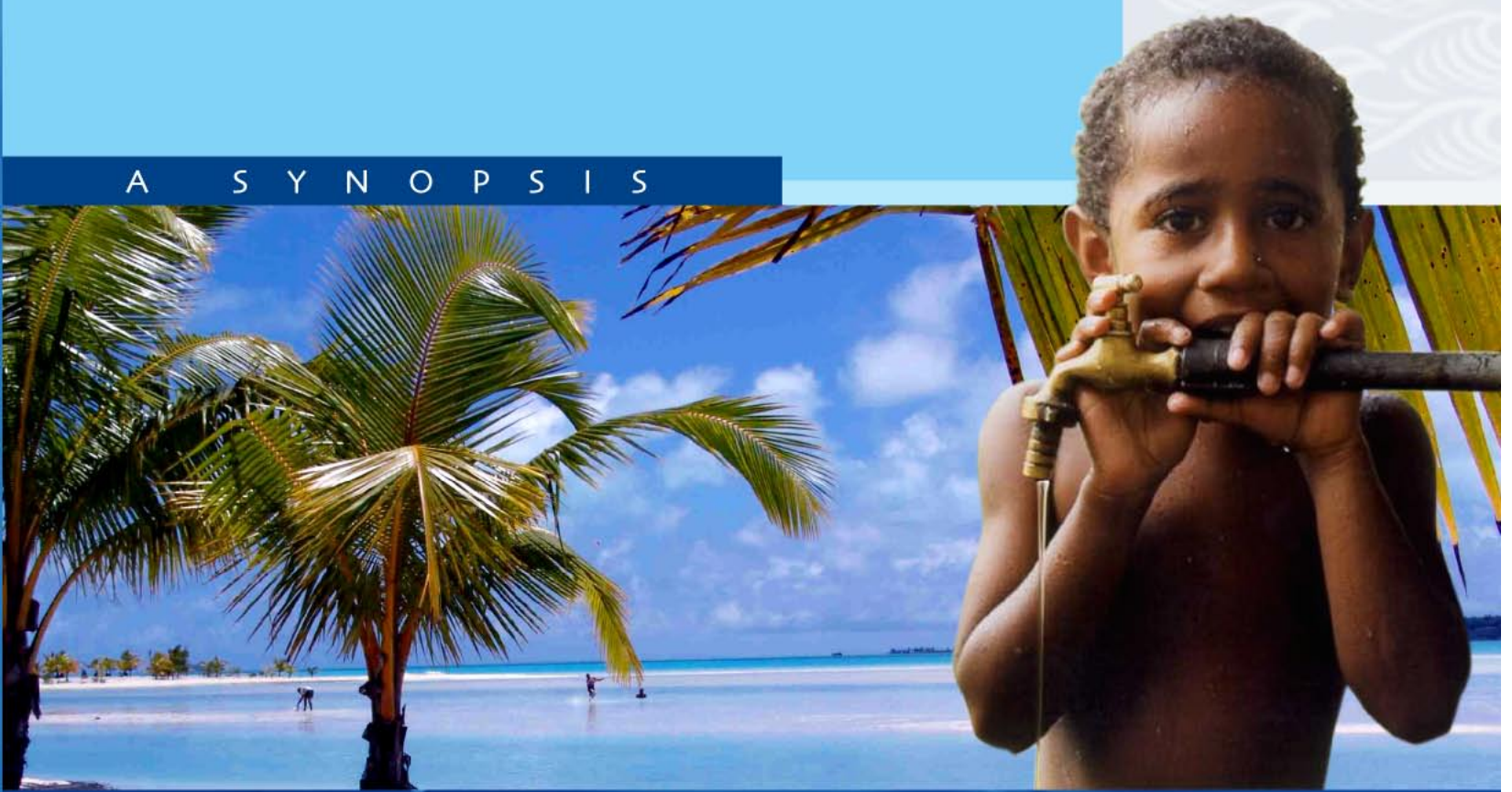
INTEGRATED WATER RESOURCES MANAGEMENT IN PACIFIC ISLAND COUNTRIES

A SYNOPSIS







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Integrated Water Resources Management in Pacific Island Countries

A Synopsis

Compiled by GWP Consultants, United Kingdom

in conjunction with the

Pacific Islands Applied Geoscience Commission, Fiji

and published by Dreamwise Limited, Fiji

Integrated Water Resources Management in Pacific Island
Countries: A Synopsis/GWP Consultants. –SOPAC: , 2007

46 p.:ill. ; 30cm

1. Water management 2. Water resources – Pacific Islands

I. SOPAC Joint Contribution Report – 192
II. Title
III. GWP Consultants

Acknowledgements

This publication represents the combined efforts and achievements of numerous organisations, government departments, communities and individuals from the Pacific that were involved with the development of the Diagnostic Reports for the project countries and to whom we are deeply grateful.

We acknowledge the financial assistance provided by the Global Environment Facility (GEF) and the technical assistance provided by the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).

Finally, we would like to recognise the efforts of Clive Carpenter of GWP Consultants who was the principal author of the publication and Leonard Ganilau, Dreamwise, Fiji for graphic design and layout.

Abbreviations

ADB	Asian Development Bank
CBOs	Community Based Organisations
CIA	Central Intelligence Agency
CSD	Commission on Sustainable Development
EIA	Environmental Impact Assessment
EU	European Union
FSM	Federated States of Micronesia
GDP	Gross Domestic Product
GEF	Global Environment Facility
GoN	Government of Niue
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities
GWP	Global Water Partnership
ICZM	Integrated Coastal Zone Management
IWRM	Integrated Water Resources Management
IWCAM	Integrated Watershed and Coastal Area Management
lpd	litres per capita per day
MDGs	Millennium Development Goals
MHMS	Ministry of Health and Medical Services
MPA	Marine Protected/Conservation Area
MRD	Mineral Resources Department (Fiji)
NGOs	Non Governmental Organisations
Pacific RAP	Pacific Regional Action Plan on Sustainable Water Management
PICs	Pacific Island Countries
PNG	Papua New Guinea
RMI	Republic of the Marshall Islands
SIDS	Small Island Developing States
SIWA	Solomon Islands Water Authority
SOPAC	Pacific Islands Applied Geoscience Commission
sq km	Square kilometre (1 km x 1 km)
TDS	Total Dissolved Solid
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US	United States (of America)
VIBA	Vanuatu Island Bungalow Association
WEHAB	Water, Energy, Health, Agriculture and Biodiversity
WF	Water Facility
WHO	World Health Organisation
WSSD	World Summit on Sustainable Development (held in Johannesburg in 2002)
WUE	Water Use Efficiency
WWF-5	5th World Water Forum (to be held in Turkey in 2009)

Preface

Local approaches to Integrated Water Resources Management (IWRM) have been practiced in the Pacific Islands region for centuries by local communities through their observations of traditional coastal, land and water resources management measures which have sustained islands' resources for hundreds of years.

However, our islands have changed with issues such as rapid population growth, increasing urbanisation, damage to water catchments resulting from deforestation, poor waste management practices leading to water pollution, and climate change posing serious challenges to Pacific Island Countries in respect of how they achieve sustainable management of their water resources.

Consequently, the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and the Pacific Islands Applied Geoscience Commission (SOPAC) have developed a project on "Sustainable Integrated Water Resources and Wastewater Management" in Pacific Island Countries (Pacific IWRM Project).

The Pacific IWRM Project responds to a call from the region to address these challenges and is founded on the regionally endorsed Pacific Regional Action Plan on Sustainable Water Management (Pacific RAP). This plan aims to improve the assessment and monitoring of water resources, reduce water pollution, improve access to technologies, strengthen institutional arrangements, and leverage additional financial resources in support of IWRM.

The Pacific IWRM Project provides the region an opportunity to build on the successful practices from the past whilst addressing the complexities of sustainable development in this modern age and developing and implementing dynamic and innovative IWRM approaches. The project methodology adopts the use of demonstrations of sustainable water management in specific catchments and aquifers in each country, as a catalyst for further expansion on the approach throughout the country, thereby resulting in better, more effective national water resources management.

The Pacific IWRM programme represents the first strategic step in the development of IWRM planning and implementation in the Pacific Islands region. This approach is consistent with the United Nations advocacy of IWRM as the means to accelerating progress towards achieving the water and sanitation related Millennium Development Goals - the IWRM Road Map. The responsibility now lies with Pacific Island governments and our international development partners to support, sustained IWRM implementation in the Pacific.

The Pacific IWRM Synopsis contains on overview of Small Island Developing States' water issues and the application of IWRM in Pacific SIDS, through the GEF-funded demonstrations. I commend this publication to you which is a result of the insight and knowledge gained during the process of developing the Pacific IWRM Project. We hope that you view it as making both a useful and invaluable contribution to the promotion and advocacy of IWRM in the Pacific Islands region and beyond.

With Thanks

Cristelle Pratt
Director
SOPAC Secretariat

Contents

1. EXECUTIVE SUMMARY

Sustainable development requires a balance to be maintained between the needs of economic development, public health and environmental protection. Inevitably these three pillars of sustainability create competing and sometimes opposing pressures and demands upon the limited land and water resources of countries.

Whilst many countries have made great progress to realising sustainable development and achieving the Millennium Development Goals (MDGs) and targets, such endeavour has been generally made through sectoral approaches. In doing so the competitive demands of different sectors have become difficult to manage, with increasing stress placed upon water resources as pollution increases and populations continue to grow.

Pacific Small Island States Water Issues

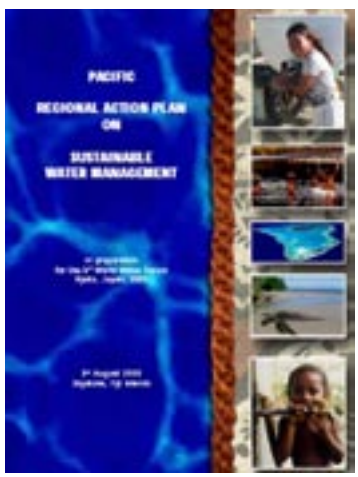
Where Small Island Developing States (SIDS) differ with other countries is the immediacy of these problems, and the limit of their capacity to respond. With limited land mass and even more limited natural water resources, the pressures of economic development coupled with climate change associated climate variability make water shortages, flooding, soil erosion, chemical pollution and salinisation a present day reality for all sector users. For some SIDS these pressures and demands are now close to exceeding the natural carrying capacity of the islands and watersheds, especially those hosting the country capitals with higher population densities.

Pacific SIDS are having to address these challenges whilst recognising they have limited human and financial resources, and do not have the benefits of the economies of scale that larger countries can utilise.

Integrated Water Resources Management and SIDS

Integrated Water Resources Management (IWRM) is a planning and management approach which aims to manage both water and land resources through improved sectoral collaboration and partnership between the government functions and those of civil society. It specifically focuses on establishing and improving the linkages between land and water management, competing sectors, government agencies, civil society, and the private sector. The United Nations considers IWRM to be of such importance to achieving the MDGs it agreed an IWRM National Plan development target of 2005, and has now developed an IWRM Road Map for delivering the MDGs.

...IWRM as a solution to managing and protecting water resources, improving governance arrangements and therefore improving water supply and sanitation provision...



The potential importance of IWRM to SIDS has been stated within the Pacific Regional Action Plan on Sustainable Water Management (Pacific RAP) in 2002, which specifically identifies IWRM as a solution to managing and protecting water resources, improving governance arrangements and therefore improving water supply and sanitation provision. The Pacific RAP was formally endorsed by the Pacific Heads of State in 2003.

Pacific SIDS IWRM Barriers

Country diagnostic studies have revealed the barriers the SIDS have to overcome to implement IWRM. These include:

- Limited and fragile water resources susceptible to over-exploitation and pollution, but with little technical management capacity to exploit and protect them;
- Vulnerability to climate variability resulting in rapid onset of flooding and droughts;
- Insufficient political and public awareness of the critical role of water in supporting economic development, public health and environmental protection;
- Excessive urban water demand due to high water losses and poor water conservation and inadequate drinking water treatment due to limited technical resources;
- Inadequate wastewater management resulting in widespread freshwater and coastal water pollution due to reliance upon on-site septic tanks and poorly maintained sewerage systems;
- Fragmented national water governance due to little formal communication and coordination between government departments;
- Conflicts between national versus traditional rights, especially balancing the needs of land and water resources planning with customary land ownership;
- Inadequate financing of water and sanitation provision due to poor cost-recovery but also a lack of 'economies of scale' for funding resources, health and environmental protection; and
- Weak linkages to other stakeholders both within the water sector but particularly to other economic sectors, public health and the environment.

IWRM Solutions

Countries identified the need to build upon existing activities by improving the coordinating and integrating planning and management, moving away from sectoral and institutional delivery, to more effective and efficient collaborative implementation using:

- IWRM Apex (over-arching) Bodies
- Integrated Land Use Planning
- Water Resources Assessment and Quality Monitoring
- Watershed and Land Use Management
- Demand Management and Water Use Efficiency
- Water Rights, Policies and Legislation
- Water Resources Information and Management Systems
- Education, Awareness Raising and Civil Society Engagement

Specific examples of the application of these approaches prioritised by the countries are:

- Drought Preparedness
- Flood Management and
- Water Quality improvements through Watershed Management

The IWRM Road Map and the Role of International Fora

Two IWRM programmes have recently commenced in the Pacific, one addressing long term IWRM Planning, the other focussing on reducing environmental stress through the application of IWRM approaches at a demonstration project level. These programmes have enabled the SIDS to commence development of National IWRM plans whilst simultaneously demonstrating IWRM benefits for priority issues in critical areas.

However country-wide implementation of SIDS IWRM Plans and replication of the demonstration projects will require a much greater political and financial commitment and prioritisation of SIDS IWRM, both at the country level and internationally.

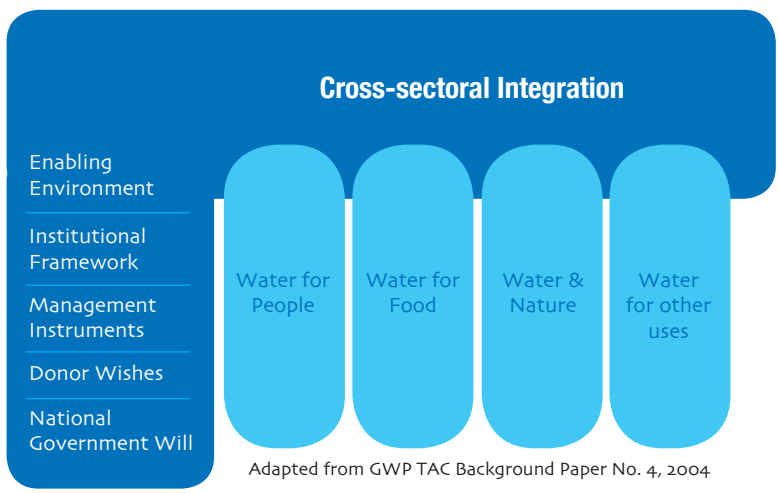
1. Introduction to Integrated Water Resources Management (IWRM)

1.1 What is IWRM?

Integrated Water Resources Management (IWRM) is a planning and management approach which aims to manage both water and land resources through improved sectoral collaboration and partnership between the government functions and those of civil society.

IWRM therefore takes appropriate account of the important physical, social, economic and cultural linkages within a water resources system, such as:

- Physical linkages between land use and surface and groundwater quantity and quality;
- Economic linkages between various, and sometimes competing, water uses;
- Social linkages between water development schemes and potential beneficiaries or those adversely affected; and
- Institutional linkages, both horizontally and vertically, among various formal and non-formal stakeholder institutions.



Adapted from GWP TAC Background Paper No. 4, 2004

The Global Water Partnership (GWP), one of the foremost global advocates of IWRM, describes IWRM as:

'IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.'

1.2 How does IWRM relate to the Millennium Development Goals?

Sustainable development requires a balance to be maintained between the needs of economic development, public health and environmental protection. Inevitably these three pillars of sustainability create competing and sometimes opposing pressures and demands upon the limited land and water resources of countries.

Whilst many countries have made great progress to realising sustainable development and achieving the Millennium Development Goals and the related Water and Sanitation Targets, such endeavour has been generally made through sectoral approaches. In doing so the competitive demands of different sectors are difficult to manage, and the result is a continued increase in population growth, land use and water usage.

In 2002 the United Nations not only prioritised the delivery of the Water-Related Targets, within the WEHAB (Water, Energy, Health, Agriculture and Biodiversity) Initiative, but recognised the contribution water plays to achieving the other WEHAB priorities and the MDGs in general. In response the international community agreed to an IWRM Target for the development of National IWRM and Water Use Efficiency (WUE) Plans by 2005, in time for the commencement of the Water for Life Decade.

Whilst this initial Target has now passed, UN-Water is now promoting an IWRM Road Map to deliver the original Target and to achieve the MDGs by 2015. The contribution that IWRM can make to realising all the MDGs is therefore fully recognised by the international community.

1.3 Why is IWRM a priority to Small Island Developing States?

The potential importance of IWRM to Small Island Developing States can be clearly seen by referring to the Water in Small Island Countries Statement at the 3rd World Water Forum in 2003. This Statement identified three critical challenges to achieving sustainable water management in SIDS, namely:

- Fragile and limited water resources highly vulnerable to climatic variability;
- Water supply and sanitation provision restricted by human and financial resources; and
- Complex water governance arrangements.

In response to these challenges, the Pacific SIDS developed the Pacific Regional Action Plan on Sustainable Water Management (Pacific RAP) in 2002, in advance of the World Summit on Sustainable Development (WSSD). The Pacific RAP specifically identifies IWRM as a solution to managing and protecting water resources, improving governance arrangements and therefore improving water supply and sanitation provision. The Pacific RAP was formally endorsed by the Pacific Heads of State in 2003. The Pacific RAP aims to improve the assessment and monitoring of water resources, reduce water pollution, improve access to technologies, strengthen institutional arrangements, and leverage additional financial resources in support of IWRM.

Where SIDS differ with other countries is the immediacy of these problems, and the limit of their capacity to respond. With limited land mass and even more limited natural water resources, the pressures of economic development coupled with climate change associated climate variability make water shortages, flooding, soil erosion, chemical pollution and salination a present day reality for all sector users. For some SIDS these pressures and demands are now close to exceeding the natural carrying capacity of the islands and watersheds, especially those hosting the country capitals with higher population densities.

SIDS need to act now to address these issues, but are hampered by small populations which limit the amount of technical capacity in-country as well as the economic base from which to finance mitigation measures. In such circumstances, IWRM, which aims to improve

integration of existing agencies, stakeholders, sectoral planning and activities, provides an ideal way to use the existing but limited capacity and funding within SIDS to their best effect.

For SIDS, who have to face the extreme climatic impacts of drought and flooding on a near annual basis, as well as increasing water demand and man made pollution, IWRM can improve economic productivity, improve public health and protect the natural and built environment. There is therefore tangible financial benefit to adopting and implementing IWRM.

1.4 Why is SIDS IWRM important to the rest of the World?

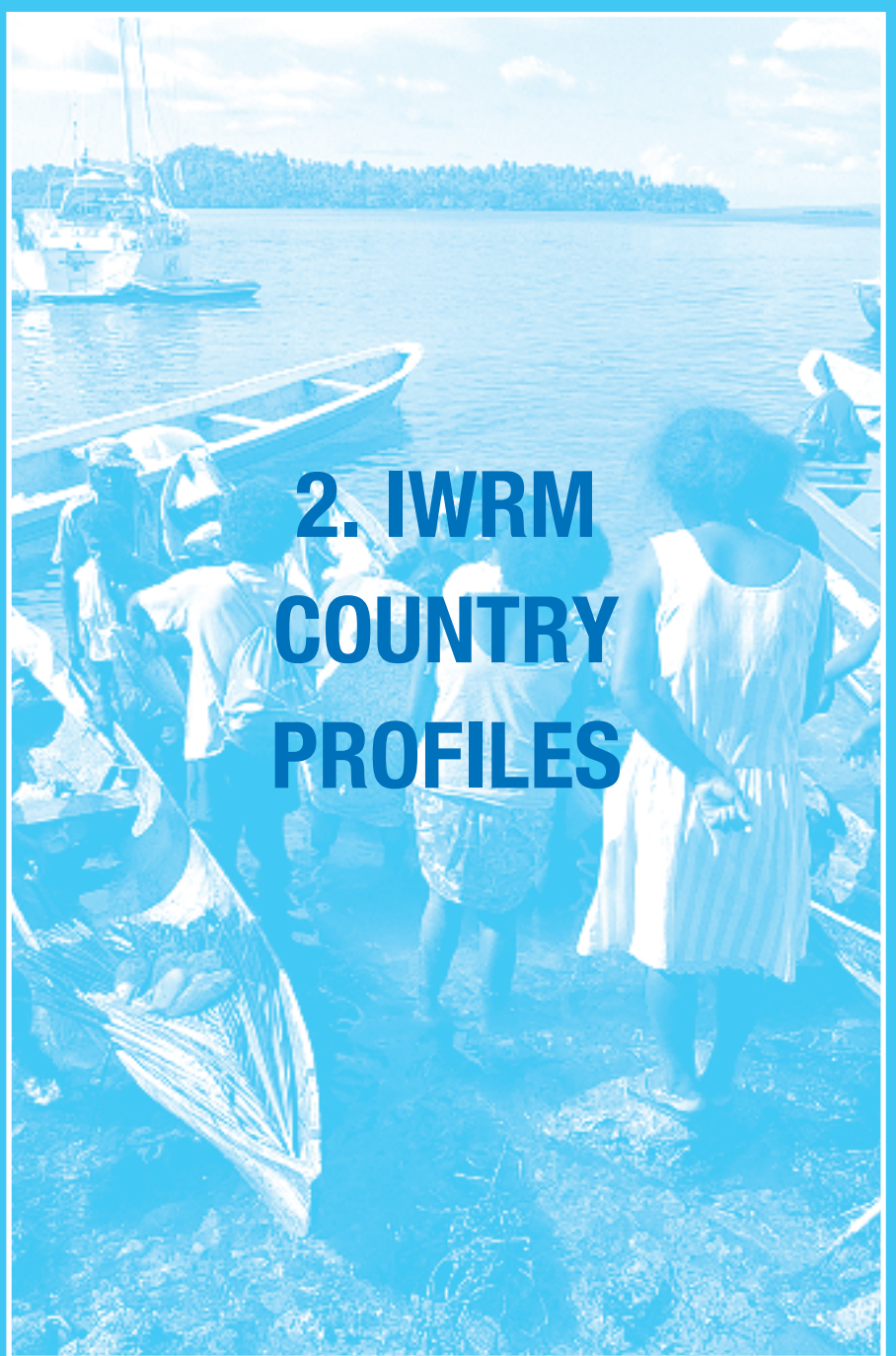
IWRM is being promoted throughout the world as a planning and management approach which improves not only water and land management but results in economic, social and environmental benefits.

IWRM is a move away from 'business as usual' and requires a long term commitment and effort by all stakeholders to achieve more sustainable development. It is therefore important that the amount of benefit resulting from IWRM is worth the effort put in by these stakeholders. This is especially the case where some stakeholders will perceive their contribution and efforts as a loss of revenue or productivity.

The importance of tangible benefits as demonstrated by IWRM Indicators cannot be overestimated. Such tangible benefits might include a reduction in flood damage, an increase in hydropower generation, reductions in public health expenditure, increases in coastal tourist revenue, and reductions in water supply treatment costs. Understanding these benefits and demonstrating them is fundamental to the credibility of IWRM.

In order for these benefits to be realised, IWRM has to have a significant impact within the watersheds and aquifers. This means that the percentage of the catchment area or water balance being altered has to be sufficiently large, and that the impacts of these management changes can be observed in a reasonable timescale. For continental countries and international river basins, these are long term objectives to which these catchments will respond slowly over time. These timescales are out of synchronicity with the realities of modern day governmental priority and political office residency.

In order to demonstrate the credibility of IWRM to the global audience it is important to have examples of IWRM success as soon as possible. Achieving IWRM success quickly is most likely to be accomplished where the hydrological systems (catchments and aquifers) are small and as a result limited water and land management changes can have a catchment wide impact, and the catchments will respond to these changes rapidly. Small Island Developing States provide the ideal hydrological environment for demonstrating IWRM approaches and achieving tangible and quantifiable benefits. SIDS IWRM success can be a powerful catalyst to IWRM implementation worldwide.



2. IWRM COUNTRY PROFILES

2.1 COOK ISLANDS

Area	235 sq. km
Population	15,017 (2001 census)
Population Density	64 person/sq. km
Rainfall	2,100 mm/year. Wet season from December to March
GDP	NZ$ 232 million (2005 est)
GDP/capita	NZ$ 12,878 (2005 est)
Land Use	arable land: 17%
	permanent crops: 13%
	other: 70%
Water Consumption	1200 lpd (Rarotonga, 1987); 100-150 lpd in Aitu.

Description: 15 widely dispersed islands, divided into the Southern Group, comprising volcanic islands (including Rarotonga) and the Northern Group comprising coral atolls.

Economy: The key economic sectors include agriculture and fisheries (13%), tourism (63%), black pearls, offshore banking. Economic development is hindered by isolation from foreign markets, lack of natural resources, periodic devastation from natural disasters, and inadequate infrastructure. The main economy base is agriculture with copra and citrus fruits being the major export. Limited manufacturing focuses on fruit processing, clothing and handicrafts.

Water Availability: Surface water on the volcanic islands of the Southern Group (including Rarotonga) and groundwater and rainwater on the coral atolls of the Northern Group. Some imported bottled water. Water tankers have been used in periods of drought to transport potable water to resorts and outlying islands.

Island Vulnerability: Simultaneous increases in rainfall in the southern Cook Islands and reduced rainfall in the Northern Cook Islands occur during El Nino events. Cyclones are also associated with El Nino events. Flooding during storm surges and drought are therefore of major concern. Aquifer saline intrusion is reported in the outer islands. Although agriculture presents problems for water resources, particularly through high water demand (supplied by the reticulated system) and piggery runoff, the major land use and water quality concern is from poorly functioning septic tanks. Development on the Rarotonga has lead to increased sediment and nutrients entering the lagoon system, causing damage to the corals and the lagoon.

Power Generation: There is no use of renewable electricity production.

Health: The World Health Organisation (WHO) reports that the standard of health in the Cook Islands is high. The infant mortality rate was 28.6 per 1000 live births in 2005. The water supplies in Rarotonga and the outer islands are neither properly filtered nor disinfected. The main water related diseases are diarrhoea (835 cases in 2003) and dengue fever. A water supply and sanitation improvement programme, with the building of flush toilets in all schools and health centres on the outer islands has enhanced the reduction in infectious diseases. Environment and Tourism: The Cook Islands

economy is largely dependent on tourism, the major attraction being the clean and clear lagoon waters. The lagoon-reef systems are important food sources for Cook Islanders and are use commercially for black pearl production on Manihki and Penrhyn. In the Cook Islands there are several reserves and sanctuaries created for habitat protection and biodiversity reasons. Suwarrow, in the Northern Cook Island group, was declared a National Park in 1978. It is a breeding ground for rare species of turtles and crabs and it is an important sea-bird breeding site not only for the Cook Islands but for the region and the world. There are major concerns about eutrophication in the Rarotonga lagoons.

IWRM Barriers

The Cook Islands identified the following barriers preventing IWRM implementation:

Reticulated water supply leakage; drought season water shortages due to reliance on rainfall harvesting and ephemeral streams; contamination of groundwater due to septic tank leakage; piggeries near streams and no buffer areas; cyclone associated flooding; poor understanding of linkages between catchment land management and impacts upon freshwater and coastal water quality; high reticulated water usage due to agricultural supply; high sediment run-off; poor inter-agency coordination, e.g. water quality monitoring; lack of ownership of wastewater treatment; lack of clear and over-arching legal framework for water resources management; lack of cost recovery associated with water supply; land tenure and land use rights; and a lack of human resources and appropriate IWRM capacity.

IWRM Solutions

The Cook Islands identified it is already carrying some of the IWRM Tools required. Water resources monitoring, disaster management planning and climate change adaptation measures are already being practiced to some extent and/or are scheduled for further implementation.

Community awareness of land use, freshwater-coastal linkages, improved water supply infrastructure, water demand management and water quality monitoring have some activities but need considerable strengthening through IWRM.

Areas requiring considerable attention are institutional arrangements (including policy and legislative changes), financing and wastewater treatment.

The IWRM demonstration project is expected to target the protection of the Rarotonga lagoons (a major tourist attraction) through wastewater management improvements and understanding groundwater linkages to lagoon water discharge.

An economic evaluation of the avoidable costs associated with IWRM for Rarotonga alone has been estimated at NZ$ 7.4 Million per annum (3% of GDP).

2.2 Federated States of Micronesia

Area	700 sq. km
Population	108,000 (2006, ADB)
Population Density	154 person/sq. km
Rainfall	3000-4900 mm/year. Wet season from June to October.
GDP	US$ 244.7 million (2006, ADB)
GDP/capita	US$ 2266 (2006, ADB)
Land Use	arable land: 5.7%
	permanent crops: 45.7%
	Other (forest): 48.6% (CIA World Factbook, 2005)

The need for improved disaster management planning is recognised at the state level.

Description: 4 major island groups consisting of 607 islands spread out over more than 2.5 million sq. km which vary geologically from high mountainous islands to low lying coral atolls and volcanic outcroppings on Pohnpei, Kosrae, and Chuuk.

Economy: Key economic sectors are agriculture (subsistence farming), agroforestry, fisheries and tourism (plus some high grade phosphate deposits). GDP is not equally distributed between the four states. Geographical isolation and poorly developed infrastructure are the major impediments to development. 80% of people depend on subsistence or semi-subsistence livelihoods (75% of household income).

Water Availability: Surface water is in the form of small, intermittent streams that drain catchments of limited aerial extent. Groundwater on volcanic islands is abstracted from small, dispersed zones of sedimentary deposits, weathered volcanic and weathered schist, suitable for multiple, low to medium yielding wells. On raised coralline islands, and in those coastal areas composed of coral sand deposits and lagoon sediments, groundwater is abstracted from the freshwater lens by shallow hand-dug wells. Rainwater harvesting is concentrated mainly in the outer islands and rural areas. Competition has led to a reduction in price of bottled filtered water. Bottled water is therefore a popular form of potable water consumption in FSM.

Island Vulnerability: The island groups of Yap, Chuuk and their adjoining outer islands are particularly prone to typhoons, extended drought, landslides, tidal erosion and extensive floods. Drought is perceived to be occurring with increasing frequency and intensity. Siltation of the fringing reefs as a result of deforestation and subsequent erosion is causing significant damage to traditional marine food supplies. Urbanisation, pollution, poorly planned development, inappropriate farming practices, over-exploitation of marine resources and destruction of habitat have also been identified as concerns by stakeholders. The country's fragmented composition of small islands and its dependence on subsistence agriculture and tourism make it vulnerable to such natural and man-made disasters.

Power Generation: The only hydropower plant in FSM is on Pohnpei, which has a capacity of 1.7 MegaWatts. This is a supplementary power supply.

Health: Major health concerns are water related diseases, especially cholera (resulting in an epidemic in Pohnpei in 2000), leptospirosis, hepatitis and amoeba, which are all endemic. With the expansion of potable water, the incidence of water related diseases is decreasing. However all rural community water systems are untreated and the outer islands (which rely on rainwater collection) remain at risk.

Environment and Tourism: The biodiversity and natural heritage of the FSM is both globally significant and the foundation for the country's long term economic self-sufficiency. The islands of FSM contain over 1,000 plant species, at least 200 that are found nowhere else on Earth. Its reefs, which provide coastal protection and the source of livelihood for a majority of the local population, are home to nearly 1,000 species of fish and more than 350 species of hard coral. Decline in biodiversity is clearly linked to factors such as increased centralisation and urbanisation of the population, very high population growth rates, commercialisation including increased exportation of natural resources, reliance on imported commodities and increasing consumer demands. Maintaining the habitats and ecosystems that nurture biodiversity is crucial for sustaining economic interests such as fishing, agriculture and tourism. However, pollution from improperly located pig pens and toilets that discharge directly or indirectly into the rivers have affected many of the popular waterfalls and rivers used by tourists, with consequences for public health, the watershed ecosystem and the economy.

IWRM Barriers

The Federated States of Micronesia have identified the following IWRM challenges:

Vulnerability to climate change and climatic extremes (droughts and floods); deforestation of watersheds and resultant sedimentation of lagoons and coastal areas; water-related disease through poor sanitation and lack of effective wastewater treatment; lack of awareness on water-related diseases; sustainability of power utility subsidisation of water supply; lack of water resources management technical capacity; land access issues (especially in Chuuk), loss of biodiversity through deforestation and lagoon degradation.

IWRM Solutions

The National Sustainable Council has launched initiatives on public education and watershed protection.

Each State has its own programme on watershed and coastal management. The Pohnpei Nature Conservation Society programme is the longest running formal catchment protection initiative in the Pacific.

The need for improved disaster management planning is recognised at the state level.

The following are reported as recognised as priority IWRM areas for improvement: capacity building in the water and environmental sanitation sector planning; support and prioritisation of IWRM by communities and politicians; conjunctive use of rainwater harvesting, stream flows and groundwater; wastewater management improvements; and using tariffs to adequately fund water supply and wastewater treatment operation and maintenance.

2.3 FIJI

Area	18,333 sq. km
Population	850,000 (World Bank, 2005)
Population Density	46 person/sq. km
Rainfall	2000-3000 mm/year
GDP	$5.594 billion (2006 est., CIA World Factbook)
GDP/capita	$6,200 (2006 est., CIA World Factbook)
Land Use	arable land: 11%
	permanent crops: 4.6%
	other: 84.4% (CIA World Factbook, 2005)
Water consumption	Urban 200 lpd, semi-urban 150 lpd, rural 100 lpd

Description: Over 300 islands, of which a third are inhabited. Three main islands, with major urban areas on Viti Levu and Vanua Levu. The archipelago is comprised of volcanic peaks and low lying coral islands

Economy: One of the most developed of the Pacific Islands, endowed with forest, mineral and fishery resources. Sugar exports and rising tourism are the major source of foreign exchange. Sugar represents one-third of industrial activity. Long-term economic problems include low investment and uncertain land ownership rights. Limited gold metal mining has occurred in past decades. Bottled water exports have increased rapidly in recent years.

Water Availability: Surface water is used as the main source of supply for all major towns on the larger, high islands of Fiji, as well as for industry and irrigation. Some small, low-lying islands rely exclusively on groundwater and may or may not use rainwater. Rainwater harvesting is widespread in Fiji, but improvements are required to sustain supply during droughts.

Island Vulnerability: Flooding is currently a very high priority political issue for Fiji, in light of serious flooding which has occurred throughout various parts of the country over the last few years. These floods caused loss of life and significant damage to property and infrastructure as well as disrupting economic activity and affecting the lives of communities on the largest of the Fiji Islands. Drought is also a serious issue. During 1998, half of the country had no significant rainfall for more than seven months and food was distributed by the government to 105,000 people. Logging and progressive removal of forest cover may cause flood peaking to become more extreme in the future. On small, low-lying islands, groundwater resources may be very vulnerable to over-exploitation and contamination. Industrial pollution, urban drainage and sewage are cause for concern on large islands.

Power Generation: 80.6% of electricity was produced from renewable sources (2004, UN), specifically hydropower.

Health: Even though 70% of the population has access to treated, metered reticulated water, continuity of supply is not ideal and maybe in question, particularly in the drier months. Wells on many small islands are

Development in Fiji Islands over the last 15 years has been severely constrained by a succession of political coups. However, there is much optimism in both the community and government as reflected in the Governments Strategic Development Plan 2003-2005.

contaminated with faecal coliform due principally to a lack of sanitation and awareness.

Environment and Tourism: The health of the near-shore environment is of particularly high importance, owing to tourism development along the coast. Development in Fiji Islands over the last 15 years has been severely constrained by a succession of political coups. However, there is much optimism in both the community and government as reflected in the Governments Strategic Development Plan 2003-2005.

IWRM Barriers

Fiji identified the following IWRM Barriers:

A lack of water resources management technical capacity and formal responsibilities; a lack of public awareness on water conservation and water pollution; land tenure and water rights, conflicting policies and unclear legislation; a lack of effective formal coordination; and inadequate planning mechanisms.

IWRM Solutions

The government has made a number of IWRM related initiatives in the past five years, including: creation of the National Water Committee - a coordinating committee of officials to meet under the chairing of MRD; development of a draft national water policy which has been accepted subject to consultation, which has not yet taken place; and commitments to consider new water resources legislation and national coordinating arrangements (as stated in the draft policy which reflects earlier cabinet decisions).

Fiji recognises it needs IWRM Tools and approaches to overcome the identified barriers, including: IWRM policies and legislation; improved coordination, information and data; water resources planning; technical capacity building; public information; and awareness raising.

2.4 KIRIBATI

Area	811 sq. km
Population	92,428 (2005 census)
Population Density	127 person/sq. km
Rainfall	2048 mm/year (1000 to 3,200 mm/year across country)
GDP	$240 million (2006 est., CIA World Factbook)
GDP/capita	$2,800 (2004 est., CIA World Factbook)
Land Use	arable land: 2.7%
	permanent crops: 48%
	other: 49.3% (2005, CIA World Factbook)
Water consumption	est. 30-100 litres/person/day

Description: 32 low lying coral islands and one raised coral island in three main island groups, the Gilberts, Phoenix and Line Islands, scattered over three million km^2 of the central and western Pacific Twelve 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.

Economy: The islands have few natural resources. The phosphate was exhausted at the time of independence. Copra, fishing and seaweed now form the bulk of production and exports. Tourism represents about one-fifth of GDP. Development is constrained by a shortage of skilled workers, weak infrastructure and remoteness from international markets.

Water Availability: Rainwater, shallow unconfined groundwater (generally within less than 2 m of the surface), imported water or desalination. Seawater is used by many for washing. 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.

Island Vulnerability: Kiribati is subject to frequent, long and severe droughts. 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. Sea level rise is considered the greatest threat posed by global warming to low small islands; ultimately sea levels will inundate low lying islands. There is the potential for the sea to overtop parts or even whole islands during storm surge, periodically leading to destruction of infrastructure, salinisation of some fresh groundwater and the death of breadfruit trees. Rapid population increase since 1963 and inward migration to South Tarawa are pushing sanitation and water supply to the limit of sustainability. Heavy reliance on imported fuel could lead to major power outages and reticulated water shortages. Limited land area poses problems for solid waste disposal.

Power Generation: Fuel is imported. There is no renewable electricity production (2004, UN).

Health: Close, communal living in island communities, continuing urbanisation of islands with limited land

area and 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. There was a cholera outbreak in Tarawa in 1977, prior to the installation of the saltwater sewage system. The alarming infant mortality rate due to diarrhoeal disease in Kiribati is amongst the highest in the Pacific and in 2005 just over 1 in 3 of the South Tarawa population was affected by diarrhoea and dysentery. 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. Pit latrines have been installed in rural areas with assistance from Ministry of Health and Medical Services (MHMS) Environmental Health Unit.

Environment and Tourism: 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 and are protected by law. Kiritimati was used during the 1950's and 60's for nuclear testing. There is relatively little tourism in Kiribati although there is potential for an expansion, particularly in the northern Gilberts and in Kiritimati.

IWRM Barriers

The key challenges in the water resource sector have been investigated in much detail in recent years. These 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.

IWRM Solutions

Kiribati has outlined a possible integrated IWRM strategy, commencing with the establishment in February 2007 of the National Water and Sanitation Coordination Committee to report to the national government on water resources management, water demand management, health and environmental impacts, policy and regulations. Kiribati recognises it requires additional IWRM support for a national water policy, plans and legislation, more sustainable water supply and sanitation systems through the introduction of a tariff system, capacity building in water resources assessment, increased community participation, participatory groundwater protection, increased rainwater harvesting, and new water sources for South Tarawa.

2.5 MARSHALL ISLANDS

Area	181 sq. km (SOPAC)
Population	50,840 (1999 census)
Population Density	281 person sq. km
Rainfall	2000 to 4000 mm/year (2000mm/year in the northern atolls to 4000 mm/year in the southern atolls). Wet season from mid-April to December
GDP	$115 million (2001 est., CIA World Factbook)
GDP/capita	$2,900 (2005 est., CIA World Factbook)
Land Use	arable land: 11.1%
	permanent crops: 44.4%
	other: 44.5% (2005, CIA World Factbook)
Water consumption	100 litres/person/day on Majuro and Ebeye, less on Outer Islands

Description: Two roughly parallel chains of 29 coral atolls and 5 single coral islands. Mostly low coral limestone and sand.

Economy: Agriculture is primarily subsistence. Tourism employs less than 10% of labour force. There is a US military base on Kwajalein, which provides rental income. The main opportunity for additional revenue is from existing natural resources

Water Availability: There is a rainfall gradient, with heavier rainfall in the southern atolls and islands and less rainfall in the northern atolls and islands. Household rainwater harvesting is practised heavily on Majuro (71% of households) and the Outer Islands, and less so on Ebeye (22% of households). Rainwater is harvested on Majuro using the airport runway as a catchment area pumped to a series of reservoirs, which feed a reticulated distribution system. There is some groundwater use on Majuro and the Outer Islands, but almost none on Ebeye. Several reverse osmosis units on Majuro are used during dry periods. At least two Majuro companies also use desalination to produce and sell bottled drinking water. The importation, sale and consumption of bottled drinking water is also on the rise in Majuro and Ebeye. Many Ebeye households rely on importation of water from the US military base on neighbouring Kwajalein Island.

Island Vulnerability: Like many PICs, the fragmented and isolated nature of the country, the location of its settlements along the coast, high population density and low relief make the RMI vulnerable to a number of natural and man-made types of disasters. These include: typhoons, tropical depressions, storm surge, flooding, sea level rise (and other climate change effects), droughts, fires, marine oil spills, water supply pollution and disease outbreaks. Urbanisation, population growth, high-risk development practices and power supply insecurity also contribute to island vulnerability.

Power Generation: Reliance on imported fuel.

Health: Water quality is becoming an increasingly critical health issue due to increased urbanisation, population growth and mounting economic challenges faced by many households and families. Health risks are posed by contaminated and polluted home rainwater storage, wells, and coastal areas. Lagoons and coastal waters tested showed elevated bacterial contamination,

Mixed forest communities, freshwater and brackish water bodies and marine areas are home to a wide range of endemic species of plants and animals.

particularly in the urban areas of Majuro and Ebeye. Risk factors for outer islands are also high, stemming mostly from unsanitary home rainwater catchment and collection systems. The number of gastrointestinal cases has climbed sharply from 2001 to 2004 and in late 2000 and early 2001, an outbreak of cholera occurred on Ebeye and Lae Islands.

Environment and Tourism: Mixed forest communities, freshwater and brackish water bodies and marine areas are home to a wide range of endemic species of plants and animals. Endangered species found in the RMI include: blue whale, sperm whale, Micronesian pigeon, leatherback turtle, and the hawksbill turtle. Coral reefs, coastal beaches and coastal mangrove areas are particularly critical as they help prevent erosion. These critical areas are under increasing pressures from urban development, sea walls, pollution and other threats, and deterioration of these habitats directly affects tourism potential. A number of new hotel and resort investments are currently underway, commercial and private cruising tourism is growing, and in 2007, Majuro Atoll received its first direct charter flights from Japan. However, local operators are increasingly concerned over rising lagoon pollution and other environmental threats. Tourism is also placing pressure on local water resources, through increase potable water demand and increased wastewater production.

IWRM Barriers

The Marshall Islands reports the following IWRM challenges:

Natural water scarcity; under-resourced Public Utilities; water resources contamination; weak conservation and demand management; non-integrated management; water resources assessment and monitoring remains limited; weak disaster and emergency planning and preparedness; training and capacity building needs are high; no overall water sector strategy; high vulnerability to marine floods and droughts; sea level rise; lack of disaster preparedness; limited awareness and limited awareness efforts; no targeting of government and traditional leaders; limited funding; limited engagement of women; unreliable water supply and sanitation systems; organizational weakness; overlapping authorities and outdated policies; institutional weaknesses; ignoring traditional authority; weak compliance; non-integrated institutions; financial performance of utilities poor; and water leakage and theft.

IWRM Solutions

The Marshall Islands developed an outline plan for addressing these issues. The responses included:

Improved water resources assessment, monitoring and management; improved demand management; improved disaster preparedness, capacity building; improved climate forecasting and drought planning; awareness campaigns; targeting of political and traditional leaders; expanded rainwater harvesting and wastewater treatment capacities; water resources strategy and legislation; clear institutional responsibilities; water safety plans; civil society engagement; improved utility financial performance (tariffs and billing); appropriate budgetary funding for environmental health and environmental protection.

2.6 NAURU

Area	22 sq. km
Population	8,500 (2005, est.)
Population Density	386 person/sq. km
Rainfall	2,090 mm/year
GDP	$60 million (2005 est., CIA World Factbook)
GDP/capita	$5,000 (2005 est., CIA World Factbook)
Land Use	arable land: 0%
	permanent crops: 0%
	other (mining related activities, public buildings and residences): 100% (2005, CIA World Factbook)
Water consumption	40 litres/person/day (totally reliant on desalinated water until plant failure in 2001)

Description: As the world's smallest independent republic, the tiny state of Nauru consists of one 22 km^2 island and is 1 of the 3 great phosphate islands of the Pacific Ocean (although reserves are now depleted). Nauru is an isolated uplifted limestone island located just south of the equator, surrounded by a fringing coral reef some 120 to 300 metres wide. A narrow coastal plain surrounds a raised coral limestone plateau of pinnacles and outcrops, the latter 70% and 30% of the island land area respectively. The limestone plateau has been the focus of extensive phosphate mining for the past 80 years which is to be finally phased out in the next 10 ten years.

Economy: Revenues of this tiny island have traditionally come from exports of phosphates, but reserves are now depleted. Few other resources exist. The rehabilitation of mined land and the replacement of income from phosphates are serious long-term problems. Off-shore banking and export of coconut products contribute to the economy.

Water Availability: Sources of freshwater for Nauru's island communities are restricted to rainwater, imported water, shallow unconfined groundwater and limited desalination. The need for reliable power supply and appropriate technical capacity to run the desalination plant means that it has been out of action for several years. Seawater and non-potable well water (from shallow groundwater bores next to houses) are used by many for bathing. Apart from Buada Lagoon, there are no surface freshwater resources on Nauru apart from a few brackish ponds near the base of the escarpment, mostly on the north-east of the island, and an underground lake in Moqua Cave in the southeast.

Island Vulnerability: Nauru is susceptible to natural disasters including severe droughts and the threat of sea level rise. Groundwater pollution from seawater intrusion due to over-pumping, contamination from seawater sewerage systems and leachate from mining and residential waste, fish stock depletion, power supply insecurity and food scarcity are also major issues. The drought from 1998 to 2001 stretched the water resources on the island and highlighted the urgent need for a sustainable water supply system. The drought resulted in overuse of the lens and a decline in water quality, leading to rising health and environmental issues due to seepage from household sewage pits into the increasingly brackish and contaminated groundwater.

Power Generation: Reliance on imported fuel.

Health: There is no routine water quality testing program for potable and non-potable water supplies due to lack of capacity, although previous studies have found elevated levels of TDS and E coli in potable and non-potable water supplies. Contaminated groundwater is thought to be the cause. The hospital is under-resourced, with frequent power and water interruptions. The incidence of water borne diseases is therefore not documented.

Environment: To date, phosphate mining has disturbed or destroyed 1,400 ha of the 2,200 ha of Nauru. Hence it has had a massive impact on the terrestrial environment. It is planned to rehabilitate the mined land over the next 20 to 30 years, and replant it. An area of 124 ha has been allocated to agriculture. This would place a very heavy demand on the groundwater resource. There is also concern that reef ecosystems are stressed and that there has been a substantial reduction in the number of fish caught on the reef. This is attributed to the increase in fishing pressure for subsistence, as a consequence of the recent financial crisis.

IWRM Barriers

Nauru reports the key water resource management issues that would benefit from an IWRM approach are: the lack of a legal and policy framework for water resource ownership and management - groundwater is owned by the landowners and not the nation and there is no legislative framework for water resources, sanitation and environmental matters; capacity building in the area of integrated management - there is a shortage of capable people for water management and for maintenance of existing facilities; poor waste water treatment in septic tank systems and cess pits, seepage of nutrients to groundwater and into the lagoon; climatic vulnerability in water supply, particularly to drought; and high power demand for desalination.

IWRM Solutions

Nauru has identified the following IWRM solutions: water resources must be managed in an integrated way, based on a scientific understanding of the sustainable supply; a good appreciation of the demand for water; a sustainable delivery system; and an integration of cultural perceptions, ownership rights and practical economics; a National Water Plan; a National Sanitation Plan; improved drought supplies using conjunctive use (rainwater and groundwater); improved community engagement; water conservation; improved wastewater management; establishment of a National Water and Sanitation Committee; improved financing through greater cost-recovery tariffs.

2.7 NIUE

Area	259 sq. km
Population	1,625 (GoN statistics, 2006)
Population Density	6.3 persons/sq. km
Rainfall	2,180 mm/year. Wet season between December and March.
GDP	$13 million (GoN statistics, 2003)
GDP/capita	$7,700 (GoN statistics, 2003)
Land Use	arable land: 11.5%
	permanent crops: 15.4%
	other: 73.1% (CIA World Factbook, 2005), including 64% forest (GoN, 2004)
Water consumption	350 litres/person/day (2004 est. SOPAC)

Description: Single raised karstic coral atoll with highest elevations around the rim (60m) and a lower plateau (former lagoon) in the centre (35m).

Economy: Agriculture is mostly subsistence, though there has been investment in vanilla and nonu production for export. Limited industry concentrates on fruit processing, honey and coconut cream. Eco-tourism is being promoted.

Water Availability: There is no surface runoff in the form of streams, rivers and lakes. As such water for residential and commercial consumption can only be drawn from the karstic aquifer groundwater lens. Historically Niueans used cave water and coastal springs for their water supply. A limited amount of bottled fresh water is imported for sale from New Zealand as alternative source which mostly caters for tourists. A desalination plant at a fish processing factory is for industrial use.

Island Vulnerability: Niue is prone to damage from natural disasters such as cyclones, drought, and potentially from earthquakes. Man-made disasters include marine oil spills and pollution from agrichemicals such as paraquat (herbicide) and human waste. Vulnerability is exacerbated by very limited human resources and technical capacity.

Power Generation: Dependence on imported fuel.

Health: To date Niue is fortunate that its underground water source is still free from pollution and contamination. Water related diseases do not prevail on Niue although in the past cases of diarrhoea and intestinal infections have been reported to Health department, and the public were notified urgently to ensure that water for drinking was to be boiled. No data exists on the prevalence of water borne diseases. Groundwater and rainwater storage is untreated, except following Cyclone Heta as a precautionary measure.

Environment and Tourism: Significant concerns about the negative impacts of deforestation gave rise to the Huvalu Forest Conservation area located on the south-eastern side of the island. The site, containing approximately 75% of the remaining forest on Niue, complements and strengthens traditional conservation methods, activities and sustainable use. Two recognised marine protected areas (MPA) have been set up, both on the north-western side of the island. These are

examples of the watershed and coastal management measures that are required to allay concerns relating to the potential degradation of attractive natural or historical sites and the future of the tourism industry.

IWRM Barriers

Niue has noted the deficiencies in its capacity to efficiently adopt and embrace IWRM principles to conduct proper planning, development, and sustainable management of its limited and vulnerable water resources. Its lack of capacity – institutional and human, geographical isolation and financial dependence are major obstacles which are further compounded by the continued decline in population due to emigration. Recent cyclone damage has resulted in a relocation of a significant proportion of the population further into the centre of the island. This has highlighted fears of inappropriate land use and inadequate wastewater treatment impacting upon the main groundwater wellfields.

IWRM Solutions

Niue has reported a wide range of activities it would like to consider within an IWRM strategy. These include:

Strengthen capacity to conduct water resources assessment; formulate and implement strategies to utilize appropriate methods and technologies for water supply and sanitation systems; implement strategies to protect watersheds and the remaining forest from further depletions; strengthen capacity development to enhance the collection and application of climate information to cope with climate variability and change; promote hazard assessment and risk management rather than disaster response; set up a high quality participatory framework; include water and sanitation in the formal education system; improve the communication and coordination of all stakeholders in sustainable water and wastewater management including government, NGOs, Civil Society and Private Sector; identify appropriate institution, infrastructure, and information to support sustainable water and waste water management; continue collaboration with regional and international partnership; develop a comprehensive consultative process to develop shared IWRM national; strengthening national instruments, national vision, policies, plans and legislation; promote an appropriate institutional arrangements and sufficiently resourced; develop national leadership in water resources; create a better environment for investment by public and private sector; improved operational efficiency, using benchmarking, development of water-loss reduction programmes.

2.8 PALAU

Area	487 sq. km
Population	20,000 (2005)
Population Density	44.6 persons/sq. km (245 person/sq. km in Koror and Airai states)
Rainfall	3700 mm/year.Wet season between June and August.
GDP	$124.5 million (2004 est., CIA World Factbook)
GDP/capita	$7,600 (2005 est., CIA World Factbook)
Land Use	arable land: 8.7%
	permanent crops: 4.4%
	other: 86.9% 2005 (CIA World Factbook, 2005)
Water consumption	700 litres/person/day (Koror/ Airai); 150 litres/person/day (southwest islands)

Description: Republic of Palau is comprised of 350 islands. Two main inhabited islands, Koror and Babeldaob. A range of island settings, including volcanic, raised and low coral islands and atolls.

Economy: Primarily tourism, subsistence agriculture and fishing.

Water Availability: Surface water is abundant and largely continuous. The Ngerikiil River and Ngerimel Dam supply the Koror/Airai Water treatment plant on the island of Babeldaob. The islands of Peleliu, Angaur and Kayangel rely on groundwater for their public water supply systems. 90% of people living in Palau have access to piped treated water. The platform islands and low atolls get their water from aquifers and household rainwater harvesting systems. Bottled water is imported. Currently there is a proposal to reuse wastewater from a newly constructed sewage treatment plant, mainly for irrigation purposes.

Island Vulnerability: EL Nino impacts on Palau are felt heavily when the dry season is extended from its usual 1.5 months to 2-3 months. In the period after this, La Nina, higher than average rainfall is expected along with more intense and more frequent storms. Palau remains vulnerable to man-made disasters such as fires, marine oil spills, disease outbreaks, high-risk and unplanned development and chemical and sewage pollution of water supplies. The increasing number of tourists visiting the islands is putting a strain on the existing wastewater treatment systems. Hotels are required to have their own wastewater treatment facilities but most rely on the public system, thus pushing the system beyond its maximum capacity.

Power Generation: Reliance on imported fuel for electricity generation.

Health: Because most of the water supply systems are treated, water borne disease incidence relating to the public water supply is low. Of greater concern are individual household catchments. The Division of Environmental Health is using the hydrogen sulphide test to test for bacterial contamination in household catchments. Most of the outbreaks of water-borne illness come in cluster outbreaks, usually from campers in the forests using rivers directly as a drinking water source. Dengue fever is a concern due to the large number of mosquitoes and larvae at the ponding systems of the Malakal Treatment Plant. According to

the Division of Environmental Health, small dengue outbreaks occur at least once a year, with larger outbreaks happening every 2 to 3 years.

Environment and Tourism: Palau is home to the internationally renowned 'Rock' islands. In 2006, the number of tourists was four times the population of Palau. Unintentional damage caused by tourists (e.g. coral damage, congestion, increase use of personal watercrafts) has led the State of Koror to pass legislation to delineate tourist activity areas and a tour guide certification program for the Rock Islands tour companies was developed. Projects are in place to develop more hotels. Most of these proposed developments are high-end boutique cottages that cater to a limited number of people per year. For the most part, the developers have a vested interest in protecting the environments that their customers come to enjoy. However, there is the potential for larger-scale hotels to develop within the watersheds, thus creating more wastewater and putting strain on the environment and infrastructure.

IWRM Barriers

Palau has reported the following major concerns:

Increasing demand for and contamination of water resources due to increasing population and urbanisation; watershed misuse and sediment erosion; deforestation and pesticide use; inadequate wastewater management; sectoral management approaches and a lack of connectivity; increasing tourism pressures; vulnerability to natural and man-made disasters; lack of water resources assessment and monitoring; little disaster preparedness; too many awareness programmes but not enough community involvement; ineffective water demand management; over-reliance on unenforceable regulatory approaches; insufficient water tariffs; reliance on donor funding; weak linkages to ecosystem and public health.

IWRM Solutions

Palau has identified it requires the following IWRM strategies to compliment its existing activities:

A national water resources committee; awareness raising and community advocacy; integrated land use and water resources information and planning; research on effective regulatory approaches, water resources management, sanitation, ecosystem protection; linkage capacity building.

2.9 PAPUA NEW GUINEA

Area	462,840 sq. km
Population	5.9 million (2005 est. WHO)
Population Density	12.9 person/sq. km
Rainfall	1000 - 8000 mm/yr. Wet season from late December to mid-April
GDP	$15.41 billion (2006 est., CIA World Factbook)
GDP/capita	$2,700 (2006 est., CIA World Factbook)
Land Use	arable land: 0.5%
	permanent crops: 1.4%
	other: 98.1% (CIA World Factbook, 2005), of which 78% forest

Description: Several large high volcanic islands and numerous high volcanic and coral atolls.

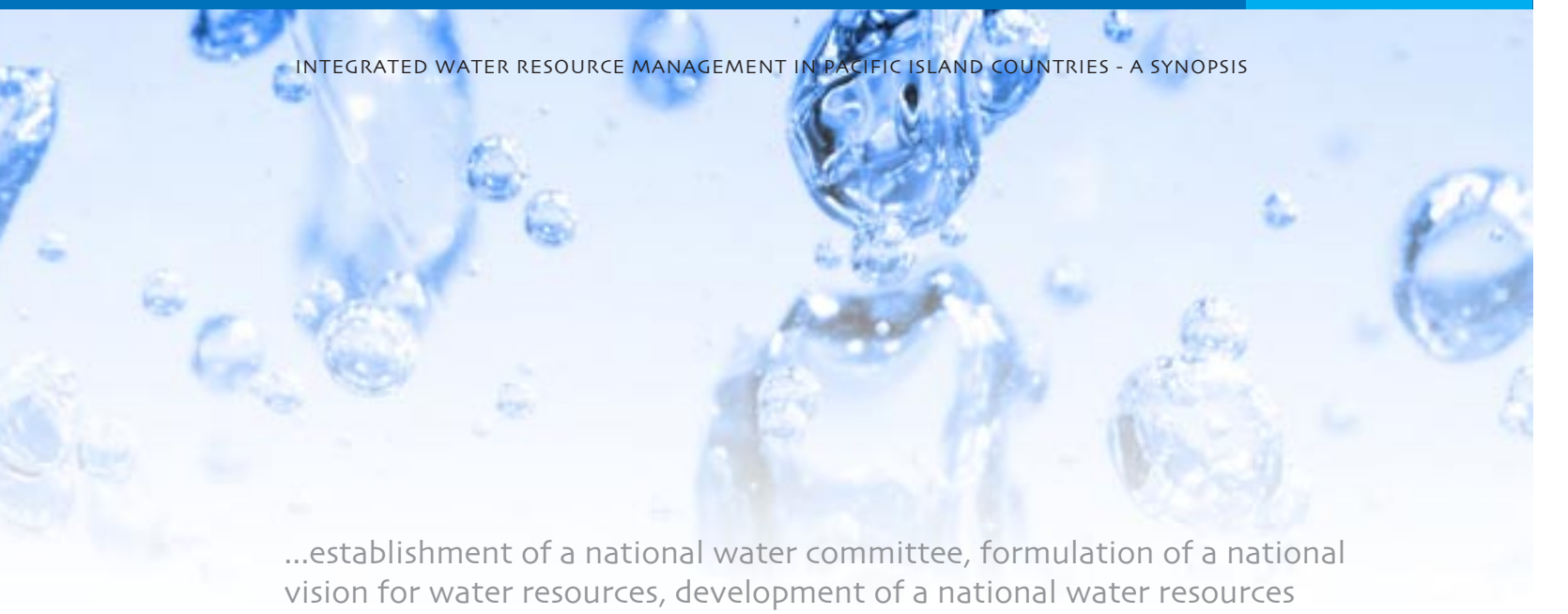
Economy: Subsistence and commercial agriculture (including food crops, fishing, livestock, hunting), forestry, mining, crude oil production and petroleum refinery

Water Availability: Water resources include surface fresh water from streams, rivers, lakes, ponds, reservoirs, estuaries and swamps; groundwater from confined and unconfined aquifers; surface and subsurface brackish water showing varying degrees of salinity; rainwater harvesting; and effluent water, which can be treated and recycled. A few commercial establishments in the drier areas of the country operate small desalination plants to supplement their water supply during the dry seasons. In rural PNG, only 20% of the population have access to an improved water supply which include public standpipes, boreholes, protected wells or springs In the urban areas which PNG Waterboard services, 91% have access to treated and reticulated water but only 60% of these households get piped water directly into their houses. In its nationwide urban water supply network the PNG Waterboard has succeeded in reducing unaccounted for water from the 1987 level of 50% to the present level of 31%.

Island Vulnerability: Due to its location on the intersection of the Australian plate and the Pacific plate, many parts of PNG are vulnerable to the effects of natural disasters. These include tsunamis, earthquakes, volcanic eruptions and landslides. Flooding, droughts and saline intrusion are also common. Wastewater discharge from large urban centres, mining, logging and major agricultural activities, increased sediment, bacterial and chemical pollution from untreated waste streams and improper solid waste management. As a consequence, destruction will continue to be caused to aquatic flora and fauna and the health of people downstream will be affected.

Power Generation: Papua New Guinea has large hydropower stations in Rabaul, Kainantu and Port Moresby. Smaller scale and micro-scale plants also generate electricity. National oil and gas supplies are also consumed.

Health: 78% of the population (more than four million people) do not have access to safe sanitation services. Diarrhoea is the number one cause of mortality and



...establishment of a national water committee, formulation of a national vision for water resources, development of a national water resources management policy, review and finalisation of a national water services policy, review of institutional mechanisms and capacity building in water resources management, disaster preparedness, awareness raising, water supply and sanitation services, institutional reform and sustainable financing...

morbidity in the country and 2.9% of all deaths are caused by typhoid. The current low access to potable water and safe sanitation increased the risk of a Cholera epidemic. Adverse impacts on water resources in catchments arise from road construction, agriculture, logging, mining and improper disposal of solid and human waste. This is major cause for concern as 60% of the rural population obtain drinking water directly from a natural source and preparation. The Department of Health has been promoting better hygiene, improved sanitation and proper solid waste disposal throughout the country but it needs the support of other government agencies, provincial and local level governments as well as NGOs and CBOs.

Environment and Tourism: PNG has a variety of terrestrial, coastal and marine ecosystems ranging from glacier covered high mountain peaks, through humid tropical forests and swampy lowlands to pristine coral reefs. Forest cover is the dominant vegetation in Papua New Guinea. Forests cover 360,000 km^2 (78 %) of the total land area. These forests, the extensive mangrove forests that characterise the major river deltas along the southern coast of Papua New Guinea and the coral reefs are all of global biodiversity significance. The main threats to these interconnected ecosystems are activities such as commercial logging, commercial agriculture, subsistence agriculture, road clearance, mining and petroleum developments, industrial and sewage effluents as well, as indiscriminate solid waste disposal. The impact on watersheds by tourism is minimal mainly because the concentration of rural based eco-tourism facilities and the annual volume of incoming tourists is relatively low.

IWRM Barriers

Water resources availability in terms of quantity and quality is coming under increasing threat from the pressure induced by rapid population growth as well as runoff and point source pollutant laden discharges from mining, logging, agriculture, infrastructure development and industrial processing, entering surface and groundwater bodies. While existing regulatory controls are in place to minimize these impacts, better monitoring and compliance arrangements are required to regulate these activities. In order to overcome the constraints imposed by limited regulatory funding from the government, monitoring networks involving partnerships with private sector, NGOs and local landowners should be seriously pursued. Rural water supply access is limited and wastewater access nationwide inadequate.

IWRM Solutions

In order to safeguard the availability of water with respect to quantity and quality to maintain ecological integrity, cater for natural and anthropogenic water uses as well as minimize impacts arising from floods, droughts and climate change, Papua New Guinea identify there is an urgent need to apply integrated water resources management involving all stakeholders and focusing on catchment units. Several institutional, legislative, operational, strategic, capacity, public consciousness and resource related barriers have been identified for appropriate treatment in order to achieve effective IWRM in PNG. These include the establishment of a national water committee, formulation of a national vision for water resources, development of a national water resources management policy, review and finalisation of a national water services policy, review of institutional mechanisms and capacity building in water resources management, disaster preparedness, awareness raising, water supply and sanitation services, institutional reform and sustainable financing.

2.10 SAMOA

Area	2,820 sq. km
Population	180,000
Population Density	63.5 person/sq. km
Rainfall	3000 mm/year. Wet season from November to March.
GDP	$1.218 billion (2006 est., CIA World Factbook)
GDP/capita	$2,100 (2005 est., CIA World Factbook)
Land Use	arable land: 21.1%
	permanent crops: 24.3%
	other: 54.6% (2005, CIA World Factbook)
Water consumption	230 litres/person/day (Samoa Water Authority)

Description: Two main islands (Upolu and Savaii) and several smaller islands, plus some uninhabited islets. A narrow coastal plain with volcanic rugged mountains in the interior.

Economy: Two-thirds of the labour force are engaged in agriculture, which provides 90% of exports (coconut cream, coconut oil and copra). Limited manufacturing concentrates on agricultural products. Fisheries resources appear to be falling. Tourism is growing and now represents 25% of the GDP. The economy of Samoa has traditionally been dependent on development aid and family remittances from overseas

Water Availability: Water supply in northern, eastern and southern Upolu and eastern Savaii is from surface water intakes, where as that for western Upolu and rest of Savaii is from groundwater. Water shortages are reported during the dry season, especially during extended dry periods associated with the ENSO, in the Apia area on Upolu (served by surface water intakes) and in the Falealupo Peninsula on Savaii (where groundwater is often brackish saline and the population relies upon rainwater harvesting). Water consumption in Apia has been controlled through the introduction of metering.

Island Vulnerability: Flooding associated with cyclones and storm surge is exacerbated by small catchments and steep slope gradients. El Nino related dry periods can cause urban water supply problems in Apia, even if rainfall is reduced for relatively short periods. Population growth, increased urbanisation and an increase in major developments put pressure on natural resources and result in land degradation, waste generation and land and water pollution.

Power Generation: There are five micro-hydropower stations, all in Upolu, which provide about 40% of the national requirement. Sediment erosion is threatening hydropower generation and has resulted in the abandonment of the Fulausou hydropower plant.

Health: Improved access to drinking water is high in urban areas (90%, 2004, UN) as well as rural areas (87%, 2004, UN). However, only around a third of the population of Samoa receive treated water and, even when treated, only 85% of samples taken pass the relevant standards. 1 in 60 people attend hospital each year for treatment of water borne diseases.

Environment and Tourism: Tourism in Samoa is growing. All resorts are located on the coast. Tourism contributes to heavy water demand and high wastewater production and thus places pressure on the watershed as well as the near-shore environment. Increased coastal development impinges on reefs, mangroves and other habitats, which contribute to the protection of the terrestrial environment from storm waves, tsunamis and coastal erosion. The impact of integrated coastal and catchment management on the terrestrial and marine environments as well as the economy is recognised.

IWRM Barriers

Samoa has identified some significant barriers to achieving IWRM, despite having some of the more integrated water governance in the Pacific. These include:

A lack of natural water storage resulting rapid onset of low flow levels within several weeks and conversely very rapid flooding events; water and energy demand increasing despite water demand management measures; increasing population and land use pressures, especially around the capital area, land degradation in the catchments is a concern; inadequate wastewater management and solid waste management in the lower catchments, and increasing vegetation clearance due to urban expansion and cash cropping in the upper catchments not only reduces low flows and increases flash run-off, but also is resulting in perceived increases in erosion, sediment loading and nutrient enrichment of the water courses. Collectively these increasing pressures are perceived to be impacting upon public water quality, public health and causing degradation of environmental habitat.

IWRM Solutions

Samoa is proposing an IWRM approach, the ethos of which is to build on the activities undertaken to date (water resources assessment and monitoring, participatory watershed management, integrated disaster preparedness, institutionalisation of traditional governance rights, extensive water demand management, water safety planning, wastewater management improvements, country-wide civil society consultation, the integrated multi-agency water committee, appropriate water supply tariffs) and to improve the coordinated and integrated planning and management of these activities, moving away from sectoral and institutional delivery, to more effective and efficient collaborative implementation.

2.11 SOLOMON ISLANDS

Area	30,000 sq.km
Population	409,042 (1999 census)
Population Density	13 person/sq. km
Rainfall	1,500-5,000 mm/year. Wet season from November to April
GDP	$230 million (1999, ADB)
GDP/capita	$510 (1999, ADB)
Land Use	arable land: 0.6%
	permanent crops: 2%
	other: 97.4% (CIA World Factbook, 2005)
Water consumption	150 litres/person/day (urban areas)

Description: About 1000 scattered islands comprised of volcanic peaks and low lying coral islands, divided into 9 provinces

Economy: The economy consists of a mixed subsistence sector on which over 80% of the population depend, and a small monetised sector dominated by large-scale commercial enterprises. Log exports remain the major foreign exchange earner for the country Over-reliance on one commodity magnifies the country's susceptibility to external shocks. The islands are rich in undeveloped mineral resources.

Water Availability: Water resources availability in Solomon Islands varies considerably for each island. It ranges from sizeable rivers to small streams from high mountainous and dense rainforest islands to rainwater harvesting and thin fresh water lens of underground aquifers of the small low-lying atolls and islets.

Island Vulnerability: Cyclones, flooding and drought affect the Solomon Islands. Sea level rise also poses a threat. Soil erosion and increased sediment load in rivers result from human activities such as subsistence farming, logging and developments and residential housing. Untreated sewage, industrial discharges, leakage from oil storage tanks, human disturbances to vegetation, mine drainage and leaching from mine waste, and drainage from the residues of agricultural fertilizers and pesticides pollute water bodies, the extent of which is not well understood due to lack of data.

Power Generation: Significant potential for hydropower generation

Health: Water quality analysis is a major problem. Most of the existing laboratories are incapable of undertaking the necessary analysis as specified in the International standards for water quality. Faecal coliform and high nutrients detected in samples taken from boreholes suggest waste water leachate contamination from overflowing septic tanks during heavy rains.

Environment and Tourism: Solomon Islands is recognised for its high level of biological diversity in terrestrial and marine environments. The coral reefs, shallow lagoons and mangroves of Solomon Islands are amongst the most biologically diverse in the world. However, many reefs are at risk due to continued exploitation for food and other resources through the

use of unsustainable and destructive harvesting methods. Industrial and agricultural and sewage pollution of water courses, logging and coastal development also threaten mangrove habitiat. Tourism is still a small sector and has little impact on watershed and coastal ecosystems at present.

IWRM Barriers

The Solomon Islands has identified the following barriers to achieving IWRM:

A lack of comprehensive water assessment; inappropriate water resources governance and legislative framework, poor coordinative approach by organizations responsible for water; inadequacy of River Waters Act; lack of capacity to ensure water analyses in-country; threat from logging and mining; flooding and droughts and no hydrological stations with capability for flood warning; low level of national literacy; lack of basic water related data to back up awareness program; women are not included in decision making process for water; ageing infrastructure for water and wastewater services; lack of monitoring and enforcement; lack of appropriate technologies and procedures; lack of training; no national water resources policy; no comprehensive water resources legislation; lack of financial resources - only urban areas supplied by SIWA are commercially viable, whereas provincial governments lack of qualified staff and funds to properly maintain rural water supply systems.

IWRM Solutions

The Solomon Islands recognises the need for the following IWRM solutions, some of which it has already initiated:

Hydrology equipment and hydrology training for resource assessment; water conservation and reuse; pollution prevention; establishment of a national water quality guideline committee; awareness programs on hydrology; disaster preparedness; community based monitoring programs; high level advocacy; improvements to wastewater treatment or discharges; shared water resources information; integrated and linked institutional arrangements and policy and legislative framework; capacity building; financial restructuring of SIWA to improve revenue and sustainability of service in urban area; effective billing systems for cost recovery; public-private partnership and robust regulatory oversight.

2.12 TONGA

Area	747 sq. km
Population	114,600 (2006 est.)
Population Density	127 person/sq. km
Rainfall	1689 - 2185 mm/year. Wet season from November to April
GDP	$178.5 million (2004 est., CIA World Factbook)
GDP/capita	$2,200 (2005 est., CIA World Factbook)
Land Use	arable land: 20%
	permanent crops: 14.7%
	other: 65.3% (2005, CIA World Factbook)
Water consumption	170 litres/day (Nuku'alofa area est., 1998)

Description: Archipelago of 172 named islands, of which 36 are inhabited. The archipelago comprises a western line of steep sided volcanic islands and an eastern line of generally low-lying limestone and mixed geology islands

Economy: Tonga, a small, open, South Pacific island economy, has a narrow export base in agricultural goods. Squash, coconuts, bananas, and vanilla beans are the main crops, and agricultural exports make up two-thirds of total exports. The country must import a high proportion of its food, mainly from New Zealand. Tourism is the second-largest source of hard currency earnings following remittances. The country remains dependent on external aid and remittances from Tongan communities overseas to offset its trade deficit. Tonga has a reasonably sound basic infrastructure and well-developed social services.

Water Availability: The water resources of Tonga are primarily in the form of groundwater. Surface water resources are not present on most islands, except 'Eua and some of the volcanic islands including Niuafo'ou and Niuatoputapu. Groundwater is normally pumped from drilled wells and some old dug wells, some of which are over 50 meters deep. The water supplies for the main urban centres: Nuku'alofa (Tongatapu), Pangai (Ha'apai) and Neiafu (Vava'u), and some villages' water supplies are also source from groundwater. Rainwater is the supplementary source of portable water and is mainly collected from the rooftop and stored in reinforce concrete, fibre glass and galvanizes iron tanks. There are currently no functioning desalination systems in Tonga. Domestic greywater is commonly re-used for livestock especially pigs. Bottled water is increasingly being imported from Fiji and Asia, but is mainly used by ex-patriates and tourists.

Island Vulnerability: Cyclones which occur in the kingdom on an average of once a year can inundate low lying areas causing surcharge of sewage and other contaminants. Earthquakes and volcanic eruptions can cause infrastructure damage and derogation of water supplies. Extended drought reduces re-charge of groundwater, concentrates contaminants, reduces food production for subsistence and income, and may increase incidence of communicable diseases due to in adequate water for hygiene purposes. Saltwater intrusion of groundwater can also reduce potable supplies. Man-made disasters include chemical pollution

...to facilitate co-operation and sharing of resources and information, and to nurture traditional and cultural values and knowledge of resource management...

from pesticides and fertilisers, oil, fuel, industrial chemicals, which can rapidly infiltrate the porous soils, and biological pollution from septic tanks, pit latrines, and pigs. In the case of Nuku'alofa township, the aquifer had to be abandoned as pollution caused an increase in diarrhoea.

Power Generation: Reliance on imported fuel for electricity generation.

Health: Reticulated water from the Tonga Water Board and village water systems is treated and is delivered to 80% of households. Rainwater harvesting systems are connected to 60% of households and wells provide supplementary groundwater supply to 3% of households. This water is not treated. In 1999 and 2000 the incidence of diarrhoea related diseases peaked during drought conditions, which led to the assumption that reduced water supply had led to unhygienic conditions and practices in many communities. This may have been exacerbated by greater concentration of contaminants and drawn down from point sources of pollution such as septic tanks to water supply sources such as wells and village pumps. It has been observed that dengue outbreaks are more common in cyclone seasons when hot humid conditions are favourable to reproduction.

Environment and Tourism: Tonga has a variety of habitats that are rich in biodiversity. These include forests, mangroves and coral reefs. Some damage to coral reefs has been sustained (e.g. from destruction for aggregates and die-off due to nutrient run-off). Over-hunting threatens the native sea turtle population. Under the Parks and reserves Act of 1976 five marine parks have been designated on Tongatapu. The parks cover 250 hectares of coral reef, which is 10% of Tonga's total coral system. None of the other island groups have marine parks although surveys have been conducted with this intention in mind. Deforestation is a serious concern as more and more land is cleared for agriculture and settlement. Nutrient run-off and increased sedimentation also threatens to trigger an algal bloom and silting up of the lagoons.

IWRM Barriers

Tonga reports the following constraints on implementing national IWRM approaches:

There is no functioning information or data exchange systems on water resources or 'National Hydrological Network' for water resources assessment and monitoring; demand management measures, augmenting water supply, drought vulnerability assessment and climate forecasting are all recognised as being important but are not yet adequately supported; wastewater management is almost entirely in the hands of the householder as all sanitation treatment in Tonga is on-site, there is no centralised reticulated sewerage system in Tonga; no comprehensive law in Tonga dealing with issues of ownership, management and protection of water resources; no specific land use policy; complex traditional land tenure system; lack of control of groundwater abstraction rates, sanitation and solid waste disposal practices, the use of agrichemicals, and deforestation; inadequate funding for rural water supply and sanitation.

IWRM Solutions

Tonga report the emphasis on IWRM solutions should be to build on existing skills and relationships, to facilitate co-operation and sharing of resources and information, and to nurture traditional and cultural values and knowledge of resource management.

This includes: comprehensive water resources legislation (providing for effective planning, assessment, development, control, monitoring and protection of water resources); clear institutional mandates and co-ordinate other agencies in supporting roles, providing an opportunity for integrated planning and ongoing adaptive development of a national water policy and strategy; a partnership approach with the community to ensure compliance, including water users and landholders who are providing access to groundwater; a National Water Resources Committee will be established to keep all stakeholders involved and informed, and to assess training and capacity building requirements; strengthened and integrated (multi-agency) water resources monitoring programme including monitoring systems and information databases; water resources technical capacity building; improved wastewater management using eco-sanitation technologies; improved rainwater harvesting; improvements to farming practises (organic approaches).

2.13 TUVALU

Area	26 sq. km
Population	11,000 (2007 est.)
Population Density	425 person/sq km
Rainfall	3569 mm/year (Funafuti, Falkland and Woodroffe, 1997). Wet season November to April
GDP	$14.94 million (2002 est., CIA World Factbook)
GDP/capita	$1,600 (2002 est., CIA World Factbook)
Land Use	arable land: 0%
	permanent crops: 66.7%
	other: 33.3% (2005, CIA World Factbook)
Water consumption	< 50 litres/person/day

Description: 9 very low-lying coral atolls comprised of very coarse coral sand and gravel. Limited fresh groundwater lens formation and heavy reliance on rainwater harvesting

Economy: Government revenue comes from the income generated by the Tuvalu Tonga Trust (capital), the 'dotTV' internet domain (asset) and from fishing licenses granted to foreign fishing companies (natural resources). The private sector contributes approximately 30% of GDP of which half is from external remittances.

Water Availability: Since there are no streams or rivers and groundwater is not potable, most water needs must be met by rainwater catchment systems with storage facilities. Groundwater is a non-potable, secondary source, used on islands where salinity is not prohibitively high and in times of drought. Desalination plants were installed on Funafuti, Vaitupu and Nanumaga after Tuvalu experienced drought in 1999. Some bottled water is imported. Natural brackish ponds are the construction and cleaning of pig pens and for dumping rubbish.

Island Vulnerability: The natural disasters that can affect Tuvalu include cyclones (not common but highly destructive when they do occur) and drought, both of which could be exacerbated by climate variability and change and sea-level rise. Human activities/practices also contribute to vulnerability to disaster. Insufficient capacity and storage and poor construction and maintenance of rainwater harvesting systems means that supply is depleted in dry spells of one or two weeks. The community then relies on the government tanker to transport water from the national reserves. Poorly controlled waste disposal is still commonplace throughout Tuvalu. Pollution of groundwater and marine waters from inappropriate sanitation systems and animal waste (especially pigs) is a serious threat. Increase in population and the growth in demand for permanent housing and infrastructure in Funafuti has resulted in an increased demand for sand and gravel for building and construction purposes. The sourcing of aggregate from coastal environments is increasing the risk of coastal erosion and flooding. Increasing population and limited land for subsistence farming, especially in the capital Funafuti is leading to dependence on imported food.

Power Generation: Heavy oil dependence. Small, solar-powered backup pumps in shallow wells used during droughts.

Health: In 1990 there was an outbreak of cholera. There were 1809 reported cases of severe diarrhoea between July and November that year. It was considered that the outbreak was due to inadequate hygiene resulting from lack of water, and contamination of water supplies and the lagoon water due to poor sanitation. There were 2449 cases of acute respiration infections from June to October, and a conjunctivitis outbreak, in November. All of these problems are associated with sub-standard hygiene and high household densities, which is exacerbated by disease transmission by flies. Many children under five have diarrhoea and intestinal parasites. Environment and Tourism: A Marine Conservation Area (MPA) encompassing 33 km^2 of marine and terrestrial habitats has been established on the capital atoll of Funafuti in Tuvalu. Fish, coral and algae surveys have been conducted to measure the 'health' of the reef. As a result its success, other islands such as Nui, Vaitupu, and Nukufetau are interested in setting up MPAs in support of their traditional marine management systems. It has been estimated that the net economic value of the MPA is $162,120 per annum and relates to increased fisheries productivity, coastal protection from healthy coral reefs, improved opportunities for eco-tourism, dive tourism, ocean recreation and similar income generating activities (ADB 2003). Promotion of the MPA and the conservation work that is being undertaken there would be a useful focus for marketing Tuvalu tourism, and increased visitor numbers would help to generate funds to support the MPA. However facilities for visitors need to clearly demonstrate sustainable water resources and wastewater management.

IWRM Barriers

Tuvalu reports the following major challenges to implementing national IWRM plans:

No National Hydrological Network for water resources assessment and monitoring; high vulnerability to climate variability due to reliance on rainwater harvesting; no community-based monitoring of quality; limited maintenance of rainwater harvesting systems; limited water conservation and demand management activities; inadequate wastewater management; pollution from solid and liquid wastes, coastal erosion; sea level rise; limited financial resources and technical support available to households; a lack of knowledge and awareness of people within the community of the environmental impacts caused by 'un-managed' wastewater on surrounding marine and freshwater quality; a lack of waste management legislation and enforcement; inadequate funding; complex formal and informal governance structures; no national water plan; no water storage regulations; land disputes; no land use policy; and limited linkages between different sector stakeholders.

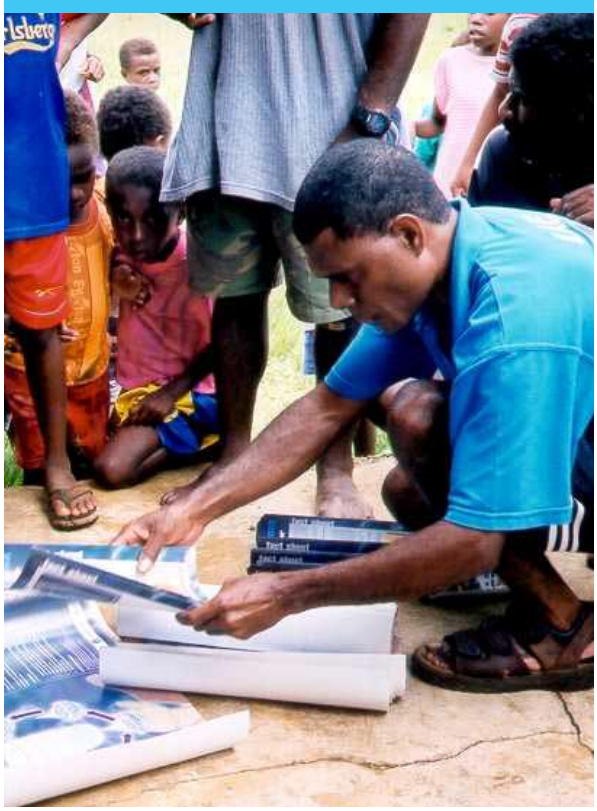
IWRM Solutions

Tuvalu considers any IWRM framework must address the three key issues of adequate rainwater harvesting, improved wastewater management to reduce the contamination of valuable drought resistant groundwater resources and protection of the marine shore fisheries from land based pollution (especially wastewater). This strategy identifies:

Need to refurbish or supplement fresh water resources by improving rainwater harvesting systems, and expanding the use of groundwater resources; demand management; improvements in the management of wastewater; collaboration of government institutions, non-government and community-based organisations and in particular householders themselves; trial of waterless zero discharge sanitation systems (reducing water demand and groundwater pollution); strengthen the National Water and Sanitation Committee; review existing legislation; increase capacity building in water resources assessment, integrated planning, demand management, cost recovery, community liaison and appropriate household water supply and sanitation technologies.

2.14 VANUATU

Area	12,281 sq. km
Population	200,000
Population Density	16 person/sq. km
Rainfall	2000 - 4000 mm/year. Wet season from November to April, with cyclones from December to April
GDP	$739 million (2006 est., CIA World Factbook)
GDP/capita	$2,900 (2003 est., CIA World Factbook)
Land Use	arable land: 1.6%
	permanent crops: 7%
	other: 91.4% (2005, CIA World Factbook), of which 75% natural vegetation



Description: Archipelago of over 80 islands, of which 69 are inhabited. Volcanic and raised limestone islands. 81% of the population live in rural areas and are mainly occupied in subsistence and small holder farming with the remaining 19% of the population living in the two main urban areas of Port Vila on Efate and Luganville on Santo.

Economy: Based primarily on small-scale agriculture that provides a living for 65% of the population. Fishing, offshore financial services and tourism are the other mainstays of the economy. Negligible mineral deposits.

Water Availability: All larger islands have groundwater and many also have surface water resources. Some smaller islands such Mataso & Buninga in the Shepard's Group, all of Torres Group, and small islands off Malekula and Santo have neither ground nor surface water. During times of national disaster such as cyclone damage to islands relying on rainwater catchment, the National Disaster Management Office has provided a desalination plant as a temporary measure. Bottled water is increasingly used in Port Vila and other urban areas.

Island Vulnerability: Vanuatu is situated on the Ring of Fire and is in the centre of the South Pacific's Cyclone Alley. It is vulnerable to natural disasters such as tsunamis, earthquakes, volcanic eruptions, and cyclones and is known as the most disaster prone country in the South Pacific. Atolls, low-lying islands, and low-lying coastal areas of Vanuatu are particularly susceptible to erosion, flooding and inundation during tsunamis, storm surges, high seas, sea level rise and periods of intense rainfall. Vanuatu's population is concentrated along the coastal environment that plays a vital role in the subsistence and commercial life of ni-Vanuatu. Increased human activity in this coastal environment is placing greater pressure on sensitive areas such as beaches, coral reefs and mangroves.

Power Generation: Electricity is produced by hydropower plants on Vanuatu. Fuel is also imported.

Health: Scabies, skin diseases and malaria are water related diseases and are the three of the most common health issues in Vanuatu. Poor drainage and waste management provide pools of water that are favorable breeding sites for the malaria mosquito. Unmanaged and uncontrolled sanitation and wastewater are also major concerns for health. Whilst there are currently

no major issues related to this there is concern particularly in high-density areas that should a problem emerge it will be difficult to control, especially as communicable diseases account for a large proportion of illness and death in Vanuatu. The tourism industry is also under threat from poor sanitation facilities. The Vanuatu Island Bungalow Association (VIBA) is participating in the Eco-Sanitation Program in an attempt to introduce more hygienic and more acceptable sanitation to remote tourist locations. Community awareness programs are continuously improving.

Environment and Tourism: There are seventeen reserves in Vanuatu that cover a range of habitats including coastal areas, inland areas, forests and waterways. Despite the biodiversity study undertaken by the Environment Unit there is still a lack of research and knowledge of habitats and endangered species. Outside the system of reserves, no formal sectoral linkages are currently known to plan for or manage coastal development or the impacts of land based activities on waterways and coastal ecosystems. It has been suggested that eco-tourism is promoted as a means to protect the environment.

IWRM Barriers

Vanuatu has reported the following constraints upon achieving national IWRM approaches:

Lack of planned methodical water resource assessment and monitoring; declining ground water levels and quality due to septic tank use and cattle grazing; decline in coastal water quality where septic tanks are used; poorly prepared for climatic and geological disasters; government awareness programs infrequent and sector based; lack of a coordinated approach between government and NGOs; lack of involvement of women; conflicts with custom land tenure and resource ownership; logistical difficulty of reaching outer islands on a regular basis; water supply does not meet demand; poor waste management; all government and municipal water supply providers are severely constrained by limited human and financial resources; sectoral planning has not met resource management needs, failed to address customary land tenure and resource ownership issues; lack of capacity to interpret, implement and enforce existing legislation; lack of sustainability and coordination of external interventions; lacks a national land-use policy.

IWRM Solutions

Vanuatu suggests an IWRM strategy framework targeting research, public awareness, capacity building, and policy and institutional development.

Research focuses on water resources management, ecosystem inventory and stress reduction approaches, health and links to water quality, appropriate sustainable sanitation, disaster vulnerability reduction measures, impact assessments and information management.

Public awareness focuses on resources and information provided to NGOs who are already delivering community awareness programs and government departments integrating community awareness into their core responsibilities and using NGOs to implement their programmes.

Capacity building focuses on leadership, strategic planning and coordination mechanisms and approaches, and technical skills especially in water resources management, sanitation and data management.

Policy and institutional development focuses on legislative reviews and reforms, land policies including land ownership, service provision and regulation, tariffs and subsidies, and IWRM application in inter-agency programmes.

A Pacific regional review of IWRM practise in the Pacific SIDS in 2004 reported there was an increase in

3. BARRIERS TO ACHIEVING IWRM IN SIDS

integrated planning and management in recent years in some countries, however whilst the Pacific has a strong traditional and cultural understanding of the connection between land and fresh water activities and the coastal environment (95% of the Pacific population live within a kilometre of the seas and most rely on both the land and sea for their livelihood), this was not apparent in any formal policy or institutional way. It is not surprising therefore that the 2005 IWRM Target for IWRM and WUE Plans was not achieved by any PIC, as indeed it was not by many countries in the world.

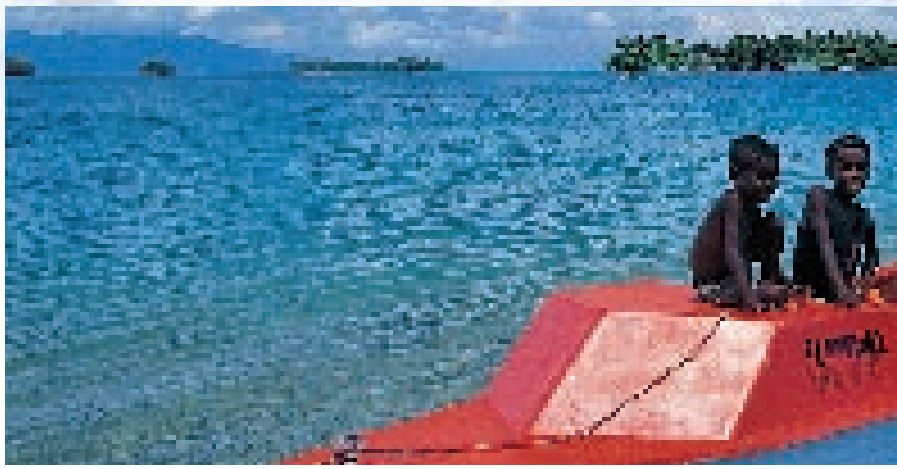
A more detailed diagnostic analysis of IWRM in the Pacific Region at the country level has been carried out in 2006-2007 and completed for 14 PICs as part of the Global Environment Facility supported Pacific IWRM programme development. These country diagnostic reports provide the clearest picture yet as to why the Pacific SIDS are struggling to adopt and implement IWRM.

Ultimately, like all IWRM challenges, the barriers relate to overcoming the existing demands for and availability of water, existing land usage and associated pollution potential and the capacity of people and organisations to overcome these issues.

The main barriers are provided below with supporting information.

Limited and Fragile Water Resources – all countries identified their available water resources were of very limited size, mostly due to small land mass areas and close proximity to coastlines. In the more populace areas, population densities (especially on capital atoll islands) can become so great that water demand exceeds water availability. In some volcanic islands competing water demand in urban catchments results in complete loss of stream flows and degradation of downstream users supplies. Water quality degradation in urban areas, and especially in low-lying atoll islands (where groundwater is <1m below ground surface) from numerous dispersed sources was widely sited. All countries identified a lack of water resources expertise and subsequent baseline knowledge as being a fundamental barrier to any informed decision-making on water resources management and protection, including IWRM.

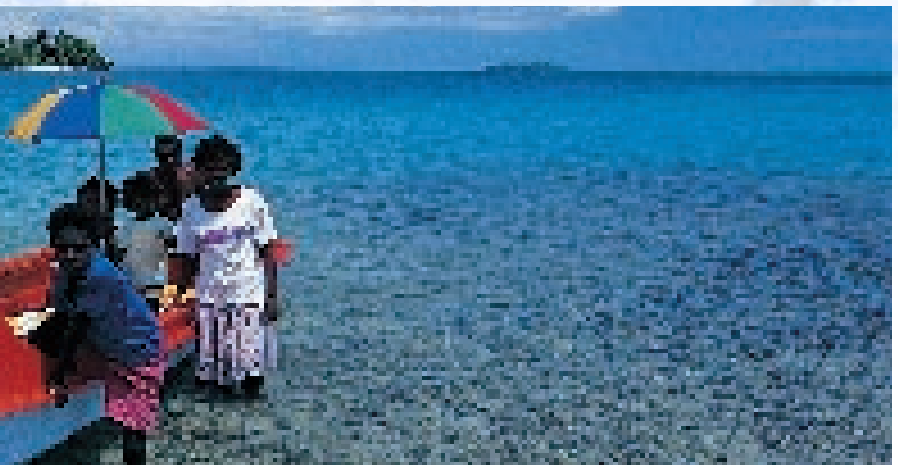
Vulnerability to Climate Variability – all countries recognised that their water resources were not only small in size, but due to this small size they were highly



vulnerable to climate variability, be it dry periods and subsequent drought or wet periods and rapid flooding. The time lag between a climatic extreme and a water shortage could be as small as a week for those countries entirely reliant on rainwater, to a month for those reliant on surface water and six months for some groundwater bodies. Flooding, especially that associated with cyclonic rainfall events, can be near instantaneous, and outside of Papua New Guinea, arrive less than 6 hours after the rain storms. The ability to manage such rapid on-set of drought and flooding (sometimes concurrently) within the countries was limited.

Insufficient Political and Public Awareness – most countries identified that there was limited political understanding of the economic and public health importance of water, except that is during periods of drought and flooding. Because water is actually important to every sector, no one agency or sector has responsibility, the issue has no political champion, and the issue does not get the political support, be it budgetary, institutional or prioritisation it requires. Similarly, whilst the public generally understands the value of water to their daily lives, it is either assumed to be always available or given insufficient priority over other issues (e.g. health, education, income), despite being implicitly important to achieving these more valued family goals.

Excessive Water Demand and Inadequate Water Treatment – most urban areas in the Pacific are supplied water by urban service providers. A shortage of technical capacity, as well as inadequate funding, is often sited in



the reports as the reasons behind high water losses (leakages, theft, poor metering) in the systems. However in some countries per capita household demands are still excessively high, despite water conservation campaigns. Water treatment plants often operate beyond their design limits, and fail to cope with high flows, especially during periods of high turbidity. A lack of sufficient drinking water quality monitoring in many countries then fails to ensure these problems are resolved quickly.

Inadequate Wastewater Management – within the 14 PICs, only a few capital areas have any sewerage systems, with the vast majority of the Pacific populace dependent upon on-site sanitation systems, most of which are unmanaged and therefore ineffective. Groundwater pollution is wide spread, especially in the low-lying atoll countries. Of the capital areas serviced by sewerage systems, few and perhaps none, work to the original design standards, discharging untreated or inadequately treated sewage effluent into the near shore environment and local fisheries. Inadequate wastewater management was identified as the single largest cause of freshwater contamination in the Pacific by the UNEP International Waters Programme.

Fragmented National Water Governance – all countries identified that although water resources and supply were important to many if not all sectors, including public health, fisheries, tourism, the environment, power generation, commercial enterprises and the government administrative function, and were also impacted upon and affected by these sectors as well as others, including forestry and agriculture, that there was very little formal communication and coordination both at the planning and the implementation stages between these departments, ministries and agencies, when it came to water resources allocation, usage, pollution prevention, monitoring and management. Where attempts at integration have been made, some were overly ambitious (following 'western' models) and lacked not only the political and institutional commitment required to sustain them but also had not taken into account the limited capacity of the countries themselves to fulfil these functions.

National Government vs. Traditional Governance Conflicts – almost without exception, the countries reported there were traditional values, beliefs and rights that if not adequately recognised, considered, consulted and resolved could become significant if not insurmountable barriers to any forms of water and land management. The most obvious of these is the issue of customary land ownership, and the associated rights of land usage, access, purchase and even water usage. Whilst many of the countries were aware how these conflicts could be resolved, usually through extensive community engagement, these approaches rarely coincided with the shorter timescales associated with engineering project implementation.

Inadequate Financing – the size of the Pacific SIDS populations and economies prevents the 'economies of scale' being available as they are in larger countries. The costs of operating a water service provider, a regulator, an environmental health department or a water resources agency, are higher per capita, thus resulting in limited human and financial resources available to fulfil these functions. Insufficient cost-recovery be it due to cultural, political or technical reasons, by water and wastewater service providers contributes to under staffing, inadequate maintenance levels and thus water losses, water and wastewater treatment failures and pollution.

Weak linkages to Other Sectors – some countries have made progress in improving the linkages within the water sector per se, including the water provider, water resources protection agency and the environmental health department. However linkages beyond the water sector remain weak, with no formal or informal linkages at any levels between the water sector and agriculture, forestry, tourism, power generation and environment. With so little linkages, the inertia for creating institutional reform is considerable.

4. SOLUTIONS TO ACHIEVING IWRM IN SIDS

4.1 IWRM Pacific Style

In developing IWRM strategies in SIDS it is important to recognise that whilst IWRM remains a relatively new "brand" in the Pacific Islands, the concept and the approaches it embodies has been practised at a traditional level for centuries in the Pacific Islands.

The idea that all activities affect each other, given the very small landmasses in the Pacific, is well understood by people living in the islands. The concept of competing land pressures, the choice of whether to use precious land for a plantation, a water reserve, a school or recreation area, are appreciated at the household, village and community level. In particular, every coastal village community understands the connection between activities on the land and in the sea, as they impact on freshwater, fisheries stock and coral reefs.

Transboundary river basins - the scale at which IWRM first took hold and was seen to be of value, is not an issue in the Pacific. Basins or catchments are generally too small to manage individually except at the community level, and with no international land borders in the region, 'transboundary' in the Pacific refers to marine pollution and migratory fish stocks. Capacity building, advocacy and awareness raising are most effective at the national level, but have regional level implications.

Cyclone and drought events, to which the PICs are especially vulnerable (due to the small size of the catchments and aquifers and therefore the lack of natural storage) affect all water users. The need for national drought and disaster preparedness plans (as opposed to sector wide plans) are two forms of climatic extreme water resources management, recognised as national priorities in many PICs, and which to a greater or lesser extent show signs of more integration.

Since the late 1990's mounting evidence, collected through international programmes such as the UNEP GPA suggested, that pollution on land from inadequate wastewater disposal, increased sediment erosion, and industrial discharges were impacting upon coastal water quality and fishing stocks. This pollution has had an impact on entire island wide food security as well as valuable tourist revenue, and has also led to recognition for the need for more integrated land and coastal-marine management (often referred to as Integrated Coastal Zone Management – ICZM).

In response to this islands have started to look at managing water resources not only within the watershed but also the receiving coastal waters. In the Pacific this management concept has been referred to as "Ridge to Reef" or "Hilltops 2 Oceans - H2O". In the Caribbean it is known as "White Water to Blue Water".

There is therefore some relevant experience in the region of awareness, advocacy and existing programmes, from which to develop IWRM policies, strategies and activities, as demonstrated by the findings of the country IWRM diagnostic reports. The formalisation of these IWRM strategies and implementation programmes must build on this baseline, as well as that in other SIDS regions, such as the Caribbean with its regional "Integrated Watershed and Coastal Area Management" (IWCAM) Initiative.

4.2 A Synopsis of IWRM Tools from the Pacific Country Assessments

Despite the hydrological, geomorphological, economic and cultural diversity of the Pacific Island Countries, the solutions they identified to achieving IWRM were consistent and are summarised in the list below. Clearly not all are relevant to all countries (e.g. hydropower is not applicable in atoll and karst islands, where surface water is absent). Notable by it's absence from the list is irrigation – which is entirely rain fed in the Pacific Region.

- Water Resources Management
- Upper Catchment Watershed Management
- Flood and Drought Management
- Public Awareness and Education
- Community Engagement and Ownership
- Sustainable Rural Livelihoods
- Water Demand Management
- Water Quality Management
- Wastewater Management
- Hydropower Generation
- Lower Catchment Urban and Coastal Planning
- IWRM Partnership and Planning
- Legislative Reform
- Cost Recovery and Appropriate Tariff Setting
- Regulatory/Management Funding
- Sustainable Land Management
- Public Health protection
- Environmental Protection

Nearly all of these activities, tasks and functions are being addressed to some extent in all the countries, but crucially from an IWRM perspective, most of these are being undertaken at either the institutional scale or the sectoral level. There is therefore relatively little integration of these functions between ministries, between sectors, and between government and civil society stakeholders.

4.3 Integration of existing Water Resources Management

A comparison of the Pacific IWRM requirements with that of globally accepted IWRM best practice is worthwhile. The Global Water Partnership (GWP), a key IWRM advocate, identifies 3 main areas of action as part of what it refers to as its IWRM Toolbox. These are the:

- Enabling Environment – including national policies, the legislative framework and adequate water funding;
- Institutional Roles – including well defined responsibilities, capacity building to undertake those functions, and coordination between these agencies; and
- Management Instruments – including water resources assessment, demand management, public awareness and education, water allocation mechanisms, regulations, EIA, risk assessment and management tools (e.g. flood and drought) economic tools (e.g. tariffs and subsidies) and information management and exchange.

A rapid comparison between the required IWRM measures derived from the diagnostic reports and the GWP list clearly shows that the national reviews identified all of these IWRM issues.

The focus therefore for the countries now is to create and improve linkages across the sectors and scales (communities, watershed, islands, nation), and build capacity within and between the stakeholders in utilising the management instruments and tools. This is most likely to achieve political, institutional and general public support in the short term by addressing the most obvious pressing key priority issues in each country.

The countries identified the following integrated (cross-sectoral) approaches to deliver IWRM policy, planning and management implementation by improving inter-agency communication, coordination and work programme execution:

- An IWRM Apex (over-arching) Body
- Integrated Land Use Planning
- Water Resources Assessment and Quality Monitoring
- Watershed and Land Use Management
- Demand Management and Water Use Efficiency
- Water Rights, Policies and Legislation
- Water Resources Information and Management Systems
- Education, Awareness Raising and Civil Society Engagement

Specific examples of the application of these approaches prioritised by the countries were:

- drought preparedness
- flood management and
- water quality improvements through watershed management.

4.4 The Pacific Response to the IWRM Challenge

The recognition of the importance of IWRM as demonstrated by the Heads of State endorsement in 2003 of the Pacific Regional Action Plan on Sustainable Water Management has provided considerable leverage for the Pacific Region to secure resources to promote IWRM at the regional and country level.

Two specific programmes, developed in 2004-2005 and approved in 2006-2007 target IWRM capacity, advocacy and awareness raising at the national level, supported by regional activities:

- GEF-funded UNDP UNEP IWRM Demonstration Projects (2008– 2011) US$ 12 Million
- EU WF-funded IWRM Planning Programme (2008 – 2010) US$ 3 Million

The GEF IWRM project focuses on immediate IWRM implementation of critical issues in priority areas in each country. The project is designed to reduce environmental stress through the use of IWRM approaches, and to demonstrate the benefits of these approaches to country stakeholders (government and civil society) and encourage replication at the catchment, country and international scale.

The EU Water Facility IWRM Planning Programme focuses on more medium term objectives, including the establishment of IWRM policies, strategies and plans for each country.

The two programmes have been designed together and provide complimentary and mutually beneficial support

to each other. The GEF project demonstrates short term tangible benefits of IWRM which are so important to the IWRM credibility required for the longer term IWRM planning programme, whereas the EU programme provides the replication and institutionalisation required to sustain the IWRM functions practiced within the demonstration projects.

Collectively, the two programmes provide the Pacific SIDS with the means to commence the IWRM process, by undertaking the situation or needs analysis (the diagnostic reports), which leads to policy development, strategy choice, and finally the development of National IWRM Plans, whilst carrying out demonstration scale implementation and evaluation of IWRM changes to the enabling environment, institutional roles and management approaches/tools.

Full scale and sustainable implementation of the IWRM Plans follows on after these programmes.

4.5 Pacific SIDS IWRM Implementation and the IWRM Road Map

The Pacific SIDS have to date positioned themselves well through national political commitment, development agency engagement and stakeholder advocacy to secure support for the initial stages of IWRM development.

IWRM Plans should be in place by 2009 and demonstration scale IWRM implementation projects in the most critical catchments completed by 2011. Resolving the water resources management problems country wide by 2015 however requires a much greater level of support.

The implementation of the IWRM and WUE Plans nationwide will require a concerted effort beyond that required for IWRM plan development and demonstration project. That effort will require political commitment to IWRM prioritisation, public and government stakeholder ownership and support, and for the SIDS, external assistance (both technical and financial).

Pacific Island Countries need to champion the support of SIDS IWRM nationally and internationally, and secure the domestic and international commitments they need to implement their IWRM Plans.

The annual Commission on Sustainable Development, tri-annual World Water Forums and one of events such as the Asia-Pacific Water Summit, provide high profile opportunities to not only report on Pacific SIDS progress towards achieving IWRM success, but more importantly provide the opportunity to secure national government, civil society and international development agency support and commitments to IWRM implementation and reaching the MDG targets.

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