

The Economics of Drinking Water Safety Planning: An Advocacy Tool

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ABSTRACT

Good water quality is essential for the wellbeing of all people. In response to a growing realisation that safe water is limited, the United Nations has declared access to clean water a basic human right. Unfortunately in many countries around the world, including the Pacific islands, some drinking water supplies are becoming increasingly contaminated, impacting the health and economic development of the country. To protect drinking water safety, conventional practice in many Pacific island countries has been to monitor the quality of the treated drinking water at the end of the supply chain through water quality testing and assessing compliance against standards. However, this approach does not, among other things, provide timely information to prevent the consumption of contaminated water already distributed. Consequently, the World Health Organization (WHO) now promotes the use of drinking water safety planning to assess and manage the risks associated with drinking water from catchment to consumer.

Selected Pacific island countries have endorsed the drinking water safety planning approach and are working with SOPAC and WHO to establish their own supply-specific water safety plans. Nevertheless, as the concept of drinking water safety planning is still new, evidence is required to demonstrate the value of the approach to ensure that government agencies and water suppliers not only adopt the approach but maintain sustainability through ongoing financial and technical support.

This paper describes an economic cost-benefit analysis of the Koror-Airai drinking water safety plan from Palau to demonstrate the value to society of the drinking water safety planning approach in the long term. The cost-benefit analysis for implementing the Koror-Airai drinking water safety plan showed that a return of US\$ 6.00 was expected on every US\$ 1.00 invested towards implementing the plan. The case study provides an effective advocacy tool for the promotion of drinking water safety planning both in the Pacific region and globally.

Key Words: Drinking water safety planning, water quality, cost-benefit analysis, Pacific island countries, Palau

INTRODUCTION

Access to safe drinking water is a basic human need and essential to public health. The resolution of the 64th United Nations General Assembly has declared the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights (UN News Centre, 2010).

Unfortunately in many countries around the world, including the Pacific islands, some drinking water supplies are becoming increasingly contaminated which has impacted the health and economic status of the populations. Every year 2800 deaths in the Pacific region result from diarrhoea, and most are children under 5 years of age (WHO and SOPAC, 2008).

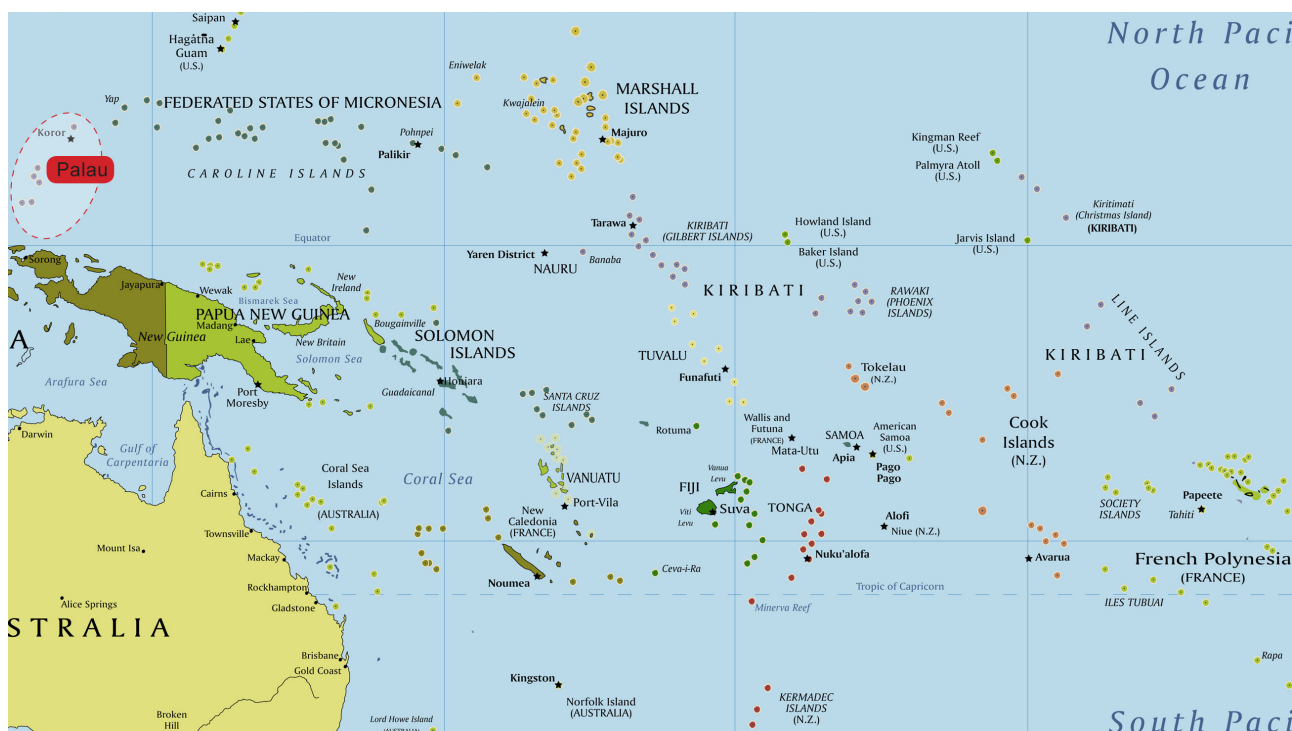
Currently, the practice in many Pacific island countries is to monitor the quality of the treated drinking water at the end of the supply chain through water quality testing and assessing compliance against standards. The various shortfalls and limitations in relying on end-product testing as an indication or guarantee of safe water quality are now being realised. For example, only a fraction of the water produced and delivered would be tested, and negative results might not be timely as the water would already have been distributed and consumed. It is now generally

accepted worldwide that it is impossible to “sample a product into compliance” (Khatri *et al.*, in press).

To overcome such limitations, the latest edition of the World Health Organization (WHO) Guidelines for Drinking-water Quality (WHO, 2004) emphasises effective preventive management through the framework of drinking water safety planning. Drinking water safety planning is a “comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer” (WHO, 2004). It is the most effective means of consistently ensuring the safety of a drinking water supply thereby reducing the burden of water related diseases.

Nevertheless, it is challenging and difficult to culture behaviour change for the adoption of new approaches such as drinking water safety planning which requires a preventive rather than a reactive approach.

This paper describes an economic cost-benefit analysis of the Koror-Airai drinking water safety plan from Palau to demonstrate the value to society of the drinking water safety planning approach in the long term.



Map 1 Pacific island countries. [Source: SOPAC]

METHODOLOGY

A well prepared drinking water safety plan will be designed specifically for the supply situation at hand. It will give confidence of consistently safe drinking-water instead of relying on the end-point water quality standards testing, which is unable to detect all pathogens and can only be done after water has been distributed and consumed.

The drinking water safety planning approach is being implemented in Pacific island countries by SOPAC¹ and WHO (South Pacific Office). The initial funding to pilot the approach was received from AusAID over the period 2005 to 2009. As part of their regional mandates, SOPAC and WHO are upscaling the approach across the Pacific region.

¹ Pacific Islands Applied Geoscience Commission, www.sopac.org and www.pacificwater.org

Drinking Water Safety Planning

The greatest facet of drinking water safety planning is the applicability of the risk assessment and risk management approach to any water supply system (large or small, urban or rural). The approaches for implementation of drinking water safety planning can differ, however, the risk assessment and management principles ensuring safety of drinking water supplies is consistent.

Development of a drinking water safety plan for a specific water supply is just a single stage of a wider drinking water safety planning process. In order to establish a sustainable drinking water safety plan it is important to ensure that it is being supported at the national level. Figure 1 shows the various stages needed to support drinking water safety planning nationally.

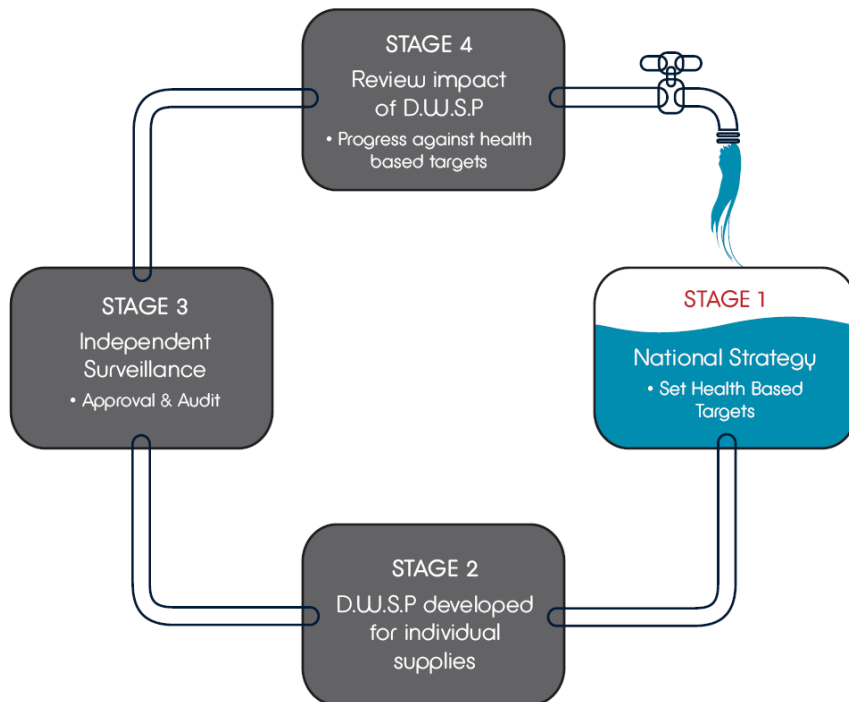


Figure 1. Stages of the national processes to support drinking water safety planning [adopted from Mudaliar et al., 2008]

The various steps which SOPAC and WHO use with Pacific island countries to assist them develop and implement supply-specific drinking water safety plans is shown in Figure 2.

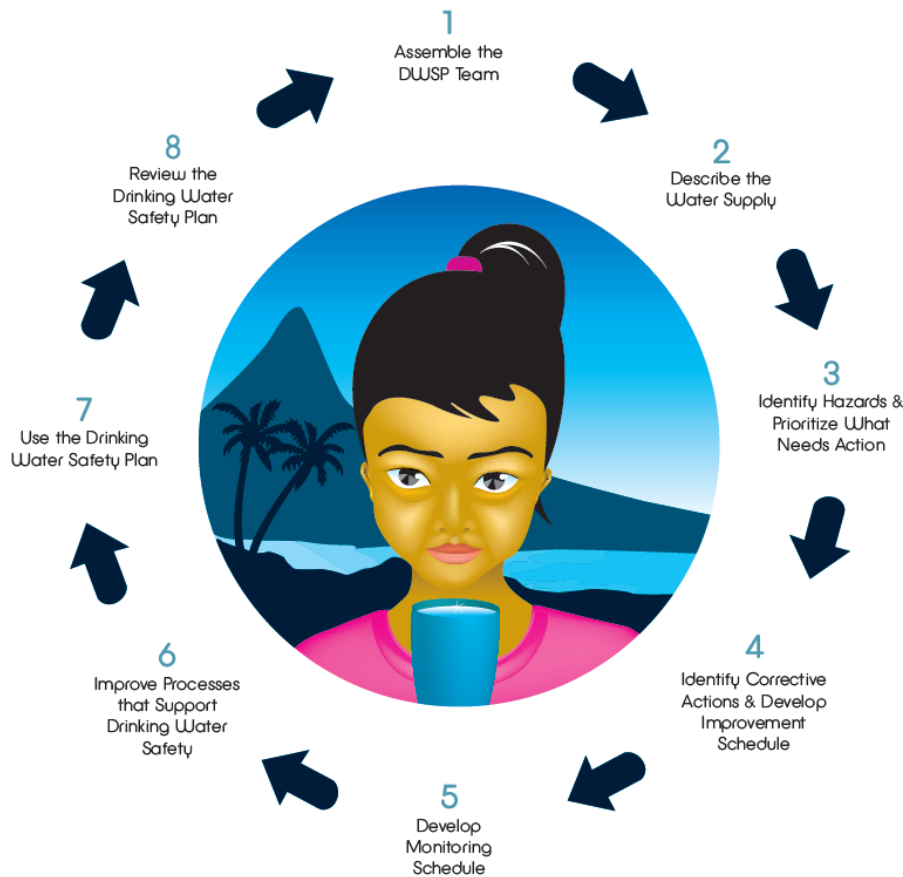


Figure 2. Steps to develop and implement a supply-specific drinking water safety plan [adopted from Mudaliar *et al.*, 2008].

For further details on the national stages and the various steps for drinking water safety planning, please refer to the Practical guide for Pacific island countries on Drinking water safety planning (Mudaliar *et al.*, 2008).

Some of the major benefits that can be expected from developing and implementing a drinking water safety plan are as follows (Mudaliar *et al.*, 2008):

- Health benefits – [studies indicate] that quality assurance processes such as Drinking Water Safety Plans can greatly reduce health burdens.
- Cost saving – [studies have shown] that by adopting the monitoring and verification process of drinking water safety planning a cost saving of approximately 30% can be achieved.
- Investment planning – increased monitoring at field level results in clearer prioritisation of system improvement.
- Greater risk assurance – provides greater confidence in the continuous and sustainable delivery of drinking water.
- More integrated approach – recognises the linkage between source water; treatment processes; distribution; and storage and handling as potential areas of risk and suggests greater communication between agencies for integrated management.

Drinking Water Safety Planning in Palau

Palau (refer to Map 1) is one the initial countries where the drinking water safety planning approach was introduced and implemented by SOPAC and WHO; the other countries are Vanuatu, Cook Islands and Tonga.

Palau has a population of 20,796 (CIA, 2009), two thirds of which reside in the Koror and Airai states. The Republic of Palau is made up of about 350 islands in the far North-Western Pacific Ocean. It stretches between 2 and 8 degrees north of the equator and is approximately 3000 km South of Tokyo and 1600 km East of Manila with a total land area of 487 km².

ADB report that water management in Palau is not efficient, even though 90% of households in Palau have access to piped, treated water (ADB, 2009). The introduction of the drinking water safety planning approach to Palau is thus a key step in improving water quality in the country. The approach has been implemented for the Koror-Airai water supply with the intention that the benefits encourage the replication across Palau.

The Koror-Airai drinking water safety plan contains a technical analysis of threats of water safety issues as well as an improvement schedule, with a list of water management improvements to be made within a stated tentative timescale. Parts of the improvement schedule are now beginning to be implemented. The improvement schedule items are ranked according to the highest risk posed in relation to health and the urgency with which each item should be addressed (within available resources).

Table 1 shows an excerpt from the risk assessment worksheet for the distribution system of the Koror-Airai water supply used during the drinking water safety planning process. Table 2 shows an excerpt from the costed improvement schedule of the Koror-Airai drinking water safety plan.

Table 1. Distribution system (D) risk assessment worksheet example from Palau

Risks to Water Quality		Control measures	Risk priority
D1	Loss of water due to water wastage	None	High
D2	Increase in water loss from pipe breakages due to aging pipes	None, lack of equipment	High
D3	High water loss due to unattended and/or un-reported leakages in the distribution lines	None	Medium

Table 2. Costed improvement schedule from Palau

Improvement	Risk	Priority	Agency	Stages/Actions	Time Frame	Cost estimate
Increase public awareness on water conservation	D1	2	Water supplier, Environmental Quality Protection Board (EQPB), Non government organisation	Develop and implement water conservation and awareness campaigns	2009	\$20,000
				Develop campaign on water hygiene practice in schools	2009	\$20,000
Leak detection program				Engage suitable resources to quantify water loss through leak survey	2010	\$30,000

Economics of Drinking Water Safety Planning in Palau

An economic assessment of the Koror-Airai drinking water safety plan was conducted using a standard cost-benefit analysis (Gerber, in press). The economics in this paper is based on the assessment report by Gerber (in press). A cost-benefit analysis (CBA) measures the social benefits and costs of an activity, not merely its financial costs. This distinguishes economic

analysis from financial analysis. Financial analysis reflects only the flow of expenditure over time but do not reflects the full resource cost ('opportunity cost') of an activity such as health improvement.

Following identification of costs and benefits of implementing the Koror-Airai drinking water safety plan, these values were compared to the business-as-usual situation. The 'net' value of having and implementing a drinking water safety plan – the Plan's benefits less its costs – can be calculated by comparing the situation without a drinking water safety plan to the situation with it, to determine the value of improvements. In economics, this is referred to as a 'with and without analysis'. With regards to Palau, the situation with drinking water safety planning involves the benefits of improved health and reduced bottled water consumption, whereas without drinking water safety planning health costs due to unsafe water continue to rise, as does bottled water consumption. Valuing benefits and costs under a CBA may not be straight forward. Various assumptions were made during the CBA including 10 per cent discount rate, maintenance costs at 3 per cent of total costs (which includes a consideration of fuel prices) and both population growth and inflation were assumed at 2 per cent – nominal values for costs and benefits were adjusted using these assumptions over a 20-year time period. A sensitivity analysis on a variety of these assumptions was also conducted.

Data used for the CBA was procured from the following sources:

- Directly interviewing EQPB personnel *in situ* in Palau.
- Internet-based research. The data collected here are not always tailored exactly to the nature of this work and had to be amended or extrapolated in most cases to suit the country specifications of Palau.
- Past SOPAC reports.
- SOPAC/WHO water safety/quality team.

RESULTS

A summary of the general 'with and without' scenarios for the drinking water safety plan of the Koror-Airai water supply in Palau is provided in Table 3.

Table 3. Potential 'with and without' scenarios for Koror-Airai water supply.

	Without drinking water safety planning	With drinking water safety planning
Costs	<ul style="list-style-type: none"> • Health costs persist for treatment of gastrointestinal health impacts induced by unsafe water • Loss of water through leakage continues • Purchase of alternative sources of water continues 	<ul style="list-style-type: none"> • Installation of equipment as part of improvement schedule • Maintenance costs of new equipment installed • Education and awareness raising costs • Change to proactive approach of risk assessment and management
Benefits		<ul style="list-style-type: none"> • Reduced health care costs • Reduced purchases of alternative sources of water • Reduced water losses hence less operational costs

The results of the CBA indicated that the total cost of establishing and implementing the Koror-Airai drinking water safety plan, discounted from 2010 over 20 years using a 10 per cent discount rate, was estimated at US\$ 0.2 million. By comparison, the total value of benefits over time was expected to be US\$ 1.34 million. In other words, the expected net benefits of the implementation

of the Koror-Airai drinking water safety plan in Palau were estimated at US\$ 1.11 million. This means drinking water safety planning generates high estimated benefit:cost ratio of 6:1.

That is a return of US\$ 6.00 can be expected for every US\$ 1.00 invested in implementing and maintaining the Koror-Airai drinking water safety plan.

DISCUSSION AND RECOMMENDATIONS

The analysis suggests that the benefits of implementing the plan are greater than the costs. The high estimated benefit:cost ratio of 6:1 suggests that investment in establishing and implementing the Koror-Airai drinking water safety plan would justify its support from a socio-environmental perspective (Gerber, in press).

The most important benefit drawn from a correctly implemented Koror-Airai drinking water safety plan is improved health through reduced water-induced gastrointestinal diseases. Other important benefits of implementing the Koror-Airai drinking water safety plan are reduced water losses (non-revenue water) and reduced consumption of alternative water sources such as bottled water.

On the other hand, the main costs of successful implementation of the drinking water safety plan involve maintenance costs as well as the costs of education and awareness raising in the issues of safe and consistent drinking water supply and hygiene. With a return of US\$ 6.00 for every US\$ 1.00 spent, the investment seems justified and beneficial in the long term.

The greatest benefit from reduced risk of water-induced gastrointestinal illnesses is to the people of Palau who would most likely suffer the most: the young, the old and those with compromised immune systems. Hence implementing the Koror-Airai drinking water safety plan will not only reduce the burden on medical services both financially and human resource wise but could be expected to ultimately increase productivity and the economy of the country.

One of the main issues that emerged from this CBA was the scarcity of baseline water-borne health data. In order to gauge the success of the Koror-Airai drinking water safety plan in the future, a more effective means of collecting and comparing health data should be put in place, specifically for water-derived gastrointestinal illnesses.

In light of the drinking water safety planning approach and after discussions with Palau, it is recommended that:

- The Koror-Airai drinking water safety plan improvement schedule should be implemented as planned and reviewed periodically as required. The findings of the economic analysis provide baseline information that could be used to underpin assessment of the progress of drinking water safety planning.
- The drinking water safety planning approach should be replicated across the water supplies in Palau.
- The water demand management practices as a component of the Koror-Airai drinking water safety plan should be improved.

The overall general recommendations for drinking water safety planning which are based on the Palau case study include the following:

- The proactive risk assessment and risk management approach of drinking water safety planning to consistently ensure the safe quality of drinking water is beneficial and cost-effective in the long term.
- The drinking water safety planning approach can be started at small scale for a selected water supply and then scaled up to all the water supplies nationally using experiences and lessons learned from the initial site (WHO and IWA, 2010).

CONCLUSION

The case study on the economics of drinking water safety planning in Palau demonstrates that the proactive risk assessment and risk management approach of drinking water safety planning to consistently ensure the safe quality of drinking water is beneficial and cost effective in the long term. The benefits gained from drinking water safety planning are greater than the costs.

The case study also serves as a good tool for advocacy and promotion of the drinking water safety planning approach. The greatest benefit of implementing the drinking water safety planning approach is improved health of people through reduced risk water-related diseases, which is the ultimate goal of national governments – the wellbeing of its people. Drinking water safety planning is an effective approach to assist governments realise this goal.

ACKNOWLEDGEMENTS

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LIST OF ACRONYMS USED

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CBA	Cost-benefit Analysis
DWSP	Drinking Water Safety Planning
EQPB	Environmental Quality Protection Board
SOPAC	Pacific Islands Applied Geoscience Commission
US	United States
WHO	World Health Organization

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