply system based on hard date instead of guessing.

During the team's visit, only four out of twelve intake water meters were operational. Thus it was impossible to assess how much water was entering the distribution system.

If the amount of water was being supplied by the 12 water sources and the amount of water used was known (by water meter readings), then it becomes easier to assess if a problem is caused by (i) water shortage; (ii) water conveyance; or (iii) water usage.

It is strongly suggested that bulk water meters are installed (fixed or replaced) within the distribution system and that all water connections are metered to enable the sustainable management of the water supply.

User Pays System

It is suggested that a user pays system be initiated to generate funds necessary to supply water through out Rarotonga for domestic, commercial, industrial, and limited agricultural use. Water is essential for the existing and developing tourism industry which Rarotonga heavily relies on. Rarotongans pay for their electricity, their petrol and other consumables so why not pay for their water.

All non-domestic users should be targeted first. Most commercial and industrial user already have water meters installed. Therefore the balance of non-domestic users should be metered at once and water supplied paid for. Non-domestic users all financially benefit from the water supply so why shouldn't they contribute to the operation, maintenance and capital improvements of the supply.

Along with providing revenue, overseas experience has shown that water consumption also decrease when users have to pay. Paying for water will reduce water demands and therefore reducing the need for alternative water sources, storage facilities and other capital works. The environment also benefits by providing reducing stream abstractions that enhances in stream users.

Discussion

Basic data is required to be able to manage any resource in a sustainable manner. An example is a bank account. To know how much money can be spent (with out going into overdraft) you need to know how much money is going into the account. This is true with water resources. How can a water supply system be managed if you do not know how much water is available and how much is being used? Currently in Rarotonga there is no way to assess water supply and demand. Only when the supply and demand of the water supply system is known can the system be managed in a sustainable manner.

As a priority, bulk and individual water meters must be installed and monitored to assess water entering and exiting the water supply system. Once this information is available the system can be analysed thus allowing management decisions to be made to improve the service and to conserve the limited water resources.

Existing information suggests that there is considerable wastage of water within both the distribution system and individual private systems. Because most connections are not metered and there is no charge for supplying water, there is no means to monitor or to control water usage.

It is very likely that with water meters installed and a user pays system in place that water wastage will reduce through leakage repairs and water consumption rates will decrease due to water charges. The end result will be a more efficient water supply system, reduction in water usage as well as funds to operate, maintain and improve the water supply system for future development. The need for large storage reservoirs and additional water sources may not be needed or postponed until a real need.

Since there is very little existing data regarding surface water resources, an investigation of Rarotonga's water resources is most appropriate. With the data generated by the proposed study the safe sustainable catchment yields can be assessed with confidence.

Protection of the water supply catchments is most important to ensure both water yield and quality for generations to come. The proposed Rarotonga water supply catchment zone legislation (as per Progress Report on the Rarotonga Water Catchment Committee, October 1996) that restricts land use in all areas located above the 150m contour is strongly supported.

A Few Strategies to Consider

- The lack of information regarding the amount of water supplied to users and the amount of water consumed by users is preventing the optimal management and development of water supply systems.
- Bulk and individual water meters need to be installed to provide information to manage and develop water supply systems.
- The introduction of a user pays system for water would encourage the wise use and conservation of water plus provide revenue for operation, maintenance and capital costs.

- Information regarding surface/ground water resources is required to enable the assessment of sustainable safe water catchment/aquifer yields.
- Leak detection and pipeline rehabilitation programs are required to locate and fix system losses.
- Public education and awareness programs on water conservation to reduce consumption rates.
- Legislation to protect water supply catchments and aquifer by restricting land use, is required to ensure sustainable water yields and water quality for future generations.