Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries

National Integrated Water Resource Management Diagnostic Report

Kiribati

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GLOBAL ENVIRONMENT FACILITY

UNDP

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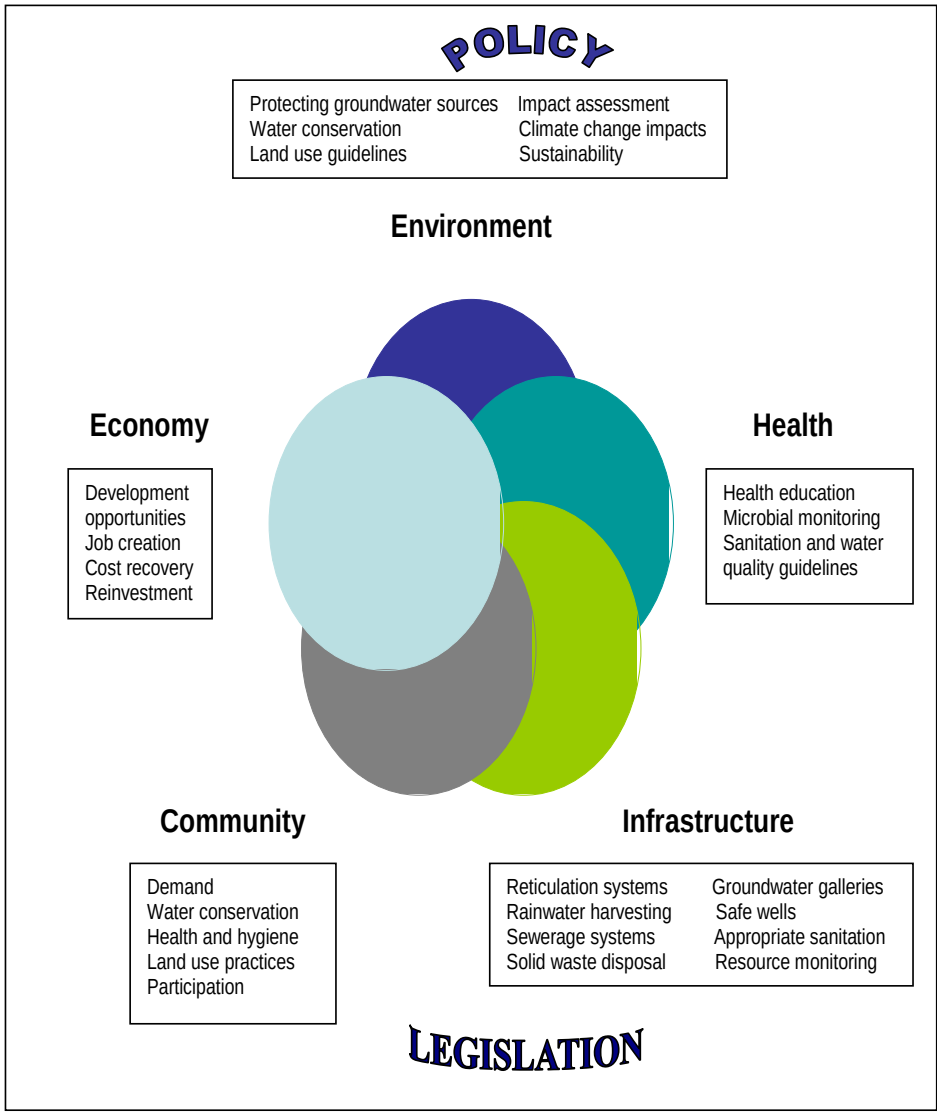
Acronyms

AIDAB	Australian International Development Assistance Bureau (now AusAID)
ADB	Asian Development Bank
AGO	Attorney General's Office
ACIAR	Australian Centre for International Agricultural Research
AMAK	Kiribati Women's Federation
AusAID	Australian Agency for International Development
CCA	Climate Change Adaptation
CCST	Climate Change Study Team
CHARM	Comprehensive Hazard and Risk Management
CIRAD	
DCC	Development Coordinating Committee
EU	European Union
ECD	Environment and Conservation Division (within MELAD)
EHU	Environmental Health Unit (within MHMS)
ENSO	El Niño- Southern Oscillation Index
EVI	Environmental Vulnerability Index
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOK	Government of Kiribati
HSA	Hot Spot Analysis
ICWM	Integrated Coastal and Watershed Management
IHP	International Hydrological Programme (of UNESCO)
IWRM	Integrated Water Resource and Sanitation Management
KANGO	The Kiribati Association of NGOs
KAP	Kiribati Adaptation Program (Phases I, II & III)
KL	Kilolitre (= 1 m^3)
KWASP	Kiritimati Water Supply and Sanitation Project
MABS	Multi-Agent Based Simulation
MCTTD	Ministry of Communications, Transport and Tourism Development
MELAD	Ministry of Environment, Land, and Agricultural Development
MEYSD	Ministry of Education Youth and Sport Development
MFED	Ministry of Finance and Economic Development
MFMRD	Ministry of Fisheries and Marine Resources Development
MHMS	Ministry of Health and Medical Services

MISA	Ministry of Internal and Social Affairs
MLPID	Ministry of Line and Phoenix Island Development
MPWU	Ministry of Public Works and Utilities
MO	Meteorology Office (within MCTTD)
MPWU	Ministry of Public Works and Utilities
NAPA	National Adaptation Plan of Action
NCC	National Council of Churches
NASC	National Adaptation Steering Committee
NEP	National Economic Planning (within MFEP)
NGO	Non-government organisation
NZAID	New Zealand International Aid and Development Agency
NSPRAU	National Strategic Policy and Risk Assessment Unit (within OB)
NWSCC	National Water and Sanitation Coordination Committee
OB	Office Te Beretitenti (the President)
OFM	Oceanic Fisheries Management
OICWSP	Outer Island Community Water Supply Project
PfWG	Pacific Water Governance
PIC	Pacific Island Country
PUB	Public Utilities Board (within MPWU)
PVC	Poly vinyl chloride
PWD	Public Works Division (within MLPID)
RAP	The Pacific Regional Action Plan for Sustainable Water Management
RPU	Rural Planning Unit (within MISA)
SAP	The Strategic Action Programme, International Waters of the Pacific Small Island Developing States
SAPHE	Sanitation, Public Health and Environment Improvement Project
SIDS	Small Island Developing States
SIWRWMPIC	Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries
SOI	Southern Oscillation Index
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Program
UNDTCD	United Nations Department of Technical Cooperation for Development

UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPR	Uniform price rebate
WEU	Water Engineering Unit (within MPWU)
WHO	World Health Organization
WUE	Water Use Efficiency



Interdependencies in the water and sanitation sector in Kiribati

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Executive Summary

Small island nations in the Pacific face water supply and sanitation problems amongst the most critical in the world. This is especially so in the Republic of Kiribati where shallow, fresh groundwater is the major source of water. It is extremely vulnerable to natural and human-induced changes. Storm surges, droughts and over-extraction cause seawater intrusion. Settlements and agricultural activities can extremely rapidly pollute the shallow groundwater. The incidence of illnesses and deaths from water-borne diseases, especially amongst children, are unacceptably large.

Limited land areas in small islands restrict freshwater quantities, which are especially vulnerable during frequent, severe ENSO-related droughts. The threat of sea level rise due to global warming is also a major concern. Demand for freshwater is increasing due to population growth and to urbanisation, both of which impact also on water quality. Water use for traditional crops often competes with water supplies for communities and the fertilisation of crops and the raising of domestic animals, particularly pigs, contribute to groundwater pollution.

Human and financial resources are limited and the problem of equitably treating both urban and small, numerous and widely dispersed rural outer island villages across three million km^2 of the central and western Pacific is complex and difficult. Land ownership, which carries with it traditional subsistence and resource rights, is essential for survival, even in urban areas. Land is of high value and carries with it social, political and legal significance (Talu et al. 1979). This presents problems in the declaration of groundwater reserves over private lands. Culturally, water ownership remains a contentious issue. The absence of Government-approved unified, national water policy, plans, and legislation compounds difficulties. In addition, government agencies tend to operate independently so that collaboration on water and sanitation issues is currently minimal.

Numerous studies, reports and national consultations have identified the key priorities in Kiribati. The key challenges in the water resource sector are: limited freshwater resources; sustainability of water harvesting; impacts of settlement and land use on water quality; fragmented control, management and protection of water resources; increasing demands for water resources; insufficient knowledge and understanding of water resources nationwide; social and environmental impacts of water abstraction proposals; land ownership in water reserves; limited use of rainwater harvesting; lack of community understanding and appreciation of responsible water management; lack of conservation incentives; limited community involvement in water resource management and protection; impacts of human waste; lack of national water policy and legislation; impacts of droughts and storm surges on groundwater; and predicted impacts of climate change.

In the water and sanitation services sector the challenges are: highly variable and inadequate levels of service; high levels of leakage and unaccounted for water loss at household levels; low levels of cost recovery and non-financially viable operations; increasing water demand and usage; limited available and relevant technical skills and capacity; insufficient knowledge and understanding for planning and management; inadequate attention paid to wastewater disposal and sanitation; inadequate appreciation of responsible water management and use by communities; limited community involvement in water service planning, management and delivery; uncoordinated development across sectors; deteriorating water quality and quantity at supply sources; inappropriate land use in water reserves; and in rural areas, lack of safe water supplies and sanitation.

This Diagnostic Report builds on these previous detailed analyses and priorities and presents strategies that will improve integrated water resource and sanitation management and move toward sustainability: these include formation of the whole-of-government National Water and Sanitation Coordination Committee; development and approval of a National Water Policy, plans and legislation; a move to sustainable water supply and sanitation systems; capacity building in

water resource assessment, monitoring, analysis and reporting, improved community participation; better protection of groundwater sources, increased rainwater harvesting and in the provision of new, safe freshwater sources for South Tarawa. The demonstration concept project based on these strategies will serve as a model for the protection of freshwater sources in North Tarawa, designated development centres in other atolls and outer islands.

ACKNOWLEDGEMENTS

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1. Introduction

The increased focus on integrated water resources management (IWRM) in recent years reflects the growing consensus that access to adequate supplies of potable water is essential in addressing the challenges of sustainable livelihoods and development. IWRM helps to protect the environment, promote democratic participation in governance, ensures the equitable distribution of water for human and biodiversity and improves health. Water policy and management are beginning to reflect the fundamentally interconnected nature of hydrological resources, and IWRM is emerging as an accepted alternative to sector-by-sector, top down management style that has dominated in the past. This report uses an IWRM approach to examine water and sanitation in the Pacific island nation of the Republic of Kiribati.

Despite often relatively high rainfalls, small island nations in the Pacific have water supply problems amongst the most critical in the world. Many have very limited surface runoff so that shallow, fresh groundwater is the major source of water in many atolls. Shallow groundwater is especially vulnerable to natural and human-induced changes. Storm surges, droughts and over-extraction cause seawater intrusion. Settlements and agricultural activities can extremely rapidly pollute the shallow groundwater. The incidences of illnesses and deaths from water-borne diseases are unacceptably large. Limited land areas in small islands also restrict freshwater quantities, which are especially vulnerable during frequent El Niño Southern Oscillation (ENSO) related droughts when stored rainwater is quickly exhausted.

Demand for freshwater in Pacific Island countries (PICs) is increasing due to population growth and urbanisation, both of which impact water quality. Water use for traditional crops often competes with water supplies for communities and the fertilisation of crops and the raising of domestic animals, particularly pigs, contribute to groundwater pollution. Human and financial resources are limited and the problem of equitably treating both urban and often small, numerous and widely dispersed rural settlements is complex and difficult. Culturally, water ownership remains a contentious issue. In addition, small island developing states are also subject to the often short time scales and external priorities of aid and donor organisations, which sometimes divert efforts from national priorities.

All these problems are exemplified in the Republic of Kiribati whose population is spread amongst 167 rural villages and one urban area in 21 islands and atolls across over 3 million km^2 of the central and western Pacific. This Diagnostic Report details the freshwater and wastewater situation in the Republic of Kiribati.

1.1 Sustainable integrated water resources and wastewater management in Pacific Island countries

The Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries (SIWRWMPIC) proposal coordinated by SOPAC evolved from the Strategic Action Programme (SAP) for the International Waters of the Pacific Small Island Developing States carried out in August 1997. The SAP identifies the priority concerns, imminent threats and root causes, and provides solutions and the proposed activity areas to implement those solutions. The goal of this SAP was to develop a strategy for the integrated sustainable development and management of International Waters in the region. The priority transboundary concerns for Pacific Island International Waters were defined as arising from imminent threats to the health of those waters:

1. Pollution of marine and freshwater (including groundwater) from land-based activities
2. Physical, ecological and hydrological modification of critical habitats
3. Unsustainable exploitation of living and nonliving resources.

The root causes of these threats lie within management and institutional deficiencies, particularly those of a lack of effective governance, as well as the lack of information and understanding at all levels together with a narrow sectoral focus. The SAP provides the regional framework within which actions are identified, developed and implemented. Targeted actions within the SAP are envisaged in two complementary, linked consultative contexts: Integrated Coastal and Watershed Management (ICWM) and Oceanic Fisheries Management (OFM). Through the ICWM and OFM approaches, the SAP sets out a path for the transition of the Pacific islands from sectoral to integrated management of International Waters as a whole. The regional SIWRWMPIC proposal is addressed specifically to the Integrated Coastal and Watershed Management context. It is noted here that, for low coral islands, the watershed, being the land area that contributes to the recharge of fresh groundwater, is generally the entire island.

1.2 Linkage with the Pacific Regional Action Plan on Sustainable Water Resource Management

The regional SIWRWMPIC assists Pacific small island developing states (SIDS) to implement the Pacific Regional Action Plan (RAP) (SOPAC and ADB 2003). The Pacific RAP on sustainable water management articulates the Pacific's position on water resources management and was endorsed by all Pacific countries in 2003 at Pacific Ministerial and Heads of State level meeting in Auckland, New Zealand. The Pacific RAP on sustainable water management aims to improve the assessment and monitoring of water resources, to reduce water pollution, improve access to technologies, strengthen institutional arrangements, and leverage additional financial resources in support of IWRM and is structured around six thematic areas. Each theme section consists of key messages to stakeholders with supporting statements drawn from the discussions of the respective working groups at the High–Level Consultation in Sigatoka Fiji in 2002 as a precursor to the Third World Water Forum held in Kyoto in March 2003. The six thematic areas in the RAP are:

1. Water resources management
2. Island vulnerability
3. Awareness
4. Technology
5. Institutional arrangements
6. Finance

The Pacific RAP provides a framework for small island nations and calls for:

1. National water sector assessments
2. Broadly-based national water vision
3. National water action agenda and plans
4. Empowerment of communities
5. Design of capable institutions
6. Integrated investment plans
7. Regional support
8. Dialogue with investors and donors

The Pacific RAP was also submitted as a Type 2 Partnership Initiative on Water, Sanitation and Hygiene to the Commission for Sustainable Development in Johannesburg during the World Summit on Sustainable Development in August 2002 and announced at the Third World Water

Forum (WWF) in Kyoto, Japan in March 2003. This Partnership initiative has since evolved into the Pacific Partnership Initiative on Sustainable Water Management with the support from the Asian Development Bank (ADB) and is the implementation vehicle for the regional SIWRWMPIC through the linkages between its many small island partners.

1.3 Aim of the SIWRWMPIC

The overall aim of the regional SIWRWMPIC is to assist Pacific Island Countries achieve sustainable, equitable, safe and efficient management of water resources and wastewater through Integrated Water Resource and Sanitation Management (IWRM) and Water Use Efficiency (WUE) plans based on regionally-appropriate best practices and demonstrations of barrier removal.

1.4 Scope of this Report

This report provides general background information on the Republic of Kiribati and analyses the current but evolving state of integrated water resource and sanitation management within the country under the six themes of the RAP. It details the intimate links between other sectors, especially human health, the engagement with stakeholders, other activities related to IWRM, capacity development and resource needs for removing barriers to implementation of IWRM. The report draws heavily on the plethora of reports and publications that are available for Kiribati and the Government of Kiribati (GOK) policy initiatives over the past 20 years. These have established a clearly enunciated, long-term roadmap for water and wastewater management and use in the country.

This report explicitly recognises the direction provided by the overall policy aim of the Kiribati Draft National Water Resources Policy: “To ensure that communities have affordable access to sustainable water supply systems providing water of suitable quality and appropriate quantities and to appropriate sanitation to meet all reasonable health, environmental, and development needs.”

Its specific policy objectives are to:

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1. Improve the safety of freshwater supplied from groundwater and rainwater systems.
2. Protect fresh groundwater resources from adverse human impacts.
3. Sustainably manage all aspects of the use and conservation of freshwater.
4. Improve knowledge of the quality and quantity of the nation’s freshwater resources and demand for them.
5. Improve knowledge and management of water resources under climatic extremes and change.
6. Improve outer island water supplies.
7. Increase community awareness and understanding of water resource and sanitation issues.
8. Increase community participation in water resource and sanitation management.
9. Increase the use of rainwater harvesting.
10. Develop instruments to help manage demand and allocation of water.
11. Review and revise, where necessary, all legislation, regulations and organisational responsibilities relevant to water and sanitation.
12. Ensure that people working in the water and sanitation sector have appropriate

knowledge and skills.

13. Ensure an adequate supply of trained personnel for the water and sanitation sector.
14. Ensure cost effective planning, operation and maintenance of water supply and sanitation systems.

While water for traditional subsistence crops and providing for the near-shore environment are important, it is clear from these and goals that the provision of adequate, sustainable safe water supplies to ensure human health and wellbeing is the overwhelming priority in Kiribati.

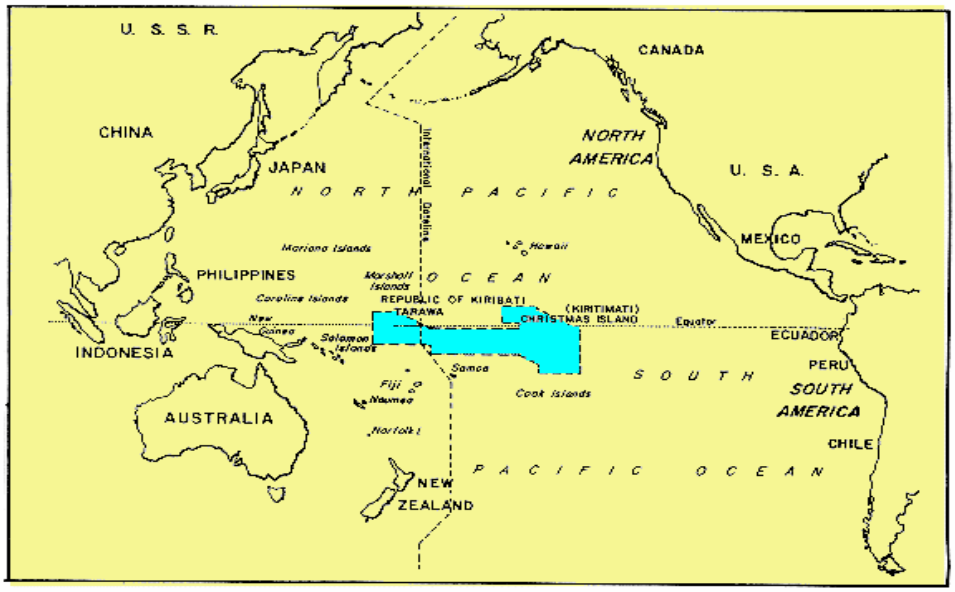
2. General overview

2.1 Country Background Information

2.1.1 Location, distribution and topography

The Republic of Kiribati became an independence sovereign state, after decades of British colonial rule, on 12th July 1979. It lies in the central and western Pacific between 4° N and 3° S and 172° E and 157°W (see Figure 1). The nation consists of 32 low-lying coral islands and one raised coral island in three main island groups, the Gilberts, Phoenix and Line Islands, (see Figure 2) scattered over three million km^2 of the central and western Pacific. Eleven of these islands are currently unoccupied. Most islands are usually not more than 2 km wide, and, except for the raised island of Banaba, are not more than 6 m above sea level. Banaba, a former phosphate island, rises to 81 m above mean sea level. Total land area is estimated to be 811 km^2. The Gilbert group contains 90.5% of the country's population and has a land area of 286 km^2.

Figure 1. Location of the Republic of Kiribati in the central Pacific.



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The capital, South Tarawa located in Tarawa atoll (see Figure 3) in the Gilberts, is highly urbanised and has 43.5% of the nation's population. Key national statistics are listed in Table 1. Of particular note is the limited land area which constrains water supply options. The quantity and quality of freshwater available to island communities is partly known in only two atolls (ADB 2004), Tarawa in the Gilberts and Kiritimati in the Line Islands. South Tarawa has three main centres, Betio, Bairiki and Bikenibeu although the population is spread out over 35 km from Bonriki to Betio which follows the main road. North Tarawa is not connected by road to South Tarawa and remains rural with a population of less than 6,000 spread over the 43 km from Buariki to Buota. Mean tidal range in Tarawa is 2.2 m.

Total land area of the eight islands in the Phoenix Group some 1750 km east of Tarawa, is 28.6 km^2. Its only inhabited island is Kanton (Canton) with land area of 9 km^2. The Line Group also has

eight islands with land area of 496 km^2, extending over a north-south line 2,100 km long, lying between 3,280 and 4,210 km east of Tarawa, and beginning 800 km south of Hawaii. This Group has 9.5% of the country's population and the largest island in Kiribati, and the largest atoll in the world, Kiritimati Island, a designated growth centre, with an area of 388 km^2. Kiritimati was used for atmospheric nuclear testing during the post war period as a British colony.

Table 1: Summary of some of the key features of the Republic of Kiribati

Property	Value
Geographic location[1]	between 4° N and 3° S, and 172° E to 157° W
Composition [1]	32 coral atolls, 1 raised coral island (Banaba)
Land area (km^2) [1]	811
Ocean area (km^2)	3,000,000
Length of coast (km) [1]	1,143
Length of coast/land area (km^{-1}) [1]	1.41
Highest elevation (m above mean sea level)[1]	81 (Banaba)
Fraction of land elevation < 10 m above msl (%)[2]	99
Climate [1]	Tropical
Cyclones	No
Mean annual rainfall (P mm) [4]	2048 (Tarawa)
Coefficient of variation annual rainfall (CV,%) [3]	48 (Tarawa)
Annual potential evaporation (E mm) [3]	1795 (Tarawa)
Mean annual Aridity ratio = E/P	0.88 (Tarawa)
Principal water sources [4]	Reticulated groundwater (South Tarawa, Kiritimati)
	Private groundwater wells
	Public groundwater wells & galleries (outer islands)
	Private rainwater tanks
	Desalination*
	Seawater (washing, toilet flushing)
Estimated per capita demand freshwater (L/cap/day) [4]	50 (Tarawa)
Estimated sustainable yield safe freshwater (L/cap/day) [5]	49 (Tarawa reticulation system)‡
Agencies responsible for water supply	PUB (South Tarawa)
	MPWU (outer islands)
	Households
Population [1]	92,428 (2005)[7]
Population growth rate (%) [1]	1.8 (2005)[7]

Mean population density (cap/km^2)	127
Maximum population density (cap/km^2)	15,637 (Betio, Tarawa)
GDP/capita	US$1,900[1]
Environmental Vulnerability Index (EVI)[2]	3.70
EVI ranking (out of 235 countries) [6]	34/235

[1]CIA World Factbook (2005)
[2]Pratt and Mitchell (2003)
[3]Falkland and Woodroffe (1997)
[4]Fakland (2005)
[5]Alam *et al.*(2002)
[6]Kaly *et al.* (2003)
[7]Preliminary results 2005 census
[*]Desalination plants are currently inoperative.
[†] Assumes no losses from reticulation system
[‡] Excludes use of private wells or raintanks

2.1.2 Climate, soils, hydrogeology, vegetation and agriculture

The climate of Kiribati is tropical. Weather is controlled by the seasonal movements and annual variations of the Inter-tropical Convergence Zone and the Equatorial Doldrum Belt (Falkland 1992). The nation spans across 3,500 km of the equator and rainfall is strongly correlated with position of the Pacific warm pool (Falkland 1992, 2005). Average annual rainfall in the Gilberts ranges from 1,300 mm south of the equator to 2,000 mm on Tarawa, and over 3,200 mm in the northernmost islands, while it is less than 1,000 mm in Kiritimati in the eastern Line Islands. There are no rainfall measurements for nine atolls. Annual rainfall is highly variable with coefficients of variability as high as 74% in the Gilbert Islands, 80% in the Phoenix Islands and 91% in the Line Islands (ADB 2004). Table 2 summarises the known and estimated island rainfalls and their coefficients of variability. Figure 4 shows the strong correlation between rainfall in South Tarawa and the sea surface temperature anomaly in the Nino 3.4 central Pacific region. Long and severe droughts of up to 16 months, highly correlated to ENSO events, are common with an average frequency of 6 to 7 years (White et al. 1999a).

The soils of the low coral islands consist of unconsolidated Holocene coral sands and gravels overlying Pleistocene karst limestone. The hydraulic conductivity of the surface sediments is much higher than rainfall rates so that surface ponding occurs rarely (Wheatcraft and Buddemeier 1981) and usually close surrounding relatively impermeable surfaces such as roadways and runways. This means that there are no perennial surface streams in Kiribati. The large hydraulic conductivity also means that surface contaminants are quickly transported into shallow groundwater and that the soils are generally infertile. The islands are mainly covered with coconut and pandanus palms. The mining of phosphate has left the surface of Banaba in a generally barren state although small pockets of fertile soils remain.

Figure 2: Three main island groups of the Republic of Kiribati

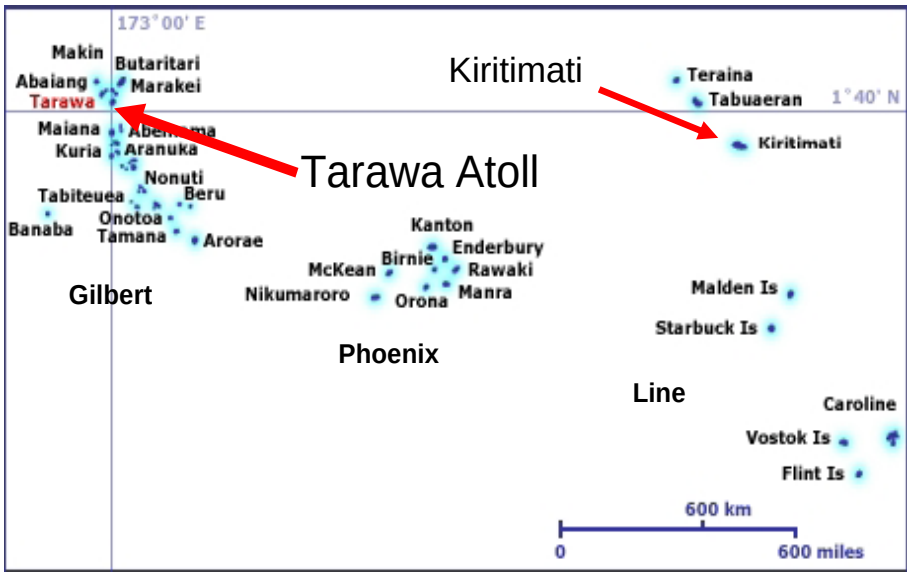

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Figure 3: Tarawa Atoll, Bonriki in the southeast to Betio in the southwest

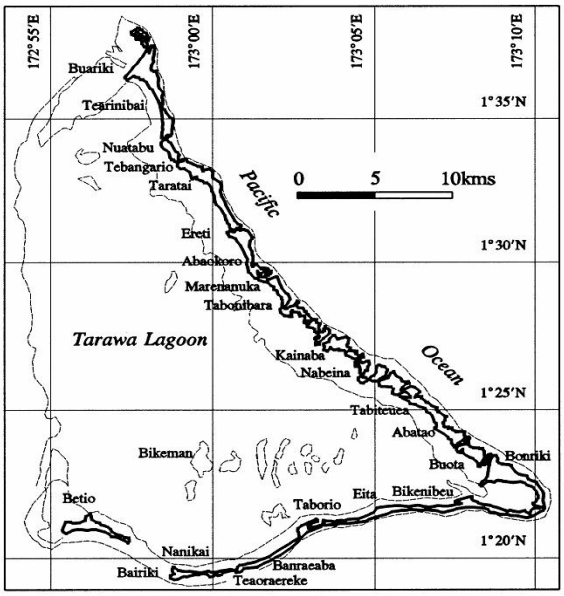

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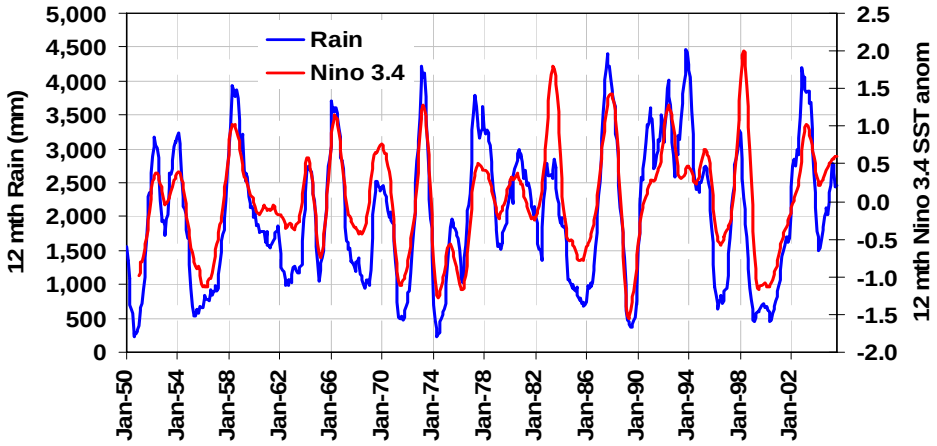
Figure 4: Correlation between annual rainfall in South Tarawa and the 12 month Nino 3.4 sea surface temperature anomaly



Source: White et al. 1999

The generally poor atoll soil offers little potential for agricultural development apart from the major agricultural export crop, copra, which is harvested as coconuts from abundant coconut trees and processed locally. Seaweed is also grown in the Gilbert and Line Islands and exported. The vast fishing waters around the islands of Kiribati are renowned for their fish which are one of the principal sources of protein for the country and a major source of external revenue. The other main protein sources are pigs and chickens and it has been estimated that Kiribati has on average 2.5 pigs and 4 chickens per household (Saville and Manueli 2002).

Table 2: Mean annual rainfalls and coefficients of variability in Kiribati

Atoll/Island	Island Group	Annual Rainfall (mm)	Coefficient of Variability
Banaba	**Gilbert**	1,847	0.60
Makin		2,821	0.37
Butaritari		3,107	0.29
Marakei		2,053	0.45
Abaiang		2,158	0.41
Tarawa (North)		1,949	0.50
Tarawa (South)		1,949	0.49
Maiana		1,543	0.55
Abemama		1,518	0.49
Kuria		1,518	0.64
Aranuka		1,518	0.67
Nonouti		1,507	0.65

Tabiteuea (North)		1,418	0.59
Tabiteuea (South)		1,418	0.74
Beru		1,355	0.57
Nikunau		1,242	0.63
Onotoa		1,230	0.59
Tamana		1,425	0.65
Arorae		1,826	0.51
Kanton	**Phoenix**	958	0.80
Orona (Hull)		1171	0.60
Enderbury		*1000*	
Birnie		*1000*	
Rawaki (Phoenix)		*1000*	
Manra (Sydney)		*1000*	
Mackean		*1000*	
Nikumaroro (Gardner)		1319	0.57
Teraina (Washington)	**Line**	3,021	0.36
Tabuaeran (Fanning)		2,107	0.43
Kiritimati (Christmas)		974	0.75
Malden		676	0.91
Starbuck		*700*	
Vostock		*800*	
Millennium (Caroline)		*900*	
Flint		*1,000*	

Source: ADB. 2004. Sectoral Strategy and Action Program. Promotion of Effective Water Management Policies and Practices
Shaded rainfalls *in italics* for uninhabited atolls in Table 2 are estimated.

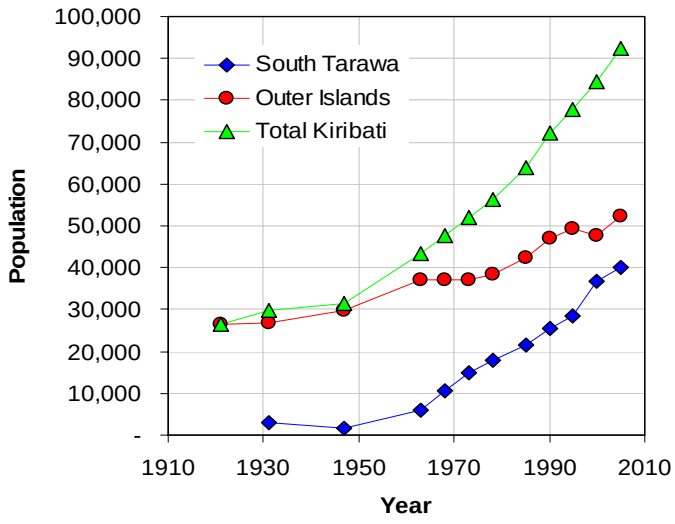
A relatively small amount of fish is also farmed from ponds in South Tarawa. In Kiritimati in the Lines group, a large amount of milk fish is farmed with a potential market in Honolulu. Small family-owned market gardens produce fruit and vegetables for local markets and fruit, particularly bananas are grown in the wetter northern islands of the Gilberts for inter-island trade mainly to South Tarawa. Compost, mostly with a substantial component of pig manure, is used to enrich the soil in market gardens. Banaba has the potential to grow crops for inter-island markets because of pockets of phosphate-rich soils but fresh water limitations and transport remain barriers to this.

2.1.3 Demography and socio-economic aspects

The population of Kiribati is generally drawn from one ethic group and speaks a common language, I-Kiribati, The 2005 census estimates that there were 92,428 people in Kiribati spread over 21 atolls and one raised coral island. These live in a total of 14,172 households in 185 villages (2005 census). Table 3 details the island populations at the 2005 census. The country's population has grown approximately exponentially at a rate of 1.8% per annum since 1963 (see

Figure 5). The rural population is scattered throughout 8,932 households in 169 villages in outer islands and North Tarawa with an average size of less than 50 households per village and an average of 5.8 people per household. In general, outer island communities live under subsistence conditions.

Figure 5: Population increase in Kiribati, rural outer islands, and urban South Tarawa



Source: Government of Kiribati 2005

The highly urbanised and densely settled South Tarawa has a population of 40,212 in 5,240 households with an average of 7.7 people per household. Island population densities in the main port of Betio exceed 15,000 people/km^2. The exponential growth rate of the urban South Tarawa population since 1963 is 4% while that for rural outer islands is 0.9%. This inward migration from rural areas to urban centres is common throughout Pacific Island countries (Ward 1999).

The Government of Kiribati has recognised that continued urbanisation of South Tarawa poses significant risks and in the early 1990's identified four alternate growth centres in Beru, Butaritari, and Tabiteuea North in the Gilberts and Kiritimati in the Line islands. Apart from Kiritimati in the Line Islands, these growth centres remain to be developed. The problem of equitably supporting a low density, dispersed rural population and one high density urban centre spread across such a large area of the central Pacific is a major challenge for the government.

The country earns export income from the sale of fishing rights in its extensive national waters, from the export of copra and seaweed and from remittances from overseas I-Kiribati, especially seamen working in merchant ships. Overseas income is also earned from selling fishing licences to other nations. Revenue from fishing licenses amounted to about 23% of Gross National Product in 2001-2002.

Table 3: Island populations of Kiribati 2005

Atoll/Island	Island Group	No. of Villages	Distance from Tarawa (km)	Persons	Households	Cap/Households
Banaba	**Gilbert**	3	450	**301**	61	4.9

Makin		2	190	**2388**	328	7.3
Butaritari		11	173	**3267**	564	5.8
Marakei		8	82	**2738**	437	6.3
Abaiang		18	51	**5478**	806	6.8
Tarawa (North)		15	0	**5704**	898	6.4
Tarawa (South)		16	0	**40212**	5240	7.7
Maiana		12	45	**1909**	354	5.4
Abemama		14	152	**3398**	592	5.7
Kuria		5	134	**1081**	202	5.4
Aranuka		3	146	**1158**	227	5.1
Nonouti		9	266	**3176**	568	5.6
Tabiteuea (North)		13	294	**3603**	606	5.9
Tabiteuea (South)		6	294	**1306**	251	5.2
Beru		10	403	**2238**	462	4.8
Nikunau		6	496	**1912**	373	5.1
Onotoa		5	451	**1611**	332	4.9
Tamana		3	544	**869**	196	4.4
Arorae		2	620	**1254**	275	4.6
Kanton	**Phoenix**	1	1751	**41**	9	4.6
Orona (Hull)		1	1756	**?**	?	?
Enderbury		0	1821	**0**	0	0
Birnie		0	1790	**0**	0	0
Phoenix		0	1880	**0**	0	0
Sydney		0	1849	**0**	0	0
Mackean		0	1517	**0**	0	0
Gardner		0	1524	**0**	0	0
Teraina (Washington)	**Line**	9	2900	**1154**	197	5.9
Tabuaeran (Fanning)		9	3000	**2536**	411	6.2
Kiritimati (Christmas)		4	3200	**5094**	783	6.5
Malden		0	3483	**0**	0	0
Starbuck		0	3524	**0**	0	0
Vostock		0	4021	**0**	0	0
Caroline		0	4214	**0**	0	0
Flint		0	4125	**0**	0	0
Total		185		**92428**	14172	6.5

Total (Outer Island)		169		**52,216**	8,932	5.8

Source: Government of Kiribati 2005 Census

The principal form of employment in Kiribati is through the government. Approximately 10% of the population is formally employed in the cash economy, with two-thirds of the jobs provided by the public sector. Many in both the rural areas and in urban South Tarawa rely on subsistence activities to support families. The government-subsidised harvesting of coconuts for shipping to the government's copra factory in Betio is a principal source of income in rural areas. Remittances sent home from I-Kiribati working overseas, particularly seamen working on merchant ships, are an important source of external income. Other internal sources of income include the local marketing of fish, vegetables, fruit and toddy. In South Tarawa, provision of minibus services and other service industries are additional sources of income.

The relatively low per capita Gross Domestic Product (GDP) should not be taken as an indication of poverty. Most adult I-Kiribati own or have access to land. Land ownership, traditionally has social, political and cultural significance and carries with it fishing, harvesting and resource rights and provides access to building materials and food. Land ownership is of central importance in Kiribati (Talu et al. 1979).

There are cultural influences in small island nations that have a direct bearing on water management. At their heart is the conflict between the demands of a highly urbanised society and the traditions and practices of subsistence communities developed over millennia (Jones 1997; White et al. 1999). In island communities, access to land and common property resources is essential for survival, even in urban areas (Jones 1997). Land tenure has customary rights including ownership of groundwater and in some islands allegiance is to the extended family not to society at large. Finally, there is a marked reluctance to share knowledge and skills (Talu et al. 1979; Crennan 2002). To alter these characteristics to achieve better water and wastewater management involves behavioural change, which is a long-term process.

The geographic setting of Kiribati and the hydrogeology of its islands impose significant problems for the sustainable delivery of water and sanitation services across widely dispersed and isolated communities, from low density subsistence populations to high density urban areas, with mostly limited land areas (except Kiritimati), limited good quality freshwater, increasing populations and with significant climate variability. Added to these difficulties are human and financial resource limitations which make sustainable, equitable and efficient water resource management a major challenge.

3. Integrated water resources management for Kiribati

3.1. Water resources management

3.1.1 Sources of freshwater

Sources of freshwater for Kiribati's island communities are restricted to rainwater, shallow unconfined groundwater (generally within less than 2 m of the surface), imported water or desalination (Falkland 2002). Seawater is used by many for bathing. The need for reliable power supply to run desalination units, their maintenance and operational requirements means that desalination plants are often difficult for small, isolated rural island communities to maintain. Of five desalination plants installed in Kiribati over the past seven years only one is partly operational on the island of Banaba. The raised island of Banaba uniquely has fresh water pools in subterranean caves that could serve as an emergency source of water in times of severe drought (Overmars and Butcher 2001). In addition, during the British Phosphate Commission period water was imported in phosphate boats and stored in large 4,500 m^3 storage tanks on the island. Water in these tanks is currently unused because of the presence of rust suspension in the water.

3.1.1.1 Bottled water. Bottled water was produced in South Tarawa from a privately owned reverse osmosis desalination plant using seawater as feedstock. This is no longer working due to operational problems. Currently, between 300 and 500 m^3 of bottled water are imported annually. Its price of about US$1.00 per/litre puts it beyond the reach of squatters and many subsistence communities.

3.1.1.2 Shallow fresh groundwater. Shallow fresh groundwater is the principal source of freshwater in Kiribati's low coral islands and is restricted to a relatively thin freshwater lens, mostly confined to the unconsolidated Holocene sediments overlying seawater in the karst limestone (Wheatcraft and Buddemeier 1981).

The viability of groundwater lenses in low coral atolls as sources of freshwater is determined by the thickness of the freshwater lens, generally between about 1 and 25 m. Thin lenses are more vulnerable to rainfall variability and over-extraction. Lens thickness depends on the groundwater recharge rate, the hydraulic conductivity of the unconsolidated aquifer, the width of the island, the intensity of mixing of the base of the freshwater lens with the underlying seawater, the peripheral discharge of groundwater at the edge of the lens to the sea and the groundwater extraction rate.

The extremely large hydraulic conductivity of the Pleistocene karst limestone aquifers means that tidal pressure signals are rapidly transmitted throughout the karst aquifers. The pressure from the karst system is then transmitted vertically upward through the overlying unconsolidated sand aquifer. This forces diurnal fluctuations of the groundwater across the islands. This creates a wide transition or mixing zone between freshwater and seawater and advects salt into the upper freshwater zone (Oberdorfer et al. 1990, Underwood et al. 1992). In relatively thick lenses, chloride contents in the upper groundwater may be up to 200 mg/L and in thinner lenses may reach 2,000 mg/L, above the WHO (2004) drinking water guideline value of 250 mg/L. In times of severe drought the salinity of freshwater lenses can increase dramatically and is particularly important in islands with thin freshwater lenses.

The quantity and quality of freshwater available to island communities is partly known in only two atolls; Tarawa in the Gilberts and Kiritimati in the Line Islands. Where hydraulic conductivities of the unconsolidated surface sediments or the underlying karst limestone are very large (of order 1,000 m/day), and where rainfalls small or island width is small (of order 100 m), useable fresh groundwater lenses are absent (Wheatcraft and Buddemeier 1981).

3.1.1.3 Rainwater harvesting. The westernmost island of the nation, Banaba, relies almost totally on the collection of rainfall for its water supply (Overmars and Butcher 2001). However, the sophisticated rainfall collection and storage scheme installed in the 1960's under the British

Phosphate Commission is in urgent need of restoration. In some other islands, such as Kiebu in Makin, and atolls such as Nonouti, also in the Gilbert Group, groundwater is brackish, particularly during droughts, and rainwater harvesting is important. Rainfall collection has been used in Kiribati for many years, but it is regarded, at best, as a supplementary source of water. The potential for increasing rainwater harvesting is large and enactment of building regulations obliging house owners to construct gutters and tanks for the harvesting of rainwater is recognition of its importance.

There are several reasons why rainwater is underused. Firstly, the cost of rainwater collection and storage is beyond many particularly in outer islands, so that building regulations are largely ignored. Secondly, there is a cultural preference for the taste of groundwater. This is because of the traditional use of toddy for drinking. Rainwater mixed with toddy does not taste as good as when mixed with groundwater. Thirdly, many building roofs are made using traditional materials such as pandanus and coconut thatch. These are less than ideal for rainwater harvesting. Fourthly, many conventional-sized affordable rainwater tank systems would fail during the frequent droughts. Finally, people do not realise the risks involved in drinking untreated groundwater. Despite the regulations, many public buildings with large suitable roof areas, such as maneaba's (meeting houses), continue to be constructed without rainwater collection and storage systems. There is currently little information about the quantity, condition or quality of rainwater harvesting systems.

An incentive Loans Scheme for government employees to install rainwater harvesting and/or sanitation facilities has been operating in South Tarawa since 2002. This incentive scheme based on a revolving fund was established under the SAPHE[1] Project to assist households to purchase 6,000 litre capacity plastic rainwater tanks. In the years 2002 to 2004, about 710 loans were given for roof rainwater harvesting and storage equipment. Repayments of loans of up to a maximum of AU$1,500 are guaranteed by ensuring loans are given only to people with regular incomes and by recovering regular repayments from fortnightly salaries. The scheme is administered by the Kiribati Housing Corporation. Under the water component of the Kiribati Adaptation Program Phase II (KAPII) it is planned to attempt to trial this scheme in rural areas and outer islands. In some outer islands, such as those in Nonouti or Banaba in the Gilberts, communities are forced to rely solely on collected rainwater. These communities are most vulnerable to droughts (SOPAC 2001). Because of the lengths of the major droughts suffered in Kiribati it is extremely difficult for households to store sufficient water to meet demand throughout droughts.

3.1.2 Types of freshwater use

Water is used by the community for domestic drinking consumption, cooking and washing, for agriculture, and for industry. There is relatively little tourism in Kiribati although there is potential for an expansion, particularly in the northern Gilberts and in Kiritimati. Daily groundwater production figures are available for the reticulated water supply system in South Tarawa (currently around 2,300 m^3/day), but not from the other reticulated groundwater supply systems in Kiritimati. In the agriculture sector, fresh groundwater is used by traditional crops, such as coconuts and babwai (swamp taro), hand-irrigated vegetable and fruit crops and livestock, mainly pigs and chickens. There are an estimated total number of over 34,000 pigs and 55,000 chickens in the country. Apart from coconuts, there is little information on freshwater use in either agriculture or in industry, although it is estimated that 2 pigs require the water equivalent to one human. Sap flow measurements have shown that mature coconut trees are estimated to use approximately 150 L/day of groundwater, equivalent to the current reticulated supply of a family of 5 people (White et al. 1999). There is little information on actual water use from various available water sources, or its quality, in either urban or rural areas, apart from water supply figures for South Tarawa.

[1] Sanitation, Public Health and Environment Improvement Project

3.1.3 Major issues and concerns

Numerous reports and policy decisions have clearly enunciated the major issues and concerns in water and sanitation in Kiribati. Some of the principal concerns are discussed below.

3.1.3.1 Provision of adequate water for human health and community development.

In urban areas, per capita demand is growing as acquisition of water-using devices such as washing machines increases. In the absence of that information, estimates of the daily per capita potable water requirements have varied between 30 and 100 litres, with the WHO recommending a lower limit of 40L/person/day. Well water, even when brackish or polluted is accessed for washing and other non-consumptive uses. Urban freshwater reticulation and outer island water supply projects have aimed at supplying design demands of 30 to 50 L/person/day. The key information then required for design of such systems is the estimated number of people in any community.

If the population growth trends shown in figure 5 were to continue, the total population of Kiribati by 2020 is expected to exceed 113,000 and South Tarawa is likely to have well over 60,000 people. If a low estimate of consumption rate of 50 L/person/day of reticulated water is assumed for South Tarawa then demand has already exceeded the current estimated sustainable yield of the sources of reticulated fresh groundwater from Bonriki and Buota water reserves. In some of the outer islands and North Tarawa, there are relatively large fresh groundwater reserves capable of sustaining higher than current populations. In most cases, however, the actual quantities of water available for extraction remain to be assessed. Accurate estimates of the sustainable groundwater yield from freshwater lenses are only available for Bonriki in South Tarawa, Buota, Abatao and Tabiteuaea in North Tarawa and for local lenses at Decca, Four Wells, Banana and at New Zealand Airfield in Kiritimati (Falkland 1983; Falkland et al., 2003 2004). Table 4 provides a crude estimate of the sustainable groundwater yield of atolls and islands in Kiribati and an estimate of the maximum population that is likely to be sustained by fresh groundwater resources. This is based on the estimated sustainable yields in the ADB 2004 study, ‘Promotion of Effective Water Management Policies and Practices’.

Table 4 assumes that the design per capita demand is 100L/person/day. This allows for a small quantity of water for agriculture and industry. The current Public Utilities Board (PUB) design figure for South Tarawa is 250 L/household/day. The assumption here is that safe water will be the limitation for population support. No attempt has been made to determine if these populations would encroach on water reserves, thereby limiting the volume of safe groundwater available. In these rough estimates of the sustainable fresh groundwater extraction rates and maximum populations that can be supported by groundwater resources, no allowance for rainwater harvesting has been made.

The estimated maximum population of the nation in Table 4 that can be sustained by the estimated groundwater resources is about 580,000. From the exponential total population growth curve in Figure 5, it is expected that this population will be reached in the year 2110 if this population growth rate continues. Of the island groups in Table 4, the Phoenix Group has by far the smallest estimated groundwater sources which accounts for the fact that all but two islands in the group are uninhabited. South Tarawa stands out in Table 4, since the estimated maximum population that may be safely sustained from the groundwater reserves at Bonriki and Buota is half the present population. On South Tarawa, the agricultural demand is smaller and people are expected to supplement their water requirements from domestic wells, many with dubious quality water, and some from stored rainwater. It is emphasised here that the numbers in Table 4 are a guide only. The available safe groundwater resources of most of islands have yet to be assessed.

Table 4: Estimated sustainable groundwater yield and maximum population sustained by groundwater assuming a demand of 100 L/person/day

Atoll/Island	Island Group	Estimated Sustainable Yield (m^3/day)	Estimated Max Population	Population 2005
Banaba	**Gilbert**	?	?	301
Makin		*2,790*	*27,900*	2,388
Butaritari		*8,755*	*87,550*	3,267
Marakei		*626*	*6,260*	2,738
Abaiang		*2,766*	*27,660*	5,478
Tarawa (North)		*4,620*	*46,200*	5,704
Tarawa (South)		**2,000**	**20,000**	40,212
Maiana		*1,315*	*13,150*	1,909
Abemama		*3,156*	*31,558*	3,398
Kuria		*1,867*	*18,665*	1,081
Aranuka		*1,263*	*12,634*	1,158
Nonouti		*1,722*	*17,216*	3,176
Tabiteuea (North)		*2,025*	*20,248*	3,603
Tabiteuea (South)		*537*	*5,370*	1,306
Beru		*1,155*	*11,554*	2,238
Nikunau		*978*	*9,776*	1,912
Onotoa		*404*	*4,040*	1,611
Tamana		*480*	*4,795*	869
Arorae		*1,381*	*13,806*	1,254
Kanton	**Phoenix**	*483*	*4,831*	41
Orona (Hull)		*142*	*1,418*	?
Enderbury		*181*	*1,812*	0
Birnie		*68*	*680*	0
Rawaki (Phoenix)		*227*	*2,270*	0
Manra (Sydney)		*272*	*2,719*	0
Mackean		*181*	*1,812*	0
Nikumaroro (Gardner)		*344*	*3,440*	0
Teraina (Washington)	**Line**	*7,268*	*72,682*	1,154
Tabuaeran (Fanning)		*6,546*	*65,464*	2,536
Kiritimati (Christmas)		**2,000**	**20,000**	5,094
Malden		*1,105*	*11,047*	0
Starbuck		*725*	*7,253*	0
Vostock		*53*	*534*	0
Millennium (Caroline)		*200*	*1,999*	0

Flint		*340*	*3,398*	0
Total		*57,974*	*579,740*	92,428
Total (Outer Island)		*55,974*	*559,740*	52,216

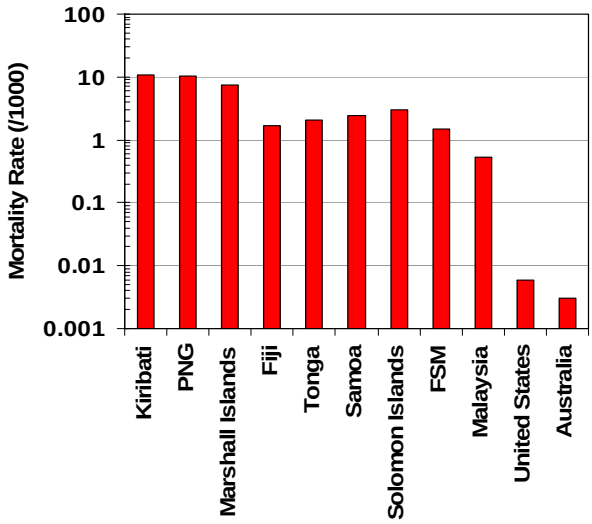
Note: Figures in **Bold** represent careful estimates of sustainable yield. Figures in *italics* represent crude estimates.

There is insufficient national data to estimate the percentage of water use by traditional crops and population. For Bonriki Island in South Tarawa, the annual average long-term water balance shows that about 50% of mean annual rainfall is lost through evapotranspiration mostly by traditional crops and 26% of mean rainfall supplies the freshwater reticulation system for South Tarawa (White and Falkland 2004).

3.1.4 Provision of equitable access to safe water

The high permeability of the unconsolidated upper sediments means that surface contaminants are transported in less than an hour into the groundwater. Human and animal faecal contamination of groundwater is a major problem which has resulted in one past outbreak of cholera in 1977 and numerous isolated occurrences. The rate of infant mortalities due to water-borne diseases exemplifies the impact of society on the quality of water supply systems.

Figure 6: Infant (<5 yrs) mortality rates per 1000 due to diarrhoeal diseases
A comparison with Pacific and other countries.



Source: WHO 2005. Note log scale.

Health statistics from clinics in Kiribati for 2005 show that South Tarawa, with 43.5% of the country's population had over 55% of the nation's reported diarrhoea and dysentery cases. Just over one in three of the population was affected. The crowded township of Betio, with 31% of South Tarawa's population, had over 54% of South Tarawa's diarrhoea and dysentery cases. These figures demonstrate that, in atoll communities, higher density populations can lead to higher incidences of water-borne diseases. The social and economic costs of these illnesses through loss of family members, absences from work and general lack of wellbeing are very large.

In general, there is little information or systematic monitoring of the microbiological quality of water supplies especially in rural outer islands.

In addition to microbial quality, industrial contamination, particularly leaking hydrocarbons from diesel power generators pose major problems for island communities in urban areas.

3.1.5 Protection of water sources

The impacts of increasing population density and human settlements on water quality and the speed at which surface contaminants are translocated by rain into shallow groundwater has led to the abandonment of groundwater source areas in some islands along South Tarawa. Because of this, government regulations enabled the declaration of Water Reserves over major groundwater sources in South Tarawa which prohibit settlement and allow eviction of existing dwellers and land owners from the Reserves. The lands overlying the freshwater lenses in the larger islands of Buota, Bonriki and Teaoraereke were declared Water Reserves. Since 1992, Teaoraereke, however, has not been used as a freshwater source for reticulated water because of continued encroachment by human settlement. Encroachment is a continuing threat to water reserves, despite regulations, because of increasing population pressures and limited available land area for settlement in South Tarawa which contribute to the contamination of groundwater.

The declaration of water reserves over privately-owned land causes considerable tensions and conflict between affected communities and the government because of the loss of local amenity when land owners are evicted from their land or when some traditional land uses are prohibited. This has led to costly ongoing disputes and vandalism of water infrastructure and groundwater monitoring boreholes (White et al. 1999b). To reduce conflict, the Government pays affected landowners annual commercial rents for the land resumed as water reserves. Despite recommendations (White et al. 1999b, Jones 2001), local landowners have not been involved in the on-going management of water reserves.

In Kiritimati, land is owned by the government so conflicts over the declaration of water reserves need not arise. However, encroachment of settlements over shallow groundwater used for water supply is a continuing problem in areas such as Banana and Tabakea.

Only the current fresh groundwater sources in South Tarawa have regulations aimed at protecting them from contamination. Despite these regulations the groundwater reserves on South Tarawa are still impacted by inappropriate land uses such as gravel mining and squatter settlements mainly in Bonriki. There are no equivalent regulations for protecting water sources in rural areas or outer islands.

3.1.6 Provision of appropriate sanitation

In low density, rural areas it is the practice to defecate on the beach or from over-sea latrines and allow the tide to remove the waste. In high population density urban areas these practices present problems. Before 1977, the only toilet facilities on South Tarawa were septic tanks, pit latrines and over-sea latrines. Following the outbreak of cholera in 1977, the Australian Government funded the Tarawa Sewerage Project. This Project, which ran from 1978-982, provided sewerage systems for communities in Betio, Bairiki and Bikenibeu, South Tarawa.

Because of the limited freshwater supply in South Tarawa, reticulated seawater is provided for toilet flushing in these sewerage systems, and sewage is macerated by pumps and disposed as untreated effluent via ocean outfalls at locations in Betio, Bairiki and Bikenibeu (Metutera 1994). There is some evidence to suggest that a plume of sewage from the Betio outfall can swing around the western edge of the Betio and enter into the lagoon. Because of limited coverage of this system, the unsuitability of some of the public toilets and the large number of squatters on South Tarawa, more than 60% of people in South Tarawa, according to 2000 census data, continue to defecate on the beach despite it being declared illegal to do so. It has been estimated that only 23% of households in South Tarawa are connected to the sewerage system.

In rural areas, as part of a World Health Organization program, pit latrines have been installed with assistance from Ministry of Health and Medical Services' (MHMS) Environmental Health Unit. Pit latrines are excavated to the shallow groundwater and are supposed to be installed at least 30 m down gradient from the nearest water well, on the ocean or lagoon edge of the island. Often, however, pit latrines are located near to water wells. There is no monitoring to determine if any contamination from these sources has occurred. Composting toilets, which do not pollute groundwater, have been trialled in South Tarawa and Kiritimati. As part of the AusAID Kiritimati Water and Sanitation Project (KWASP), 153 composting toilets were constructed in Kiritimati in the late 1990s. These did not operate well and the community there prefer flush toilets. There is a similar sentiment to composting toilets in South Tarawa and a general community resistance to composting toilets throughout the country although trials of improved systems are currently planned.

3.1.7 Impact of droughts on water supplies

The high correlation between annual rainfall and the Southern Oscillation Index (SOI) or the position of the Pacific Warm Pool means that Kiribati is subject to frequent, long and severe droughts. An analysis of rainfall records in South Tarawa since the mid 1940s revealed that, for 12 month rainfalls, there have been 10 major droughts with an average return period of 73 months (White et al. 1999a). Islands with no or limited groundwater, such as Banaba, suffer severe shortages during these droughts. Even in islands with reasonably thick freshwater lenses, lenses become thinner and salinity increases. Severe droughts have even caused temporary abandonment of some islands in the past.

Extended low rainfall periods occurred in 1998 and the early part of 1999 throughout Kiribati, and particularly in South Tarawa, Banaba and certain remote, narrow, outer islands with limited groundwater. This resulted in rainwater tanks running dry, dramatic increases in salinity in domestic wells, the death of some trees, die-back in others and an increasing demand on potable, reticulated water. The drought and its impacts led to the declaration, by the President, of a State of Disaster in the Republic on 26 February 1999. This declaration highlighted the need for appropriate quantitative measures of the severity of droughts (Falkland 1999b) or a drought index for small coral islands which takes into account the different sources of water for domestic supplies.

The 1998-2002 drought, the worst on record for 12 month rainfalls, demonstrated that the country does not have protocols in place to warn the government of the potential onset of droughts or their likely impacts on the availability of water resources. An important deficiency in the current system of monitoring is that there is no central database repository for monitoring and assessment data from urban and rural locations and there is no apparent mechanism for triggering action should values exceed critical levels.

3.1.8 Impact of sea level rise on water resources

Sea level rise is considered the greatest threat posed by global warming to low small islands in the Pacific. However, movement of the Pacific Warm Pool along the equator already causes significant changes in the relative monthly elevation of the sea by up to 0.5 m. When storms and high tides coincide with these periodic sea level rises, there is the potential for the sea to overtop parts or even whole islands. These inundations have periodically led to destruction of infrastructure, salinisation of some fresh groundwater and the death of traditional crops such as breadfruit trees at the margins of islands.

3.1.9 Provision of sustainable water supply and sanitation systems

Where they have been carried out, estimates of the sustainable rates of groundwater extraction in Kiribati are a fraction of the mean groundwater recharge rate, usually 20-30%. These rates are estimated to ensure that, even under the longest drought on record, the fresh groundwater lens

will remain viable. This rate of extraction leaves 70-80% of the mean recharge to discharge from the freshwater lens to the sea. There is no information on the impact of the diminution of groundwater discharge rates caused by pumping on surrounding coral reefs and coastal waters. Reliable estimates of sustainable groundwater extraction rates have only been determined for a small number of locations in just Tarawa and Kiritimati. Under the water component of KAPII, those assessments will be extended to a small number of other high priority locations.

Discharges from the four sewage outfalls in South Tarawa presents a significant environmental problem as they currently deposit sewage at the ocean-side reef edge rather than the design of 15 m depth below the reef edge provided in the ADB SAPHE project.

The GOK's current policy is that households are not charged for sewage services. The failure to achieve adequate cost recovery from urban and rural water supply and sanitation systems results in insufficient funds for routine maintenance and operations and totally excludes the ability to make any major capital investment. There has been a dependence on donor support and development loans not only for initial capital expenditure but also for subsequent upgrade phases of the capital works. The sector needs to become more financially independent and to be a provider of economically viable services, with less dependence on both Government subsidy and donor support.

3.1.10 Ensuring groundwater supply systems do not compromise rights or livelihoods

One of the concerns raised by villagers owning land in areas declared as water reserves in Tarawa is that pumping of shallow groundwater impacts significantly on the health and productivity of their traditional crops, mainly swamp taro and coconuts. This concern has spread to other villages in potential groundwater source areas in North Tarawa. If villagers can demonstrate that pumping reduces production from coconut trees, potentially they could claim compensation from the government. It is important to provide villagers with evidence on the impact of pumping on subsistence livelihoods.

There are two ways pumping of shallow groundwater could affect crops. The first is by lowering the shallow water table so that crops have reduced available soil water. The second is through increasing the salinity of the upper layers of the groundwater by upconing of underlying seawater. The infiltration galleries and pumping rates used to extract groundwater (UNESCO 1991) were designed to have minimal water table drawdown and seawater upconing, but they had not been comprehensively tested. Measurement of maximum water table drawdown and salinity change due to pumping from 28 galleries in both groundwater reserves in Bonriki and Buota Islands showed negligible salinity changes and a mean maximum drawdown across both water reserves of 36 mm. This drawdown is smaller than the diurnal tidally-forced watertable fluctuation (of order 80-150 mm) so that pumping effects should have minimal impacts on crops.

Villagers in water reserves have no confidence in these measurements because they are unhelpful in their claims for compensation from the government. An appropriate community-based monitoring system needs to be developed.

3.1.11 Improvement in water governance, capacity building and maintenance of skills

Extensive community discussions have taken place which could form the basis for development of a national water policy. Water policy is currently a collection of poorly connected statements and decisions. There is no comprehensive national water policy although a draft has been developed. It is critical that a national policy be enunciated to provide clear direction for planning and strategy development. Draft National Water Legislation has been under consideration since 1992 but has not been enacted. While National Water Plans were drafted in 1994 and revised in 2000 and in 2006, they have yet to be sanctioned. A whole-of-government National Water and Sanitation Committee has been recently formed to better coordinate government activities in

these sectors. The Cabinet decision in 2004 to make outer island water supply systems sustainable, particularly in finances, provides a clear policy direction.

A key to improved water governance is community participation in planning and decision making (UNWAP 2006). In Kiribati, there is very little community involvement in either. Continuing population growth in South Tarawa means that additional sources of freshwater will soon be needed. Potential groundwater sources have been identified and assessed in parts of North Tarawa (Falkland et al. 2003). Increased community participation in planning new sources may be the key to reducing potential conflict between local communities and the government.

The absence of comprehensive national water and sanitation policy, national water legislation and approved strategic water plans, and community participation at the national and local village levels are barriers to good governance. Protection of groundwater sources by communities is an essential step. These barriers are compounded by organisational overlaps and conflicts as well as limited capacity and resources. The absence of national policy and plans makes the country vulnerable to the agendas of external donor and loan organisations.

Attracting, mentoring and retaining young staff in the water and sanitation sector and building the capacity of existing staff remains a major challenge in small island states. It is important to develop strategies to attract young people into the sector and to provide capacity building opportunities for existing staff. Water resource planning and management is complex and requires a multi-disciplinary approach and the training requirements need to be addressed in a comprehensive manner.

3.1.12 Improvement in knowledge and monitoring

A sound knowledge base of the sector is essential for understanding and for informed planning and decisions. Lack of baseline, accessible information, irregular reporting and lack of analysis of information exacerbate the problems. The gaps in knowledge at the country level span many different facets such as hydrology, water quality, demand, meteorology, health, environment, finance, community attitudes, service performance, laws and regulations, and crosses ministerial boundaries. It requires improvements to information systems ensuring that there is free access and regular analysis and reporting of information.

3.3.13 Land and water ownership in water source areas and common perceptions

Water resource ownership in declared water reserves over private lands remains an issue of contention. The traditional view is that landholders have rights over groundwater. Land on most islands in Kiribati is exclusively owned by individuals. The government only owns land in Kiritimati. On South Tarawa government leases lands from individual land owners mainly in Betio, Bairiki and Bikenibeu. Harvesting of groundwater for common use from privately-owned but declared water reserves therefore presents problems. The traditional view of water ownership colours people's opinions and is a strong element in the reluctance of people to pay for reticulated water. Some villages seek to restrict access to groundwater resources, to control distribution and demand compensation for restrictions on land use. A practical and equitable solution to this issue is urgently required.

Water is still regarded by many as a free resource despite its high delivery costs. Whilst measures such as installing meters can contribute considerably to reducing water wastage, major changes in community attitudes are also required. Such change can only be achieved over extended timeframes and through complementary measures such as information and education campaigns.

3.1.4 Methods to manage impacts and concerns (IWRM)

A soundly based approach to manage impacts and concerns in the water and sanitation sector must recognise the strong interdependencies between nationally important factors which cannot

each be considered in isolation. Community needs and behaviour are intimately linked to the economy, health, the environment and infrastructure. These interdependent factors are overlain by national policy, legislation and regulation. The interdependencies and complexities in the water and sanitation sector is best managed as a complete sector, bringing together all aspects under one coordinated, strategic action programme under a framework of IWRM.

3.1.5 National Water and Sanitation Coordination Committee

There is currently no method of systematically reporting to GOK on water resources assessment, monitoring, water quality, water demand and use, or on the effectiveness of policy and regulations. In order to improve the situation the Ministry of Public Works and Utilities (MPWU), the country's designated lead agency in water, has just convened the first meeting of the National Water and Sanitation Coordination Committee (NWSCC) on 22nd February 2007. Membership of the committee includes all government agencies with responsibilities in water or water related activities. These include the Ministry of Public Works and Utilities (MPWU), Ministry for the Environment, Lands and Agricultural Development (MELAD), Ministry for Health and Medical Services (MHMS), Public Utilities Board (PUB), Ministry of Finance and Economic Development (MFED), Ministry of Line and Phoenix Islands Development (MLPID), The Meteorology Office (MO), Ministry of Communications, Transport and Tourism Development (MCTTD), Rural Planning Unit, Ministry of Internal and Social Affairs (MISA), Ministry of Fisheries and Marine Resources Development (MFMRD), and Ministry of Education Youth and Sport Development. Also represented is the KAPII office. The inclusion of non-government organisations (NGOs) and community groups in the committee will be considered when the committee is fully functional and proposed projects are implemented.

The draft mission of the committee (yet to be approved by Cabinet) is:

To coordinate, facilitate and enhance Government and community activities in the water and sanitation sector to ensure that communities have access to water of suitable quality and appropriate quantities and to appropriate sanitation to meet all reasonable health, environmental, and development needs.

The suggested aims of the Committee are to:

1. Promote the sustainable management, conservation and use of water and related land resources by implementing Government policy and by coordinating and enhancing Government and community activities and involvement.
2. Facilitate and enhance initiatives to raise the quality of life by improving the quality and availability of safe water and decreasing illness and infant mortality rates due to water-borne diseases.
3. Coordinate and facilitate information gathering and assessment, policy and instrument development and review, and identification of other needs for the water and sanitation sector throughout Kiribati.
4. Provide broadly-based strategic advice to the Government of Kiribati, the community, non-government and donor organisations on the nation's water resources and sanitation service and their management and use.

The method of reporting to Cabinet has yet to be agreed on. One suggestion is through the recently established Strategic National Policy and Risk Assessment Unit (SNPRAU), Office Te Beretitenti (the President) (OB). The planned outcomes of the NWSCC are:

- Coordination of government agencies with responsibilities in the water and sanitation sector;

- Facilitation of the development of broadly-based policies on water and sanitation which are consistent across sectors and with other related government policies;
- Identification of mutually-agreed priorities and processes;
- Provision of broadly-based advice to government on water and sanitation;
- Improvement in administration efficiency because advice and proposals have been thoroughly discussed and vetted before they go to Cabinet;
- Increased multi-sectoral understanding of the condition of the nation's freshwater resources, water supplies and sanitation services through coordinated monitoring and assessment;
- Provision of a single forum for interaction and information dissemination between agencies, the GOK and the community;
- Coordinated and thoroughly reviewed water and sanitation proposals for the Government of Kiribati and for donor and investment organisations;
- Increased confidence of donor and investment organisations in the sector.

3.1.6. Water resources assessment and monitoring

The Meteorological Office monitors daily rainfall in selected inhabited islands throughout Kiribati. The Water Engineering Unit (WEU), MPWU is responsible for water resources throughout the nation and monitors from time to time the freshwater lens thickness using salinity boreholes at Bonriki, Buota, Abatao and Tabiteuea in Tarawa. The PUB monitors daily the volume of water produced from the combined pumping output from Bonriki, and Buota water reserves and its salinity and chlorine residual levels. The situation in Kiritimati is unclear. The Environmental Health Unit (EHU) of MHMS monitors the microbiological quality of water episodically, mostly after water-borne disease outbreaks. The Environment and Conservation Division (ECD) of MELAD, is responsible for the monitoring of wastes and pollution. Domestic water wells are a major source of water throughout Kiribati. These are not monitored by the government instead the community monitors salinity levels and quality by taste. There is no systematic reporting of any monitoring data except when crises occur.

3.1.7. Conservation and reuse

There is little information on actual water use from various available water sources in either urban or rural areas apart from the gross water production figures in South Tarawa. The design supply figure of 250 L/household/day provides no information on water used by household from supplementary sources. Installation of rainwater tanks in houses with metal roofs has increased over the past 5 years but large public buildings with metal roofs, such as maneabas (meeting houses) are still being constructed without rainwater collection systems, despite government building regulations requiring installation.

Under the SAPHE project, water demand in South Tarawa was to be controlled by supplying water 24 hours a day in a trickle-feed to 500 litre household tanks, to limit supply to approximately 50 L/person/day. This has proved ineffective in controlling demand, partly because not all households were supplied with this system, there are still open pipe connections in the system, partly because there was no community education and communication program on the use of the system and partly because of deliberate by-passing or tampering with the trickle-feed systems. Currently, demand is controlled by supplying water to different urban locations on alternate days for 5 hours with the design aim of supplying the households connected to the system with 250 L/household/day.

The current water pricing mechanism for the urban water sector in South Tarawa contains no incentives for conservation. The deliveries by tanker of bulk water are charged at a rate of

AU$2/m^3 for domestic use and AU$5/m^3 for commercial use with a AU$10 delivery charge. Because not all households were equipped with 500 litre household tanks in the refurbished water supply system, piped water supply is currently charged at $10 per household per month for domestic water users and $5/m^3 for industrial users. The marginal cost of water is currently AU$3.80/m^3 if the costs of leasing the water reserves from traditional landowners are taken into account or AU$2.55/m^3 if they are set aside. Revenue raised is less than the operational and maintenance costs for water supply. A proposal has been recently prepared by the PUB on a three-tiered tariff for supplied water which is intended to control demand and recover costs. It will require the installation of water meters at all connections, the reading of meters and charging consumers.

Using water pricing to control demand in South Tarawa is problematic. Firstly, there are many settlers and squatters who cannot afford to pay for water. Secondly, most households have domestic wells even in densely settled areas such as Betio and if the price is too high households will simply increase use of dubious quality well water. Finally, charging for water cuts across the traditional view that water is a common property resource.

At present there is no charge for water in the outer islands, partly due to the breakdown of community water supply systems installed under the United Nations Department of Technical Cooperation for Development (UNDTCD) Outer Island Community Water Supply Project (OICWSP) and other projects. Following the Cabinet decision to make outer island water supply systems sustainable in 2004, the MPWU developed a policy to *put in place a sustainable water supply system on outer islands that uses solar powered pumps for the extraction and distribution of potable water to households by establishing a revolving fund through the user-fee concept.* The proposal is to charge households AU$2 per month for the use of the system and to use water technicians with the support of the Island Council and the village to collect the fee. The proposal is currently under review by MISA who are responsible for Councils. In some other island nations in the Pacific, village water committees are used to locate, manage, protect, operate and maintain local village water systems. These committees may employ both a village plumber and a village mechanic for system maintenance and operation, whose fees are paid by modest charges. These village-level water technicians could be trained and mentored by island water technicians who are currently employed by WEU, MPWU.

Wastewater from domestic use is generally discharged onto the ground where it rapidly recharges shallow groundwater for re-use or submarine discharge to the sea. The sea-water transported sewage system returns macerated sewage via outfalls to the ocean at four locations.

3.1.8 Protection of water reserves

The high transmission rates of liquids through the coral sands, overlying the shallow fresh groundwater systems in most of islands in Kiribati, means that groundwater is easily polluted by surface contamination. Because of this, regulations under the Public Utilities Board Act in 1977 permitted the declaration of Water Reserves over major groundwater sources in South Tarawa and Buota which prohibit settlement and allow eviction of existing dwellers and land owners from the Water Reserves. In South Tarawa, the lands overlying the freshwater lenses in Buota, Bonriki, and Teaoraereke were declared Water Reserves. Teaoraereke is no longer used as a freshwater source in South Tarawa because of continued encroachment by human settlement.

Encroachment is also a continuing threat to water reserves in Bonriki and Buota because of increasing population pressures in South Tarawa and the limited available land area for settlement. Currently in Bonriki, gravel extraction from the water reserve is an on-going concern despite being declared illegal. A community-government Committee for the Management and Protection of Water Reserves Management was established in 2000 and was intended to address such issues in the Water Reserves for South Tarawa. It has been defunct for some time.

A large percentage of people (estimated to be between 40-60%) still defecate on the beach, or in the bush despite it being declared illegal in South Tarawa. In low density, outer islands, this is less of a threat to water supplies than pit toilets. Without adequate sanitation there is little opportunity for the situation in South Tarawa to change. While defecation on the beach presents little risk to local groundwater, since the beach is down gradient, using the bush is more problematic.

In order to relieve the pressures on land owners in water reserves, the SAPHE project took up a suggestion (Falkland, 1992) to permit settlement on the outer 50 m wide perimeter of water reserves, down hydraulic gradient from collection wells. A road was constructed at the 50 m boundary on the ocean side of Bonriki and Buota Water Reserves and land owners were permitted to settle there. In Kiritimati there are water reserves at Decca, Four Wells, Banana and New Zealand Airfield. There appears to be a regulation made under the provisions of the Land Planning Act (Cap 48) that no development will take place within 250 m of a designated Water Reserve. There are no equivalent regulations for the protection of groundwater sources in the outer islands.

3.1.9 Managing the impact of drought.

The relation between sea surface temperature or the SOI and drought is sufficiently strong that a robust system for drought prediction can be developed. Even using rainfall percentiles provides a method with a 50% chance of predicting major drought several months in advance (White et al. 1999a). A system needs to be developed to permit early warning of the onset of sever drought. This will involve close collaboration between the Meteorology Office, the Ministry of Public Works and Utilities and the Ministry of Environment, Lands and Agricultural Development. In addition to drought prediction system, strategies must be in place to conserve water following a drought declaration.

3.2. Island vulnerability

Many of the issues related to island vulnerability have been covered in section 1. It is worth noting in Table 1, that SOPAC's environmental vulnerability index for Kiribati is 3.7, the 34th highest of 235 countries studied (Pratt and Mitchell 2003; Kaly et al. 2003).

3.2.1 Types of disasters

3.2.1.1 Disease outbreaks. Close communal living in island communities means that any disease outbreaks can rapidly become an epidemic if not quickly controlled. The use of untreated water from domestic dug wells for water in both urban and rural areas means that there is the potential for the spread of water-borne diseases such as typhus and cholera. The 1977 cholera outbreak in Tarawa, prior to the installation of the seawater-flushed sewage system is one example. Encroachment of settlements on water reserves in South Tarawa and the reluctance to enforce existing regulations increase the risk of major disease outbreaks, despite water treatment.

3.2.1.2 Severe droughts. Annual rainfalls throughout Kiribati are very highly correlated with the Southern Oscillation Index or the position of the Pacific Warm Pool so that Kiribati is subject to frequent, long and severe droughts. Droughts during the 1940s and 1950s led to the abandonment of some islands, including Kiritimati. While relocation to other countries such as the Solomon Islands was possible under a colonial government, it is now not possible. The declaration by the President of a State of Disaster in the Republic in February 1999 during the 1998-2002 drought highlights the fundamental impacts of these frequent droughts. An analysis of droughts in Tarawa is available in White et al. (1999b). A key concern here is that in most households that rely on rainwater harvesting for a substantial portion of their freshwater supply, storage volumes are seldom sufficient to last through the major droughts experienced in Kiribati.

3.2.1.3 Flooding. The high permeability of surface sediments in the islands of Kiribati means that there are no perennial surface streams in Kiribati. Local flooding can occur due to runoff, particularly in higher rainfall El Niño events, from less permeable surfaces such as roads and runways and lead to local, low-level short-term flooding. This is more of an inconvenience and is not generally life threatening although some properties such as cars have been lost. Global warming is expected to increase the mean annual rainfall in Kiribati by about 7% by 2050. Disease incidences appear to increase after periods of flooding and heavy rain, particularly diarrhoea in infants.

3.1.2.4 Sea level rise. Sea level rise is considered the greatest threat posed by global warming to low-lying small islands in Kiribati. Model calculations suggest that initial rises will actually increase groundwater storage (Alam et al. 2002) but ultimately sea levels could inundate parts of low-lying islands. The degree of inundation will depend on the rate of sea level rise and the consequent rates of coral growth, sediment production and island nourishment from sediments. Since available land area is already severely restricted, this presents a major potential threat to Kiribati. It has been claimed by some that the loss of Bikeman Island in Tarawa lagoon was a consequence of mean sea level rise. Others claim that the completion of a causeway between Betio and Bairiki changed the circulation in the lagoon which led to the loss of the low-lying island. What appears to have happened is that the island was lost during storms that were associated with significant El Niño episodes in the 1980s, before the causeway was built.

In 1999-2000, the World Bank funded a study of vulnerability and adaptation in Tarawa, conducted by experts from the International Global Change Institute and others. The study found that climate change and sea level rise are likely to lead to incremental impacts, disrupting major economic and social sectors. By 2050, it was estimated that Kiribati could experience potential economic damages of US$8-16 million a year (in 1998 dollars), approximately 20-30% of GDP. The major impact is loss of land in low-lying areas (World Bank 2006).

Relative sea level height is monitored at Betio both by the Australian Bureau of Meteorology's National Tidal Facility and by the University of Hawaii. The monthly record shows a relative rise of about 5 mm/year, but because of large changes in elevation caused by movement of the Pacific warm pool, the trend is not significant. In addition it is impossible to determine if change in sea level is due to sea level rise or land subsidence from the tide gauge record.

3.2.1.5 Storm surges. In general, the islands of Kiribati fall outside the northern and southern cyclone belts. Movement of the Pacific Warm Pool along the equator as part of the ENSO cycle causes significant changes in the monthly sea levels. When storms coincide with high tides and periodic sea level rises, there is the potential for the sea to overtop parts or even whole islands. These inundations have periodically led to destruction of infrastructure such as seawalls and boat ramps, salinisation of some fresh groundwater and the death of breadfruit trees at the margins of islands.

Because of the depth of the central Pacific around the islands of Kiribati and the rapid transition from seafloor to coral reef, tsunamis pass through islands in Kiribati without building up major waves.

3.2.1.6 Other Impacts of global warming. Other mooted consequences of global warming which could have disastrous consequences on Kiribati include changes in the rate of oceanic circulation in the central Pacific, leading to changes in the frequency of drought and heavy rains, coral bleaching, due to increased sea temperatures and changes in the abundance of fish on which island communities so heavily depend. In addition it is expected that the incidence of mosquito-carried diseases will increase with rising temperature.

3.2.1.7 Exponential population growth and inward migration. The populations of Kiribati as a whole and South Tarawa have grown exponentially since 1963. The current population numbers

and the rate of inward migration to South Tarawa suggest that it is close to its limit of sustainability, particularly in terms of sanitation and current water supply.

3.2.1.8 Oil shortages and power failures. Electric-powered pumps with power supplied by diesel generators are used to extract groundwater 24 hours a day for the water reticulation system in South Tarawa. Oil shortages or prolonged power failures could lead to major reticulated water shortages. These in turn could force many to resort to more heavy reliance on dubious quality groundwater. If this also coincided with drought, a potential disaster could arise.

3.2.1.9 Solid waste generation. A critical feature of most of the islands in Kiribati is limited land area. This poses particular problems in solid waste disposal. With the growth in wealth of the population waste generation has increased. Efforts to install bunded waste disposal sites on the edge of the lagoon at Nanikai and Bikenibeu in South Tarawa under the SAPHE project have not been successful and leachate from compacted wastes continues to be discharged to the sea.

3.2.2 Major issues and concerns

Most of the major issues and concerns concerning island vulnerability have already been detailed in Section 2). In a statement to the Maneaba ni Maungatabu (Kiribati Parliament), on the opening of its fifth session on October 31, 1994, Te Beretitenti (The President) of the Republic, presented an outline of the Government policy on all areas of its responsibility. Water, health and development were key themes.

The Kiribati National Consultation on Sustainable Water Management, conducted in the lead-up to the Pacific Regional Consultation on Water in Small Island Countries in 2002 prior to the Third World Water Forum in Kyoto in 2003, identified the continuing need for adequate supplies of safe drinking water and for better coordination of the water sector.

Consultations throughout the Gilbert Group conducted for the Global Environment Fund (GEF)-World Bank National Adaptation Program of Action (NAPA) of the Kiribati Adaptation Project Phase I (KAP I) in 2003 identified ten water and sanitation-related priority strategies in the top 25 strategies for adapting to global climate change. These were concerned with adequacy of supply, conservation of water, improving water quality and sanitation.

The 1994 policy statement and the two community consultations clearly reflect community concerns over some of the potential risks to water supplies and the environment and are reflected in Section 2.

3.2.3 Methods to manage impacts and concerns (IWRM)

Several current strategies have been developed to address the risks posed by these potential disasters and to reduce vulnerability. They range from explicit government policy statements, through a long-term program to the establishment of particular organisations to address priority concerns.

In June 2005, the Government of Kiribati adopted the following formal Policy on Adaptation to Climate Change:

(a) Kiribati should be mentally, physically and financially well prepared to deal with whatever climatic trends and events the future may hold;

(b) this should be achieved through a coordinated, participation-based adaptation programme carried out by official and private agencies; and

(c) external financial assistance should be obtained to meet the costs of the national adaptation programme.

The GOK also adopted a Climate Change Adaptation Strategy, which is being implemented through the Kiribati Adaptation Program (KAP).

3.2.3.1 Kiribati Adaptation Program, (KAP). In 2003, the GOK, with support from the World Bank, started the KAP under MFED, with the key goal of reducing Kiribati's vulnerability to climate change, climate variability and sea level rise. The program is designed with three phases. Phase I, Preparation (which ran from 2003-2005), aimed to incorporate adaptation into national economic planning, prepare a National Adaptation Program of Action (NAPA) under MELAD and design an intermediate pilot implementation phase, KAP-II. All of these activities were based upon an extensive consultation process, as well as several technical studies in key affected sectors.

The recently commenced KAPII, Pilot Implementation, (planned for 2006-2008), jointly funded by GEF, NZAID and AusAID, aims to develop and demonstrate the systematic diagnosis of climate-related problems and the design of cost effective adaptation measures, while continuing the integration of awareness and responsiveness into economic and operational planning. This will be achieved through continued consultation and awareness raising; consolidation of the mainstreaming of adaptation into national economic planning; and implementation of pilot adaptation measures to address pressing adaptation issues while building capacity in key government ministries, local government and communities. Finally, KAPIII, Expansion (planned for 2009-2015), is designed to gradually scale up the investments piloted under KAPII to cover all major islands and vulnerable sectors of Kiribati.

KAPI prioritised adaptation options under the following categories: awareness; water resources; inundation/coastal erosion; agriculture; health; family planning; overcrowding/migration; fisheries and waste management.

The water resources projects proposed for the water resources category of KAPII are listed in Table 5. These projects present a good start at addressing some of the key priority issues in the water sector identified in section Two. However, there are some exceptions. While the development of national policy is fundamental to providing a vision for water resources it also needs to be underpinned by medium-term national water and sanitation plans. The proposed projects do not address the critical issue of improving the reporting of monitoring and analysis which has been identified here as a major issue. In addition, protection of water resources and management of water reserves have been raised as key issues of concern and a pilot project on this would be extremely valuable, not just in Kiribati but in the region. Finally all the projects are directed at essentially a single Ministry, MPWU (or PUB within MPWU). It would be valuable to have a pilot project that included other key ministries with responsibilities in water, particularly MELAD and MHMS.

3.2.3.2 National Strategic Policy and Risk Assessment Unit. The GOK has recently approved establishment of a National Strategic Policy and Risk Assessment Unit (NSPRAU) within the Office Te Beretitenti (OB) under its Secretary. The National Strategic Policy and Risk Assessment Unit (NSPRAU), which has yet to be staffed, will have oversight of KAPII. The intended role of the NSPRAU is to:

- Provide support to Cabinet and the President on Cabinet Memoranda
- Review national policies of strategic national importance and of long-tem risk;
- Facilitate inter-ministry coordination on specific issues of national importance;
- Oversee disaster and crisis management arrangements.

3.2.3.3 National Adaptation Steering Committee A National Adaptation Steering Committee (NASC) has been set up under KAPI and is responsible for promoting and monitoring coordination among KAPII project activities across the implementing agencies, including the use and sharing of technical expertise. The Steering Committee will be chaired by the Secretary for the Office of Te Beretitenti, and consist of senior officials from the main implementing agencies; MELAD, MPWU, MFMRD, MISA and MCTTD and representatives of the Kiribati Association of NGOs (KANGO), the Kiribati Women's Federation (AMAK), the Kiribati National Council of

Churches, and the Chamber of Commerce. The Steering Committee reports to the Development Coordinating Committee (DCC), a permanent body composed of Secretaries of all the Ministries, chaired by the Secretary to the Cabinet (based at OB). It is intended that NASC will be assisted by an inter-sectoral Technical Team, responsible for day-to-day technical coordination, and derived from the Climate Change study team. NASC and the technical team are expected to assist the NSPRAU not only in managing KAP, but also undertake other hazard risk management initiatives in Kiribati.

Table 5: Water resources related projects in component 3 of KAPII

Project No.	Project Title	Project Cost AU$'000
3	**Freshwater resources**	**2,795**
3.1	Update national water policy, standards and capabilities	340
3.1.1	Assist MPWU to develop National Water Policy	75
3.1.2	Strengthen capacity in water resources assessment and improvements in groundwater monitoring	210
3.1.3	Revision of national building codes	50
3.1.4	Development and promotion of guidelines on rainwater catchment, storage and use	5
3.2	**South Tarawa water planning, remedial actions and pilot projects**	**1,226**
3.2.1	Assist MPWU/PUB to prepare Master Plan for water in Tarawa atoll	Included in 3.1.1
3.2.2	Consumer education and awareness programme	220
3.2.3	Carry out additional freshwater lens assessments on Tarawa atoll	116
3.2.4	Study of artificial island freshwater lens	75
3.2.5	Leakage detection and rehabilitation of Betio distribution and household plumbing	325
3.2.6	Install rainwater collection/storage facilities at govt/community buildings	100
3.2.7	Pilot project: rainwater collection for groundwater recharge	65
3.2.8	Improvements in South Tarawa freshwater supply - Tungaru Hospital and Temaiku	325
3.3	**Outer islands priority assessments and system upgrades for CCA**	**1,229**
3.3.1	Water resources assessments in 8-16 priority locations	134
3.3.2	Implement water supply system improvements in 8-16 locations	550
3.3.3	Re-assess feasibility of non-polluting sanitation systems	14
3.3.4	Outer islands household loan scheme for roof catchment and sanitation	306
3.3.5	Priority water supply upgrades on Banaba	225

3.2.3.4 National Water and Sanitation Coordination Committee. MPWU convened the NWSCC in February 2007 to provide a whole of government approach to water and sanitation. The draft terms of reference for this Committee (yet to be approved by Cabinet) are:

1. Coordinate and enhance the strategic activities of Government Ministries in the water and sanitation sector to ensure management.
2. Facilitate and coordinate the review and assessment of water and sanitation-related policies, regulations, plans, instruments and standards and make recommendations to Government on policy development, program implementation and potential improvements.
3. Provide the Government with broadly-based, coordinated, strategic advice on priorities for water and sanitation and on water-related development opportunities.
4. Provide a national forum for the discussion of water and sanitation-related issues.
5. Coordinate and facilitate an annual, national, island-based assessment report on the quality and quantity of water resources, water consumption, rainwater harvesting and demand for water and encourage strategic systematic monitoring.
6. Coordinate and facilitate assessments of risks in the water and sanitation sector and possible adaptation strategies in relation to global change and extreme events.
7. Enhance and coordinate strategies to improve community understanding of and participation in water and sanitation use and planning and in furthering water conservation and protection.
8. Coordinate the review and assessment of, and prioritise and make recommendations on proposals for water and sanitation-related projects.

It is intended that the NWSCC will provide the medium for integrated policy development and program implementation and for coordination and enhancement of information gathering, analysis and clearing; and dialogue and consultation on matters of policy and regulations for the nationally vitally important water and sanitation sector.

3.2.3.5 Waste minimisation and recycling. In 2006 MELAD introduced a recycling program into South Tarawa. This public-private partnership commenced by recycling aluminium cans. The tremendous environmental and economic success of this scheme has led to the trial recycling of plastics, batteries and the planned recycling of glass and car bodies. The government petroleum company, KOIL already recycles oil. The success of these schemes suggests that the risks to groundwater posed by solid waste can be reduced by such recycling schemes.

3.3 Awareness and community participation

A major problem in the water and sanitation sector has been that almost all water and sanitation initiatives in Kiribati have been driven by externally-funded projects; and over the past 20 years have involved components dedicated to raising community awareness. These awareness campaigns have spanned the range from highly successful to totally ignored or even disruptive. A key issue in awareness is the cultural background and sensitivities of the recipient communities. One issue often overlooked by external projects is that the traditional forms of communication are through song and dance. Lengthy, printed documents often lie unopened and unread.

Community participation in water projects has been less well covered than awareness raising as many projects have been driven top-down. While almost all projects have set-up steering committees consisting of members drawn from relevant government ministries, very few have involved community representatives. In addition, when community participation has occurred, projects have seldom appreciated the length of time required for discussion at the village or maneaba level. Involvement at this level is a long-term process.

3.3.1 Awareness campaigns, consultation and participation

3.3.1.1 Committee for the Management and Protection of Water Reserves, 2000. In order to control encroachment of settlers onto water reserves a community-government Committee for the Management and Protection of Water Reserves was established in 2000 as a lead-in to the SAPHE project. This Committee had community representatives from local Water Reserve villages, from Tarawa *unimwane* (traditional elders) and government agency representatives. Government agencies were uncomfortable with community participation and the committee has been defunct for some time.

3.3.1.2 Kiribati National Consultation on Sustainable Water Management, 2002. The Kiribati national consultation on sustainable water management, conducted as a lead up to the Pacific Regional Consultation on Water in Small Island Countries in Sigatoka, Fiji, in 2002, consulted all relevant government ministries and agencies, NGOs, the Kiritimati Water Supply and Sanitation Project (KWASP), the SAPHE project, community-based groups on South Tarawa including women's and youth groups, church groups, general community, and schools. Based on the consultations with the stakeholders listed above, water and sanitation are both regarded as an environmental and health priority.

Improvement in the provision of sufficient quantity of water of appropriate quality water was a high priority as people were increasingly aware of the impacts of insufficient and poor quality water on their family's health, wellbeing, and economic security. Outer island communities mainly required the upgrading and rehabilitation of old and damaged water systems originally installed under the UNDP/INCDF OICWSP. Other villages without water systems wanted to have better access to limited freshwater water sources. One main concern was brackish well water caused by seawater intrusion particularly in islands with narrower widths. Another issue raised was the need for better coordination of the water sector.

3.3.1.3 National Consultations under the Kiribati Adaptation Program Phase I, 2003. Two major national consultations which built awareness and commitment for adaptation and climate change were conducted under KAPI using established risk management tools (Comprehensive Hazard and Risk Management, CHARM) developed by SOPAC. The first national consultation, was held in the Gilbert and Line Island Groups from 23 of June to 15 August 2003, brought together Chief Councillors, government staff, clerks, *unimwane* representatives, women and youth from each of the islands of Kiribati. Key results included:

- Awareness that the changes they faced were not unique to their islands, but shared across the islands
- A catalogue of kinds of changes experienced over the last 20-40 years, and traditional coping mechanisms used to deal with those changes
- A preliminary assessment of areas where people felt they needed additional assistance in coping with their vulnerabilities
- A strategy to take results back to their islands for further local level consultations
- A shared and distinctively I-Kiribati definition of what is *vulnerability* and *adaptation*

The second national consultation (November-December 2003) included most of the same stakeholders from the first consultation, but also Island Project Officers. Key results included:

- Prioritisation of vulnerabilities identified by the island stakeholders
- Identification of adaptation (coping) strategies for the identified vulnerabilities
- A classification of adaptation strategies into (a) those which were urgent and could be undertaken by communities themselves; (b) those which were urgent and would require

outside help, and (c) those which were less urgent and did not need to be addressed immediately.

Participants then assigned urgent adaptation strategies for which outside help was required in order for inclusion in the operational plans of relevant ministries.

The national consultations were coordinated with development of the 2004-2007 National Development Strategy. As a consequence, adaptation issues are well integrated into the National development Strategy, and climate change is recognised as one of the key issues potentially affecting economic growth. In the national consultations, 7 out of the 10 identified highest priority adaptation strategies were related to water.

3.3.1.4 Use of companion modelling to reduce conflict, ACIAR-CIRAD, 2004. Continuing population growth in South Tarawa means that additional sources of freshwater will soon be needed. Potential groundwater sources in some larger islands of North Tarawa have been identified and assessed (Falkland et al. 2003). In the past the declaration of water reserves over privately-owned land has generated significant conflicts between affected landowners and the government which has resulted in vandalism of infrastructure. An ACIAR project, *Equitable Groundwater Management for the Development of Atolls and Small Islands* was developed with the French agency CIRAD (Centre of International Cooperation and Research on Agriculture Development) to address the sources of conflict.

In an effort to reduce conflict between local communities and the government, a companion modelling approach was developed using multi-agent systems (Dray et al. 2006). This approach attempted to provide relevant information to local government and community representatives in order to facilitate dialogue and to collectively devise sustainable and equitable water management strategies. Multi-agent based bimulations (MABS) coupled with a Role-Playing Game were developed as aids to reduce conflict over natural resource management and resource allocation and improve decision making (Perez et al. 2003). These allowed participants to see the problem from other perspectives. Community and government representatives participated enthusiastically in the process and developed a flow chart of key financial, technical and social solutions.

It was clear from the solutions that water management and land ownership were inextricably linked. Unfortunately, further progress was prevented by both entrenched community representatives, whose sole interest was compensation from the government, and by external loan agency and government agency priorities, whose main concern was to complete major water supply, sanitation and environment projects as quickly as possible (Dray et al. 2006). Again, it was clear that agencies were uncomfortable working with the community.

3.3.1.5 KAPII, Information and consultation, 2007. A key component of KAPII focused on policy, planning and information. Part of that involves the development and use of frameworks and processes for participation and awareness. Much of Climate Change Adaptation (CCA) and KAPII are about changing people's attitudes and understanding about the climate and the environment in which social and economic activity takes place. Difficult and potentially unpopular choices lie ahead for governments and communities. The process by which important and sometimes complex issues are canvassed and decided needs to be carefully designed, so that the process itself builds trust and increases understanding among those involved. This sub-component comprises the review, and redesign if necessary, of the consultation and participation process in use in Kiribati to mobilise public support for major policy initiatives such as Climate Change Adaptation.

One of the strengths of KAPII and its companion program, NAPA, is the foundation provided by two rounds of national consultations in 2002 and 2003 through KAPI. Insights gained there have helped to shape the KAPII program. More national consultations are planned to sustain and build on that foundation, creating greater and more competent awareness of climate change and variability, and appropriate responses, throughout the country. The activities will have close

involvement from other members of the National Adaptation Steering Committee (NASC), including KANGO, AMAK, and the Council of Churches. It is planned to hold two-yearly national consultations with themes and content about climate change adaptation.

3.3.2 Major issues and concerns

3.3.2.1 Community participation in planning, management and protection of water of water resources. There is a general reluctance in government agencies to participate with communities in the design, planning management and protection of water resources. Instead the approach is to introduce regulations with stiff penalties for infringement. An examination of the past success of regulations to control behaviour, such as settlement, on Water Reserves would suggest that they have limited effectiveness, particularly when enforcement is difficult. Involving the communities as partners would seem a more cost effective and successful technique.

3.3.2.2 Village level water and sanitation coordination committees. There are no village-level water committees in rural areas to oversee water and sanitation issues. Such committees provide local ownership and management of water supply systems.

3.3.3 Methods to manage impacts and concerns (IWRM)

3.3.3.1 Involvement at the national level. The NASC of KAPII involves NGOs and community representatives as does the Outer Island Project Coordination Committee. The original draft plans for the NWSCC suggested participation from NGOs and community representatives. At the inaugural NWSCC meeting in February 2007 the committee agreed, in principle that participation of members of the civil society is crucial, but their participation will be more helpful when projects on community awareness and participation are initiated, designed and implemented.

3.3.3.2 Lessons from other PICs. In some other PICs, Village water committees are used to locate, manage, protect, operate and maintain local village water systems. These committees may employ both a village plumber and a village mechanic for system maintenance and operation whose fees are paid by modest charges. These village-level technicians could be trained and mentored by island Water Technicians supported by WEU, MPWU. KANGO is well placed to help implement these committees which could bring about change in the attitude of agencies.

3.4. Technology

3.4.1 Types of water supply systems

3.4.1.1 Groundwater- Domestic water wells. Open hand-dug wells are the traditional method used by the I-Kiribati to obtain freshwater for their basic needs from shallow groundwater lenses. Wells 1-2 metres in diameter are normally excavated to less than 0.5 m below the watertable. The walls are usually supported by stones and the well is left uncovered for people to draw water as needed. Because they are open, the water is exposed to contamination and algal blooms. Villagers also tend to dig these wells close to their dwellings, their pigs and other domestic animals. Pigs, with an average of almost 2.5 pigs per household nationally, are a major concern for groundwater pollution, particularly in urban South Tarawa, because of their high faecal coliform outputs. Pig manure is often used to fertilise vegetable gardens and fruit trees. In some villages, pigs are penned close to the lagoon to lessen the risk of groundwater pollution at well sites. Many young pigs, however, roam freely. The introduction of pit latrines, in numerous villages as part of sanitation programs poses significant risks for drinking water from shallow hand-dug domestic wells. These domestic wells are a major source of water in both urban and rural areas. There is almost no monitoring of the quality of water in domestic wells.

Improvements have been introduced in the construction of dug wells by the villagers. The walls are supported by concrete rings that are placed up to about half a metre above ground level. A concrete apron is cast around the well to impede the seepage of mud from the surface into the water, and a concrete cover is placed over the well; with an opening for drawing water out with a

bucket or; completely covered and using a simple but almost fool-proof PVC Tamana pump is fitted to draw water. This type of well is intended to serve up to five households and it has been estimated that there are about 1,600 of them in the country. A major drawback with these domestic wells is that they are still located close to dwellings and pit latrines.

In an attempt to minimise local contamination, the UNDP/UNDTCD project installed covered wells located up to 750 m from rural villages with water drawn through pipes to the village using a hand suction pump. These systems usually consisted of up to three pumps per transmission main, with each pump designed to supply 10 families, at an assumed per capita consumption rate of 30 litres/day. Maintenance of the heavily-used hand pumps proved to be a major problem and very few if any of these systems are now operating.

Where the distance from the well or gallery to the village exceeds 750 m a solar powered pump has been installed nearby and discharges into one or more 13.5 m^3 capacity tanks. Water was distributed from tanks to up to 6 stand-pipes in the village and each tank was intended to supply up to 20 households. Again, maintenance of solar pumps was a problem and few of these systems remain operational. There has been no systematic monitoring of water quality from these more sophisticated rural village water supplies.

3.4.1.2 Groundwater- infiltration galleries. Fresh groundwater in low coral islands exists as a thin freshwater lens, usually less than 30 m thick, overlying seawater. Extraction of groundwater using conventional vertical groundwater well pumps or boreholes can readily cause salinisation of extracted water due to the upconing of the underlying sea water. In order to overcome this, long horizontal infiltration galleries or skimming wells, placed just below the groundwater surface are used to skim freshwater from the lens.

On Kiritimati Island there were several open trenches, each 150 m long and approximately 3 m wide, dug to about 0.5 m below the water table. The sides of the trenches were supported usually by slabs of coral stone and trenches were sometimes covered by sheet metal or timber boards and water was pumped from the trench. These systems were open to contamination and are harder to construct than buried infiltration galleries. All these open systems have now been replaced by buried infiltration galleries under KWASP.

The infiltration galleries installed in South Tarawa, Kiritimati and in some outer islands, in most cases the gallery systems are located close to the thickest parts of the groundwater lens and a few hundred metres or more away from dwellings the village to minimise risk of pollution. Power for pumping either is supplied by mains electricity (Bonriki and Buota), solar (outer islands, Kiritimati) or wind power (Kiritimati) or diesel (Kiritimati, when there is insufficient wind or sunshine). Most of the solar power pumps installed in outer island galleries by the UNDTCD are not operational due to lack of maintenance and support.

3.4.1.3 Groundwater-reticulated water supply systems. Both South Tarawa and Kiritimati have reticulated groundwater supply systems. In Tarawa, water is pumped from long collection galleries installed in two fresh groundwater lenses from two islands on the south-eastern corner of Tarawa, Bonriki (22 galleries) and Buota (6 galleries). Extensive hydrogeological investigations have been carried out in Bonriki and to a lesser extent in Buota. The sustainable yield of the groundwater system is known and has also been estimated for two islands in North Tarawa, Abatao and Tabiteuea (Falkland et al. 2003, 2004). The volume of water produced, its residual chlorine concentration and electrical conductivity are monitored daily by the PUB, who also periodically monitors the salinity produced from individual gallery pump stations. No reports are published or transmitted to the government.

The combined discharge of the infiltration galleries is aerated to remove hydrogen sulphide before being chlorinated and introduced to the 30 km long 225 mm diameter rising main, refurbished under SAPHE, for distribution via elevated tanks to communities along the island chain from Bonriki to Teaoraereke. From Teaoraereke water is fed into a 150 mm rising main installed under

an AusAID project in the 1980s. In Betio, at the end of the rising main, water is stored in a large ground level reservoir and is chlorinated again before redistribution. Because of leakage in the domestic reticulation system and due to the large number of squatters, particularly in Betio, water is also distributed via tankers. Few domestic connections have water meters and the collected fees do not cover operational and maintenance costs. Despite the new rising main installed under SAPHE, leakage losses in the domestic reticulation systems within villages is estimated to be 50%.

Only 61% of households in South Tarawa have access to the reticulated supply of treated water. Even in these, water supply is supplemented by domestic well water of dubious quality. Table 6 summarises the connections in South Tarawa. Only 43% of households have improved connections while over 15% have open-ended connections so that leakage losses are large.

Table 6: Household connections to the reticulated water system in South Tarawa

Item	No. of Households
Total number of households in South Tarawa from 2005 census	5,238
Households connected to reticulation system	3,224
Households with new SAPHE 500 L tank connections	2,229
Households with low level taps	178
Households with open pipes	817

Source:

The freshwater reticulation system in South Tarawa (see figure 7) has been recently partially upgraded under the ADB SAPHE project. Improvements introduced during this project have reduced losses from the rising main. As part of that project, a total of 2,229 storage tanks of 500 litre capacities were installed at households throughout South Tarawa. These tanks had a constant flow trickle feed and were designed to supply about 500 L/household/day and to allow pumping for 24 hours a day. Difficulties in maintaining supply, leakages from the village reticulation system and household plumbing, not addressed in the SAPHE project and tampering with the trickle feed system in tanks has meant that water is now only supplied to households every alternate day.

Unfortunately not all households connected to the reticulation system were supplied with storage tanks. Some even have an open-ended pipe as a connection. To cope with the limited quantity of water available, the PUB's new water quota is 250 L/household/day, irrespective of the number of people living in a household. Households are expected to use well water, rainwater and the PUB water tanker service to supplement water supplies. Plans to extract additional water from other islands in North Tarawa may be problematic because of land ownership and compensation issues and costs. The two-fold problem is to supply people in South Tarawa with adequate quantities of safe reticulated water while developing strategies that encourage decentralisation.

Figure 7 shows water is currently being extracted from the groundwater through the combined infiltration galleries in Buota and Bonriki at a rate of 2,300 m^3/day. This is 15% above the long-term sustainable limit of approximately 2,000 m^3/day. While this is not a problem during the present wet-period, this extraction rate could become problematic during long dry periods.

The protection of groundwater sources has been a major problem because of encroaching settlements, which has seen the abandonment of groundwater sources on Betio, Bairiki and Teaoraereke. In order to address this, regulations under the Public Utilities Board Act permitted the declaration of Water Reserves over major groundwater sources in South Tarawa and Buota. These prohibit settlement and allow eviction of existing dwellers and land owners from the Reserves. This has generated on-going friction between the communities affected and the

government especially at Bonriki. Currently the government pays commercial rent to the landowners. Additional problems arise because of community concerns over the impacts of pumping on the productivity of traditional subsistence crops such as coconuts and *babwai* (swamp taro).

Reticulated water supplies on Kiritimati are also sourced from groundwater at several locations throughout the island. Water supply sources exist at Decca, supplying Ronton and Tabakea; at Banana supplying Main Camp, Banana and the Fisheries buildings near Kiritimati Airfield; and at New Zealand airfield supplying Boran (Poland). The public water supply system on Kiritimati was upgraded in the late 1990s under the AusAID KWASP with new infiltration galleries, pumps, distribution pipelines, header tanks and disinfection systems being installed together with constant trickle flow 500 litre tanks with water meters for households. Installation of a reticulation system at Banana has been delayed pending the relocation of Banana away from the groundwater source. The Government is the landowner in Kiritimati, so ownership problems over declaration of water reserves do not arise. Problems still persist with the water supply systems in Kiritimati and there appears to be no monitoring of the quantity of water produced, of its quality or of demand. It is unclear whether any revenue is collected from water consumers.

3.4.1.4 Rainwater harvesting. The westernmost island of the nation, Banaba, relies almost totally on the collection of rainfall for its water supply. There, however, the sophisticated rainfall collection and storage scheme constructed during the phosphate mining days, which ended in 1979, is now abandoned and would be difficult to maintain by local residents.

In some other islands, such as Kiebu in Makin, and atolls such as Nonouti, also in the Gilbert Group, groundwater is brackish particularly during droughts and rainwater harvesting is important.

Rainfall collection has been used in Kiribati for many years, but it is regarded, at best, as a supplementary source of water. The potential for increasing rainwater harvesting is large and enactment of building regulations obliging house owners to construct gutters and tanks for the harvesting of rainwater is given recognition of its importance.

There are several reasons why rainwater is underused. Firstly, the cost of rainwater collection and storage is beyond many, particularly in outer islands, so that building regulations are largely ignored. Secondly, there is a cultural preference for the taste of groundwater. This is because of the traditional use of toddy for drinking. Rainwater mixed with toddy does not taste as good as when mixed with groundwater. Thirdly, many of the roofs of buildings using traditional materials such as pandanus or coconut thatch are less than ideal for rainwater harvesting. Fourthly, many conventional-sized affordable rainwater tank systems would fail during the frequent droughts. Finally, people do not realise the risks in drinking untreated groundwater in densely settled areas. Despite the regulations, many public buildings with large suitable roof areas, such as maneaba's, continue to be constructed without rainwater collection and storage systems. There is currently little information about the quantity, condition or quality of rainwater harvesting systems.

An incentive Loans Scheme to allow private individuals to install rainwater harvesting and/or sanitation facilities has been operating in South Tarawa since 2002. This scheme based on a revolving fund was established under the SAPHE Project. In the years 2002 to 2004, about 710 loans were given for roof rainwater harvesting and storage equipment. Repayments of loans of up to a maximum of AU$1,500 are guaranteed by ensuring loans are given only to people with regular incomes and by recovering regular repayments from fortnightly salaries. The scheme is administered by the Kiribati Housing Corporation. Under KAPII it is planned to attempt to trial this scheme in rural areas and outer islands.

3.4.1.5 Subterranean caves and bulk importation. The raised island of Banaba uniquely has fresh water pools in subterranean caves (Overmars and Butcher 2001) that could serve as an emergency source of water in times of severe drought. During the British Phosphate Commission period water was imported in phosphate boats and stored in large 4,500 m^3 storage tanks on the

island. Water in these tanks is currently unused because of the presence of rust suspension in the water.

3.4.1.6 Bottled water. Bottled water was produced in South Tarawa from a privately owned reverse osmosis plant using seawater as feedstock. This is no longer operational due to water quality problems. Currently, between 300 and 500 m^3 of bottled water are imported annually. Its price of about US$1/L means that it is beyond the reach of many people.

3.4.1.7 Desalination. Five reverse osmosis desalination plants capable of producing over 100 m^3/day have been installed in South Tarawa and Banaba since 1999. Only that on Banaba is currently partially operational. These desalination plants were introduced to address water shortages during severe droughts. Problems with maintenance, the expense of spare parts and the costs of supplying power limit the longevity of desalination in many developing Pacific Island nations. In Kiribati it has been estimated that seawater desalination was 16 times more expensive than groundwater extraction in energy consumption terms (Metutera 2002). It is much cheaper and less risky to firstly develop groundwater extraction and rainwater collection systems.

3.4.2 Types of wastewater/sanitation systems

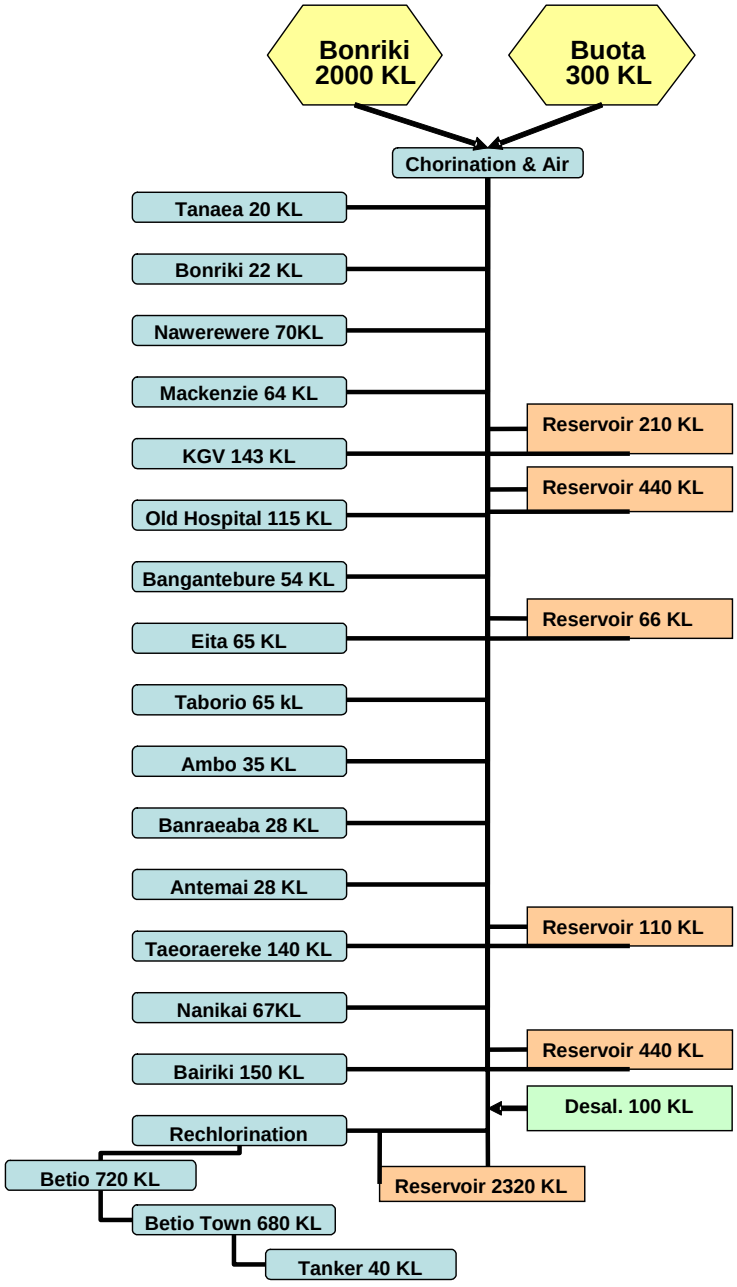
There are no wastewater reticulation or treatment systems in Kiribati. Greywater from washing and cooking is returned to the ground where it quickly recharges shallow water and is available for re-use or submarine discharge to the sea.

In low density rural areas it was the customary practice to defecate on the beach or from over-sea latrines and allow the tide to remove waste. This is efficient, safe and without cost. In high population density urban areas these practices present problems.

Before 1977, the only toilet facilities on South Tarawa were septic tanks, pit latrines and over-sea latrines. Following the outbreak of cholera in 1977, the Australian Government funded the Tarawa Sewerage Project. This Project, which ran from 1978 to 1982, provided sewerage services for communities in Betio, Bairiki and Bikenibeu. Because of the limited freshwater supply, reticulated seawater is provided for toilet flushing, and sewerage is macerated by pumps and disposed as untreated effluent via ocean outfalls at four locations. There is some evidence to suggest that a plume of sewerage from the Betio ocean outfall can swing around the western edge of the Betio and enter the heavily used lagoon. Because of limited coverage of this system, the unsuitability of some of the public toilets and the large number of squatters on South Tarawa, more than 60% of people in South Tarawa, according to census data in 2000, continue to defecate on the beach despite, it being declared as illegal to do so. It has been estimated that only 23% of households are connected to the sewerage system. There is no systematic monitoring on the impacts of sewage discharge on the receiving reef and ocean at the outfalls.

In rural areas, as part of a WHO programme, pit latrines have been installed with assistance from MHMS Environmental Health Unit. Pit latrines are excavated down to the shallow groundwater and are supposed to be installed at least 30 m down gradient from the nearest water well, on the ocean or lagoon edge of the island. However, this is often not the case and pit latrines are often located near wells. There is also no monitoring to determine if any contamination from these sources has occurred. Composting toilets, which do not pollute groundwater, have been trialled in South Tarawa and Kiritimati. As part of the AusAID KWASP, 153 composting toilets were constructed in Kiritimati. Because of design problems, the community there prefer flush toilets and there is currently strong community resistance to composting toilets. A sustainable sanitation trial of compositing toilets is about to start in Bonriki by MELAD and MHMS.

Figure 7: Freshwater distribution system in South Tarawa showing daily diversions (KL)



3.4.3 Major issues and concerns

Many of the major issues and concerns have been raised in Section Two. Of particular note in this section are:

3.4.3.1 Condition of outer island water supply systems. The failure of hand pumps and solar-powered pumps in outer island water supply systems installed under the OICWSP point to a lack of training of local water technicians in operation and maintenance of these systems. In addition, it underlines the fact that with no revenue collected from these systems, they are not financially sustainable.

3.4.3.2 Leakage from the domestic reticulation system in South Tarawa. With water in such short supply, the leakage from the domestic component of the reticulation system is a major concern. In addition the number of households with open-ended connections defeats the purpose of having an improved rising main.

3.4.3.3 Lack of systematic monitoring, analysis and reporting. The lack of systematic monitoring, analysis and reporting by all the key Ministries is a major problem for public and domestic water supply systems as well as the sewage system, is a major issue. The public water supply system in Tarawa is being run close to the estimated sustainable limit so it is necessary to keep a close watch on the quality of the water. The systems in Kiritimati are of particular concern. It is very difficult to manage a system if there is no information available on its performance. Kiritimati has a relatively low and highly variable rainfall and monitoring there of groundwater availability and quality is a high priority.

Domestic water wells continue to be a major source of water for households in both urban and rural areas. There is no information on the general quality of water or on the volume of water extracted from them.

3.4.3.4 Rainwater harvesting. The number of large public buildings still being constructed without rainwater harvesting systems despite building regulations which is a particular concern. Despite considerable progress on the installation of raintanks for households, there is still room for improvement.

The situation in Banaba, with its once sophisticated rainwater harvesting system in disrepair, and large volumes of stored water unusable, requires urgent attention.

3.4.3.5 Encroachment on water reserves. The modern theory of water supply systems is to have multiple barriers between the consumer and any contaminants. An uncontaminated water source area is a major cost-effective barrier. Encroachment of human settlements in South Tarawa has already forced the abandonment of two water supply systems there. The continued settlement and misuse of the freshwater reserve at Bonriki is a major concern.

3.4.3.6 Sources of water for South Tarawa. The extraction rates from the groundwater sources for the reticulated water supply in South Tarawa are currently above their sustainable limits during the current wet period. Significant water shortages may arise and an increase in salinity of supplied water is probable if population growth continues at its current rate and especially when dry conditions return. Planning is required to consider how to cost-effectively increase water supplies for South Tarawa.

3.4.3.7 Sewerage services in South Tarawa. The traditional ways of human waste disposal practiced in low-density islands is inappropriate and a health risk in urban South Tarawa. The extension of sewerage services for South Tarawa is urgently required but poses complex problems. Space is too limited for anything other than primary treatment and increasing the discharge of untreated sewage could dramatically alter the ecology of the receiving waters. While compost toilets offer a solution for households in lower density areas, their use in higher density

areas, and particularly squatter areas may be problematic. The provision of incentives for people to move to other designated development centres is a high priority.

3.4.3.8 Locally owned solutions. A large number of aid and loan water and sanitation projects have been conducted in Kiribati over the past 25 years. Some have proved remarkably robust, such as the infiltration galleries installed at Bonriki and Buota, while others have been much less successful. Most of those had little local ownership of the project, involved minimal training, had no strategy for ensuring long-term benefits or were incomplete and only partially addressed priorities. Critical project review during projects and a clear locally-owned medium- to long-term strategic plan would seem necessary.

3.4.4 Methods to manage impacts and concerns (IWRM)

3.4.4.1 KAPII. The Water Resources component of KAPII is intended to address some of the priority concerns identified above. Between 8 and 16 priority outer island villages will have assessment of their water resources and their and, Banaba's water supply systems improved. Leakage detection will be carried out in Betio. Assistance is also planned for the PUB and MPWU to improve monitoring. Rainwater harvesting nationally in both South Tarawa and outer islands is also specifically targeted. Assessment of the water resources in two islands in North Tarawa, the feasibility of constructing a totally government-owned artificial island, and the use of rainwater recharge in sports fields to supplement South Tarawa's water supply will be undertaken. The use of composting toilets in outer islands will also be considered.

3.4.4.2 NWSCC. KAPII targets the water responsibilities in MPWU and PUB but does not involve those in MHMS, or MELAD, although MELAD is involved in the NAPA and the NASC. Since water borne diseases are a fundamentally important concern, it is vitally important that MHMS be included in water initiatives. One of the aims of the National Water and Sanitation Steering Committee is to provide a whole-of-government approach to the coordination and facilitation of an annual, national, island-based assessment report on the quality and quantity of water resources; water consumption; rainwater harvesting and demand for water; and encourage strategic systematic monitoring. In addition this committee aims to promote locally identified priorities and concerns and to set the agenda nationally for water resource and sanitation development and improvement.

Both of these initiatives, however, fail to address the specific concerns of encroachment and settlement on groundwater source areas and the sanitation requirements of South Tarawa and the involvement of communities at the village level in planning and management. The demonstration concept project developed from this diagnostic report addresses these gaps.

3.5 Institutional Arrangements

3.5.1 Types of institutional arrangements

3.5.1.1 Ministerial responsibilities. Water and sanitation cut across traditional sectoral boundaries so that no single ministry entity has complete responsibility for the water and sanitation sectors in Kiribati. It is, however, a vital and strategic sector that requires coordination. The following outlines the Ministerial responsibilities and Figure 8 provides an organisational structure diagram for the sector.

3.5.1.2 Office Te Beretitenti The *Directions Assigning Ministerial Responsibility* (5 August 2003) includes "Ministerial Coordination" and "Cabinet taskforces Chairmanship" in the responsibilities of Office Te Beretitenti (the President). The strategic national importance of water and health suggests that government and community activity in water and sanitation should be coordinated by the Office Te Beretitenti within the National Strategic Policy and Risk Assessment Unit (NSPRAU). The role of the NSPRAU is to:

- Provide support to Cabinet and the President on Cabinet Memoranda;

- Review national policies of strategic national importance and of long-tem risk;
- Facilitate inter-ministry coordination on specific issues of national importance;
- Oversee disaster and crisis management arrangements.

The *Directions Assigning Ministerial Responsibility* also specify particular line Ministry responsibilities in water:

- Minister for Public Works and Utilities – water management; sewerage systems
- Minister for Health and Medical Services – health inspectorate services and environmental health.
- Minister for the Environment, Lands and Agricultural Development – environment and conservation; waste and pollution management.

3.5.1.3 Ministry of Public Works and Utilities - Public Utilities Board. The Public Utilities Board (PUB) was established on 1st July 1977 to coordinate and manage water supply and sewage disposal in urban South Tarawa. PUB is a Government-owned corporation under the Ministry of Public Works and Utilities responsible for power generation, water supply, and sewerage. PUB's Board of Directors is appointed by a panel of three Ministers chaired by the Minister for Public Works and Utilities with two other Ministers appointed by Cabinet. The Board is directly responsible to the Minister for Public Works and Utilities. Regulations under the PUB Act permitted the declaration of water reserves over major groundwater sources for South Tarawa. These prohibit settlement and allow eviction of existing dwellers and land owners from the Reserves. In Tarawa the lands overlying the freshwater lenses in Buota, Bonriki, and Teaoraereke are declared Water Reserves.

3.5.1.4 Ministry of Public Works and Utilities - Water Engineering Section. The Water Engineering Unit, WEU of the Ministry of Public Works and Utilities was established in March 1986, to coordinate outer island water project activities by conducting investigation of new water supply schemes, preparing designs and estimates, preparing project documents for funding submissions, implementing and managing outer islands water supply projects (except Kiritimati). WEU has water technicians in all inhabited outer islands except Canton, Fanning and Washington.

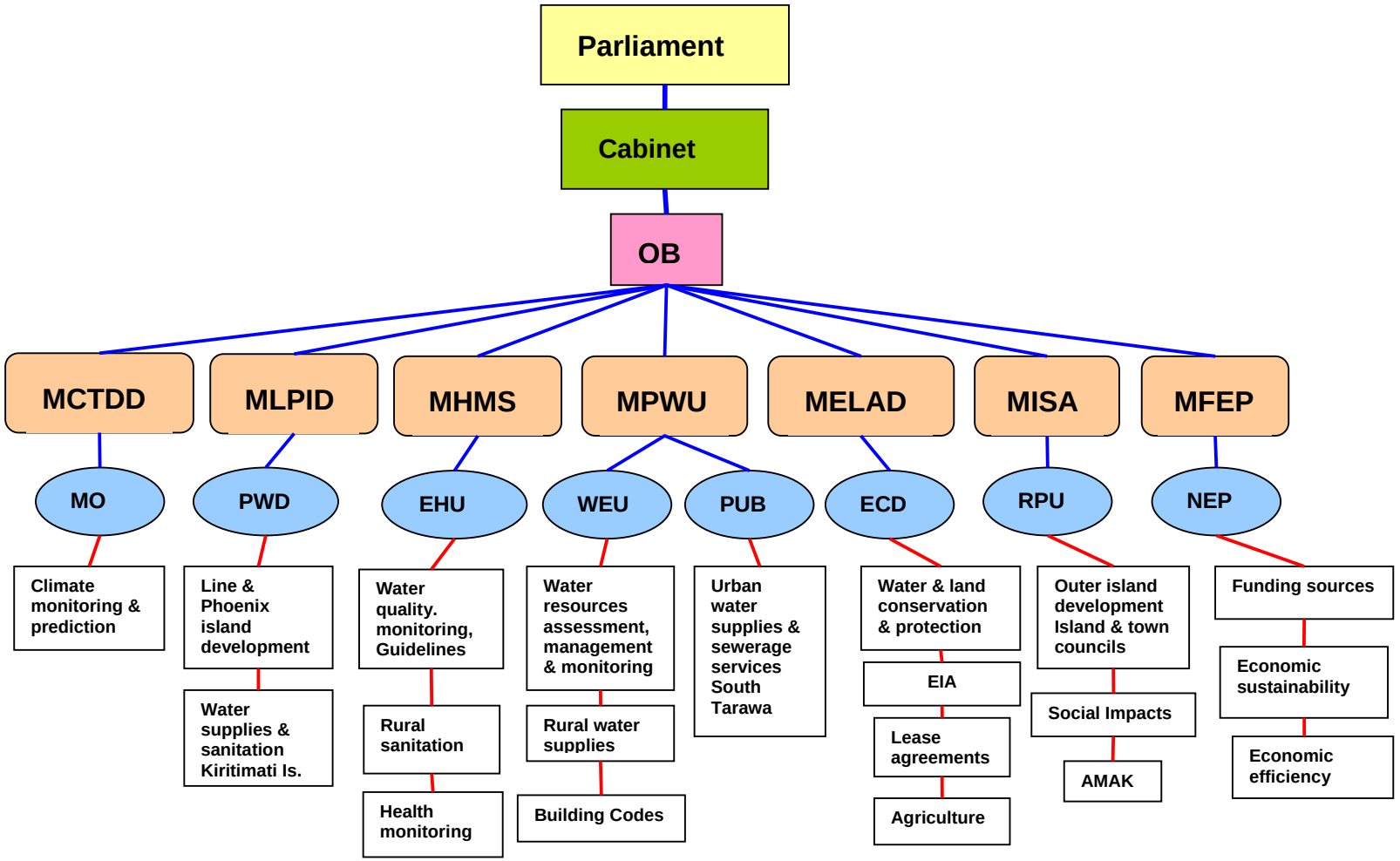


Figure 8: Kiribati water sector organisational and responsibility

In 2003 the WEU was delegated responsibility for overall water resources management in the country, including South Tarawa and Kiritimati. This responsibility includes water resource assessment, monitoring, planning, and controlling demand and the provision of water supplies in rural areas. The Ministry of Public Works and Utilities also has responsibility for establishing building regulations that include installation of rainwater collection systems.

3.5.1.5 Ministry of Health and Medical Services. In the late 1960s, responsibility for water supply in the outer islands was under the then Ministry of Health and Family Planning (MHFP). In 1985, this was transferred to the then Ministry of Works and Energy, firstly to PUB but then to the newly established Water Engineering Section. The Ministry of Health and Medical Services retains the responsibility for monitoring the quality of drinking water and has laboratories on South Tarawa and Kiritimati. The Environmental Health Unit of the Ministry is responsible for the provision of sanitary facilities to the villages outside South Tarawa which includes design and assistance with construction of pit toilets.

3.5.1.6 Ministry of Environment, Lands and Agriculture Development The Environment and Conservation Division within the Ministry of Environment, Lands and Agriculture Development is responsible for carrying out Environmental Impact Assessments (EIA) on major water resource developments, sanitation and waste disposal projects to assess their impacts on the environment. In addition, it has responsibility for ensuring the appropriate protection of groundwater reserves, of ensuring the conservation of freshwater sources and assessing the implication of climate change on freshwater and associated land resources. The Lands Division of the Ministry is responsible for the oversight of lease agreements with landowners on water reserves in South Tarawa.

3.5.1.7 Island Councils and the Ministry of Internal and Social Affairs. Island Councils play a key role in the implementation of rural water and sanitation schemes. A UNDP/UNCDF Outer Islands Community Water Supply Project (OICWSP) was undertaken in 73 villages in 13 islands of the Gilbert Group in the 1990s. The project reached an agreement between the Water Engineering Unit and Island Councils that Councils involved in the project should take responsibility for the basic maintenance of hand pumps, and contribute voluntary labour and local materials. In addition, the Island Council sanitary aides, who were employed by the then MHFP network, were recruited as water technicians by the MPWU and are responsible for regular quality control and water supply in the villages. All Councils come under the Ministry of Internal and Social Affairs (MISA).

3.5.1.8 Other Ministries. In addition to those with direct responsibilities in the water and sanitation sector, other ministries have influence, interests and responsibilities in the sector. Funding water projects and on-going maintenance costs as well as cost recovery programmes fall under the Ministry of Finance and Economic Development (MFED). Water supply and sanitation services in Kiritimati are run by the Water and Sanitation Service of the Public Works Department under the Ministry of Line and Phoenix Islands Development (MLPID). Climate measurement, especially rainfall, is the responsibility of the Meteorology Office, within the Ministry of Communications, Transport and Tourism Development.

Outer island water supplies and sanitation and attendant development opportunities are of special interest to the Rural Planning Unit, MISA. Community groups and organisations such as the Kiribati Women's Federation (AMAK) and Island Councils also fall under MISA.

3.5.1.9 Policy statements on water sanitation and national legislation. There is no clearly enunciated national policy statement on water and sanitation. Instead there are a collection of ministerial statements and decisions and the outcomes of national consultations.

The very high incidence of diarrhoeal diseases in South Tarawa, particularly amongst young children led to the GOK requesting Australian assistance in 1993.The Pacific Regional Team concluded that community health, education, water supply, sanitation, appropriate technology,

institutional strengthening and management aspects needed to be considered in a coordinated approach and that the GOK develop suitable strategies and policies for addressing the issues.

In a statement to the Maneaba ni Maungatabu (Kiribati Parliament), on the opening of its fifth session on October 31, 1994, Te Beretitenti (The President) of the Republic, presented an outline of the Government policy on all areas of its responsibility. Those policies that had direct or indirect implications for the water sector of Kiribati were:

- Strong emphasis placed on the improvement of living standard of an I-Kiribati.
- Resources and efforts directed towards developing subsistence and employment opportunities, and improving living conditions.
- Efforts to reduce population growth to continue.
- The resettlement programme to continue to be developed, new sources of livelihood explored, and basic essential services ensured and expanded.
- Efforts to promote Kiritimati Island as a focus of development will continue.

The *Draft National Water Plan*, developed with assistance from the United Nations Department of Technical Cooperation for Development (UNDTCD[2]), in 1992, and updated in 2000 by the WEU of the then Ministry of Works and Energy in collaboration with the PUB, identified some of the urgent national issues in water management that needed to be addressed. The most important were the need for national policy guidelines in order to develop priorities and to coordinate the water sector. It also pointed out that authority for overall water resources management had not been vested in any Government authority and that competence for water resources management and conservation was not identified in any of the then directions assigning Ministerial responsibilities. This was partly addressed in the Directions Assigning Ministerial Responsibility, August 2003.

The Kiribati National Consultation on Sustainable Water Management, conducted as a lead up to the Pacific Regional Consultation on Water in Small Island Countries in 2002, identified the continuing need for adequate supplies of safe drinking water and for better coordination of the water sector. The consultations throughout the Gilbert Group conducted for the National Adaptation Program of Action, Kiribati Adaptation Project Phase I (KAP I) identified 10 water and sanitation -related priority strategies in the top 25:

- Water pumps/pipes to get water from good source to settlement areas and homes
- Protect water wells
- Assess and locate available water on the islands
- Water conservation at home (including awareness raising)
- Improve sanitation, construct toilets
- Water conservation in piping systems
- Install rainwater tanks
- Install desalination plant
- Collect water from further away in the bush
- Proper use of land

[2] now the United Nations Department of Economic and Social Affairs, UNDESA

The Asian Development Bank (ADB) Technical Assistance Project, Promotion of Effective Water Management Policies and Practices in 2004 which excluded South Tarawa because of the then ongoing ADB Sanitation, Public Health and Environment project, developed a 20 year Kiribati Water Sector Road Map that set out strategies and a long-term action programme. Strategies were identified under four key areas: water resource assessment and monitoring; community assessment, consultation and participation; institutional arrangements and policy framework, water and sanitation development and arrangement. The strategies were arranged under eight projects within these areas. A central initial 12-month task proposed was the development of national policies and procedures for the improvement of operation of the water sector.

The Kiribati National Development Strategy 2003-2007 includes some policies and goals of direct relevance to the water sector:

- Raise the quality of life by improving supply and quality of water.
- Ensure sustainable use of water resources.
- Promote community participation for better use of water resources.
- Provide sound infrastructure and services at reasonable costs.
- Rehabilitate and expand existing water supply systems.
- Improve collection, storage, treatment and distribution of water.
- Rehabilitate the sewerage and sanitation system and improve its operation and management.
- Improve maintenance standards for government assets.
- Ensure that all future construction projects comply with the Environment Act.

Finally, the Cabinet decision in 2004 to make outer island water supply systems sustainable provides a clear policy direction but one that needs to be imbedded in a broader national water policy framework.

The above provide the basis for summarising a list of policy priorities for the water and sanitation sector:

- Increase per capita supplies of safe freshwater to improve health;
- Control demands for water and decrease losses from reticulation systems and storages;
- Protect groundwater sources and rainwater stores from contamination;
- Improve sanitation;
- Increase rainwater harvesting;
- Increase community understanding of and participation in the water and sanitation sector;
- Move towards sustainable water supply systems;
- Improve assessment and monitoring of island freshwater resources;
- Increase capacity in water resources planning and management;
- Develop and implement appropriate technology for rural water supplies and sanitation services.
- Improve risk assessment for water resources to climate variability and change;
- Review and improve legislation, policy, and administrative issues;

- Set the agenda for donor agencies and financing organisations in water resources and sanitation projects.

A European Union (EU) Pacific Water Governance (PfWG) Project, coordinated by SOPAC has initiated a draft National Water Resources Policy which is yet to be considered by the newly formed NWSCC. It is consistent with the above statements, international priorities and the Pacific RAP. The overall draft policy goal is to: "*ensure that communities have affordable access to sustainable water supply systems providing water of suitable quality and appropriate quantities and to appropriate sanitation to meet all reasonable health, environmental, and development needs.*"

Comment: Page number for quote

The draft planned policy outcomes are listed in Table 7.

Table 7. Planned outcomes of draft national water resources policy implementation

- Improved public health due to a decrease in water-born diseases;
- Equitable access to safe freshwater;
- Sustainable water supply systems;
- Protection of freshwater resources from adverse impacts of human activities;
- Better knowledge of the quantity and quality of fresh water resources, and improved monitoring;
- Efficient allocation of water to various users;
- Improved risk assessment and management for the water sector;
- Greater public awareness of water resources issues;
- Enhanced water and sanitation educational programs;
- Increased stakeholder involvement in water protection of freshwater sources;
- Increased community participation in the conservation and management of water and water sources;
- More effective governance and clear identification of roles and responsibilities;
- Increased ability to respond quickly to water crises;
- Strengthened institutional capacity and training in the water sector;
- Improved levels of cost recovery;
- Improved access to donor and loan schemes.

One mechanism necessary for the implementation of policy is the enactment of supporting water legislation. While regulations exist specifically for the operation of the PUB, there is no equivalent set of regulations for the outer islands. Draft National Water Legislation was drawn up in 1992 and has been with the Office of the Attorney General since that time. It has yet to be enacted.

3.5.1.10 National Water and Sanitation Coordination Committee. Under Cabinet direction the Ministry of Public Works and Utilities, the country's designated lead agency in water, convened the first meeting of the whole-of-government National Water and Sanitation Coordination

Committee (NWSCC) in February 2007. Membership of the committee includes all government agencies with responsibilities in water or water related activities. These include Ministry of Public Works and Utilities(MPWU), Ministry for the Environment, Lands and Agricultural Development (MELAD), Ministry for Health and Medical Services (MHMS), Public Utilities Board (PUB), Ministry of Finance and Economic Development (MFED), Ministry of Line and Phoenix Islands Development (MLPID), The Meteorology Office, Ministry of Communications, Transport and Tourism Development, Rural Planning Unit, Ministry of Internal and Social Affairs (MISA), Ministry of Fisheries and Marine Resources Development (MFMRD), and Ministry of Education Youth and Sport Development. Also represented is the KAPII office. There is an apparent reluctance to include NGO or community groups within the NWSCC.

3.5.1.11 Legislation. Most legislation relevant to water and sanitation was drawn-up in the mid to late 1970s and mainly deals with the institutions and procedures necessary for supplying freshwater to South Tarawa. Terms of reference of the NWSCC include review of legislation.

3.5.2 Major issues and concerns

Many of the issues and concerns in this section have been already raised in previous sections.

3.5.2.1 Lack of unified national water and sanitation policy, legislation and approved plans. It is claimed that impaired governance is the main obstacle to better and more equitable water sharing and improved water supply and services in many water-stressed countries (Solanes and Jouravlev 2006; UNWWAP 2006). A clear, unified national policy provides the framework for the conservation, sustainable use and management of Kiribati's water resources and for the provision of safe and adequate water to island communities. It represents the vision of the people of Kiribati for the water and sanitation sector. At present this is lacking. Without national policy, it is difficult to introduce legislation or national plans. One of the main impediments to the introduction of the 14 year old draft national water legislation is the key issue of water ownership and its relation to land tenure.

3.5.2.2 Lack of coordination and cooperation Previous attempt to coordinate sector activities in government agencies have failed. Some of the reasons cited for this are loss of initial enthusiasm, disputes over which Government Ministry should be the lead Ministry, a traditional reluctance to share knowledge, and a lack of clear definitions of responsibilities and terms of reference. Instead project-specific steering committees have been formed, but these lack continuity and strategic direction and are driven by the goals of the project rather than by national priorities.

3.5.2.3 Lack of community participation. A key to improved water governance is community participation in planning and decision making (UNWWAP 2006). In Kiribati, there is very little community involvement at the national, island or village level.

3.5.3 Measures to manage issues and concerns (IWRM approaches)

3.5.3.1 National Water and Sanitation Coordination Committee. The draft planned outcomes of the recently established NWSCC are:

- Coordination of government agencies with responsibilities in the water and sanitation sector;
- Facilitation of the development of broadly-based policies on water and sanitation which are consistent across sectors and with other related government policies;
- Identification of mutually-agreed priorities and processes;
- Provision of broadly-based advice to government on water and sanitation;
- Improvement in administration efficiency because advice and proposals have been thoroughly discussed and vetted before they go to Cabinet;

- Increased multi-sectoral understanding of the condition of the nation's freshwater resources, water supplies and sanitation services through coordinated monitoring and assessment;
- Provision of a single forum for interaction and information dissemination between agencies, the GOK and the community;
- Coordinated and thoroughly reviewed water and sanitation proposals for the Government of Kiribati and for donor and investment organisations;
- Increased confidence of donor and investment organisations in the sector.

3.6. Financing

3.6.1 Types of financing arrangements

3.6.1.1 Asset investments- urban and rural water supply systems. Portions of the reticulated water supply system for urban South Tarawa were upgraded under the SAPHE project which was completed in late 2005. The project replaced gallery pumps, installed an air sparging system (aeration unit) to remove hydrogen sulphide and a main 400 m^3 storage tank and distribution pumps, replaced the rising main to Teaoraereke, built extra elevated 22 m^3 pressure head tanks, and installed 2,229 household tanks with capacities of 500 litres. There is a considerable investment in water supply assets as listed in Table 8.

Infiltration gallery groundwater pumping systems and reticulated systems were installed in Kiritimati under an AusAID funded project in the late 1990s. The water supply assets currently in Kiritimati are given in Table 9. Rural and outer island water supply systems were installed under the UNDP/UNCDF OICWS project. It is been estimated that the current replacement value of galleries, solar and hand pumps, tanks, taps and pipe systems in outer islands (excluding Kiritimati) installed under the UNDP/UNCDF OICWSP is around AU$8 million.

3.6.1.2 Asset investments - urban sewerage system. The assets and estimated replacement value of the salt-water sewerage system installed in three locations in South Tarawa is given in Table 10. The seawater system used is subject to corrosion problems and the ocean outfalls are at risk of damage during storms.

Table 8: Water supply assets and their replacement value for South Tarawa

Assets	2007	Replacement Value (AU$)
Infiltration galleries and pumps	28	$2,871,300.00
Chlorination plants	2	$12,000.00
Aeration units	1	$106,000.00
Storage Tanks/Reservoirs	5	$100,000.00
Elevated Tanks (22 Kilolitres Capacity)	14	$132,000.00
Rising main length (km)	30	$1,200,000.00
Rising main diameter (mm)	225	
Number 500 L household tanks	2229	$1,340,000.00
Water meters:	2229	$154,000.00

Table 9: Water supply assets and their replacement value for Kiritimati

Assets	2007	Replacement Value (AU$)

Infiltration galleries and pumps	10	$1,000,000.00
Chlorination plants	3	$10,000.00
Storage and elevated tanks	6	$100,000.00
Rising main length (km)	8.5	$600,000.00
Rising main diameter (mm)	150	
Number 500 L household tanks	588	$353,000.00
Water meters:	588	$41,000.00

Table 10: Sewerage system assets and their replacement value for South Tarawa

Assets	2007	Replacement Value (AU$)
Sewage pump stations	20	$350,000.00
Elevated salt water tanks	3	$150,000.00
Seawater inlets	3	$300,000.00
Ocean outfalls	4	$200,000.00
Sewer main length (km)	25	$3,750,000.00
Sewer main diameter (mm)	250	
Saltwater main length (km)	25	$1,500,000.00
Saltwater main diameter (mm)	150	
Manholes	618	$500,000.00
Vacuum pumper	1	$100,000.00

3.6.1.3 Maintenance and operations costs The PUB is a multi-utility organisation supplying electricity to South Tarawa and up to Nabeina village in North Tarawa, and water and sewerage services to parts of South Tarawa. The current operation (expenditure) budget for the PUB is AU$10 million of which diesel fuel charges for electricity generation make up AU$7 million. The costs of operating and maintaining the water supply and sewerage services on South Tarawa are approximately AU$0.8 million. On Kiritimati the annual costs of maintaining and operating the water supply system are AU$297,526.00 (Kiribati Government Budget 2007).

The Water Engineering Unit in the MPWU is responsible for operating and maintaining outer island (with the exception of Kiritimati) water supplies. The annual operations and maintenance budget for this Unit is AU$325,861.00.

3.6.1.4 Cost recovery mechanisms. The current mechanism for cost recovery for the urban water sector in South Tarawa is through charging for bulk water deliveries by tanker at a rate of AU$2/m³ for domestic use and $5/m³ for commercial use with a AU$10 delivery charge. The piped water supply is currently charged at $10 per household per month for domestic water users and $5/m³ for industrial users. The marginal cost of water is currently AU$3.80/m³ if the costs of leasing the water reserves from traditional landowners are taken into account or AU$2.55 /m³ if they are set aside. In 2005 this charging scheme raised an estimated AU$120,000, less than the operational and maintenance costs for water supply. A current PUB proposal for a three-tiered water pricing scheme with different rates for domestic and industrial users is under consideration

for urban South Tarawa (Table 10). This, however, relies on the presence of currently non-existent water meters to assess water consumption.

Table 11: Proposed tiered water charges for private and industrial water users in South Tarawa

Domestic Water Rates

Use Category	Monthly Volume Used (m^3)	Price/m^3 AU$
Low	0-5	2.00
Medium	>5-10	3.00
High	>10	5.00

Industrial Water Rates

Use Category	Monthly Volume Used (m^3)	Price/m^3 AU$
Low	0-10	5.00
Medium	>10-20	10.00
High	>20	12.00

In Kiritimati, the water tariff was set at approximately AU$1.50 per 1000 litres. Households are currently charged at AU$15 per month on average and households consuming more than 10,000 litres a month are charged at a much higher rate. The government also runs a water tanker delivery service with a charge of $5 per 1000 litres. The total revenue collected for water supply services in Kiritimati amount to only AU$118,199 in 2005.

At present there is no charge for water in outer islands, partly due to the breakdown of community water supply systems installed under the OICWSP and other projects. Following the Cabinet decision to make the outer island water supply systems sustainable, the MPWU (2005) developed a policy to put in place a sustainable water supply system on outer islands that uses solar powered pumps for the extraction and distribution of potable water to households by establishing a revolving fund through the user-fee concept. The proposal is to charge households AU$2 a month for the use of the system and to use water technicians with the support of the Island Council and the village to collect the fee. The proposal is currently under review by MISA who are responsible for Councils. In some island nations in the Pacific, village water committees are used to locate, manage, protect, operate and maintain local village water systems. These committees may employ both a village plumber and a village mechanic for system maintenance and operation whose fees are paid by modest charges. These village level technicians could be trained and mentored by island Water Technicians supported by WEU, MPWU. KANGO appears well placed to help implement these committees.

Comment: 3rd use of this para. in the report..

3.6.1.5 Sewerage cost recovery The delivery of annual sewerage services in South Tarawa costs AU$480,000. The Government has decided that there will be no charge for sewerage services in South Tarawa. None the less, the PUB are developing a proposal to recover modest sewerage charges, first from government departments and industry and then from households.

3.6.1.6 Performance Monitoring. Financial performance monitoring in the water and sanitation sector has had a low priority. It relies on the presence of reliable and accurate information. This in turn needs effective mechanisms for data collection and performance measurement. These aspects require strengthening. Any improvements should consider a range of levels from operational aspects to higher-order goals as set out in national development targets.

3.6.1.7 Revolving fund for purchase of rainwater tanks. Rainwater tanks return some of the responsibility of demand management to households; however, the initial purchase price is beyond most households. As part of the SAPHE project, a revolving fund loans scheme was established for government employees to install rainwater harvesting and/or sanitation facilities. It has been operating in South Tarawa since 2002. In the years 2002 to 2004, about 710 loans were given for roof rainwater harvesting and storage equipment. Repayments of loans of up to a maximum of AU$1,500 are guaranteed by ensuring loans are given only to people with regular incomes and by recovering regular repayments from fortnightly salaries. The scheme is administered by the Kiribati Housing Corporation. Under KAPII it is planned to attempt to trial this scheme in rural areas and outer islands.

Comment: The 3rd time this para has been used in report.

3.6.1.8 Externally funded water projects. A number of external organisations have contributed to the development of the water and sanitation sector in Kiribati over the past 40 years. In the late 1960s the then South Pacific Commission (now Secretariat of the Pacific Community, SPC) funded water supply and sanitation projects on the island of Nikunau in the southern Gilbert group. The water supply system on the island was rehabilitated in 1988 using a solar pumping system with funds from USAID, via the SPC.

The New Zealand and Australian Governments contributed to the development of a reticulated water supply system for South Tarawa sourced from groundwater in the early 1970s and later in the mid 1980s. The Australian government, through AIDAB (now AusAID), constructed a sea water-flushed sewerage system for Betio, Bairiki and Bikenibeu in South Tarawa from 1978 to 1983. AusAID also funded assessments of groundwater resources in Tarawa and Kiritimati in the 1990s.

The UNDP Integrated Atoll Development Program in 1987 installed a solar pumping system on the northern part of Tamana Island, provided rainwater tanks to village maneabas and supplied so-called Tamana pumps to individual houses on the island. The Australian and New Zealand government also funded water solar pumped supply schemes on some islands, including the villages of Tekaman and Tekabuibui on Tabiteuea North and a rehabilitated windmill system in Tewai village on Tabiteuea South.

Following major diarrhoeal outbreak in children in South Tarawa and the breakdown of communal toilets, the GOK requested Australian assistance in upgrading the sanitation and water supply systems in 1993. AIDAB's Pacific Regional Team conducted a field appraisal of the proposal in and concluded that the problem in South Tarawa was critical and that it should be addressed in as comprehensive manner as possible if sustainable and effective development is to be achieved. It recommended a multi-disciplinary, coordinated, long-term (at least 10 years) programme with multiple components being conducted in parallel rather than by implementing individual components and with annual budgets of several million (1990) dollars. This first IWRM proposal for Kiribati was ignored by AIDAB but was later culminated through a concessional loan facility with the Asian Development Bank and developed into the SAPHE Project.

Assistance from the UNDTCD produced the first Draft National Water Plan in 1992. The UNDP/UNCDF OICWSP Project started in the early 1990s to provide safe water supply systems for rural areas and outer islands in the Gilbert Group. As part of this project, draft water legislation and organisational arrangements for the water sector of Kiribati were also proposed.

Groundwater pumping systems, reticulated water supply, sanitation and solid waste disposal systems of Kiribati's largest island and a designated growth centre, Kiritimati were upgraded from 1997 to 2002 in the AusAID funded Kiritimati Water Supply and Sanitation Project, KWASP.

An UNESCO International Hydrological Programme (IHP) project in the late 1990s reassessed recharge estimation to improve estimates of sustainable groundwater yield. It also examined the social and cultural aspects of the water sector and in South Tarawa and made recommendations on increasing community involvement in the management of groundwater reserves. A joint

ACIAR-French Government (CIRAD) project determined the impacts of pumping and landuse on the freshwater lens as well as trialling multi-agent based simulation methods and role-playing games for minimising conflict over water resource use.

From 2000 to 2005, the AU$14 million ADB funded SAPHE Project introduced improvements to the water pumping, treatment, reticulation and waste disposal systems in Tarawa. This project also included a substantial community consultation and education component. At the same time, a range of technical assistance projects were undertaken under AusAID, ADB and EU funding.

As a precursor to the 3rd World Water Forum, SOPAC and the ADB sponsored a series of national consultations throughout the Pacific that culminated in the *Pacific Regional Action Plan on Sustainable Water Management,* endorsed by all Pacific Island Nations Heads of State. This provided a framework for improvements in the water sector in many small island countries.

Following this, an ADB technical assistance project Promotion of Effective Water Management Policies and Practices helped develop a “road map” for the Kiribati water sector for the next 20 years focused mainly on outer islands. The road map proposed the establishment of a National Water and Sanitation Committee (or a number of committees) to advise the Government on all aspects of water supply and sanitation for all of Kiribati. There was no initial response to this project.

As a response to the potential impacts of climate change, Kiribati and Colombia were the first countries in the world to be selected under the Global Environmental Facility (GEF) Strategic Priority on Adaptation. Extensive community consultations carried out throughout the Gilbert Group for the World Bank-GEF supported a National Adaptation Program of Action. Kiribati Adaptation Program Phase I (KAP I) in 2004 identified 50 key adaptation strategies. Seven out of the top ten priorities were water and sanitation-related. The World Bank implemented project Kiribati Adaptation Program – Pilot Implementation Phase (KAPII), supported by AusAID and NZAID was signed in May 2006 and involves a significant number of projects on water related to the Kiribati road map. KAPII is a planned precursor to KAPIII.

An EU sponsored project run by SOPAC, the Pacific Water Governance Project has chosen Kiribati as a pilot study to implement practical water governance in 2006-7. This project is designed to be a precursor to KAPII and has facilitated the setting up of a National Water and Sanitation Coordination Committee involving a whole-of-government and community partnership approach to integrated water and sanitation management. It has also produced a draft National Water Policy and a revised draft National Water Plan.

While all these largely externally-driven projects have proved beneficial to Kiribati, they have tended to be relatively short term and many were addressing immediate, narrowly focused problems or following external agenda. What is needed is a strategic ordering of priorities and actions within a broader framework so the longer-term issues of vital concern to the nation can be addressed in a systematic fashion.

3.6.2 Major issues and concerns

3.6.2.1 Financial unsustainability of water and sanitation systems. Revenues from urban water charges do not meet the operating and maintenance costs of the supply agencies. There are no revenues collected from rural outer island water supply systems. Consequently, there is no scope for raising finances for infrastructure development or renewal costs from water revenues so the GOK must rely on donor or loan funds for any major water and sanitation project.

3.6.2.2 Inequity in sanitation services. The government decision to supply sanitation services in South Tarawa to the 23% of households connected to the seawater-flushed sewerage systems means that this privileged few are being cross-subsidised by the rest of the community.

3.6.2.3 A fair water tariff system. The issue of tariffs is critical. Without a demand management-controlling tariff in place and an equitable and efficient procedure for collecting revenues, demand is likely to outstrip the systems' supply and/or the effective water treatment capacity. Consumer dissatisfaction will inevitably result. Using water pricing to control demand in South Tarawa, however, is problematic. Firstly there are many households and squatters who cannot afford to pay for water. Secondly, most households have domestic wells, even in densely settled areas such as Betio, and if the price is too high households will simply increase use of dubious quality well water. Finally, charging for water cuts across the traditional view that water is a common property resource.

3.6.2.4 Improved financial reporting. The GOK and the general public need to be informed regularly of the running and replacement costs of water and sanitation systems in rural and urban areas.

3.6.3 Measures to manage issues and concerns (IWRM approaches)

3.6.3.1 Three-tiered water charges. The proposed PUB three-tiered scheme of charges for fresh-water (Table 10), currently being considered by GOK, is designed to recover maintenance and operation costs of the freshwater reticulation system in South Tarawa. The proposal is politically sensitive and involves the installation of water meters at all connections. An alternative uniform price with rebate (UPR) tariff arrangement will also be considered. In the UPR, a certain equivalent cost of water will be deducted from the total monthly water charge as a rebate.

3.6.3.2 Policy and proposal on the sustainability of outer island water supplies. The Cabinet decision in 2004 to make outer island water supply systems sustainable, particularly in finances, provides a clear policy direction. The MPWU (2005) developed a proposal to put in place a sustainable water supply system on outer islands that uses solar powered pumps for the extraction and distribution of potable water to households by establishing a revolving fund through the user-fee concept. The proposal is to charge households AU$2 per month for the use of the system and to use water technicians with the support of the Island Council and the village to collect the fee. The proposal is currently under review by MISA who are responsible for Councils. The keys to the sustainability of water supply systems in outer islands is the provision of technical support at the village level, the improvement of infrastructure services in and to the outer islands and the financial capacity of individual households to meet the marginal cost of water.

3.6.3.3 KAPII. One of the water resources components of KAPII is to provide technical assistance to PUB in such things as consumer education and awareness, pricing policy for water and monitoring programs. In addition there are also components to strengthen the capacity of the WEU, MPWU in assessment and monitoring of water resources and to establish a revolving loan fund for the purchase of household water tanks in outer islands.

3.6.3.4 NWSCC. The draft TOR of the NWSCC directs it to review instruments and to improve monitoring and reporting in the water sector.

4. Linkages with other sectors

4.1. Landuse and Agriculture

The CIA World Factbook suggest that land use over the total land area in Kiribati consists of 2.7% arable land, 48% permanent crops as coconut and pandanus trees and 49.3% others, mainly consisting of saline areas in Kiritimati.

4.1.1 Groundwater reserves and customary land use

As has been already discussed the extremely high permeability of coral sands in Kiribati means that surface contaminants are transported into shallow groundwaters very rapidly. In areas set aside as groundwater sources, extreme care must be taken to prevent contamination. However, access to land and common property resources is essential for survival, even in urban areas (Jones 1997).

The relatively low per capita Gross Domestic Product should not be taken as an indication of poverty. Most adult I-Kiribati own or have access to land. Land ownership, is fundamentally important and traditionally carries with it fishing, harvesting and resource rights and provides access to building materials and food (Talu et al., 1979). Land tenure also has customary rights including ownership of groundwater. This presents major problems in urban areas where the declaration of water reserves over privately owned lands precludes land owners from settling on that land, selling it, or using it as they wish. It removes some customary subsistence rights. One of the current issues faced in South Tarawa is the mining of coral aggregate for use in concrete from water reserves. While this activity is illegal, it is a ready source of cash for people with limited means of earning income.

In South Tarawa the Government gives traditional land owners of the water reserves in Bonriki and Buota an annual land lease payment for use of water reserves. Under the Land Acquisition Act, compensation should be a one-off payment and the current annual payments are considered by some as illegal. Acceptable and equitable solutions need to be found before further public water reserves can be developed in other islands. The proposal to declare these water reserves as protected areas or as national park with landowners as custodians with the government or the water utility providing remunerations should be pursued as a long-term proposal.

4.1.2 Impacts of traditional crops and livestock

Traditional crops such as *babwai* (swamp taro) and coconuts as well as market gardens and the raising of pigs can have major impacts on groundwater quality. *Babwai* pits are excavated to below the watertable and compost and pig manure is used to fertilise the crop. This can seriously compromise groundwater quality as can market gardens, using manure and compost and pigs. Fortunately in Kiribati, pigs are often kept in pens close to the lagoon side of the island and usually down-gradient from groundwater wells. However many piglets and chickens as well as dogs run wild. The impacts of land use on water quality can be seen in the presence of *E. Coli* in groundwater.

Even in highly urbanised areas, coconut trees, which have been called the tree of life (Foale 2003), play a fundamentally important role in supplying food and drink, building materials, income and export earnings through copra production. Sap-flow measurements have revealed that coconut trees transpire up to 150 L/day of groundwater, equivalent to the reticulated water use of 3 to 5 people (White et al. 2002). Higher planting densities affect recharge significantly during dry periods (Falkland 1992).

The dilemma here for water resource managers is that thinning coconut trees on groundwater source areas can increase groundwater recharge and therefore increase the sustainable groundwater yield but may affect significantly the subsistence livelihoods of landowners in areas used for groundwater sources.

4.1.3 Impacts of water extraction on traditional crops

One of the concerns raised by villagers owning land in areas declared as Water Reserves in South Tarawa and potential reserves in North Tarawa is that pumping of shallow groundwater impacts significantly on the health and productivity of their traditional crops, swamp taro and coconut. The ACIAR project *Equitable Groundwater Management for the Development of Atolls and Small Islands* produced detailed scientific evidence that the water extraction from Bonriki and Buota had less impact on the water table and salinity levels than the daily diurnal tidal fluctuation. There is a need here however to provide landowners with a community-based monitoring scheme to satisfy them of this.

4.1.4 Impacts of urban areas

Human wastes, livestock and domestic animals also constitute pollution sources to groundwater in urban areas. In addition to these, spillage and leakage of petroleum products from generators and motor vehicles, wastewater seepages from solid waste repositories and leakage from sewerage systems also threaten groundwater. In densely populated areas, groundwater nitrate concentrations are so high that it causes the “blue baby” syndrome.

Comment: What is this exactly?

4.2. Habitats and ecosystems

The atoll islands of Kiribati are most vulnerable to the impacts of climate change which include accelerated sea-level rise. This is because of their small sizes and low -lying topography. This implies that the atoll islands of Kiribati would not be able to adjust to the adverse impacts of climate change and sea-level rise. It also implies that with the accelerated sea-level rise the atolls would not be able to support human habitation (MESD 1999).

A program within MELAD has identified sites of ecological significance and engendered species within Kiribati. Special reserves have been created to protect wildlife and their habitats. Kiritimati, the largest island in Kiribati, has major wildlife sanctuaries identified for its world-famous birdlife. These sites are removed from human settlement and water supply lenses are protected by law. Kiritimati was used during the 1950s and 1960s for atmospheric nuclear testing by the United States and the United Kingdom. The United Kingdom recently sent a team of experts to Kiritimati to clean the island from remnants left after the nuclear tests.

The Phoenix group of islands and surrounding seas have been recently declared a national park. The total area that will be protected spans some 184,700 square kilometres of the central Pacific and is the world’s third-largest marine protected area. The area will be out of bounds for commercial fishing, protecting precious coral reefs and undersea mountains. The benefits to Kiribati from this marine protected area can only be realised in years to come.

The program of marine protected areas could be extended to the water reserve areas on South and North Tarawa whereby landowners could act as custodians and receive some remuneration from government or other agencies responsible for exploiting or protecting groundwater resources. Other payment mechanisms can be considered which include the setting of a trust fund for the landowners to replace the current land lease payment. The water reserves protected area program on Tarawa then could be extended to other islands in the country if it is proved successful.

The consequence of the impacts of sea-level rise would make all islands in Kiribati uninhabitable. This is an extreme case that will only happen if the human race fails to use and manage the environment wisely. Based on recent scientific evidences, the sea-level is rising and the only solutions available to Kiribati are accommodation, protection, retreat and external settlement (MESD 1999). There is a need to enhance any consequential adjustment of Kiribati people lifestyles to fit with the adverse impact of climate change and in particular to the accelerated sea-level rise, which will severely affect the availability of fresh groundwater.

4.3. Health and hygiene

The main aim of any public water supply and sanitation systems is to improve public health, particularly in relation to water-borne diseases. The alarming infant mortality rate due to diarrhoeal disease in Kiribati is amongst the highest in the Pacific. In 2005, almost 1 person in 4 was affected by diarrhoea or dysentery to the degree that required a visit to a clinic (Table 12). In 2005, 56% of these cases were in South Tarawa and of them 54% came from clinics in the crowded Betio Island. Direct links to the contaminated groundwater cannot necessarily be inferred from such statistics, although it appears to be the probable cause. It is estimated that many more people suffer from the effects of water-borne diseases than are reported in the statistics from health clinics and there are significant absences from work as a result. The economic and social impacts caused by deaths and illnesses due to preventable water-borne diseases are substantial.

Table 12: Incidence of Diarrhoea and Dysentery at Health Clinics in Kiribati

Year / Illness	2003	2004	2005
Diarrhoea†	11678	7451	13991
Dysentery	8781	5623	8597
Total	20459	13074	22588

Source: Ministry of Health and Medical Services
† Diarrhoea is an Indicator and not a disease in itself.

4.4. Watershed and coastal management

All fresh groundwater lenses discharge to the sea. The importance of this submarine discharge to the near shore ecology of island reefs and lagoons has yet to be determined. The impacts of low density outer island populations on near coastal waters are relatively slight, however, in heavily populated areas along South Tarawa significant impacts occur. In South Tarawa, the practice of placing pig pens on the lagoon side edge of islands, which lessens the chance of polluting shallow groundwater, has led to algal blooms occurring on the near shore sediments.

Raw sewage is discharged at four points at the ocean-side reef edge in Nawerewere Central Hospital, Bikenibeu, Moroni High School, Bairiki and Betio on South Tarawa. Under the SAPHE project it was planned to extend these outfalls over the reef edge with a discharge point 15 m below sea level. Difficulties in construction resulted in the discharge points being some considerable distance away from the edge of the reef but at a depth of less than 10 m below mean sea level. An environmental impact of these outfalls through a long-term monitoring process is required, but initial inspections shows good dilution of the sewage plumes.

Leachate from waste dumps enters the lagoon at several points in South Tarawa. These leachates have high counts of bacteria and discharges seriously compromise the water quality of near shore waters in the lagoon. The cholera outbreak in 1977 has been attributed to eating parboiled shellfish harvested from the near shore lagoon.

Because of these coastal impacts, both MELAD and Ministry of Fisheries and Marine Resources Development (MFMRD) are members of NWSCC.

5. Stakeholder engagement

Institution	Stakeholders/Interests and Responsibility	Relevance to IWRM and reason for Inclusion	Role in the consultation process
KAP	Implementation of GEF, World Bank, AusAID, NZAID Kiribati Adaptation Program Phase II, CCA	Member NWSCC Member NASC	Information of KAPII water projects, HSA
MPWU	Water resources assessment, management and monitoring , outer island water supplies, building codes	Government designated lead water agency , lead agency IWRM and convener NWSCC, Member NASC	Convened meetings, Provided information, helped produce report, HSA
MHMS	Water microbial quality monitoring, rural sanitation, health monitoring	Member NWSCC, Government designated water agency	Provided information, reviewed report, HSA
MELAD	Water and land conservation and protection and monitoring, water reserve lease agreements, agriculture	Member NWSCC, Member NASC, Government designated water agency Lead agency NAPA	Provided information, reviewed report, HSA
MO (MCTTD)	Climate monitoring and prediction	Member NWSCC, Member NASC	Provided information, reviewed report, HSA
MFMRD	Marine resources and fisheries, coastal protection	Member NWSCC, Member NASC Lead agency SOPAC, importance of land discharges to the sea	Provided information, reviewed report, HSA
MISA	Outer island development, Island and town councils, AMAK	Member NWSCC, Lead agency OIPCC	Information on outer islands, HSA
MLPD	Line and Phoenix island development Water supply on Kiritimati	Member NWSCC, key agency South Tarawa	Provided information on Kiritimati
PUB	Water and sanitation service provider, South Tarawa	Member NWSCC	Helped write report and HSA
KANGO	The Kiribati Association of NGOs	Planned member NWSCC	Information on village associations.

WHO	Health monitoring, water quality standards, sanitation practices	Importance of water-borne diseases	Support to NWSCC, Provided health statistics

6 Other programmes, projects and activities related to IWRM

6.1 Millennium Development targets

The UN General Assembly, in its Millennium Declaration in 2000, resolved "*to halve by the year 2015 the proportion of the world's population who are unable to reach or afford safe drinking water"* and, *"to stop the unsustainable exploitation of water resources*".

The World Summit on Sustainable Development in Johannesburg in 2002 also set a new target of "*halving the proportion of people who do not have access to basic sanitation by 2015*".

These global goals are particularly relevant to population centres and outer islands in small island nations in the Pacific where provision of adequate supplies of appropriate quality water is a major challenge. In 2004 the GOK adopted a policy of to make outer island water supply systems sustainable, consistent with the Millennium Declaration.

6.2 Pacific Regional Action Plan for Sustainable Water Management

As a precursor to the Third World Water Forum, Kyoto 2003, the Pacific Regional Consultation Meeting on Water in Small Island Countries at Sigatoka, Fiji Islands, 2002 identified the following key issues, concerns and constraints:

- Freshwater availability.
- Increasing demands for water.
- Water quality degradation in surface and groundwater catchments, with consequent down gradient impacts on human health and the environment.
- Insufficient knowledge of island freshwater resources.
- Insufficient education, training and capacity in water resources.
- Inappropriate technology and methods, in relation to rural water supplies.
- Catchment and groundwater reserve management issues.
- Vulnerability of water resources to natural hazards, climate variability and change;
- Insufficient community education, awareness and participation;
- Water leakage and other losses including wastage in distribution systems;
- Legislation, policy, planning and administrative issues;
- Role of donor agencies and financing organisations in water resources projects.

In many small island communities, significant deficiencies in monitoring and assessment of water resources prevent small island nations from properly planning, developing and sustainably managing their limited and vulnerable water resources. The meeting identified that there was generally no systematic, coordinated approach to address these deficiencies.

This meeting led to the development of the Pacific Regional Action Plan on Sustainable Water Management (RAP). The RAP was endorsed by all Pacific Island Nations Heads of State during the Pacific Island Leaders meeting in Auckland in 2003, and was presented at the Third World Water Forum. The RAP calls for broadly-based national water visions, design of capable institutions, national water action agenda and plans, empowerment of communities, and integrated investment plans. It recognised that both behavioural change and long-term collaboration were essential for improvement. At the Fourth World Water Forum in Mexico in 2006, considerable progress was reported towards these objectives in the Pacific Position Paper however, major challenges remain in Kiribati.

6.3 Kiribati Adaptation Program (KAP)

In 2003, the GOK, with support from the World Bank, started the GEF sponsored Kiribati Adaptation Program (KAP), under MFED, with the key goal of reducing Kiribati's vulnerability to climate change, climate variability and sea level rise. The program is planned to have 3 phases. Phase I, Preparation (from 2003 to 2005) phase aimed to incorporate adaptation into national economic planning, to prepare a National Adaptation Program of Action (NAPA) under MELAD, and to design an intermediate pilot implementation phase, KAP-II. All of these activities were based upon an extensive consultation process, as well as several technical studies in key affected sectors.

The recently commenced KAPII, Pilot Implementation (planned for 2006-2008), jointly funded by GEF, NZAID and AusAID, aims to develop and demonstrate the systematic diagnosis of climate-related problems and the design of cost effective adaptation measures, while continuing the integration of awareness and responsiveness into economic and operational planning. This will be achieved through continued consultation and awareness raising; consolidation of the mainstreaming of adaptation into national economic planning; and implementation of pilot adaptation measures to address pressing adaptation issues while building capacity in key government ministries, local government and communities. KAPIII, Expansion (planned for 2009-2015) is intended to gradually scale up the investments piloted under Phase II to cover all major islands and vulnerable sectors of Kiribati.

KAPI prioritised adaptation options under the following categories: awareness; water resources; inundation/coastal erosion; agriculture; health; family planning; overcrowding/migration; Fisheries and waste management. The water resources projects proposed for KAPII are listed in Table 5. These projects represent a good start at addressing some but by no means all of the key priority issues identified in this report.

6.4 Revised Draft National Water and Sanitation Policy and Plan

As part of an EU funded SOPAC-coordinated Pacific Water Governance Project 2005-7, a Draft National Water Policy, Water for Healthy Communities, Environments and Sustainable Development and a revised draft 10 year National Water and Sanitation Plan National Plan and Strategies for Sustainable Water Management and Use have been produced for consideration by NSWCC.

7. Capacity development needs for removing the barriers

Small island countries with scattered island populations, such as Kiribati, face many barriers to the improvement of water supply and sanitation services as discussed previously.

7.1 Geographic spread of islands and villages

The spread of Kiribati's one urban centre, South Tarawa, and 167 rural villages across 3 million km^2 of the central and western Pacific presents particular problems for the delivery of improved freshwater and sanitation services. Most inhabited atolls have one island water technician, employed by the WEU within MPWU and an environmental health officer employed by MHMS. The delivery of services by one technician in atolls which have as many as 18 separate villages often on different islands is extremely difficult. Island technicians need to have a program of training to improve their skills in monitoring, operation and maintenance. However island technicians alone cannot deliver efficient services at the village level. Instead, what is required is the development of village-level water and sanitation committees, each with a village plumber and a village mechanic to provide services within the village. These village-level technicians could be mentored by the island water technician and the island and environmental health officer but would require training. A program of capacity development of the village water and sanitation committees is also required. Poor linkages between the outer islands, others parts of the country and Tarawa and the outside world mean that technical and logistic support for outer islands is difficult and is an impediment to the sustainability of the water supply systems in the outer islands.

7.2 Policy and planning development

The lack of integrated policy and plans at the national level demonstrates a need to provide training in the development of policy and plans and in their implementation across government ministries.

7.3 Inter- Ministry collaboration and community participation

Water ministries tend to act as "silos" and work independently of other Ministries with responsibilities in the sector. There is an urgent need for training in the development of inter-Ministry cooperative teams and in ways of effectively including the community in processes. The use of church groups to facilitate community participation is crucial given the fact that all I-Kiribati are members of church groups.

7.4 Water resource assessment, monitoring, analysis and reporting

The ability to plan for future needs, to identify developing problems and to take appropriate action is significantly hampered by the lack of systematic assessment, monitoring, analysis and reporting throughout all water Ministries. There is an urgent need to improve the capabilities of all Ministries involved in water, in water resource assessment, monitoring, and data analysis and reporting.

7.5 Health impacts of contaminated water

There is a tendency at all levels to regard the incidence of water-borne disease as part of the natural order. A general education program demonstrating that water-borne diseases are preventable is urgently needed.

7.6 Protection of groundwater sources

This report has highlighted the very high risk of contamination of shallow groundwater in small island countries by surface activities. This risk is compounded by general land scarcity and by the

fact that most land is privately owned and that land tenure infers subsistence rights. A training program is needed on available mechanisms to protect groundwater sources in such situations.

7.7 Rainwater harvesting

Harvesting rainwater has significant benefits in improving health and in controlling demand. While considerable progress has been made in this area, training is required in the design, operation and maintenance of such systems in rural outer island communities.

7.8 Improved urban sanitation

There is an urgent need to improve sanitation in densely populated urban areas. Training is required here in the design, operation and management of a variety of safe sanitation systems.

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8. Introducing an integrated approach towards barrier removal

8.1 National Water and Sanitation Coordination Committee

There is currently no method of systematically reporting to GOK on water resources assessment, monitoring, water quality, water demand and use, health and environmental impacts or on the effectiveness of policy and regulations. The National Water and Sanitation Coordination Committee (NWSCC), convened in February 2007 by the Ministry of Public Works and Utilities (MPWU) is designed to address these deficiencies. Membership of the committee includes all government agencies with responsibilities in water or water related activities. These include MPWU, Ministry for the Environment, Lands and Agricultural Development (MELAD), Ministry for Health and Medical Services (MHMS), Public Utilities Board (PUB), Ministry of Finance and Economic Development (MFED), Ministry of Line and Phoenix Islands Development (MLPID), The Meteorology Office, Ministry of Communications, Transport and Tourism Development (MCTTD [MO]), Rural Planning Unit, Ministry of Internal and Social Affairs (MISA), Ministry of Fisheries and Marine Resources Development (MFMRD), and Ministry of Education Youth and Sport Development. Also represented is the KAPII office. The ability of this committee to work cooperatively and effectively is crucial to the success of integrated water resource management in Kiribati.

8.2 National Water Policy, plans and legislation

Without a clear, unified vision as set down in national policies, without a national plan to achieve that vision, and without underpinning legislation, water and sanitation sectors are without clear direction. Draft versions of all these exist, some for more than 15 years, but they are yet to be accepted and approved by GOK. One of the planned main tasks of the NWSCC is to review, amend and carry these through to completion, in collaboration with existing and future programs.

8.3 Sustainable water supply and sanitation systems

One of the key issues facing GOK is the environmental, social and financial sustainability of water supply systems and sanitation services in urban, rural and outer island settings. Densely settled, urban South Tarawa presents major challenges. The costs of operating and maintaining urban and rural systems are not being recovered. The perception that water is a common property resource combined with the number of households and squatters who cannot afford to pay tariffs complicate issues. A proposal for a three-tiered water tariff has been advanced for urban areas and a monthly water charge for outer islands to be collected by councils has been suggested. The environmental and health impacts of sanitation systems require further monitoring.

8.4 Capacity building in water resource assessment, monitoring, analysis and reporting

Projects within the recently initiated KAPII have been specifically designed to address this issue within MPWU. There is an urgent need to extend this capacity building into the health and environment sectors and to Kiritimati.

8.5 Community participation

Increased community participation is seen as a key to improving water governance. Currently there is almost no community participation at any level. It is intended that the suggested involvement of NGOs, church and community groups in the NWSCC will be addressed at the national level. The formation of village-level water and sanitation committees is seen as essential to improved sector performance. On South Tarawa, where the water problem is reaching a critical state, the involvement of church groups in community consultation is crucial given the fact that all I-Kiribati belong to a church group. Mechanisms to facilitate consultation with church groups need to be developed.

8.6 Protecting groundwater sources

The formation or reformation of village/landowner/government agency water reserve protection committees is seen as a necessary first step in the protection of groundwater sources. A major media campaign on the prevention of pollution and the health impacts of contaminated waters would also address some of the major issues.

8.7 Rainwater harvesting

The SAPHE project presented a successful model in South Tarawa with the establishment of a revolving loans scheme for the purchase of rainwater harvest and storage equipment. The KAPII project has several projects directly aimed at improving rainwater harvesting. These include: a review of building codes; development and promotion of guidelines on rainwater catchments, storage and use; installation of rainwater collection and storage facilities at government and community buildings in South Tarawa; and the establishment of an outer islands household loan scheme for roof catchments and sanitation. It is emphasised here that the advantages of household and communal rainwater tanks are in improving the quality of water supplies and in returning conservation to the household and local levels. Rainwater harvesting schemes, however, do not provide protection against the periodic severe droughts.

8.8 Provision of new safe, groundwater sources for South Tarawa

The continuing increase in water demand in South Tarawa means that this highly urbanised area is at the limit of sustainability for the supply of treated fresh water. While resettlement schemes and provision of better services in outer islands are planned to lower the rate of inward migration, there is little doubt that new, safe sources of groundwater for South Tarawa will have to be found. This will entail complex negotiations between the government and landowners. It is important to have in place a system for negotiation that minimises potential conflicts.

The underlying principle to minimise potential conflict is that landowners should be adequately compensated for the use of their land for the benefit of the public and the nation as a whole. The proposal to declare Water Reserve areas as protected areas and their declaration as national parks might help to minimise potential conflict provided appropriate legislation and policies and financial incentives are in place.

8.9 Emphasis on alternate development centres

The proposal by the government of Kiribati to establish urban growth centres on some islands will certainly alleviate the problem now encountered on South Tarawa in terms of freshwater availability, land for development and the current problem of urban drift to one area only. Four islands have been identified as designated growth centres are Beru, Butaritari and Tabiteuea North in the Gilbert group and Kiritimati Island in the Line Islands. Kiritimati Island is the most developed of these.

In order to attract people to centres other than South Tarawa it is essential to have in place the necessary infrastructures, particularly water supply and sanitation, electricity, hospitals and schools in the proposed four growth centres. Freshwater resources have only been assessed in Kiritimati so an immediate priority is the water resource assessment in the remaining three islands. Table 2 and 4 suggested that in Beru, Tabiteuea North and Kiritimati, the availability of water will limit population growth, because of lower rainfall and higher coefficient of variability. Butaritari with higher rainfall and lower coefficient of variability can support higher number of population. It is important in these development centres that issues relating to the protection of sources of freshwater for the reticulation and land ownership and use in source areas be resolved with local community prior to any development. This will require sensitive application of IWRM principles.

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