Water Quality in Low, Pacific Small Island Countries

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Vulnerability of small island counties

The general fragility and unique vulnerability of small island countries in the Pacific to climatic, demographic, economic, and development pressures, as well as to natural hazards and extreme events, has been widely acknowledged for a long time (UNDESA 1994). So too has been the diversity of their geography, geology, and sources of available freshwater. These are is particularly evident when it comes to management of freshwater supplies in small islands whose typical land area is only 1 to 10 km^2. In these shallow groundwater lenses, underlain by seawater, in highly permeable, unconfined aquifers are vital water sources.

A recent analysis compared risks to water security from both climate change and non-climate factors in East Timor and 14 selected PICs – Cook Islands; Federated States of Micronesia (FSM); Fiji; Kiribati; Nauru; Niue; Palau; Papua New Guinea (PNG); Republic of Marshall Islands (RMI); Samoa; Solomon Islands; Tonga; Tuvalu; and Vanuatu (see Fig. 15.1). It concluded that, throughout the region out to the year 2030, the non-climate factors: increasing water demand; water pollution due to expanding populations; leakage from pipe systems and unaccounted-for water; poor water governance; and inadequate management; pose much greater risks to water security than does climate change. The most vulnerable areas identified were: densely populated urban and peri-urban settlements; remote communities; and communities in low-lying areas, particularly those in low coral atolls and carbonate islands with no fresh groundwater resources.

Water quality challenges

Across the Pacific region, the percentage of urban dwellers in total populations ranges from about 20% to 100%. Not all urban centres have treated, reticulated water supplies, as evidenced by the health statistics for water-borne illnesses. Increasing urban population growth and inward migration (Ward 1999) mean that population densities are often high, with some exceeding 10,000 people/km^2. These densities, inadequate sanitation, the added burden of waste from domestic animals, especially pigs, and rudimentary waste disposal systems mean that the quality of shallow groundwater or neighbouring streams, on which communities depend, is often compromised. As a result, death rates and diseases due to preventable water-borne illnesses are tragically high in PICs, particularly among infants and the elderly (Fig. 1).

The tragically high infant death rates shown in Fig. 1 are partly due to contamination of water by faecal material. Appropriate sanitation in small island urban centres is a major concern. Urban sanitation systems in PICs commonly use rather basic septic tanks and pit latrines. Domestic animal wastes, especially from pigs, add to biological contamination of water sources, particularly household groundwater wells, and pose major health risks in urban areas on many islands and even in designated water reserves (Fig. 2).

Besides the bacteriological quality, in low small islands and atolls, salinity of the groundwater, due to seawater mixing, coastal inundation or over-extraction of groundwater is an ever-present threat.

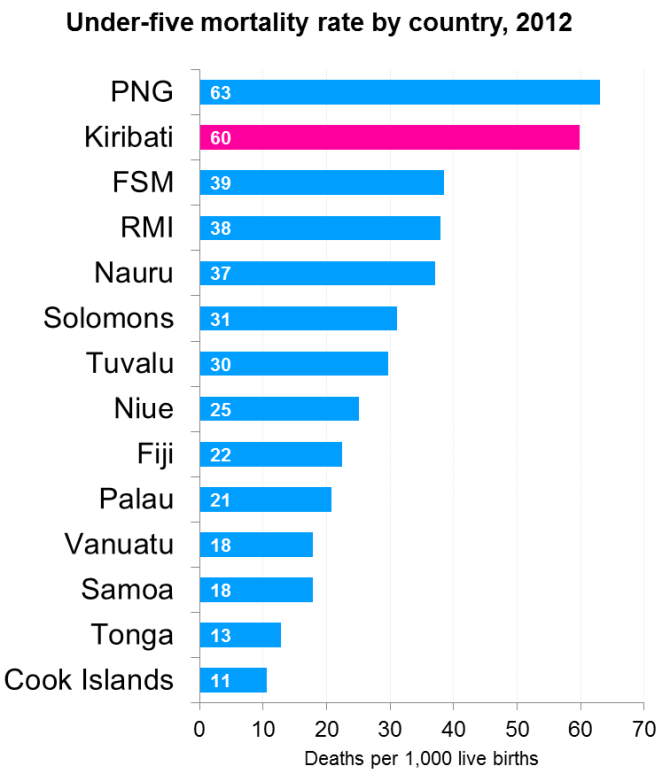

Figure 1. Infant mortality rates in Pacific Island countries (source UNICEF, 2013) due to poor hygiene and poor quality water

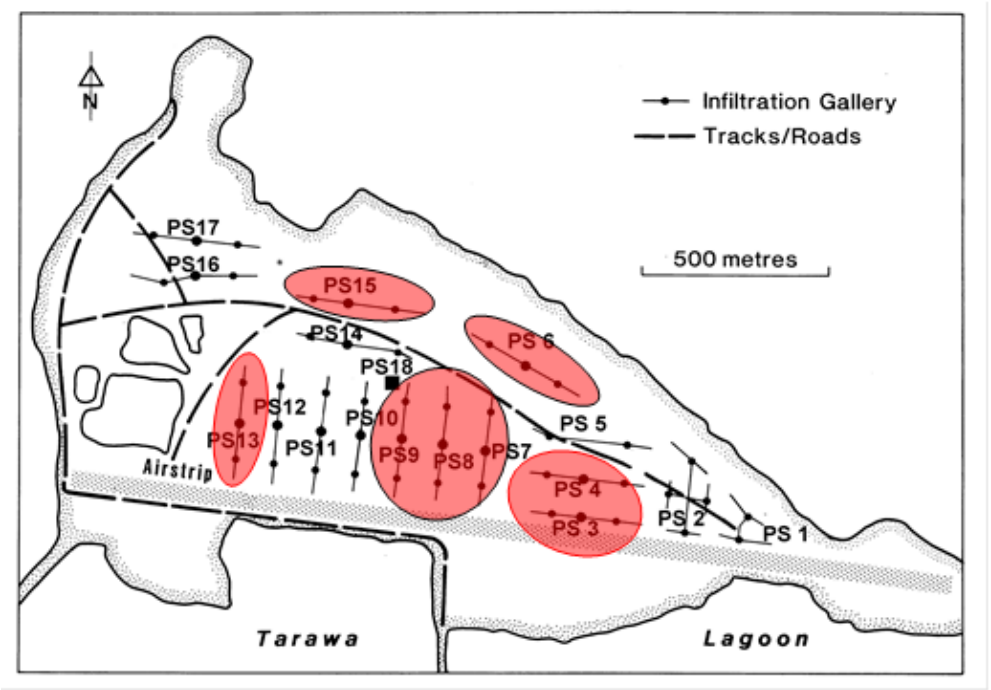

Figure 2. Shaded ellipses show distribution of positive E. coli water samples taken from urban water supply pumping galleries (PS) on Bonriki water reserve, Tarawa Atoll, Kiribati. Positive samples were found to correspond with a graveyard, pig pens, market gardens using animal manure, and squatter huts.

Water quality monitoring

The first key principle for successful public policy is that policy and associated implementation mechanisms should be based on sound knowledge. In some PICs this remains a challenge. The full extent of their water resources, their quality and fitness for use are often only partly known; the sustainable yields are poorly characterised; the impacts of climate variability, water extraction, and land use on the resources are inadequately characterised; the demand for and use of freshwater by sectors is incomplete; and the impact of management regimes and policy decisions only partly recognised. A range of techniques, from simple approximations through to sophisticated geophysical techniques and modelling, are available for assessing the extent of water resources, their sustainable yield, and the quality of the water extracted.

These knowledge gaps are especially evident for vulnerable low, small island and atoll groundwater systems supplying growing urban areas, a situation where thorough resource assessment is required along with a commitment to ongoing monitoring, analysis, and reporting. In these systems, the salinity of the extracted groundwater is a result of the dynamic balance between rainfall recharge, pumping rates, and seawater intrusion. Regular monitoring ensures that sources remain viable). PICs in the central and central western Pacific exhibit extreme variability in rainfall, which is closely correlated with sea surface temperature. Faced with this variability, monitoring of rainfall, groundwater level, and salinity and water quality, as well as water extraction rates, is vital. Limited human and financial resources in many PICs mean that assessment, monitoring, reporting, and dissemination of information, even to government, are major challenges.

The establishment of peak government–community water and sanitation committees, with responsibilities for oversight of water resources and for reporting directly to government, can promote regular monitoring, analysis, reporting, and wider dissemination of information; the committees need terms of reference that specify regular inter-agency discussions and reporting on the condition and use of water resources.

Proposed case study

Kiritimati atoll, Kiribati, the largest atoll in the world has a population of over 6,000 mostly urban people. While some population centres on the atoll have access to unreliable, untreated reticulated water, other urban area can only access local, shallow groundwater which is in close proximity to pit latrines and septic tanks. A study of the contamination issues in the reticulated and groundwater systems and an examination of simple low cost technologies for monitoring and treating water in a situation with unreliable or no power supply would be valuable across the broad region.