

Drinking Water Quality in the Pacific Island Countries: Situation Analysis and Needs Assessment

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ABSTRACT

Access to safe and adequate supplies of drinking water is fundamental for human health and well-being. Countries in the Pacific Region are constantly faced with drinking water supply problems. The World Health Organization (WHO) and partner agencies support member states in the Pacific region in their efforts to improve drinking water quality. The WHO workshop on Drinking Water Quality (DWQ) Standards and Monitoring held in February 2005 in Fiji brought together water service providers and health departments from across the Pacific region and allowed an up-to-date picture to be drawn of the current situation and needs in terms of drinking water quality in the Pacific Island Countries (PICs). Variations in water resource availability, often inadequate supply and treatment systems, increasing pollution and lack of proper institutional frameworks and resources for water quality monitoring are all issues that affect water quality in PICs. To assure the safety of drinking water there is a need to apply risk management approaches in source protection and water supply, such as the use of water safety plans. Education is needed, particularly in rural and remote communities, concerning the health risks posed by unsafe drinking water and unsanitary practice. Appropriate regulatory frameworks, compliance and enforcement requirements for safe drinking water need to be developed as well as the financial, technological and human resources for water quality monitoring and treatment.

Keywords | *Drinking water, water quality, water safety plans, risk management and Pacific Island Countries*

INTRODUCTION

The Pacific Island Countries (PICs)¹ differ significantly in size, population and resources endowment, but nevertheless share many common development constraints and challenges. PICs are constantly faced with drinking water supply problems. According to the MDG report on Water and Sanitation Targets (UNICEF & WHO 2004), approximately 3 million people in the Oceania region do not have access to safe and adequate drinking water and sanitation services. Providing this access to improved water supplies remains a priority issue in the region. Financial, institutional and structural constraints all contribute to the inability to provide safe drinking water

¹ PICs here include American Samoa, Cook Islands, Fiji, French Polynesia, Federated States of Micronesia, Guam, Kiribati, Republic of the Marshall Islands, Nauru, New Caledonia, Niue, Palau, PNG, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu

in most of the PICs. Therefore, water safety cannot be addressed in isolation but needs a holistic framework.

In response to these needs, the World Health Organization (WHO) and partner agencies, are taking initiatives to support member states in the Pacific region in their efforts to improve access to safe and adequate drinking water. A milestone in these efforts has been the publication of the 3rd edition of the Guidelines for Drinking Water Quality (GDWQ) as well as the associated WHO Regional Workshop on DWQ Standards and Monitoring held in February 2005 in Nadi, Fiji. The guidelines were reviewed during the workshop with a view to their adaptation and application as a template in the Pacific. The major outcome of the Workshop was the Pacific Framework for Action on Drinking Water Quality and Health that was later recommended for implementation at the Pacific Health Ministers meeting in March 2005, in Apia, Samoa. The Framework for Action complements the Pacific Regional Action Plan on Sustainable Water Management (SOPAC & ADB, 2003) and represents the platform for Pacific countries to develop their National DWQ guidelines and standards. Key components of the framework include the protection of water sources, the implementation of risk management strategies for improving water quality using tools such as Water Safety Plans (WSP), and the need to further develop water quality monitoring programmes. Furthermore, the need for institutional strengthening and capacity building was also highlighted.

This paper comprises two sections, firstly a situation analysis, which presents an overview of the DWQ situation in the PICs, followed by a needs assessment for mitigating water quality issues drawing on the knowledge and experience of participants of the 2005 Regional Workshop on DWQ Standards and Monitoring.

SITUATION ANALYSIS

Drinking water quality challenges are prevalent across the Pacific, however the degree of constraints vary from country to country. Variations in water resource availability, supply conditions, increasing pollution and water contaminants and lack of proper institutional frameworks for water quality monitoring, are all issues that affect water quality and consequently the health and well-being of Pacific Islanders. The following sub-sections present an assessment of the drinking water quality status in the PICs.

Water Resources Availability

The PICs are mostly small in size and are scattered across the Pacific Ocean, isolating them from each other and large continents. The geography of PICs varies from large volcanic islands, to small low-lying islands, to scattered groups of coral atolls. Populations in PICs are relatively small, except for Papua New Guinea (PNG) with 4.4 million inhabitants. Despite growing urban migration, a large percentage of the population reside in rural areas in most countries.

Due to the variation in spatial and topographical distribution and climatic conditions, resources such as freshwater, varies across nations and between different islands within a country. Naturally occurring or conventional freshwater sources for drinking in the island countries include: surface water, groundwater and rainwater. Non-conventional sources of water include desalination, importation and wastewater re-use. Other non-conventional sources include the use

of seawater and brackish water (Carpenter *et al.* 2003). For example some systems in Kiribati and the Republic of the Marshall Islands use seawater for toilet flushing.

Low-lying small islands and coral atolls such as many of the Cook Islands, Kiribati, Nauru, the Republic of the Marshall Islands, Tonga and Tuvalu, rarely have surface water sources and heavily depend on rainwater and groundwater. On small islands groundwater occurs as either perched (high level) or basal (low-level) aquifers (Carpenter *et al.* 2003). Some low-lying countries have low-level aquifers of only 10-20 cm thick, which are susceptible to salt water intrusion with high extraction rates. Larger volcanic islands such as Fiji, Samoa, Solomon Islands and PNG have abundant surface water and groundwater resources. However, all the island countries, due to climate variability, lack of adequate storage facilities and lack of source protection are vulnerable to drought and contamination of drinking water. The impacts of climate change as well as increasing development without good environmental awareness and regulation also threaten the fragile water resources of PICs.

Drinking water sources are extremely vulnerable to contamination from inadequate sanitation facilities, from sewage dumping in the sea and from other land-based pollutants. This can lead to serious outbreaks of water borne diseases such as cholera, typhoid and gastro enteritis. With most rural and even some urban water supplies in the Pacific region untreated, maintaining the quality of water sources is crucial to the health of populations.

Water Supply Status

Reticulated drinking water supplies are available in most urban and peri-urban areas of PICs. Water supply in urban areas is made available either by privately owned water utilities, the Ministry of Works, semi-autonomous public utility boards/authorities or local municipalities. Responsibility for rural water supply in some countries is with the Ministry of Works in collaboration with the Ministry of Health, while others are with the local municipalities. Table 1 presents the status of water supply coverage in the island countries.

Overall, rural population is predominant in most Pacific island countries, however, rapid urbanisation across the region is providing a major challenge to meet the growing demand for urban water supply. In addition, the increasing population and expanding demands in most countries is placing a strain on the already limited water resources. The Global Water Supply and Sanitation Assessment Report (WHO & UNICEF 2000) indicated that in seven Oceania countries more than 50% of the total population now reside in the urban areas. As such, these countries report high water supply coverage. For instance, Palau reports 100% water supply coverage as all households are connected to a single main public water supply system. Likewise, the Federated States of Micronesia (FSM) reported 100% coverage, although, from different sources.

Despite the high water supply coverage reported in some PICs, the availability of water supply can be limited to only a few hours daily. For instance, the Republic of the Marshall Islands only have 4 hours of water supply in the morning and 4 hours in the afternoon, while Kiribati has 7 hours of supply daily due to low resource availability. On the other hand, some countries such as Fiji, Tonga and French Polynesia have frequent cuts in water supply due to high leakage rates, deteriorating infrastructure, poor maintenance and lack of financial and technical resources.

Most urban water supplies have some form of treatment, generally basic filtration, which is sometimes also followed by chlorination. Most rural water supplies are untreated with

households generally advised to boil water. Ministry of Health in all the PICs has the responsibility to advise the public on water safety measures. For many water supplies no regular water quality surveillance is conducted.

Drinking Water Quality Status

The 2005 Country Health Profiles² reported an increase in the incidence of water related diseases over the past few years. The increase in water-borne diseases is thought to have resulted from increased consumption of contaminated water. Sources of contaminants differ in individual countries with variation in domestic practices and activities. However, according to the country reports presented at the Workshop, most PICs indicated that the key contamination problems result from improper sanitation facilities and leachate from inadequate disposal of household waste.

Contamination of water due to microbiological pollutants results in diarrhoea, gastro-enteritis and other health problems. Diarrhoeal diseases still form a large proportion of infant mortality and morbidity in FSM. PNG also recorded a high mortality and morbidity rate from diarrhoeal diseases in the rural communities. The Republic of the Marshall Islands has had an outbreak of Cholera on Ebeye in 2001.

Other pollutant sources include chemicals from industrial or agricultural activities. A survey of Persistent Organic Pollutants in Fiji indicated that stockpiles of pesticides are a major environmental threat. Nauru reported groundwater contamination from cadmium as well as human activities, while Niue is vulnerable to agricultural pollutants. The major health problems in Tuvalu have been from communicable diseases such as skin infections and eye infections related to a lack of freshwater. As rainwater is the main source of drinking water in Tuvalu, any period of drought poses very serious consequences to the health and well-being of the people.

Protection of groundwater and rainwater sources is amongst the highest water quality concerns for PICs. A high percentage of rural communities depend on groundwater extraction from hand-dug wells. These wells are not adequately protected and poorly managed. Wells are often unlined, left uncovered and dirty buckets are used, leaving the well open to contamination from animals and other pollutants. In addition, freshwater lenses in coral atolls and low-lying islands are vulnerable to salt water intrusion resulting from over-extraction or overtopping by seawater. A number of countries that rely on rainwater in the rural and remote areas do not have the appropriate facilities for storage and collection. Where good facilities have been constructed, they are commonly not well-maintained or regularly cleaned, allowing contamination. Similarly a high level of contamination occurs at the household level from poor handling and storage practices, due to lack of awareness in most countries.

Water Quality Standards, Monitoring and Regulation

Concerted efforts to improve drinking water quality are long overdue in most countries. The situation is made more difficult by the fact that there are usually no legal instruments to ensure quality of water supply, or to conduct surveillance or quality checks. Most countries do not have appropriate legislation or national water quality standards, or if existing, their legislation is

² Produced annually by individual PICs Ministry of Health and reported to WHO

outdated (Table 2). Countries with some legislation or standards include PNG (although without a clear policy for rural water supply), Palau and American Samoa, while French Polynesia's regulations and standards are currently being developed. Most countries apply the WHO water quality guidelines as standards while those in the Northern Pacific Region either use WHO or USEPA guidelines.

The regulating body in most of the PICs is either the Ministry of Works, Health or Environment and/or the Environmental Protection Agency. The Public Works Departments or privately owned water utilities mainly carry out regular water quality monitoring, including residual chlorine and coliform. The Ministry of Health also conducts some testing periodically to monitor water quality in some countries. However, there is little source monitoring and feedback systems to alert water suppliers about water quality problems tend to be inefficient. Some countries have ad hoc monitoring systems that take place in isolation by separate agencies and data is usually not shared resulting in duplication of work and inefficient use of resources.

Water quality monitoring is further hampered by the lack of appropriate institutional frameworks as well as a lack of resources to carry out analysis, such as proper laboratory facilities, finances or skilled personnel. However, countries are taking initiatives to improve water quality. For example, Palau has started monitoring private household water systems, as 67% of the population depends on rainwater in private catchment tanks. To assess the quality of water stored in catchment tanks a pilot project for H₂S³ testing was recently implemented and achieved great success. The H₂S test is cheap and reliable and a feasible method to ensure water quality. Likewise, the Republic of the Marshall Islands has also successfully introduced H₂S testing in outer islands as a community-based method for water quality monitoring.

³ Presence/absence test for thermo-tolerant coliform bacteria

Table 1: Drinking Water Supply in PICs (Sources: Pacific Island Country Reports 2005 & SPC 2004)

Countries	Drinking Water Supply Coverage		Supply Treated/Untreated	
	Urban	Rural	Urban	Rural
American Samoa	Reticulated water supply covers 95% total population		Treated	
Cook Islands	Reticulated supply to >50% total pop.	Primarily individual rainwater systems, some reticulated groundwater supplies.	Untreated	Untreated
FSM	Reticulated supply covers 15% total pop.	Individual rainwater systems cover 50% total pop., remainder community systems, wells or other sources	Treated	Untreated
Fiji	Reticulated supply covers 98% urban pop.	Reticulated supply covers 63% rural pop., remainder community systems, wells, springs or surface water sources	Treated	Some treated
French Polynesia	Reticulated supply covers 70% total pop.	Low-lying Is. have individual rainwater systems	Treated	Untreated
Kiribati	Reticulated supply covers 61% urban pop. (limited hours), remainder wells, rainwater	Reticulated supply covers 55% rural pop. & remainder use shallow wells & rainwater	Treated	Untreated
Republic of the Marshall Islands	Reticulated supply but only available for 4 hrs in the morning & 4 hrs in afternoon	Groundwater and rainwater sources, estimated 20% rural pop. have access to safe drinking water	Treated	Untreated
Nauru	Desalinated drinking water supply to all via trucks and storage tanks		Brackish & rainwater untreated	
New Caledonia	Reticulated supply to 40% of total pop.	Reticulated supply from groundwater or desalination or individual rainwater systems	Treated	Treated
Niue	Reticulated groundwater supply to 100% total population		Untreated	
Palau	Reticulated supply covers 95% urban pop.	Reticulated supply covers 80% rural pop., remainder individual rainwater systems	Treated	Treated
PNG	Reticulated supply covers 93% urban pop.	30% reticulated water supply; remainder groundwater, surface water sources	Treated	Untreated
Samoa	Reticulated supply covers 98% urban pop.	Reticulated supply to 63% rural pop., some individual rainwater systems	Treated	Some treated
Solomon Islands	Reticulated supply covers 81% urban pop.	Groundwater surface water & rainwater sources, estimated 22% rural pop. have access to safe drinking water	Treated	Untreated
Tonga	Reticulated supply covers 97% urban pop.	Primarily individual rainwater systems	Treated	Untreated
Tuvalu	93% total pop. have access to safe drinking water from rainwater and groundwater supplies		Untreated	
Vanuatu	Reticulated supply covers 91% urban pop.	Groundwater surface water & rainwater sources, estimated 71% rural pop. have access to safe drinking water	Treated	Untreated

Table 2: Water Quality Monitoring in Pacific Island Countries (Source: Pacific Island Country Reports 2005)

Countries	Any Water Quality Monitoring?	Any Legislation /Regulations/ Guidelines?
American Samoa	Yes	USEPA ⁴ standards & ASEPA ⁵ regulations
Cook Islands	No proper monitoring	Public health Act (2004) & Rarotonga Water Works Ordinance 1962, Standards to be reviewed
FSM	Yes in urban areas, responsibility of supplier & enforcement agencies	WHO guidelines, AWWA ⁶ & APHA ⁷ standards
Fiji	Yes in urban areas by PWD & rural areas by MoH	No standards, use WHO guidelines
French Polynesia	Yes only in urban areas by the supplier	3 statutory instruments adopted in Oct. & Nov. 1999 regulating hygiene of water, setting potability standards & establishing the monitoring programme for drinking water quality
Kiribati	Yes in urban areas only	No standards, Use WHO guidelines
Republic of the Marshall Islands	Yes in urban areas only	No proper legislation, no standards, Public Water Supply Regulation (1994) limited on water quality
Nauru	Very limited, ad hoc	No legislation, use WHO guidelines
New Caledonia	Yes, urban – well monitored Rural – little or no monitoring	Use French standards Public consumption is protected by provincial decree
Niue	Yes bacterial only	Water Resource Act (1996) but no supporting regulations, use WHO guidelines
Palau	Yes in urban & public supply systems	EQPB ⁸ Public water Supply System Regulation & Standards
PNG	Yes in urban areas only	Public health Act (1984) but no clear policies for rural & source protection
Samoa	Yes all urban & rural piped supplies	No standards, use WHO guidelines
Solomon Islands	Yes in urban areas only	No standards, use WHO guidelines
Tonga	Yes in urban areas only	No standards Water regulation outdated, use WHO guidelines
Tuvalu	Yes some monitoring	No standards Public Health Act outdated, use WHO guidelines
Vanuatu	Yes in urban areas only	Use French standards & WHO guidelines. No proper monitoring system

⁴United States Environmental Protection Agency

⁵American Samoa Environmental Protection Agency

⁶American Water Works Association

⁷American Public Health Association

⁸Environmental Quality Protection Board

NEEDS ANALYSIS

The 2005 Workshop on DWQ Standards and Monitoring brought together water service providers and health departments from across the Pacific region. Drawing on the knowledge and experience of participants, a comprehensive needs assessment for improving drinking water quality in PICs was completed. Workshop participants identified needs under six themes: Water Resources Management, Island Vulnerability, Awareness, Technology, Institutional Arrangements, and Financing.

Water Resources Management

A key outcome of the workshop was the identification of the need to adopt risk management strategies to safeguard water quality, rather than simply “end-point” monitoring as currently practiced. The use of risk management tools such as Water Safety Plans (WSPs) should be promoted as an effective means to improve drinking water quality in the Pacific region by looking at the whole water supply chain from catchment to consumer. WSP simply help identify the risks to water quality for individual water supply systems and how best they can be prevented or mitigated.

The 3rd edition of the WHO Guidelines for DWQ sets out a comprehensive water safety framework. Apart from promoting the use of WSP to improve drinking water quality, the importance of identifying the priority parameters for water quality monitoring is also emphasised. Amongst country representatives there was some concern that chemical contaminants are not given as much attention as microbial contaminants in water quality monitoring programmes. Chemical contamination of drinking water can have serious consequences for human health, however, it is sometimes overlooked as the effects can be more long-term. Protection of water sources from contamination and overuse must be a priority to ensure continuity of both quality and quantity.

Most PICs are limited in their ability to carry out comprehensive water quality monitoring. Therefore it is necessary to identify priority water quality parameters for analysis and a meaningful testing regime for individual situations. Again, a risk management approach can be used to identify the main threats to water quality. Effort is needed to promote and develop risk assessment procedures for toxic chemicals and pathogens in drinking water at local, national and regional level. Water quality monitoring is a likely component of any integrated approach to safeguard water supply such as WSP.

Research to establish a scientific knowledge base is also needed to facilitate the development of effective, efficient, and equitable policies and plans related to water resource management and public health. Specialist support is needed to develop national policies for the protection of water resources, including establishing enforcement, inspection and laboratory certifying agencies. Countries should be encouraged to establish partnership with all stakeholders to form a National Water Task Force (NWTF) that would be responsible for defining responsibilities, identifying water resources management actions and sharing of information to enable better informed decision-making. The successful adoption of risk management approaches as discussed earlier would require active cooperation between government agencies and all other stakeholders.

Water Safety Plans

The primary objectives of Water Safety Plans (WSPs) are to minimise contaminants in source waters, reduce or remove contaminants through treatment and the prevention of contamination during storage and distribution. These objectives are equally applicable to large piped drinking water supplies, small community supplies and household systems. A WSP comprises, as a minimum, three essential actions to ensure that drinking water is safe:

1. *System assessment* to determine whether the drinking water supply chain (up to the point of consumption) as a whole can deliver water that meets quality targets;
2. *Effective operational monitoring* which means identifying appropriate control measures and observing and acting on any deviation from required performance in a timely manner; and
3. *Management plans* describing actions to be taken during normal operation or incident conditions and documenting the system assessment, monitoring and communication plans.

(WHO 2004)

Island Vulnerability

As PICs and their water supplies are vulnerable to climate hazards such as drought, flood and tropical cyclones, it was recognised that emergency preparedness plans need to be developed and implemented to address contamination risks to water sources. The fragile environments of very small islands should be respected and protected. Support needs to be given to all stakeholders involved in managing the quality and quantity of source waters. Collaborative partnership between health departments, resources departments, public works, national disaster management offices and other agencies is also needed for the protection of vulnerable water resources.

Awareness

In rural and remote communities knowledge is poor concerning the health risks posed by unsafe drinking water, especially the risk to children's health. There is a need to educate the heads of households concerning sanitary measures related to individual water systems. In rural and remote communities and where public water supplies are intermittent, there is a need to educate parents and children alike concerning household water treatment and safe storage options. Community ownership, empowerment and participation in water management could substantially improve local understanding and awareness of the relationship between water and health in PICs. Further effort is needed in training both communities and community workers in participatory approaches, on water quality and health risks, protection of

water sources, household level treatment and safe storage. Development and production of appropriate awareness materials on water quality management is also essential.

Community based programmes for safe water supply monitoring in rural and remote areas should also be encouraged. Countries have reported that field-testing, such as H₂S testing, in remote areas is the most suitable method for quality monitoring as it engages local communities and as such it should be further supported. Apart from local level awareness programmes, government awareness is also fundamental in raising political commitment to support actions for safe water supply and sanitation.

Technology

PICs do not have the sufficient equipment and technology necessary to maintain safe drinking water supplies. Appropriate equipment is needed for water quality and system control, monitoring and data management in both urban and remote rural island communities. Equipment is also required for water treatment and disinfection. There is a further urgent need to invest in wastewater technologies due to the impact of wastewater on drinking water quality. In addition, the need to promote alternative technologies such as solar water supply systems or simple wastewater treatment systems for outer islands and remote areas, as well as training programs for innovative treatment systems has also been identified. Adequate equipment for laboratory and field-testing is also a key priority.

It is necessary to strengthen the technical capacity in PICs through training and technical assistance programmes for those involved in drinking water quality management including monitoring, operation and maintenance. Suitable mechanisms for equipment maintenance, calibration and replacement are also required. Research into developing appropriate field-test kits for use in rural and remote areas in the Pacific should also be promoted.

Rainwater harvesting programmes are an integral part of drinking water supply in many PICs. Water quality from rainwater harvesting schemes can be improved by incorporating “first-flush” devices into designs and facilitating community based water quality monitoring. Support should be given to incorporate these approaches into rainwater harvesting programmes.

Institutional Arrangements & Financing

One of the most important Workshop discussions focused on the need to review existing legislation related to water quality monitoring and management. It is necessary to develop National DWQ standards and guidelines that are supported by appropriate legislation and regulations. Countries reported that weak, outdated or a lack of legislation results in unclear sharing of responsibilities, duplication of work and no coordinated monitoring as agencies work in isolation.

Governments need to develop and implement appropriate regulatory frameworks, compliance and enforcement requirements to secure the provision of safe drinking water. Communication and information exchange between agencies involved with water quality data collection should be strengthened. This should include exchange and joint analysis of drinking water quality data and disease surveillance data between water supply agencies and health authorities. Water quality tests conducted by an independent agency should also form part of the regulatory framework.

Financial resources are also needed to secure safe drinking water supplies. Governments should, as a priority, develop and implement appropriate financial mechanisms to support sustained supplies of safe drinking water and sanitation services to both rural and urban communities. This requires a greater focus on planning and increased political will to tackle these issues. Raising awareness in civil society can help place pressure on governments to prioritise funding for water quality and hygiene projects. External agencies should be encouraged to support specific activities in the region where governments are unable to sustain provision of safe

drinking water and sanitation services. There is a need for governments, external agencies and communities to be involved together in discussion and planning to improve services.

In summary, the situation analysis and needs assessment of the drinking water quality status in PICs highlights a number of key priority issues. These include the need for greater water source protection, adoption of risk management approaches and increasing public knowledge about the links between water quality and health. In addition, PIC governments need to strengthen legislation and regulatory frameworks for water resource management and develop appropriate financial, technological and human resources for water quality monitoring and treatment.

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Framework for Action on Drinking Water Quality & Health in PICs

The Framework for Action makes 21 recommendations with 95 associated actions in order to address needs identified under 6 key themes:

Water Resources Management: PICs need to develop risk management approaches in assuring the safety of drinking water. Most countries need to strengthen their capacity for monitoring water quality and access to safe and sustainable drinking water and sanitation.

Island Vulnerability: Most PICs need to develop and implement water source protection measures to prevent contamination, especially for groundwater lenses in atoll and outer islands.

Awareness: Education is needed, particularly in rural and remote communities, concerning the health risks posed by unsafe drinking water, sanitary measures related to individual water systems, and household water treatment and safe storage options.

Technology: PICs do not have sufficient equipment for water quality and system control, monitoring and data management nor sufficient equipment for water and wastewater treatment.

Institutional Arrangements: PIC governments need to develop and implement appropriate regulatory frameworks, compliance and enforcement requirements to secure the provision of safe drinking water.

Financing: Financial resources are needed to secure the safety of drinking water supplies.