PACIFIC REGIONAL CONSULTATION ON WATER IN SMALL ISLAND COUNTRIES

PAPERS AND PROCEEDINGS

Sigatoka, Fiji Islands
29 July - 3 August 2002

Editors: Clive Carpenter, Jeffry Stubbs, Marc Overmars

- for 3rd World Water Forum only -

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PREFACE

It is with great pleasure that the Asian Development Bank (ADB) and the South Pacific Applied Geoscience Commission (SOPAC) accepted the request of the Secretariat of the 3rd World Water Forum to organize a consultation on sustainable water management for small island countries in the Pacific, East Timor and the Maldives.

Water is widely regarded as the critical natural resource for sustainable human and economic development in the coming decades. If we are to achieve sustainable management of our water resources and improve water services we must jointly move from vision to action with concrete commitment and leadership at national and regional levels.

The national consultations as well as a regional meeting held in Sigatoka, Fiji from 29 July to 3 August 2002 provided a platform through which participants translated ideas into decisions and policy changes resulting in a Regional Action Plan, a Communiqué and Ministerial Declaration and a commitment to form partnerships under the Type II Iniatiative on Water, Sanitation and Hygiene submitted by Pacific Islands Countries to the World Summit on Sustainable Development.

We are pleased that many stakeholders have committed themselves to get actively involved in this process and to take this unique opportunity to assist in the development of actions that help to secure a sustainable freshwater future.

The outcomes of the consultation will be carried forward and presented during the 3rd World Water Forum in Kyoto as part of the theme “Water in Small Island Countries”. We are pleased that collaboration between the Asian, Caribbean, and the Pacific regions has been established to facilitate a joint contribution to this global forum.

We would like to take this opportunity to thank the Secretariat of the 3rd World Water Forum for enabling us to organize this consultation meeting. In addition, we are grateful to the International Secretariat of the Dialogue on Water and Climate for providing sponsorship for the theme on Island Vulnerability and the Small Island Countries Dialogue on Water and Climate. We would also like to thank the Pacific Water Association (PWA) and the World Bank for their valuable contributions to the themes on Technology and Finance and AusAID, DFID, and NZAID for their financial support. We acknowledge herewith the assistance rendered by the Pacific Islands Forum Secretariat in the development of the Ministeral Declaration and Communiqué and their advice on formulating the outcomes of the consultation into the Pacific submission to the World Summit for Sustainable Development.

Finally, we would like to express our appreciation to the Government of Fiji for its assistance as host country of this important event.

Yours sincerely,

Mr Jeremy Hovland
Director General
Pacific Department
ADB

Mr Alf Simpson
Director
SOPAC

FOREWORD

The regional consultation on sustainable water management started with a planning meeting in Port Vila, Vanuatu from 31 January to 1 February 2002 where six thematic areas were identified that gave structure to the consultation process based on earlier needs assessments in the region: Water Resources Management; Island Vulnerability; Awareness; Technology; Institutional Arrangements and Finance.

Around each of the themes mentioned above, Pacific Island Countries were requested to open a national dialogue amongst their major stakeholders, to identify their own national constraints and issues as well as actions undertaken to date and those still required, to achieving sustainable water management. These national consultations resulted in national country briefing papers for the regional meeting. Six theme consultants prepared a regional overview for each theme on constraints, issues and actions for the Pacific region and case studies were prepared to illustrate potential solutions to identified issues and constraints.

This wealth of information was the basis for presentations, discussions and deliberations during a regional meeting held in Sigatoka, Fiji from 29 July to 3 August 2002. The meeting was attended by over 150 stakeholders in the water sector from Pacific island countries and concluded with the adoption of a Regional Action Plan, a Communiqué and a Ministerial Declaration, and the commitment from a wide range of stakeholders to form partnerships under the so-called Type II Initiative that was submitted to the Commission for Sustainable Development in Johannesburg during the World Summit for Sustainable Development in August 2002.

The Ministerial Declaration had the signatures of 14 Ministers and Secretaries of State as of 21 February 2003 and we are pleased that at the 33rd Pacific Islands Forum held in Suva, Fiji, 15-17 August 2002, the Pacific Islands Heads of State endorsed full participation in the World Water Forum.

The logical link between the Pacific regional consultation and the two important World Summits in South Africa and Japan will undoubtedly contribute to increased attention and commitment to address water issues in the Pacific and establish further partnerships between ourselves and small island countries regions such as the Indian Ocean and the Caribbean.

This publication contains a short report of the regional consultation, the six thematic overview papers, the consultation outcomes, the meeting programme and proceedings, the case studies, and the country briefing papers and the Type II Initiative. We hope that this wealth of information will be shared amongst all practitioners and stakeholders within the region and beyond, and provides a basis for the exchange of information that is needed to implement the Regional Action Plan on Sustainable Water Management.

Last, but not least, we would like to thank the case study authors, the country paper presenters, the thematic resource persons and all participants of the regional meeting for their hard work and constructive collaboration that made this consultation so successful.

We now have to work from Vision to Action and we wish all partners success in their endeavour to achieve a sustainable water future.

Jeffry Stubbs
Country Director
South Pacific Regional Mission
ADB

Clive Carpenter/Marc Overmars
Water Resources
SOPAC

LIST OF ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ANU	Australia National University
ASPA	American Samoa Power Authority
AusAID	Australian Agency for International Development
AWA	Australia Water Association
AWWA	American Water Works Association
BOM	Bureau of Meteorology (Australia)
CBO	Community-based Organizations
CCCCC	Caribbean Community Climate Change Centre
CHARM	Comprehensive Hazards and Risk Management
CLIPS	Climate Information and Prediction Services
CROP	Council of Regional Organizations ... in the Pacific
CSC	Commonwealth Science Council
CSO	Civil Society Organization
CSP	Conservation Society of Pohnpei
DFID	Department for International Development (UK)
DGMWR	Department of Geology, Mines and Water Resources (Vanuatu)
DWC	Dialogue on Water and Climate
ENSO	El Niño Southern Oscillation
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	European Union
FAO	Food and Agriculture Orgnization
FIT	Fiji Institute of Technology
FMS	Fiji Meteorological Service
FSP	Foundation for the People of the South Pacific
GEF	Global Environment Facility
GOOS	Global Ocean Observing System
GPA	Global Programme of Action
GWP	Global Water Partnership
HYCOS	Hydrological Cycle Observing System
ICM	Integrated Catchment Management
IETC	International Environmental Technology Centre

IHP	International Hydrological Programme (of UNESCO)
IWP	International Waters Programme
IWRM	Integrated Water Resources Management
NGO	Nongovernment Organization
NIWA	National Institute for Water and Atmospheric Research (New Zealand)
NOAA	National Oceanographic and Atmospheric Administration (US)
NZAID	New Zealand Agency for International Development (formerly NZODA)
NZODA	New Zealand Overseas Development Agency (now NZAID)
NZWWA	New Zealand Water and Wastewater Association
OHP	Operational Hydrology Programme (of WMO)
PCM	Participatory Watershed Management
PEAC	Pacific ENSO Applications Center
PIC	Pacific Island Country
PICCAP	Pacific Islands Climate Change Assistance Programme
PIFS	Pacific Islands Forum Secretariat
PNG	Papua New Guinea
PWA	Pacific Water Association
PWP	Pacific Water Partnership
SAP	Strategic Action Programme for International Waters
SIWIN	Small Islands Water Information Network
SOPAC	South Pacific Applied Geoscience Commission
SPaRCE	Schools of the Pacific Rainfall Climate Experiment
SPBCP	South Pacific Biodiversity Conservation Programme
SPBEA	South Pacific Board of Educational Assessment
SPC	Secretariat for the Pacific Community
SPOCC	South Pacific Organizations Coordinating Committee (now CROP)
SPREP	South Pacific Regional Environment Programme
SPTO	South Pacific Tourism Organization
TNA	Training Needs Analysis
TNC	The Nature Conservancy, Pohnpei, Federated States of Micronesia
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund

UNU	United Nations University
USP	University of the South Pacific
WHO	World Health Organization
WMO	World Meteorological Organization
WSSCC	Water Supply and Sanitation Collaborative Council
WWF	World Wide Fund for Nature South Pacific

PART I

SUMMARY REPORT OF THE CONSULTATION

SUMMARY

INTRODUCTION

The Asian Development Bank (ADB) and the South Pacific Applied Geoscience Commission (SOPAC) joined forces to organise a high-level regional consultation for the Pacific water sector in preparation for the 3rd World Water Forum that will take place from 16 to 23 March 2003 in Kyoto, Japan.

The consultation aimed to help small island country practitioners and regional and international organizations strengthen their policies, institutional arrangements and projects through:

- enhancing public awareness of the need for better water and wastewater management;
- exchanging views and experiences; and
- developing a shared understanding about policies, institutional frameworks and approaches to sustainable sector development.

PLANNING MEETING

A planning meeting for the Pacific preparation for the 3rd World Water Forum was held from 31 January to 1 February 2002 in Port Vila, Vanuatu. The planning meeting was convened jointly by ADB and SOPAC to establish the framework of the regional consultation process. It decided that the regional consultation would be high level and participatory. It also identified six thematic areas based on earlier needs assessments in the region, to provide a structure for the consultation. The six themes were: Water Resources Management; Island Vulnerability; Awareness; Technology; Institutional Arrangements and Finance.

NATIONAL CONSULTATIONS AND COUNTRY BRIEFING PAPERS

Countries were encouraged to initiate a national consultation process involving a wide range of water sector specialists in order to develop a clear brief for the representatives of each country.

The national consultations have involved stakeholders drawn from governments, nongovernment organizations (NGOs) and the private sector including organizations and agencies concerned with water resources management, water authorities, service providers, rural development departments, health and environment agencies and regulators. Various countries already had mechanisms in place, such as a national water committee or national water council, that facilitated this multi-stakeholder national consultation.

Facilitated by the World Wide Fund for Nature South Pacific, NGOs in the region were encouraged to take part in the national consultations and contributed to the regional consultation meeting.

PACIFIC REGIONAL CONSULTATION MEETING

A regional consultation meeting was organised in Sigatoka, Fiji from 29 July to 3 August 2002. The meeting was attended by over 150 representatives of agencies concerned with water resources management, water authorities, service providers, rural development departments, health and environment agencies, regulators and NGOs involved in the water sector, the private sector, regional organizations and international development agencies.

Country actions prepared by the national delegations were presented on Day 1. Thematic overview papers prepared by theme resource persons were presented, supported by selected case studies from small island countries in the region, on Days 2, 3 and 4. They showed specific actions that were proven to contribute to sustainable water management and were the starting point for plenary discussions on the Regional Action Plan.

For each theme a working group was established that drafted the Action Plan for that thematic area which were subsequently discussed on Day 5. A drafting committee was set up that ensured all issues and actions were included in the Communiqué and Ministerial Declaration that were both adopted on Day 6 (3 August 2002).

The regional consultation concluded with the adoption of a Regional Action Plan, a Communiqué and Ministerial Declaration, and the commitment from a wide range of stakeholders to form a partnership under the so-called Type II Initiative on Water, Sanitation and Hygiene that was submitted by the Pacific Island Countries to the Commission for Sustainable Development in Johannesburg during the World Summit for Sustainable Development in August 2002.

In adopting the action plan, the ministers and heads of country delegations from 16 Pacific Island Countries and representatives of civil society groups stressed the participatory nature of their deliberations and reinforced their commitment to sharing knowledge to address common water problems and solutions.

They noted the unique geographic and physical characteristics, as well as the fragile nature of water resources in small island countries, which impact the health and wellbeing of their peoples, environment and economic development. They also recognized the im-

portant linkages between water resources, water services, and wastewater management, including sanitation and hygiene.

OUTCOMES OF THE CONSULTATION

The outcomes of the consultation, including the Regional Action Plan and a Ministerial Declaration, were taken to the Caribbean Water and Wastewater Conference and Caribbean Dialogue on Water and Climate in October 2002. Both documents as well as the Communiqué and the Type II initiative, prepared after the consultation, are provided in Parts III and VII of this report (see CD-Rom).

A joint contribution from the Caribbean and the Pacific will be provided to the "Water in Small Island Countries" session at the 3rd World Water Forum in Kyoto.

Regional Action Plan

The Regional Action Plan is structured around the six thematic areas: Water Resources Management; Island Vulnerability; Awareness; Technology; Institutional Arrangements and Finance. Each theme section consists of key messages to stakeholders with supporting statements drawn from the discussions in the respective working groups. Under each key message the required Actions are listed including the parties that will be responsible for their implementation.

Communiqué and Ministerial Declaration

The Communiqué recognised the unique geographic and physical characteristics, as well as the fragile nature of water resources in small and vulnerable island countries which impact on the health and wellbeing of their peoples, environment and the development of their island economies.

An appeal was made to share knowledge particularly within and across the small island country regions, and agree to an action plan for sustainable water management in the Pacific islands and commitment was made to sustainable water management components of Agenda 21 agreed to ten years ago in Rio de Janeiro, Brazil and the Global Action Plan for Small Island Developing States agreed to in Barbados 1994.

The international community was urged to pursue the achievement of the Millennium Development Goals that target the vital role of sustainable water management contributing to reducing poverty, improving health and livelihoods for all people.

The Ministerial Declaration refers explicitly to the Communiqué which has been signed by 14 Ministers and Secretaries of State as of 21st February 2003.

Type II Initiative

The main objective of the Type II Initiative is to achieve sustainable water and wastewater management in Pacific island countries through:

- the establishment of a regional water network of persons and organizations, inclusive of country governments, development agencies, professional associations and donors, that work in the different fields of water resources management and service delivery in the region, to improve regional coordination and collaboration;
- the implementation of Strategies for Water, Sanitation and Hygiene that aim to build and increase the capacity in Pacific Island Countries to deliver sustainable management of water and wastewater as a means to contributing to poverty alleviation. Sustainability has to be achieved in the technical, institutional, financial, environmental and social-cultural areas. SOPAC Member Countries endorsed these strategies during the 30th SOPAC Annual Session (Majuro, October 2001), which are complementary with the efforts towards the World Summit on Sustainable Development and the 3rd World Water Forum;
- implementation of the "Regional Action Plan for Sustainable Water Management", as agreed upon by Ministers, Heads of Delegation and representatives of civil society groups with responsibilities for water affairs from 16 island countries in the Pacific, as well as East Timor and the Maldives; as part of the Pacific regional consultation and preparation for the "Water in Small Island Countries" and "Dialogue on Water & Climate" themes of the 3rd World Water Forum. The consultation process included the identification of national priority actions as determined by the participating countries on the basis of their national water strategies, national assessments and stakeholder consultations undertaken for WSSD and the 3rd World Water Forum, and the development of agreed regional actions through the regional consultation meeting process of plenary discussion, working group review and delegation approval.

Highlights of the Regional Meeting

The regional meeting saw a wide range of presentations from specialists from Pacific Island Countries

showing many examples of successful interventions for many island-specific issues. The case studies and country briefing papers that are provided in the appendix of this report provide a wealth of information on innovative ways towards sustainable water management.

A summary of the key messages resulting from the consultations on issues raised under each theme are as follows:

Theme 1, Water Resource Management

1 Strengthen the capacity of small island countries to conduct water resources assessment and monitoring as a key component of sustainable water resources management.

2 Implement strategies to utilize appropriate methods and technologies for water supply and sanitation systems and approaches for rural and peri-urban communities in small islands.

3 Implement strategies to improve the management of water resources, and surface and groundwater catchments (watersheds) for the benefit of all sectors including local communities, development interests, and the environment.

Theme 2, Island Vulnerability

1 There is a need for capacity development to enhance the application of climate information to cope with climate variability and change.

2 Change the paradigm for dealing with Island Vulnerability from disaster response to hazard assessment and risk management, particularly in Integrated Water Resources Management.

Theme 3, Awareness

1 A high quality participatory framework should be adopted at the national level to allow for open participation of communities in sustainable water and wastewater management.

2 Access to, and availability of information on sustainable water and wastewater management should be provided to all levels of society.

3 Water and sanitation education should be mainstreamed into the formal education system.

4 Improve communication and coordination of all stakeholders in sustainable water and wastewater management including government, civil society, and the private sector.

Theme 4, Technology

1 Appropriate institutions, infrastructure, and information will support sustainable water and wastewater management.

2 Utility collaboration and regional partnership to reduce unaccounted-for water will significantly improve the sustainability of utilities and reduce the need for developing new water resources.

3 Island specific regional training programmes should be developed, resulting in sustainable levels of skilled and knowledgeable people and communities within the water and wastewater sector.

Theme 5, Institutional Arrangements

1 Work together through a comprehensive consultative process, encompassing good governance, to develop a shared national vision for managing water resources in a sustainable manner.

2 Develop national instruments including national visions, policies, plans, and legislation appropriate to each island country taking into account the particular social, economic, environmental, and cultural needs of the citizens of each country.

3 Promote and establish appropriate institutional arrangements resourced sufficiently to enable effective management of water resources and the provision of appropriate water services.

4 Recognize and share the water resources management knowledge and skills of all stakeholders at a national and regional level in the process of developing and implementing the national vision.

5 National and regional leadership in water resources management should be recognized and encouraged.

Theme 6, Finance

1 Create a better and sustainable environment for investment by both the public and private sector, by developing and implementing national, sector, and strategic plans that identify the economic, environmental, and social costs of different services and develop pricing policies, which ensure the proper allocation of resources for the water sector.

2 Establish financially-viable enterprises for water and sanitation that result in improved performance by developing appropriate financial and cost-recovery policies, tariffs, billing and collection systems, and financial and operating systems.

3 Reduce costs through improved operational efficiency, using benchmarking, development of water-loss reduction programmes, and improved work practices.

4 Ensure access for the poor to water and sanitation services by developing pro-poor policies that include tariffs with lifeline blocks and transparent and targeted subsidies.

5 Achieve sustainable rural water and sanitation services at the community level through developing strategies that incorporate mechanisms for appropriate financing and capacity building.

The concerns and issues aired during the plenary discussion have also been incorporated into actions under these key messages in the Pacific Regional Action Plan on Sustainable Water Management which can be found in Part III of this volume (see the accompanying CD-Rom). The full record of the discussion during plenary sessions are also on the CD-Rom as Part IV of this Paper and Proceedings volume.

Inter-regional Collaboration and Joint Programme of Action

The Pacific consultation identified "Island Vulnerability" as a major theme that should receive particular attention in Kyoto and this provided the basis for a joint Programme of Action for Small Island Countries that will be presented during the World Water Forum.

Inter-regional collaboration was made possible through the small island countries Dialogue on Water and Climate which saw a large group of Caribbean specialists presenting case studies related to this issue.

Despite the different approaches both regions adopted in its consultations and dialogues it is obvious that there are many commonalities between the Pacific and Caribbean in addressing problems related to water and climate and collaboration between the small island countries will contribute to a successful implementation of concrete actions in the future.

The following recommendations can be made to enhance this collaboration:

- Use should be made of the solid base provided by the combined capacity of institutions like CEHI, OAS and the Caribbean Community Climate Change Centre (CCCCC) in the Caribbean and SOPAC, SPREP, PEAC and IGCI in the Pacific.
- The idea of an Island States Water Partnership should be fully explored, possibly within the framework of the Global Water Partnership (GWP).
- Initiatives in both regions on Integrated Water Resources Management (IWRM) can be exchanged and a joint Programme of Action can be developed and endorsed during the small island countries session at Kyoto.
- The programme of action can be submitted to AOSIS and tabled at the follow-up Conference on the UN Global Conference on the Sustainable Development of Small Island States (UNGCSIDS or Barbados +10).

PART II

THEMATIC PAPERS

THEME 1

WATER RESOURCES MANAGEMENT

prepared by

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August 2002

EXECUTIVE SUMMARY

The integrated and sustainable management of water resources in small island countries of the Pacific and other regions is vital for the health and social well-being of their people, the protection of their environments and the development of their economies. The very limited nature of water resources and the vulnerability of these islands and their resources, including water, to natural disasters, over-exploitation and pollution, combined with increasing demands for freshwater due to expanding populations and, in some cases, tourism, industry and agriculture, makes the sustainable management of island water resources a very high priority.

In reality, there are many issues that currently constrain the achievement of the goal of sustainable water resources management. At the national level, there is often fragmentation in the water sector and inadequate water resources legislation, policy and planning. There is often insufficient local human resources capacity to conduct water resources assessment and monitoring. In many islands, there is inadequate hydrological data available for analysis and water resources planning. Other issues include conflicts related to the use of water resources and locations of water supply systems on customary land, problems with designs and implementation of projects, and insufficient community education, awareness and participation. In addition, there are some water resources issues that require further applied research and training in order to better understand them and to disseminate results

This report outlines issues, concerns and constraints to sustainable water resources management. Actions taken in recent years to address some of these issues and concerns are then presented. The report proceeds to outline actions that could be taken to move towards a more sustainable water resources management in the small island countries of the Pacific region.

The focus of the report is not on the whole water sector, but rather on a number of important components. These include: the assessment of water resources; sustainable development of these resources, especially in rural areas; appropriate technology for rural water supply and sanitation; catchment (watershed) management to improve water quality; needs for training, capacity building, applied research, information dissemination and networking/partnerships. The needs for participation, education and awareness of communities are also considered in relation to water resources management.

There is no single action that will improve the sustainability of water resources management in small island countries. Rather, an integrated approach is required at all levels in order for this to occur. Commitment and support from national governments is required. This has to be backed by technical and financial support from bilateral, regional and international donor agencies, and others including NGOs and consultants. The capacities of national water agencies require strengthening in many areas including, water resources assessment and monitoring capabilities, water planning, and appropriate technology in water, sanitation and wastewater. In particular, there is a need for improved sanitation systems on small coral islands where current systems continue to seriously contaminate the groundwater, leading to major human health problems. Regional agencies with interests and responsibilities in water resources management should also be strengthened so that they can provide technical support to water personnel from national agencies. Additional applied research is required in order to better understand some of the fundamental hydrological and water quality processes in small island environments. Communities should be encouraged and supported to take a greater role in the management of water resources at the local level. This should include participation in the management of their own surface water and groundwater catchments to redress the water quality degradation that has occurred, and will continue to occur, unless appropriate steps are taken. Concerted efforts in the area of community awareness and education and greater recognition of the importance of both genders in the water sector are also required. Through these integrated actions, the sustainability of water resources in small island countries will improve.

1. INTRODUCTION

This report was prepared for the Pacific Regional Consultation Meeting on Water in Small Island Countries, Sigatoka, Fiji, 29th July – 3rd August 2002. The aim of the meeting, organised by the Asian Development Bank (ADB) and the South Pacific Applied Geoscience Commission (SOPAC), was to discuss key water management issues and to develop a regional policy statement and action plan to be considered by donor organisations, in preparation for the 3rd World Water Forum to be held in Kyoto, Japan in March 2003.

A Planning Meeting held in Vanuatu in February 2002 identified Water Resources Management as one of six major themes for the Regional Consultation Meeting. The other five themes are Island Vulnerability, Awareness, Technology, Institutional Arrangements and Finance.

The focus in Theme 1 and this report is on the sustainable management of freshwater resources. In the context of this report, sustainability is interpreted to mean the capacity of freshwater resources to sustain the health and social well-being of communities (rural and urban) and to provide sufficient water to meet environmental needs (particularly the needs of animals and birds).The issue of sustainability therefore relates to a broad range of topics. These include: water availability and quality; the water needs of communities; knowledge of water resources; appropriate technology to develop and manage water supplies; impacts on water resources from climate variability; land use changes and pollution; appropriate means and methods of managing catchments (watersheds) and pollution sources; appropriate institutional arrangements; and vital needs in the area of community information, education and awareness.

As this report is focused on "small islands", it is appropriate to define a small island. Islands with areas less than 2,000 km^2 or widths less than 10 km have been classified as "small" islands (UNESCO, 1991). The classification is somewhat arbitrary, but is based on a realisation that for areas less than 2,000 km^2, a number of issues, including water resources management issues, become more pronounced than those on larger islands and continents. Most small islands fit into a category of "very small islands", which are less than 100 km^2 or have a maximum width of 3 km (Dijon, 1984). In very small islands, surface and groundwater resources are generally limited to the supply of water to island communities. It is noted that many populated islands are less than 10 km^2 while some, especially those on atolls, are less than 1 km^2.

The Water Resources Management Theme (Theme 1) is considered in this report under the following headings:

- Summary data for participating countries and territories.
- Water resources of small islands and water use.
- Major water resources issues, concerns and constraints.
- Actions taken to improve water resources management.
- Actions required to move towards sustainable water resources management.
- Summary of proposed actions.

The focus for Theme 1, as identified by the meeting organisers, is on the following topics:

- Freshwater availability.
- Water quality degradation.
- Catchment (watershed) management.
- Knowledge of island freshwater resources.
- Appropriate technology and methods in relation to rural water supplies and sanitation.

Where appropriate, reference is also made in this report to aspects covered under the other five themes. Given the scope of the Water Resources Management theme, there is, inevitably, some overlap with the other themes. For instance, while rural water supply and sanitation are considered under Theme 1, it is noted that water service delivery issues are not considered, except where these affect the water resources (e.g. large losses in water supply systems due to leakage). Water service delivery issues are considered under Theme 4 (Technology).

This report is based on a wide range of relevant documents, discussions with personnel from island countries in the Pacific and other regions, country briefing papers and other material presented at the Pacific Regional Consultation Meeting, and the author's own experience.

Also relevant to Theme 1 are four case studies prepared by authors from selected small island countries. These case studies considered general water resources management issues as well as specific issues as follows: rainwater harvesting in Tuvalu (Taulima, 2002), groundwater development using infiltration galleries in Kiribati (Metutera, 2002), desalination in Maldives (Ibrahim, Bari and Miles, 2002) and integrated catchment management on the island of 'Eua, Kingdom of Tonga (Fielea, 2002).

2. SUMMARY DATA FOR THE PARTICIPATING ISLANDS

Summary data for each of the island countries and territories invited to the Pacific Regional Consultation Meeting is shown in Table 1. The data focuses on char-

acteristics which impact on freshwater resources and water use in these island countries and territories.

Included in Table 1 are 14 Pacific Island Countries (PICs), 4 Pacific Territories (of USA and France) and two countries (East Timor and Maldives) outside the Pacific region.

Most of the islands represented in Table 1 can be considered as small islands, according to the definition in section 1. In fact, many of these islands fall into the very small island category. Exceptions are the larger islands in the Melanesian countries and East Timor.

Table 1 shows that four of the 14 PICs are in Melanesia, five are in Polynesia and five are in Micronesia. Large variations in demographic and selected physical characteristics (total area, number and geology of islands) are evident. Often the conditions within PICs vary considerably, with conditions on outer islands being significantly different from those on main islands.

Most of the population in the PICs live in rural villages and towns (ESCAP, 2000) and the peri-urban areas on the fringes of the main centres. In many cases, living conditions in the peri-urban areas (fringes of urban areas) are poor and normal urban utility services (including water supply) are sparse, inadequate or non-existent.

3. WATER RESOURCES AND WATER USE IN SMALL ISLANDS

3.1 Types of water resources

While the topic of Theme 1 is Water Resources Management, emphasis is placed on freshwater resources. Freshwater resources in small islands can be classified in two main categories as follows:

- Naturally occurring water resources requiring a relatively low level of technology in order to develop them. This category, which is sometimes referred to as 'conventional' water resources, includes:

Table 1. Summary data for island countries and territories.

Country or Territory	Sub-Region	Approx. Population (in 2000)	Total Land Area (km^2)	Number of islands or atolls	Island type according to geology
Pacific Island Countries					
Cook Islands	Polynesia	16,000	240	15	Volcanic, volcanic & limestone, atoll
Federated States of Micronesia	Micronesia	114,000	702	607	Volcanic, atoll, mixed
Fiji	Melanesia	785,000	18,300	300 (approx.)	Volcanic, limestone, atoll, mixed
Kiribati	Micronesia	85,000	810	33	32 atolls or coral islands, 1 limestone island
Nauru	Micronesia	11,000	21	1	Limestone
Niue	Polynesia	1,700	260	1	Limestone
Palau	Micronesia	22,000	487	200 (approx.)	Volcanic, some with limestone
Papua New Guinea	Melanesia	4,400,000	462,000	?	Volcanic, limestone, coral islands and atolls
Republic of Marshall Islands	Micronesia	60,000	181	29	Atolls and coral islands
Samoa	Polynesia	175,000	2,930	9	Volcanic
Solomon Islands	Melanesia	417,000	28,000	347	Volcanic, limestone, atolls
Tonga	Polynesia	99,000	747	171	Volcanic, limestone, limestone & sand, mixed
Tuvalu	Polynesia	11,000	26	9	Atolls
Vanuatu	Melanesia	182,000	12,190	80	Predominantly volcanic with coastal sands and limestone
Other Pacific islands (Territories of USA and France)					
American Samoa	Polynesia	67,000	199	7	5 volcanic and 2 atolls
French Polynesia	Polynesia	254,000	3,660	130	Volcanic, volcanic & limestone, atolls
Guam (USA)	Micronesia	158,000	549	1	Volcanic (south) and limestone (north)
New Caledonia (France)	Melanesia	205,000	18,600	7	Volcanic, limestone
Island countries in other regions					
East Timor	SE Asia	800,000	24,000	1 main island	Volcanic
Maldives	Indian Ocean	270,000	300	26 atolls (1,900 islands)	Atolls

Notes:

- Populations and areas: from Case Studies and Country Briefing Reports for the Regional Consultation Meeting and SOPAC (2002). Actual population data may be different from that shown, as some of the data is from 1998.
- Number of islands: from UNDTCD (1983), UNEP (1999), UNEP (2000), various National Environment Management Strategies (NEMS) for PICs.
- Some numerical differences were noted between data sources.

- Surface water
- Groundwater
- Rainwater

- Water resources involving a higher level of technology (sometimes referred to as "non-conventional" water resources). This category includes:
  - Desalination
  - Importation
  - Wastewater reuse.

Other "non-conventional" water resources include:

- Use of seawater or brackish water for selected non-potable requirements
- Substitution.

Where available, the naturally occurring water resources are inevitably more economic to develop than the "non-conventional" water resources. The main water resources in both categories are described in more detail below, as well as the major influences on the occurrence and distribution of the naturally occurring water resources.

3.2 Naturally occurring water resources

3.2.1 Surface water

Where conditions are favourable, surface water can occur on small high islands in the form of ephemeral and perennial streams and springs, and as freshwater lagoons, lakes and swamps.

Perennial streams and springs occur mainly in high volcanic islands where the permeability of the rock is low. Many streams are in small, steep catchments and are not perennial. Some streams flow for several hours or days after heavy rainfall, while others flow for longer periods but become dry in droughts.

Freshwater lagoons and small lakes are not common but are found on some small islands. These can occur in the craters of extinct volcanoes or depressions in the topography. Low-lying coral islands rarely have fresh surface water resources except where rainfall is abundant. Many small island lakes, lagoons and swamps, particularly those at or close to sea level, are brackish.

3.2.2 Groundwater

Groundwater occurs on small islands as either perched (high-level) or basal (low-level) aquifers.

Perched aquifers commonly occur over horizontal confining layers (aquicludes). Dyke-confined aquifers are a less common form of perched aquifer, which are formed when vertical volcanic dykes trap water in the intervening compartments (e.g. on some of the islands of Hawaii and French Polynesia).

Basal aquifers consist of unconfined, partially confined or confined freshwater bodies, which form at or below sea level. On many small coral and limestone islands, the basal aquifer takes the form of a 'freshwater lens' (or 'groundwater lens'), which underlies the whole island.

Basal aquifers tend to be more important than perched aquifers because they are more common and generally have larger storage volumes. Basal aquifers are, however, vulnerable to saline intrusion owing to the freshwater-seawater interaction, and must be carefully managed to avoid over-exploitation and consequent seawater intrusion.

The term 'freshwater lens' can be misleading as it implies a distinct freshwater aquifer. In reality, there is no distinct boundary between freshwater and seawater but rather a transition zone (refer Figure 1). The base of the freshwater zone can be defined on the basis of a salinity criterion such as chloride ion concentration or electrical conductivity.

Freshwater lenses often have asymmetric shapes with the deepest portions displaced towards the lagoon side of the island, as shown in Figure 1. Typically, the freshwater zone of a thick freshwater lens on a small coral island is about 10-20 m thick, with a transition zone of a similar thickness. Where the freshwater zone is less than about 5 m thick, the transition zone is often thicker than the freshwater zone. The freshwater and transition zone thicknesses are not static but vary according to fluctuations in recharge and possibly, abstraction of groundwater.

3.2.3 Rainwater

Rainwater collection systems are common on many islands. In small islands with high rainfall (e.g. the islands of Tuvalu), rainwater catchments using the roofs of individual houses and some community buildings, are the primary source of freshwater (Taulima, 2002).

In other small islands, rainwater is used as a source for essential water needs (e.g. drinking and cooking). In drought periods, when rainfall can be very little, or nil for many months, household rainwater storages are susceptible to being severely depleted unless very strict rationing is imposed. Common materials for rainwater tanks are ferrocement, fibreglass and plastic. Steel tanks are generally not used, owing to corrosion problems, unless they are well painted. Ferrocement tanks are commonly used in some Pacific islands (e.g. Tonga, Tuvalu, Kiribati, Federated States of Micronesia) as they can be constructed by local contractors and community groups. In recent years, plastic tanks have become

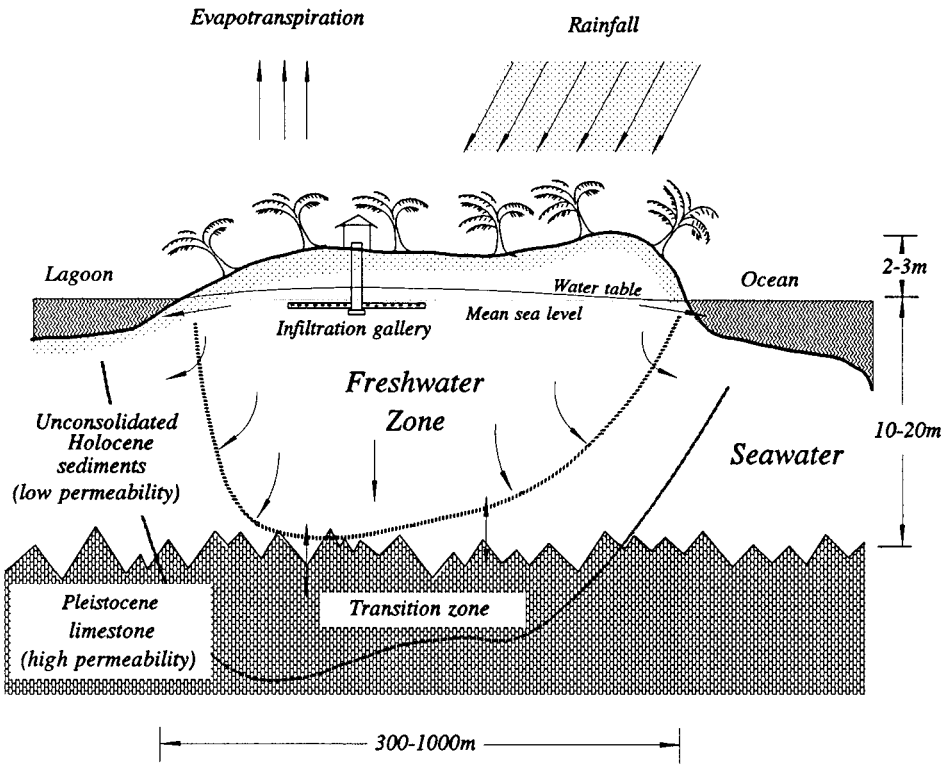

Figure 1. Cross section through a small coral island showing main features of a freshwater lens (exaggerated vertical scale and location of an infiltration gallery.

popular for household rainwater collection in many islands of the Pacific and in Maldives.

In addition to roof catchments, rainfall is sometimes collected from specially prepared surfaces. Examples are paved runways (e.g. Majuro, Marshall Islands) and specially prepared surfaces with adjacent storage tanks or artificially lined reservoirs (e.g. some islands in Torres Strait, between Australia and PNG). Simple rainwater collection systems consisting of containers (e.g. plastic barrels) located under the crown of coconut trees where rainfall is concentrated, are still used in some islands (e.g. outer islands of PNG).

3.3 'Non-conventional' water resources

3.3.1 Desalination

Desalination is another less common method of freshwater production. Desalination systems are based on a distillation or a membrane process. Distillation processes include multi-stage flash (MSF), multiple effect (ME) and vapour compression (VC). Membrane processes include reverse osmosis (RO) and electrodialysis (ED). Descriptions of these processes are provided, together with approximate costs and a comprehensive reference list, in IETC (1998). The most common method used in small island countries is RO. Further information is provided in UNESCO (1991) and SOPAC (1998a).

In the Pacific region, desalination is used for regular water supply to resident populations on Nauru (distillation using waste heat from power station) and on Ebeye, Kwajalein atoll, Marshall Islands (reverse osmosis). On South Tarawa, Kiribati, RO units have been installed at a number of sites including the main hotel, the hospital and one urban centre (Metutera, 2002). These systems, two of which have failed, deliver a small proportion of the total water supply requirements. RO units are also used on some tourist islands for water supply (e.g. Mana Island, Fiji and Akitua island, Aitutaki atoll, Cook Islands). In other regions, desalination is more common on small islands for regular water supply (e.g. Malé' and resort islands in Maldives and a number of Caribbean islands).

RO units have also been supplied and installed as an emergency source of potable water during droughts (e.g. Kiribati, Marshall Islands, Tuvalu and PNG). In non-drought periods, the units are stored for emergency use (Marshall Islands), are currently operating (Kiribati, Tuvalu) or have failed (examples in Kiribati and PNG).

Desalination is a relatively expensive and complex method of obtaining freshwater for small islands (UNESCO, 1991). The cost of producing desalinated water is almost invariably higher than 'conventional' options (e.g. pumping of groundwater) due to the high energy and operating expenses.

The use of desalination in small islands is further discussed in sections 4.6 and 5.5.

3.3.2 Importation

Water importation has been employed for a number of islands, especially as an emergency measure during severe drought situations. Water has been imported by sea transport (boats, or barges) during droughts, for instance, to outer islands of Fiji and Tonga. Sometimes people on islands with a water shortage will travel by boat or canoe to nearby islands with more plentiful water sources.

Water can also be piped to islands close to large land masses. Water is piped, for instance, to Manono Island, from Upolo in Samoa.

In many small islands, bottled water has become an alternative source of drinking water (either imported or made locally by desalination plants). Invariably, its cost is higher than water supplied by local water authorities.

3.3.3 Non-potable water sources

Non-potable water sources include seawater, brackish groundwater and treated wastewater.

There are many examples of the use of seawater and brackish waters in order to conserve valuable freshwater resources on small islands. For example, reticulated seawater is used for toilet flushing and as a source for fire-fighting in densely populated parts of Tarawa and Majuro. Dual pipe systems are used to distribute water to houses and other connections – one pipe system is for freshwater supply and the other for seawater. Seawater, or brackish well water, is often used for bathing and some washing purposes on small islands. Seawater is also used on some islands for cooling of electric power generation plants, for ice making and in swimming pools.

Treated wastewater is not a common non-potable source in small islands, but is sometimes reused for irrigation of garden and recreational areas at tourist resorts and hotels on some small islands (e.g. Fiji, Maldives).

3.3.4 Substitution

During severe drought conditions, or after natural disasters, coconut water has been used as a substitute for fresh drinking water. People on some of the smaller outer islands in Fiji, Kiribati, Marshall Islands and PNG, for instance, have survived on coconuts during drought periods. The coconut tree is very salt-tolerant and can continue to produce coconuts even when groundwater has turned brackish.

3.4 Major influences on island surface water and groundwater

Major influences on the occurrence of surface water and groundwater resources are considered in this section while further detailed information is contained in UNESCO (1991). These influences include the physical characteristics of islands, climate and human impacts.

3.4.1 Size

The water resource management issues of scarcity and vulnerability to drought and other natural disasters increase considerably as island size decreases. Islands can be classified as large, small or very small, according to the definitions outlined in section 1.

Examples of very small islands are the sand cays, coral atoll islands and small limestone islands, typically less than 1 km^2 in area, where surface water resources are non-existent and fresh groundwater resources are very limited. On these islands, freshwater sources are restricted to groundwater and rainwater. Other examples are very small volcanic islands where fresh groundwater is very limited or non-existent, and geological conditions are not favourable for surface water storage. On some very small limestone islands, the only freshwater source is rainwater, which may need to be supplemented in severe droughts by water imported by boats or barges (e.g. in some islands in Tonga) or desalination units (e.g. Funafuti in Tuvalu).

The width of islands is also important. Long, thin islands generally have lower water resources potential than near-circular islands. Width is especially important for small coral islands. Such islands rarely have a permanent freshwater lens if the island width is less than about 250 m.

3.4.2 Geology and topography

Geological conditions are one of the primary determining characteristics of the type and occurrence of freshwater resources. The structure of small oceanic islands is generally formed from volcanic, carbonate (limestone or coral sand) or mixed geology.

Small islands are often classified according to topography as either ‘high’ or ‘low’. Depending on geological conditions, high islands have potential for surface water resources as well as groundwater resources, while low islands generally have only groundwater resources.

High volcanic islands often have perennial streams or rivers (e.g. many islands in Fiji, Papua New Guinea, Samoa, Solomon Islands and Vanuatu). In the smaller islands and small catchments of larger islands, stream

flows may become very low or cease during extended droughts. Volcanic islands frequently have springs, both in elevated and coastal areas.

While raised coral limestone islands are topographically high, they generally have no surface water owing to the high permeability of the rock. Nauru, for example, is a raised limestone island with no surface water other than an interior brackish lake at sea level.

Surface water on low islands, if present, is likely to be in the form of shallow, brackish lakes unless the rainfall is very high, in which case the surface water may be fresh (e.g. Teraina island in Kiribati).

Coral sand and limestone islands generally have only groundwater resources (e.g. the atolls of the northern Cook Islands, Kiribati, Marshall Islands and Maldives; coral and limestone islands in most of Tonga, parts of the Federated States of Micronesia and some islands in almost all PICs). In coral and limestone islands, topography does not have a significant influence on groundwater resources (freshwater lenses), which occur at and below sea level. By contrast, the topography and detailed geology of volcanic islands has a significant effect on the distribution of groundwater.

3.4.3 Climate and hydrology

The climate of small islands within tropical regions is quite variable, depending on geographical location, island size and topography. The climate of small oceanic islands is governed by the regional climate, while small islands closer to continents or large islands may also be influenced by local climatic conditions.

Average annual rainfall on small islands varies considerably between islands in the tropical Pacific Ocean (e.g. Taylor, 1973 shows variations between rainfalls in excess of 4,000 mm to less than 500 mm). In high volcanic islands, orographic effects can cause much higher rainfall at altitude than in low-lying areas, while long-term rainfall does not usually vary much over low islands.

Two of the most important climatic influences on small islands in the Pacific region are tropical storms and El Niño Southern Oscillation (ENSO) episodes.

ENSO and anti-ENSO (also referred to as La Niña) episodes have a significant impact on the climate of many small islands and can produce extensive wet and dry cycles. On many Pacific Ocean islands there is a strong relationship between rainfall and ENSO. During ENSO episodes, most Pacific islands experience extensive droughts, while some others (e.g. the islands of Kiribati) experience extensive wet periods.

Many small islands are affected by random cyclonic events, which are a major problem for communities, often causing significant storm damage and flooding. Storm surges have inundated land, caused loss of life and severely damaged infrastructure in some small islands, for example, atolls in Tuvalu, the Marshall Islands, Federated States of Micronesia and the northern Cook Islands. During these events, freshwater lenses may receive considerable inputs of seawater, and many months may pass before they return to a potable condition.

The impact of current climate variability in PICs, especially in relation to droughts, has been a major focus in recent years (e.g. SOPAC, 1999a). This topic has attracted considerable attention in the scientific community (e.g. Terry, 1998), the popular media, and by funding agencies (e.g. World Bank, 2000).

In addition to current climatic variability, there is the possibility of climate change and sea level rise due to the enhanced greenhouse effect resulting from worldwide emissions of greenhouse gases. Climate change scenarios for PICs vary according to location and the models used. Most models predict an increase in frequency of El Niño episodes and increased intensity of cyclones (World Bank, 2000). There is less certainty about changes to rainfall, which could impact on the availability of island freshwater resources. Current scenarios indicate a small rise in sea level over the next few decades (approx. 0.2-0.4 m).

The impact of current sea level rise scenarios on freshwater resources is likely to be relatively minor, compared with other influences (e.g. present climate variability, human impacts). The main potential impact would be inundation on the edges of low-lying islands and coastal zones of high islands. Tarawa, Kiribati has been the focus of impact studies under possible sea level rise and climate change scenarios. Results of groundwater modelling studies to assess the impacts on a freshwater lens under the combined effects of pumping, climate change and sea level rise, show that impacts of sea level rise on freshwater lenses are not detrimental provided that land is not permanently lost by inundation at the margins (World Bank, 2000).

Further aspects of the influence of climate variability and climate change scenarios on small island water resources are presented in the Theme 2 (Vulnerability) report and in a recent publication (Burns, 2002). These aspects were also considered in the Dialogue on Water and Climate at the Regional Consultation Meeting.

3.4.4 Soils and vegetation

Soils play an important role in the hydrological cycle and may significantly influence water resources through their influence on evapotranspiration, surface runoff and groundwater recharge. Important properties are type and thickness, infiltration capacity, and susceptibility to erosion. Soil properties also influence the potential for contamination of groundwater, particularly on small coral

islands, and in sandy coastal areas of larger islands. In these situations, the highly permeable, thin soils allow water and contaminants to move easily to the water table and into the groundwater.

The type and density of vegetation have important effects on the hydrological cycle and available water resources. Vegetation intercepts part of rainfall, causes transpiration to occur and, on high islands, may slow surface runoff and reduces erosion. Interception and transpiration by vegetation decrease recharge. On many small islands, the native vegetation has been partially or largely cleared for agriculture, urban development or tourism, and significant erosion of the landscape may have occurred.

Depending on the depth to water table and type of vegetation, direct transpiration losses from a freshwater lens may be promoted. For example, coconut trees on low coral islands act as phreatophytes (i.e. they draw water directly from the water table) and can lead to a reduction in groundwater resources in relatively dry periods.

3.4.5 Human impacts

Major impacts on water resources are caused by the pattern and density of human settlements (rural, urban, peri-urban) and the location and type of activities (e.g. agriculture, forestry, mining, industry, tourism). Impacts are most severe in sensitive water catchment areas (e.g. streams, springs and groundwater systems, which are used for town or village water supplies).

Human activities impact on both the quantity and quality of surface and groundwater resources. Over-exploitation and various pollution sources have led to the depletion and/or contamination of available water resources, particularly groundwater resources, on a number of small islands.

Land use changes can be significant. These may involve: removal of trees and other vegetation, leading to increased problems of erosion and sedimentation; compaction and sealing of surfaces leading to increased surface runoff, occasional flooding, and loss of potential recharge; alteration of coastlines and construction of channels, leading to changes in groundwater storage.

Biological and chemical pollution of surface water and groundwater, caused by inappropriate sanitation and inadequate solid waste disposal, is evident on many small islands. Other sources of pollution are industrial discharges, hydrocarbon spills and leaks, and agricultural chemicals.

Further details of these impacts are presented in section 4.

3.5 Water supply and use

As part of water resources management in small islands, it is important to understand the amount and pattern of water usage. The main uses of freshwater in small islands of the Pacific are:

- Water supply for human settlements, both urban and rural.
- Industrial activities (mainly in larger urban centres) and mining.
- Agriculture and forestry.
- Tourism.
- Environmental needs.

Additional non-consumptive uses are hydropower generation (e.g. Fiji, Samoa and Vanuatu), navigation and recreation.

The primary use for freshwater on small islands is water supply to urban and rural communities. Additional freshwater supplies are required in some islands to support tourist facilities, limited industry and farm and domestic animals. Overall, there is only minor utilisation of freshwater for industrial purposes, including mining, on small islands. Irrigated agriculture is not common on most small islands due to the limited water resources.

Further details of some of the more important water uses are outlined below.

3.5.1 Water supply and usage for human settlements

Potable freshwater is used for drinking and cooking and may also be used for bathing, washing and cleaning. Other applications may include toilet flushing, cooling, heating, freezing, drinking water for animals and garden watering.

The types of water supplies and associated management systems vary from centralised water supply systems in urban areas to village and household systems in rural areas. The centralised systems most commonly consist of source works (groundwater pumping areas and/or surface water collection and storage), transmission pipelines and networks of distribution pipe systems to consumers. These water supplies are sometimes metered so that water usage can be monitored. Urban water supply systems are considered in detail in Theme 4 (Technology), while rural systems are considered in this Theme.

At the village level on many small islands, freshwater is generally obtained in traditional ways and water us-

age tends to be reasonably low, on a per capita basis. Methods of obtaining freshwater include rainwater collection at the household level, groundwater withdrawal from privately owned wells and, on high islands, collection of water from small streams and springs. In addition to fresh (potable) water, non-potable water (brackish water and seawater) is utilised on some islands in order to conserve valuable freshwater reserves. During droughts, private wells that normally supply fresh groundwater may become brackish. This water continues to be used for some purposes, for example clothes washing and bathing. In some islands, where residents have no access to freshwater, seawater is used for bathing.

Typical rural water supplies consist of communal systems and/or individual household systems. Communal systems have a distribution pipe network based on either surface or groundwater sources. Surface water systems normally use gravity flow pipelines from streams or springs to tanks or standpipes in the village. Groundwater systems generally consist of a pump, which is operated for a number of hours each day supplying water to an overhead tank feeding standpipes within the village. Individual household water supply systems typically consist of a well, a rainwater catchment (e.g. roof) or collection from a spring or stream source near the village. In some cases, water is extracted from shallow wells dug at low tide on the beach.

Communal water supply systems are often managed by village or community 'water committees'. This may include collection of revenue to provide for operating costs (e.g. in Tonga, most rural water supplies use groundwater, and village water committees raise revenue to pay for pump operation and maintenance costs). Village water committees are also the basis of rural water supply implementation and operation in the Melanesian countries.

In other PICs, communal water supplies are operated by island councils (e.g. Kiribati) or municipal administrations (e.g. Federated States of Micronesia). This may or may not include the collection of revenue from households benefiting from the water supply.

On Funafuti, the main island of Tuvalu, rainwater is collected in both household and communal tanks. Where shortages are experienced at household tanks during extended dry periods, water is delivered by small tanker from the communal tanks. This service is provided by government and a fee is charged.

Per capita freshwater usage varies considerably between islands and within islands depending on availability, quality, type and age of water distribution systems, cultural and socio-economic factors and administrative procedures. Water usage varies from low values of approximately 20-50 litres per person per day (L/p/d), where water is very limited, to more than 1,000 L/p/d on some islands where water resources are plentiful. Water usage can be high where piped water supply systems are not kept in a good state of repair (leading to high leakage rates). Typical water usage in well-managed pipe systems is in the order of 50-150 L/p/d.

Water usage tends to be higher in urban than in rural areas for a number of reasons, including the use of water consuming devices (e.g. washing machines) and the inevitable leakage and wastage from distribution systems.

3.5.2 Tourism

Water supply to tourist resorts may represent a reasonably high proportion of total water consumption in some small islands, or parts of these islands. Water usage rates of 500 L/p/d are not uncommon (UNESCO, 1991).

3.5.3 Irrigation

Irrigated agriculture schemes on small islands, where they exist, tend to be on a relatively minor scale, although there are exceptions. Many small islands, particularly coral atolls and small limestone islands, generally do not have either sufficient water resources or suitable soil conditions for irrigated agriculture. Irrigation is possible and is practised on a relatively small scale, however, in some of the high volcanic islands where water is more prevalent and soils are suitable for agriculture.

Cultivation of root and tuber crops is practised in many Pacific Ocean, islands. One important example is the cultivation of swamp taro on some coral atolls by digging pits to the water table. The production of cash crops, such as sugar cane, involves high water use. These crops are commercially grown with irrigation schemes on some islands. In Fiji, for instance, the greatest use of water is for agriculture, primarily sugar cane cultivation.

3.5.4 Hydro-power generation

There are a number of small high islands where hydroelectric power generation schemes have been implemented (e.g. French Polynesia and Pohnpei). Some larger islands have extensive hydroelectric power generation schemes (e.g. Viti Levu, Fiji). Many other high islands have the potential for hydroelectric power generation.

3.6 Freshwater resources and use in the participating islands

A summary of the main freshwater resources and uses for each of the island countries and territories invited to the Regional Consultation Meeting is shown in Table 2.

As previously mentioned, the principal use of freshwater is for water supply purposes in villages and towns.

4. MAJOR WATER RESOURCES ISSUES, CONCERNS AND CONSTRAINTS

4.1 Overview

This section summarises major issues and concerns about, and current constraints to, sustainable management of water resources in small island countries of the Pacific region. Many of these also apply to small and larger islands in other regions. As mentioned in section 1, sustainability is interpreted to mean the capacity of freshwater resources to sustain the health and social well-being of communities (rural and urban) and to provide sufficient water to meet environmental needs (particularly the needs of animals and birds). The issue of sustainable water resources management therefore relates to a broad range of topics, some of which are considered in detail in Theme 1, while others are considered in the five other themes.

Key issues, concerns and constraints, which are considered in this section within the scope of Theme 1, are:

- Freshwater availability issues, including increasing demands for water.
- Water quality degradation in surface water and groundwater catchments, with consequent downstream impacts on human health and the environment.
- Insufficient knowledge of island freshwater resources.
- Insufficient education, training and capacity in water resources.
- Inappropriate technology and methods in relation to rural water supply and sanitation.
- Catchment management issues.
- Other issues and constraints.

Table 2. Summary of freshwater resources in participating islands.

Country or Territory	Main freshwater resources[1]	Main freshwater uses[2]
Pacific Island Countries		
Cook Islands	SW, GW, RW	WS, T
Federated States of Micronesia	SW, GW, RW	WS
Fiji	SW, GW, RW, D (tourist resort only)	WS, T, H, I
Kiribati	GW, RW, D (limited)	WS
Marshall Islands	RW (from airport catchment and buildings), GW, D (emergency)	WS
Nauru	D (regular use), RW, GW (limited)	WS
Niue	GW, RW	WS
Palau	SW, GW, RW	WS
Papua New Guinea	SW, GW, RW	WS, M
Samoa	SW, GW, RW	WS
Solomon Islands	SW, GW, RW	WS
Tonga	GW, RW, SW (limited)	WS
Tuvalu	RW (primary), GW (limited), D (emergency)	WS
Vanuatu	SW, GW, RW	WS, T, H
Other Pacific islands (Territories of USA and France)		
American Samoa	SW, GW, RW	WS
French Polynesia	SW, GW, RW	WS, T
Guam	SW, GW, RW, D	WS
New Caledonia	SW, GW, RW	WS
Island countries in other regions		
East Timor	SW, GW, RW	WS
Maldives	D (main island of Malé); GW, RW (outer islands)	WS

Notes:

1. SW = Surface water, GW = groundwater, RW = rainwater; D = desalination.
2. WS = water supply to communities, T = tourism, H = hydroelectricity, M = mining, I = irrigation.

Other key water resource management issues and concerns, as listed below, are considered in detail in the overview reports for the other five themes. These issues and concerns are also briefly mentioned, as appropriate, in this section.

- Vulnerability of water resources to natural hazards and climate variability and change (Theme 2, Vulnerability).
- Insufficient community education, awareness and participation (Theme 3, Awareness).
- Water leakage and other losses, including wastage, in distribution systems (Theme 4, Technology).
- Legislation, policy, planning and administrative issues (Theme 5, Institutional Arrangements).
- Role of donor agencies and other financing organisations in water resources projects (Theme 6, Finance).

Much of the material in this section is based on a synopsis of information on freshwater and watershed management issues in the Pacific region, which was prepared for SPREP as part of their International Waters Programme (Falkland, 2002).

4.2 Freshwater availability and demand for water

Sustainability of freshwater resources is dependent on both their availability and on the demand for these resources. The issue of sustainability becomes more critical for islands of small size where population densities are high, for example some of the more densely populated islands of atolls (e.g. Tarawa, Kiribati; Majuro, Marshall Islands, Funafuti, Tuvalu and Malé, Maldives). In such islands, the fresh groundwater resources are (or have been in the case of Malé) under stress to supply even basic human needs. In the case of Malé, the groundwater resources have been depleted to the extent where desalination of seawater is now required to supply most of the water needs of the population (Bari, Ibrahim, Bari and Miles, 2002).

4.2.1 Availability of water resources

Major influences and constraints on the availability of water resources on small islands are:

- Physical characteristics and climatic conditions, as outlined in section 3.4. In particular, the area and geology of islands have major influences on available naturally occurring water resources.
- Climatic variability. Surface water resources are often severely depleted, and sometimes exhausted, during extended droughts. Groundwater resources also become depleted in drought periods, and may under natural (no pumping) conditions become brackish on small islands or near coastal zones of larger islands. During moderate to severe droughts, rainwater storages may become very low or empty, and insufficient even for the most basic of needs (e.g. drinking and cooking). In many small islands with low average rainfall and a high variability (e.g. Kiritimati Island in Kiribati), rainwater catchments do not offer a sustainable water supply, and other sources are required (e.g. groundwater). Very small islands with highly permeable geological conditions (e.g. small limestone islands) are particularly vulnerable to droughts. These islands have no potential for surface water and very little, if any, potential for fresh groundwater. During droughts, when rainwater catchments are no longer able to supply freshwater, other measures have been implemented such as importation by boat (e.g. outer islands of Tonga and Fiji) or installation of desalination units (e.g. Marshall Islands, Kiribati, PNG, Tuvalu). These measures are expensive and only partially successful.
- Water resources development methods. For example, in otherwise favourable conditions, inappropriate groundwater pumping systems can readily induce saltwater intrusion if care is not taken in their design and operation. Systems are sometimes designed and implemented without the necessary investigations and monitoring arrangements required to ensure sustainable pumping rates (i.e. rates which do not induce saline intrusion) are applied.
- Land management practices. On high islands, inappropriate clearing of native forest for timber, agricultural land and other activities, can easily cause erosion problems with consequent downstream water quality deterioration. Clearing of native vegetation and conversion to open land for grazing of animals or planting of crops increases peak stream flows after heavy rainfall. This is due to decreased interception and retention of water by the vegetation and leaf litter, and decreased infiltration into the soil. Clearing can also lead to decreased baseflow (low flow) in streams causing lower yields for other purposes (e.g. potable water supply).
- Biological and chemical pollution. These have major impacts on the quality of fresh surface water and groundwater resources with ensuing impacts on human health, as outlined in section 4.3.

4.2.2 Water demand

Demands on available water resources are increasing, sometimes rapidly, in many small islands in the Pacific and other regions, due to the following factors:

- Increasing populations and urbanisation. Populations are increasing, sometimes rapidly, in

many PICs, especially on main islands. Urban water supplies have difficulty keeping pace with urban expansion in some cases. In others, water supplies are not capable of delivering water on a 24-hour basis owing to the additional demand, but also due to high leakage and sometimes wastage. A current example is urban Tarawa, Kiribati, where the piped water supply system is available for a few hours only each day.

- Growing expectations for water supply by urban populations is increasing the water demand per capita. Past estimates of reasonable per capita water usage (say 50 litres/person/day or L/p/d) are now not capable of meeting normal expectations of reasonable consumption levels. Recent design estimates, based on analysis of usage in larger villages and small towns, suggest demands of about 100-150 L/p/d (e.g. TWB, 1997; Goodwin et al, 2000; AusAID, 2000). Per capita water usage in principal regional towns with continuous water supplies can be of the order of 250-330 L/p/d, according to a finding from an ADB funded benchmarking survey of PIC water utilities in 2000-2001 (information supplied by SOPAC).

- On islands where flush toilets are installed (normally only in urban areas), significant quantities of water (30- 40% of total demand) may be used for flushing. Hence, the use of flush toilets may have a large impact on water resources. This was taken into consideration for the design of reticulated sewerage systems in Tarawa and Majuro, with seawater being used as the flushing water.

- Increasing demands for water in other sectors, for example, tourism, agriculture, industry and mining. The growth of tourism on some very small islands puts considerable pressure on available water resources and, in many cases, requires the use of other solutions (e.g. desalination, wastewater reuse).

- Leakage and other losses from piped distribution systems act to increase the demand for freshwater. Such losses in urban centres and larger rural villages of many PICs are recognised as a major issue by the Pacific Water Association (PWA) and SOPAC (e.g. SOPAC, 1999b). Where metering data is available, it is often found that over 50% of the water diverted or pumped from sources is lost through leakage from pipelines. Increased abstractions to allow for losses due to leakage may lead to over-exploitation of available water sources. In many cases, water shortages during droughts (and often in more normal rainfall periods) could be averted, or at least minimised, if regular and systematic leakage control and other demand management measures (education and awareness) were implemented. In addition, infrastructure costs to develop new sources to supply future demands could be delayed.

4.3 Water quality degradation

Degradation of water quality is a major problem. It is an increasing threat to surface water and groundwater resources and potable water supply systems in many small islands of the Pacific and other regions. Contamination can originate from point source discharges of pollutants and diffuse pollution sources.

The small size and steep slopes of many surface water catchments on many high islands enable water and pollutants to move quickly to downstream areas. Also, the highly permeable soils and shallow water tables on many small coral islands enable pollutants to easily migrate to fresh groundwater. While the timeframe is rapid for the impacts of pollution to occur, the reversal of impacts is difficult and time consuming.

The issue of water quality degradation in PICs has been highlighted in reports over many years, for example, Brodie et al (1984), Lau and Mink (1987), Detay et al (1989), Miller et al (1991), UNESCO (1991), Dillon (1997), UNEP (2000), Crennan (2001), Falkland (2002) and Crennan and Berry (2002).

4.3.1 Pollution sources

Surface water and groundwater quality has been degraded in many small islands by a variety of pollution sources as follows.

- Discharges of untreated, or partially treated wastewater (from sanitation and greywater systems) with associated pathogenic organisms into streams, rivers and groundwater aquifers. The rapid urbanisation in some islands has put great pressure on both surface water supply catchments used for urban and nearby rural water supplies (e.g. Apia, Samoa). The dominant source of serious faecal contamination in the Ba River and estuary, Fiji was found to be the nearby urban area (Anderson et al, 1999). Groundwater underlying settlements, both urban and rural, is highly vulnerable to contamination, especially on low-lying coral islands. Further details of this major issue are provided in section 4.3.3.

- Direct faecal contamination from animals (e.g. cattle, pigs). Waste matter runoff from commercial piggeries and from less formalised urban and village pigpens is a major source of stream pollution in many small Pacific islands (UNEP, 2000). On some islands, including those with vulnerable groundwater resources, animals are allowed to wander freely through village areas with defecation occurring at random and sometimes close to wells. Human defecation in the 'bush' (often in urban areas) or on the beach is a necessary sanitation practice in some crowded urban communities on atolls, where sanitation systems are not available for all to use. Wells utilised for potable and other purposes are not al-

ways covered, and often have inadequate protection around the base, enabling pollutants to wash in after heavy rainfall.

- Inadequate solid waste disposal sites (e.g. close to streams; above groundwater systems; in or above water catchment areas). This is especially serious where solid waste, containing toxic chemicals and hydrocarbon residues, is dumped over, or close to, fresh groundwater areas. Locating landfill sites on the edges of an island (as in some very small islands with limited options for land disposal of solid waste), acts to keep pollution away from freshwater resources but can have major impact on near-shore water quality and marine resources. On some islands, there is also a threat of groundwater pollution from cemeteries and burial sites.
- Increased sediment discharges, high turbidity and colour problems in streams due to soil erosion on high islands. Serious erosion is often caused by extensive, or inappropriate logging of native forests, poorly designed or constructed roads and unplanned development activities. The erosional effects of tropical forest clearing for agriculture and urbanisation, and of road construction and other activities in surface water catchments are generally well known (e.g. Bruijnzeel, 1990; Bruijnzeel and Critchley, 1994 and many of the papers in Bonell et al, 1993). Another issue is the use of fire to clear undesired weeds in farming and forestry areas, which exposes the soil and destroys the structure of the upper soil layer (Baisyet, 1994). The risk of erosion in small 'high' tropical islands is very significant due to high intensity rainfall, destructive forces from cyclones and other major natural disasters, steep island topography and often unstable soils if vegetation is removed.
- Chemical contamination of surface water and groundwater resources, caused by uncontrolled use of agricultural chemicals (fertilisers, and toxic insecticides and pesticides). The extent of the problem is not always known, owing to there being little or no monitoring.
- Leakage of hydrocarbons (e.g. from poorly maintained fuel storages, power stations and pumping stations) and untreated industrial effluent discharges. On the island of Betio, Tarawa atoll, Kiribati, the disposal of waste oil on the ground adjacent to the power station is a source of contamination for groundwater. Detailed water quality tests at special pollution holes near power stations on another atoll, namely, South Keeling atoll in the Cocos (Keeling) Islands have revealed heavy hydrocarbon, lead and arsenic contamination (Barratt and Falkland, 1999). Similar contaminants are likely to be present in polluted groundwater near power stations on other small islands, especially small coral islands.
- Persistent organic pollutants (POPs). These are a threat in some Pacific islands due to their high toxicity, persistence in the environment, and ability to be transported long distances (Aalbersberg and Thaman, 2000). In PICs, there is only limited data on the levels of the 12 UNEP-designated POPs.
- Discharges and accidental spillages of toxic chemicals from mining sites into streams and rivers (e.g. from some of the gold mining sites in PNG).

In addition to the pollution sources, groundwater systems on small islands and in the coastal margins of larger islands can be contaminated by seawater intrusion resulting from inappropriate pumping systems. This has led to the depletion of groundwater resources on a number of small islands, as mentioned previously.

4.3.2 Major impacts of pollution

Impacts of pollution sources on both surface water and groundwater are often severe for communities and the environment, as summarised below:

- Impacts on human health due to microbiological contamination and elevated nitrate levels in water supplies. Case studies prepared for the Regional Consultation Meeting highlight this problem (e.g. Metutera, 2002; Ibrahim, Bari and Miles, 2002) although this issue has been recognised for many years. For example, Baisyet, (1994) stated that "the pollution of drinking water and the resulting health hazard may be one of the biggest watershed issues in island countries of the South Pacific." This major issue of water pollution in the Pacific region (and other regions) and the linkages with waterborne diseases has been raised in the past (e.g. Detay et al (1989), Miller et al (1991) and UNESCO (1991)) and reiterated in more recent reports including ADB (1999), Falkland (2002), Crennan and Berry (2002). The high incidence of diarrhoeal diseases and other infectious diseases (e.g. hepatitis, typhoid and sometimes cholera) on some small islands is often caused by poor quality groundwater used as a source of drinking water (e.g. Micronesian Source Water Protection Coalition, 2001; FSM, 2002, Metutera, 2002). Outbreaks of cholera in PICs have been linked to contaminated water (e.g. Tarawa in 1977, and Federated States of Micronesia - Chuuk in 1982-83 and Pohnpei in 2000). The incidence of diarrhoeal diseases in PICs has been found to vary with water availability and climate. High incidences tend to be associated with low water availability and higher temperatures (Singh et al, 2001).
- Impacts on human health from chemical pollution, either directly from the water or through the food chain.
- Impacts on physical quality of water supplies, making the water unusable for days to months. On the island of 'Eua in Tonga, high turbidity and suspended solids are experienced by consumers after periods

of heavy rainfall. The water becomes unusable for a day or more. The water quality problems on 'Eua are at least partly due to tree clearing and cattle grazing within the formerly forested catchment above the water supply intakes. Further details are provided in Fielea (2002).

- The effectiveness of water supply intakes and treatment systems is compromised by high suspended sediment loads, leading to higher costs of providing clean, safe water supplies. For instance, Apia's water supply, which is fed from a number of catchments above the town, requires filtration (roughing filter and slow sand filter) and disinfection (chlorination) to achieve adequate water quality for the consumers. After very heavy rainfall, treatment plants have been overtopped by floods and covered in sediment from contributing catchment areas, causing disruption to water supplies for months (e.g. water supply for Apia was severely disrupted after a major flood in April 2001). This sort of event is most likely unavoidable, but the frequency of major flooding which can cause such problems is increased by catchment clearing, leading to higher and more rapidly rising flows than under uncleared conditions.
- Sedimentation in water supply reservoirs and rivers is a problem in some islands due to disturbances in upstream catchments (e.g. islands of Melanesia impacted by logging and mining operations).
- Adverse impacts from sediments, nutrients, chemicals and bacteria on riverine and coastal environments (including aquatic life, fish resources, inner reef lagoons, mangrove areas and coral communities).

4.3.3 Major issue of pollution from sanitation systems

Pollution from sanitation systems, as outlined above, is a priority issue since it severely impacts on water resources and the health of populations in many small islands. Especially affected are those islands with high population densities such as the main population centres in atolls. This problem is a major one for many small island communities, as alternatives, while available, are not necessarily affordable or acceptable to all people. Unless urgent action is taken, the problem is likely to get worse as populations increase. Without appropriate, affordable sanitation systems in many small communities on islands, there will not be any significant reduction in microbiological pollution of groundwater or surface water resources currently impacted by unsatisfactory sanitation systems.

The pollution problems are generally greater in urban and peri-urban areas with high population densities, where the sanitation systems are principally pit toilets (either latrine or pour flush) and septic tanks. Many smaller villages however, also exhibit high bacterial levels in groundwater or have the potential for such pollution. This problem is endemic in many small low-lying coral islands of the Pacific and other regions and is a major constraint to improvements in water quality.

Pit toilets, which are normally dug to the water table, allow direct contamination of the freshwater lens. Where septic tanks are used, the situation is better as long as they are well constructed and maintained. However, this is often not the case, with raw sewage leaking from septic tanks due to poor construction, or overflowing due to blockages caused by lack of periodic desludging.

On islands with thin, highly permeable soils and shallow water tables (e.g. atoll islands and other small coral islands), contamination can occur readily (e.g. a high level of contamination was found in village wells on Lifuka, Tonga: UNESCO, 2001). Similar high levels of contamination were noted in extensive surveys as part of the implementation of a reticulated sewerage project on Tarawa in the early 1980s (TSP, undated) and continue to be a major problem (Metutera, 2002). Detay et al (1989) and Miller et al (1991) report extensive bacterial contamination of wells in islands in the Federated States of Micronesia. Dillon (1997) found the thickness of the unsaturated zone (i.e. zone between ground surface and water table) is the most significant influencing factor on groundwater contamination. Hence islands with sandy unsaturated zones with thickness of 1 to 2 m are probably the most vulnerable of all. Limestone islands also offer little protection from groundwater contamination unless they are overlain by thick soil sequences.

Sanitation facilities are often sited without concern for the direction of groundwater flow. They have also been installed according to guidelines which are not applicable to island environments (UNESCO, 1991; Falkland, 1999a). The normally accepted minimum distance between a sanitation facility and a well is about 15 m (50 feet). This is based on studies in hydrogeological environments quite different from those found on many small islands. In many small coral islands such conditions do not apply. Travel times through the groundwater between sanitation facilities (where wastewater is injected into the groundwater), and groundwater wells can be short in such environments. This has been clearly demonstrated in an applied research and training project on the island of Lifuka in Tonga where tracers (dye and bromide) were used to measure the travel times between injection points and measuring points several metres away (Crennan et al, 1998; Crennan, 2001; Crennan and Berry, 2002).

The density of household sanitation systems is also a problem, especially in the small coral islands. Acceptable densities and separation distances outlined from studies relevant to tropical islands (Dillon, 1997) are well exceeded in many PICs, especially in urban areas.

The problem of extensive groundwater pollution is prevalent not only in coral islands in the Pacific, but also impacts on many other small islands (e.g. coral islands in the Maldives). Pollution is widespread and, as there are very few animals compared with the Pacific (e.g. no pigs, dogs), the major proportion of this pollution is of human origin. Septic tanks are often not well constructed. Because they are often dug to the water table and have soak pits near the water table, direct contamination of the groundwater can (Falkland, 2000; Ibrahim, Bari and Miles, 2002).

4.4 Insufficient knowledge of island freshwater resources

4.4.1 Overview of issues and constraints

Insufficient knowledge of water resources, especially freshwater resources is a major constraint to the sustainable water resources development and management on many small islands.

In many small islands, knowledge of the type, extent and sustainable yields of surface and groundwater resources is very limited. This is the case, even on some islands where water shortages occur due to the existing water resources being inadequate to supply demands in drought periods.

Contributing factors to insufficient knowledge of island water resources are:

- Inadequate baseline water resources assessments.
- Insufficient regular monitoring of water resources.
- Limited analysis and interpretation of water resources data for planning and design of water resources development projects, and for water resources management of catchments.
- Knowledge gaps requiring new or further applied research in a range of island environments.

These issues have been raised at many regional workshops and meetings over the past 20 or so years (e.g. CSC, 1984; UNDTCD, 1989; UNESCO/SOPAC/UNDDSMS, 1994; WMO, 1999) but the issues still remain. A summary of key issues is contained in specific publications (e.g. UNESCO, 1991; IETC (1998). Similar concerns are expressed for small islands in other regions (e.g. Maldives: Ibrahim, Bari and Miles, 2002). National agencies concerned with water resources monitoring have indicated their problems and needs at these workshops and meetings. Major problems cited are shortages of trained staff and training opportunities, limited budgets and problems of co-ordination between national agencies and external stakeholders (donor agencies, consultants). Further difficulties include long travel distances, access to remote sites, equipment failures due to exposure to harsh environmental conditions (humid tropical environment, sea spray) and natural disasters (e.g. cyclones, flood damage).

WMO (1999) reported that the most important reasons for undertaking water resources assessment in small island countries were:

- Water resources development:
  - Databases for future planning and development;
  - Master plans for water supply development and water allocation to existing and potential users;
  - Knowledge of availability of water (for example, averages and extremes - droughts and floods);
  - Baseline data (hydrological and environmental) prior to future development;
  - Identification of potential water supply for specific purposes (for example, hydropower, mining, etc.); and
  - Integrated water resources management (for example, taking account of the interactions amongst land, water and environment).
- Sustainable management of water resources:
  - Sustainability of ecosystems.
- Hazard mitigation:
  - Flood forecasting and flood risk assessment; and
  - Drought risk management.
- Development of water related infrastructure (for example, dams, bridges, culverts, etc):
  - Island design standards based on local data for optimal design of future projects.

The concerns about the inadequate capacity to collect good quality hydrological data and undertake water resources assessments in PICs have been reiterated in two recent review/proposals (Mosley, 2000; SOPAC/WMO/UNESCO, 2001). These are considered in section 4.4.3 and elsewhere in this report.

Further details of some of the key issues are provided below.

4.4.2 Inadequate water resources assessment

While adequate baseline water resource assessments have been undertaken for some islands, particularly for some of the major urban centres on the main islands in PICs, this is often not the case for smaller towns and villages on main islands or for outer (rural) islands.

In some cases, unsatisfactory water supply and water management solutions have been implemented due to

inadequate water resources assessments having being undertaken. Examples of problems include:

- Inadequate assessment of groundwater resources on small coral islands and selection of inappropriate pumping technology leading to saline water intrusion, and hence saline water in water supply systems.
- Inadequate assessment of surface water resources leading to installation of groundwater pumping systems in the coastal area of a high island where a surface water source could have been used, with lower operational costs, to provide supply to nearby villages.
- Allowing settlement to occur in areas which once had good potential for freshwater resource development but have become polluted to such an extent that they are unusable, or require expensive treatment.
- Installation of desalination plants on small islands as a "quick-fix" response to water shortage problems in droughts, rather than a structured approach to assessing all water management options and implementing appropriate water resources and water supply solutions.

Major causes of these problems include:

- Inadequate (and sometimes nil) hydrological data on which to base the assessments (e.g. insufficient rainfall and climate data).
- Insufficient emphasis given to water resources assessment in the planning phase of water supply and water resources development projects.
- Short-term consultants undertaking water resources assessments without a thorough knowledge of island hydrology and water resources. Most water resource assessment projects in small islands are implemented by external consultants. These projects are most commonly arranged through bilateral or multilateral funding agencies, and sometimes in partnership with local staff of water supply or water resources agencies. The quality of the assessments therefore depends largely on the expertise and knowledge of the consultant(s). External consultants are selected according to criteria determined by donor agencies. Since these criteria often do not involve detailed procedures for vetting the knowledge and experience of the consultants, the quality of the work can be compromised. There are many examples in the PICs where water resources assessments have been inadequately performed, with the inevitable result that poor management decisions follow.

4.4.3 Inadequate monitoring data

"If you do not measure it, you cannot manage it" is a very relevant statement in relation to water resources management. Water resources monitoring (also known as "hydrological monitoring" or "water resources data collection") should be a regular and ongoing activity, in order to assess the long-term behaviour of water resources due to climate variability and change and the impacts of various developments and land management practices. There is, however, often a shortage of good quality meteorological, hydrological, hydrogeological and water quality data on many PICs.

From a review of issues faced by national hydrological services (Mosley, 2000), the following were identified as priority items.

- Real-time rainfall and streamflow information for flood forecasting.
- A drought forecasting capability.
- Baseline information on the water resource in waterways having hydropower potential, most of which would be at the micro- or mini-hydro scale.
- Baseline information on surface waters likely to be affected by mining or forestry development, and subsequent monitoring.
- Water resource information, including streams, springs, and aquifers, at a reconnaissance scale, in support of rural water supply projects.
- Baseline and ongoing monitoring information on the quality of groundwater, particularly in the low islands and atolls where aquifers are subject to contamination by human and animal wastes.

It is noted that these priorities were based on visits by two consultants (Rishi Raj, Fiji and Paul Mosley, New Zealand) to 7 PICs (Cook Islands, Fiji, PNG, Solomon Islands, Tonga and Vanuatu) and 2 territories (French Polynesia and New Caledonia). In addition, two other countries, Niue and Samoa attended the WMO Meeting of Experts on Hydrological Needs of Small Islands (WMO, 1999) prior to the consultants' visits. The identified needs tend to reflect those of the larger high islands in Polynesia and Melanesia.

A similar, but not identical, list of needs was presented in a review of hydrological needs and proposal "A Programme to meet Hydrological Training Needs of Small Island Countries in the Pacific"), jointly prepared by SOPAC, WMO and UNESCO (SOPAC/WMO/UNESCO, 2001). This review considered a wider scope of countries, including those mentioned above, as well as the Micronesian countries, Kiribati, Marshall Islands and Nauru. In SOPAC/WMO/UNESO (2001), the main water-related issues and water monitoring needs were identified as:

- Domestic, industrial/commercial water supplies.
- Hydropower development - including mini and micro projects.
- Irrigation.
- Flood forecasting and river training.
- Drought forecasting and resource management.
- Saline intrusion into unconfined freshwater aquifers (lenses).

From the above-mentioned reports, and the various meetings preceding these (section 4.4.1), it has been found that the reasons for inadequate data are multiple, but include:

- Inadequate and often declining commitment and funding from governments.
- Insufficient institutional capacity to carry out water resource assessments. Staff are often inadequately trained, and in some cases, there are no personnel to carry out water resources activities.
- Outdated or faulty water resources monitoring equipment.
- Lack of logistical support such as transport to travel to monitoring sites.

Governments are frequently reluctant to invest in water resources monitoring. It is often seen as a non-essential activity, which can be delayed or cut until funding becomes available. This issue is not only a problem in small island developing countries, but also affects developed countries. At a time when it could be argued that water resources monitoring is even more crucial than before (due to increasing stresses on water resources, expanding populations, increasing pollution, uncertainty over climate change and even climate variability), it appears that the level of commitment to water resources monitoring is static or declining.

At present, the agencies with the most potential capacity for water monitoring are the water supply authorities, whose budgets and income are likely to be more plentiful than other government agencies involved with natural resources management

In some islands, monitoring is often only conducted over short periods in association with specific projects, mainly donor funded and often aimed at water supply improvements. The issues become greater in the smaller island countries, particularly in the outer islands. Once the project is completed, the local staff, however willing to continue, inevitably incur problems including equipment failures, no funding for maintenance and repair of equipment, work schedules which do not cater for such activity, lack of transport and other logistical factors.

Some specific issues and concerns related to water resources monitoring are as follows:

- Good rainfall records are essential ingredients for long-term water resources assessment. In some small islands, there appears to be a decline in recent years in the quality of rainfall and climate data. Recent gaps in data in previously continuous records, often over decades, are a symptom of the problem. The causes are not always evident but point to a general lower commitment to data collection at all levels.
- Higher technology solutions have been implemented to overcome staff shortages due to budget cuts, but these have led to inadequate data being collected. An example is the replacement of manually read raingauges in outer islands with automatic raingauges connected via radio or other communications links to main islands. In theory, this enables rainfall to be captured on a central office computer. In practice, valuable data is often lost due to (a) malfunctions with the automatic raingauges (e.g. blockages which are not cleared) and (b) communications problems interrupting data transmission.
- In some islands, school-based raingauge readings (under the Schools of the Pacific Rainfall Climate Experiment or SPaRCE programme) are used as substitutes for former meteorological stations with paid observers. While this is a commendable move to fill an 'institutional gap' with a community-based initiative, there are concerns about the quality and continuity of the record. Monitoring of these (non-standard) raingauges serves as a very helpful educational tool for young people and the collected data is a useful supplementary source. However, it should not be seen as a long-term substitute for records obtained from standard raingauges by trained observers.
- Insufficient streamflow monitoring stations for water resources assessment and other needs (e.g. flash flood forecasting). Basic hydrological monitoring networks do not exist in nearly all PICs. Most streamflow stations have been established for specific projects (Mosley, 2000).
- There is generally very little, and sometimes no baseline water quality data. Water quality testing, particularly for pathogenic organisms, is also not commonly conducted, especially in outer islands. Testing is often conducted only after major health problems are detected.
- There is also insufficient data available about the physical, chemical and other biological processes that take place in island watersheds, including soil erosion and loss of biodiversity as a result of land conversion due to logging and other practices. Quantitative evidence of microbiological and chemical water quality deterioration in streams is largely una-

vailable despite much anecdotal and visual evidence of physical deterioration.

- Regular groundwater monitoring is not a common practice in some PICs. Very few islands have monitoring boreholes specifically for the purpose of monitoring the status of groundwater resources in response to climatic and pumping impacts, despite recognition of this issue. For example, FSM (2002) recognises the need to undertake groundwater monitoring for aquifer protection, but mentions that this is not presently being done.
- Metering of groundwater pumps and surface water flow diversions, required for assessment of water usage, is not always done. Where meters have been installed as part of water development projects, they are often not maintained and sometimes not read. Valuable data is thus lost.
- Direct impact or flash flooding from cyclones and storms can cause destruction to water resources monitoring equipment. Streamflow recorders established in water supply catchments in Apia, Samoa were damaged by flash floods after very heavy rainfall occurred in early 2001. The recent cyclone in the northern Pacific (Typhoon Chata'an, July 2002 which devastated parts of Federated States of Micronesia and Guam) caused very extensive damage and destruction to a network of 11 stream gauging stations on Guam.
- Vandalism and/or theft of monitoring equipment by landowners are another concern in some islands. Vandalism of groundwater monitoring boreholes has occurred over many years on the island of Bonriki, Tarawa due to disputes between the landowners and government. Vandalism and theft of surface water resource monitoring equipment has occurred in a number of countries. Solar panels used for charging batteries at remote sites are often a target of theft.

4.4.4 Limited analysis and interpretation of data

- In many PICS, routine data processing, quality assurance checks and storage of the data require improvements. Databases are usually limited to water quantity data in the form of water levels, discharge measurements, and rainfall data, but few include water quality data. Databases with partial datasets are sometimes distributed over several agencies involved in water resources (e.g. Ministries responsible for water supply, natural resources, environment and health). In some cases data has been lost due to computer problems (e.g. hard drive failures and lack of back-up facilities).
- There is often very little or no analysis, interpretation and use made of the hydrological data by water personnel within PICs, as they are often too busy on other tasks or lack the necessary training. Where analysis of available data for water resources planning, development and management purposes is conducted, it is normally done by external consultants. An example is the review of groundwater sustainable yields for the islands of Bonriki and Buota, Tarawa using groundwater and other data and groundwater models (e.g. Alam et al, 2002).

4.4.5 Insufficient applied research

There has been insufficient research into some key hydrological issues in small island environments. The need for further applied research in small island countries was raised in a major review of water resources of small islands including PICs (UNESCO, 1991) and reiterated at the Pacific Water Sector Planning, Research and Training Workshop in Honiara, 1994 (UNESCO/SOPAC/UNDDSMS, 1994). It has been noted that the results of hydrological research and investigations from large islands or continents are not directly applicable to small islands, owing to the different scales and response times. For instance, groundwater pollution, saline intrusion caused by overpumping, and the impacts of activities in surface water catchments can occur very rapidly in small islands.

The Honiara workshop recognised that the need extended not only to technical and scientific areas, but also required an emphasis on social science and community-based issues. It was also emphasised that training of personnel involved in water resources and freshwater supply systems was a major need in PICs.

Despite some progress in certain applied research areas, knowledge gaps and the need for further applied research and training remain. More recent workshops and meetings have again reiterated priority lists of projects for funding (e.g. Sankey et al, 1997 and White, Overmars and Thulstrup, 2000). Falkland (1999b) identifies current knowledge of island water resources and future needs for applied research.

National governments have also recognised this need. For instance, the "Water for All'' draft national water policy for Samoa (Samoa Government, 2000) states that ongoing research and measurement of all aspects of water resources in Samoa is an essential step towards protection and enhancement of water resources. National governments are also keen to be involved with such projects, as demonstrated by the level of interest in two applied research projects undertaken in Kiribati and Tonga in the late 1990s.

Further details of applied research projects, either undertaken or imminent, are contained in section 5.7 and recommended applied research needs are presented in section 6.8.

4.5 Insufficient education, training and capacity in water resources

4.5.1 Identification of needs

The issues raised in section 4.4 are, to a large degree, symptomatic of insufficient capacity within PICs to conduct adequate water resources assessments, to collect adequate hydrological data and to analyse such data, and to carry out applied research into areas requiring further understanding.

The need for appropriate water resources and hydrological training and education for water sector professional and technical staff continues to be raised by representatives of PICs as a key concern and constraint to water resources development and management in their countries. Regional workshops and meetings held in recent years where these concerns have been raised include:

- Water Sector Planning, Research and Training Workshop, Honiara, Solomon Islands, June 1994 (UNESCO/SOPAC/UNDDSMS, 1994).
- Water Resources Workshop, Suva, Fiji, July 1997 (Sankey et al, 1997).
- Meeting of Experts on Hydrological Needs of Small Islands, Nadi, Fiji, October 1999 (WMO, 1999).

Based on the concerns expressed at the meetings mentioned above, a review/proposal ("A Programme to Meet Hydrological Training Needs of Small Island Countries in the Pacific") was developed by SOPAC, WMO and UNESCO summarising the hydrological training needs of PICs and recommending steps to address these needs (SOPAC/WMO/UNESCO, 2001).

SOPAC/WMO/UNESCO (2001) state that the most fundamental need arising from various needs analyses was that of human resources development in association with wider institutional or capacity building. As mentioned in section 4.4, a constraint raised in the report to developing effective water resources assessment and management capability is the fragmented responsibility for water resources.

The issue of training needs and overall capacity building has also been reiterated in a needs analysis in a report on the implementation of a Hydrological Cycle Observing System for the Pacific Island Countries or "Pacific-HYCOS" (Mosley, 2000). The "Pacific HYCOS" concept is further considered in section 6.4 and in the Theme 2 report.

Again the need for training of water technicians was viewed as the highest priority at a recent meeting of the Working Group on Hydrology of the WMO Regional Association V (South-West Pacific) in January 2002 (WMO, 2002). PICs represented at the meeting (members of WMO) were Cook Islands, Fiji, Niue, PNG, Solomon Islands, Samoa and Vanuatu.

One of the constraints to current bilateral assistance projects aimed at strengthening water resources assessment capacity is the low number of staff involved in hydrology and water resources at both technical and professional level in many PICs (SOPAC/WMO/UNESCO, 2001). Often there may be only one or two people involved in these matters, and generally on a part time basis, as they usually have other responsibilities. Bilateral and multi-lateral donors have, in the past, placed water resources specialists into PICs to assist in training and development of local personnel. These specialists have found themselves on occasions with few, or even no personnel to train as the limited relevant staff are away (e.g. training course elsewhere, leave, etc).

An additional issue in relation to education and training is staff retention. It is common for staff, once trained, to transfer to other government agencies, the private sector, or to move away (Mosley, 2000).

Current education and training initiatives are presented in section 5.9 while discussion of actions required to address training and education needs are presented in sections 6.4 and 6.9.

4.6 Inappropriate technology and methods

Numerous water supply technologies and methods have been trialled in small island countries. While many have been successful, there are also examples of water supply technologies that have not been appropriate for either the natural environment or the socio-economic conditions. Generally, systems requiring a high degree of operation and maintenance have led to problems. Simple systems using tried and tested technology are the most enduring.

Some examples of inappropriate technologies are mentioned below.

4.6.1 Inappropriate groundwater pumping systems

Inappropriate groundwater pumping systems have caused saline water intrusion and hence a brackish water supply in a number of small islands. Problems have arisen where pumping rates have been set too high, the wrong type of pumping system has been installed, or insufficient consideration has being given to the sustainable yield of the groundwater. This issue is particularly important for freshwater lenses on small coral islands, where conventional wells or vertical boreholes (tubewells) are not necessarily the most suitable groundwater pumping solution.

4.6.2 Desalination in some applications

While desalination technology itself is proven, the application of this technology in small island countries presents a number of problems, which have often led to the failure of such systems. Desalination is a relatively expensive and complex technology for obtaining freshwater in small islands. The cost of producing desalinated water is invariably higher than 'conventional' options (e.g. pumping of groundwater) due to the high energy and operating costs. In the Maldives, desalination is considered as an expensive alternative, but one that is necessary in some islands (Ibrahim, Bari and Miles, 2002). In addition, trained operators and a dependable source of supply for chemicals and spare parts are essential for reliable operation.

The unit cost of supplying desalinated water from a reverse osmosis system installed on the island of Betio, Tarawa is A$5.40/m^3, compared with A$2.40/m^3 for groundwater (Metutera, 2002). In terms of energy (electricity) costs, desalinated water is about 16 times more expensive than groundwater (A$2.81 compared with A$0.17).

Emergency water supply shortages due to the impact of droughts have led to the introduction of desalination systems in some small islands. However, operational problems (e.g. inadequate filtering of feed water or insufficiently trained operators) and high operating costs have resulted in many of these units being shut down and, in some cases, stored for future emergency use.

Desalination units were installed in two of the Lihir islands of PNG as an emergency drought measure in late 2000. These units operated only for short periods before the intakes were damaged by high seas. Other problems were the high fuel costs and the lack of suitably trained operators.

Similar negative experiences have been witnessed in the past on other small Pacific islands where this type of technology has been introduced (e.g. Kiribati, Tonga and Tuvalu). A number of lessons have been learnt from these experiences and the application of this technology should be carefully managed in future. Further comments are provided in section 5.5.6.

4.6.3 Inappropriate sanitation systems

It is necessary to make mention of inappropriate sanitation systems, as these often adversely impact on the microbiological and chemical quality of freshwater resources. As mentioned in section 4.3.3, pit toilets and poorly maintained septic tanks are two examples. Because of their high pollution potential, particularly in island environments where soils are very permeable and water tables are shallow (e.g. small coral islands), pit toilets are often very inappropriate. Septic tank systems, while in theory a reasonable wastewater treatment option, are often unsuitable due to poor construction and lack of maintenance. In the past, these sanitation practices have been introduced by well-meaning donor agencies without a full consideration or appreciation of the groundwater conditions on small islands.

4.7 Catchment management issues

The major issue for both surface water and groundwater catchments (watersheds) is water quality degradation caused by human activity. Examples of activities and impacts on water quality are provided in section 4.3. Problems have arisen on many small islands because people are living above or very close to the water resources they use for water supply, including potable water.

Catchment management concerns the rational use and management of land and resources, including water, while minimising impacts on the environment within and downstream of the catchment. Catchment management necessarily involves the people who own, reside on and use the land and water resources. In many PICs, land (often called 'customary' or 'traditional' land) is owned by customary landowners and decisions about the land are community-based. The issue of customary land and its relationship to water resources and catchment management is a special and important one in many PICs. Customary land tenure systems are not readily compatible with areas designated by governments for water supply or water resources protection, especially where restrictions have been imposed rather than agreed upon. Also, water rights are often not clear. Legislation may claim that water resources are vested in the government yet customary land ownership encompasses land and other resources, including water (e.g. Samoa Government, 2000).

In some PICs, conflicts have arisen due to the actual or attempted imposition or regulation by governments of land uses for public purposes on customary land. In cases where mutual agreement over land use has not occurred, conflicts, uncertainty and protracted delays in achieving effective land and water management have resulted. Such conflicts affect both surface water catchments and groundwater catchments where the main water resources issues are the use of the water, building of water supply infrastructure and protection of the water resources from pollution.

Catchment management issues have arisen in relation to the clearing of customary land to cultivate kava (or *sakau*) in surface water catchments of Pohnpei, Federated States of Micronesia. Efforts to resolve these issues are well documented in Dahl and Raynor (1996) and Raynor and Kostka, (2001). Cultivations of kava on steep slopes in upland areas led to soil erosion and sedimentation in downstream mangroves, lagoons and coral reefs. Water supplies were also adversely affected. The need for catchment management in Pohnpei was recognised since the late 1970s, but ini-

tial catchment management procedures were focused on a regulatory approach. Enforcement of legislation failed, as it did not recognise customary land tenure and resource use, and there was very little community awareness and support for it. Measures taken since the late 1980s to resolve these issues have focused on participatory catchment management (refer section 5.4.1).

An example of a groundwater catchment issue on a designated water reserve in Tarawa, Kiribati is documented in White et al (1999) and Metutera (2002). Bonriki Island in Tarawa, Kiribati has an international airport and a declared water reserve (i.e. a groundwater protection zone) above the main part of a large freshwater lens. Groundwater is pumped from the lens for water supply for South Tarawa. Legislation from the 1970s has placed restrictions over land use within the water reserve to protect the quality of the groundwater. This legislation has been a source of friction over many years between the landowners and the government. The legal establishment of water reserves has failed to appreciate local community needs, culture, land tenure and land use requirements (White et al, 1999). In addition, the legislation concerning the water reserves shows up a lack of identified roles and responsibilities due to the absence of overarching water resources legislation. In the past 10-15 years, some landowners and tenants have moved onto parts of the water reserve and established dwellings and associated gardens, presenting a threat to the groundwater quality. At the same time, the condition of coconut trees and other vegetation within the reserve has deteriorated. Further details are presented in White et al (1999). Outlined in section 5.4.2 are recent measures taken to resolve this issue, including the establishment of a Water Resources Protection Committee to enable the local community and landowners to participate in measures to protect the groundwater resources (Metutera, 2002).

Issues of water quality degradation in catchments are not confined to customary land. Fielea (2002) provides an example of catchment management problems in a surface water supply catchment on the island of 'Eua in Tonga. The land on this island is owned by the government. Other parcels of land in Tonga, which are used for groundwater abstraction, are owned by the monarchy, the nobility or the government. There is no private or customary land ownership under the unique land tenure system in Tonga.

4.8 Other issues and constraints

There are many other issues and constraints to sustainable water resources management. Many of these are not specifically identified as aspects to be covered under Theme 1, but rather are addressed in detail in the reports of the other five themes, particularly Themes 3 and 5. However, as some issues and constraints are very important in the overall context of water resources management and impinge on aspects already covered in Theme 1, a summary of these most important aspects is presented below.

These water resources management issues cover the following areas:

- Government policy.
- Water legislation.
- Institutional arrangements.
- Community awareness and participation.

Many of these issues are identified in a number of key sources (e.g. UNESCO, 1991; UNESCO/SOPAC/UNDDSMS, 1994; and ADB, 1996) as well as other specific reports (e.g. White et al, 1999; Crennan, 2001). A brief summary of some of the major issues is provided below.

4.8.1 National government policy

Based on the results of a recent study (Mosley, 2000), water resources management has, in general, a low profile in many South Pacific island countries. This is a major constraint to achieving sustainable and effective water resources management. Governments generally see other issues as having a much higher priority than water resources management issues. Concerns about water resources management issues tend to be focused during droughts due to water shortages, and immediately after floods, especially where there is loss of life and major damage to housing and infrastructure. At other times, however, activities such as long-term water resources monitoring tend not to be viewed as important and receive a correspondingly low level of support and funding.

In general, there is a need for greater and ongoing commitment and support from national governments in the area of water resources management and, indeed, in the wider water sector. Taulima (2002) provides an example of this issue for Tuvalu.

4.8.2 Legislation

Important issues related to water legislation are:

- There is often inadequate or no legislation to protect and conserve water resources and to manage surface water and groundwater catchments (watersheds). Sometimes there is legislation related to forest management or environmental conservation, but no specific watershed management legislation.
- Water rights are often unclear. Legislation may claim that water resources are vested in the government, yet customary land ownership encompasses land

and other resources, including water (e.g. Samoa Government, 2000).

- There is often insufficient political will and/or institutional capacity to enforce legislation.

4.8.3 Institutional arrangements

- In some island countries there is effectively no national water resources agency or 'national hydrological service' (Mosley, 2000). There is generally a meteorological service with a prime function of collecting, storing and disseminating climate data. However, surface water and groundwater resources data is often not collected, especially in outer islands.
- Where water resources data is collected, this may be done by the water supply authority or by some form of national hydrological service located in a ministry for the environment, public works, or natural resources (Mosley, 2002). Such 'services' are often under-resourced, thereby reducing their capacity.
- Roles and responsibilities of agencies involved in water matters are sometimes unclear, fragmented and un-coordinated. For instance, there may be a lack of clear distinction between agencies involved in the provision of water supply and the regulation and protection of water resources.
- Competition for funding between government agencies involved in water management.
- Environmental impact assessments are very rudimentary, and in some PICs, are almost non-existent. This may enable the implementation of projects that are not sound from a catchment management perspective.
- National water quality standards and water supply guidelines are sometimes non-existent.

4.8.4 Community awareness and participation

Important issues related to the involvement and participation of communities in water resources planning and management are:

- Insufficient emphasis placed on community education and awareness.
- Insufficient consultation with communities and opportunities for participation in decisions affecting water resource development, management and protection in many PICs.
- Insufficient recognition of the important role of women in the provision of water and sanitation, particularly in rural communities within PICs.
- Insufficient use of local knowledge in relation to the assessment of water resources potential in some islands.

Measures taken since the late 1980s to resolve these issues and promote participatory watershed management are outlined in section 6.2.2.

5. ACTIONS TAKEN TO IMPROVE WATER RESOURCES MANAGEMENT

5.1 Overview

This section presents an overview of actions taken in recent years to address the issues and concerns raised in section 4. The focus is on the PICs but many of these measures apply to small island countries in other regions.

The information presented in this section, within the defined scope of Theme 1, is organised under the following headings:

- Water resources assessment and monitoring.
- Water resources planning and development strategies.
- Participatory catchment management.
- Appropriate technology for water supply.
- Appropriate technology for sanitation and wastewater.
- Applied research projects.
- Knowledge and information transfer.
- Education, training and capacity building.
- Inputs by regional and international agencies and NGOs.
- Other relevant initiatives.

Measures taken to address other aspects of water resources management, as raised in section 4.8 (government water policy, legislation, institutional arrangements and community awareness and participation), are covered in other theme reports for the Regional Consultation Meeting.

The efforts and actions in recent years to improve water resources management in at least some PICs, as outlined in this and other theme reports, have recognised the need for a more holistic approach to ensure that social, technical, economic and environmental factors are taken into account. The term "integrated water resources management" (IWRM) has been used to describe this approach with the aim of sustainably developing and managing water resources. At the global scale, there is a large amount of knowledge and a wealth of experience in the field of IWRM, but less so

in developing countries including the PICs. Further information about IWRM principles and practices is presented in section 5.11.

5.2 Water resources assessment and monitoring

This section examines some of the steps taken to address these issues and concerns, as presented in section 4.4. Actions required to improve water resources assessment and monitoring, including recommendations from recent detailed needs analyses (WMO, 1999; Mosley, 2000 and SOPAC/WMO/UNESCO (2001), are outlined in section 6.4.

The actions taken to improve water resources monitoring are considered at regional, national or institutional level, and community or local level.

5.2.1 Regional level

SOPAC has provided assistance to water resources assessment projects in some PICs. Examples include a groundwater potential assessment of Rarotonga coastal plain, Cook Islands (SOPAC, 1998b) and a water resources assessment on Banaba Island, Kiribati (SOPAC, 2000a).

5.2.2 National level

Surface and groundwater monitoring programmes are being implemented in most PICs with varying levels of effectiveness. There have been a number of projects in individual PICs in recent years, funded by bilateral development assistance agencies, multilateral agencies or private companies, which have been targeted directly at, or have included elements which have assisted with, water resources assessment and monitoring. Examples include:

- Installation of raingauges and stream gauging stations in Samoa and Rarotonga, Cook Islands. These gauging stations and related water resources, together with database training for Ministry of Works staff, are part of a 5 year NZODA funded project.
- Drilling of replacement and some new groundwater monitoring boreholes on Tarawa atoll, Kiribati. These are to be used for investigation and monitoring of the freshwater lenses used for public water supply on the islands of Bonriki and Buota (part of the ADB funded SAPHE Project).
- Drilling of groundwater monitoring boreholes, water resources monitoring training and database installation in conjunction with groundwater development projects on 3 islands, Tongatapu, Lifuka and Vava'u in Tonga for the Tonga Water Board (AusAID and EC funded projects).
- Installation of stream flow monitoring weirs and groundwater investigations for a community village water management project as part of a wider community development programme in the Lihir Islands, PNG (funded by Lihir Management Company, a gold mining company).

5.2.3 Community level

Initiatives to involve communities, particularly schools, in water resources monitoring programmes have been implemented in a number of PICs. One of the most widely implemented projects is the Schools of the Pacific Rainfall Climate Experiment (SPaRCE) which is a co-operative field project involving local meteorological services and schools. There are over 160 schools from approximately 22 different countries involved in this programme. Data obtained from SPaRCE stations is normally rainfall, but in some cases includes additional climatic information (e.g. temperature and humidity). This programme is co-ordinated through the University of Oklahoma in the USA and sponsored by a number of agencies (SPaRCE, 2002).

Live & Learn Environmental Education has developed a 'River Care' project for implementation through schools and their local communities. Based on the Streamwatch programme in Australia, River Care is a water quality monitoring and education project designed to help raise community awareness of pollution in rivers (Live & Learn; 2000, 2002). It is not intended to be a solution in itself but is designed to raise awareness in students through river monitoring. Initially, it is intended to introduce it to schools and communities in the four most polluted river catchments in Fiji, including the Rewa River catchment.

To overcome the shortage of staff to undertake routine water resources monitoring in Vanuatu, a proposal has been written which would utilise school students in streamflow and water quality assessments (Vanuatu Hydrology Section, 2001). Students would receive training in appropriate water resources monitoring and would be expected to make regular visits to selected sites to undertake this work.

Specific projects have also been undertaken in conjunction with schools. An example was the conducting of part of an applied research project at a secondary school on the island of Lifuka. The purpose of the project was to study groundwater movement of pollutants in a small coral island environment. The project was a practical example of groundwater quality monitoring and dye tracing used to educate and raise awareness of water resources management issues (Crennan et al, 1998, Crennan, 2001).

A number of potential community-based pilot projects focusing on specific freshwater management issues have been identified in a recent report for SPREP under the International Waters Programme (Falkland, 2002). These potential projects include the following:

- 'Stream Health' (similar to 'River Care'), which involves monitoring of stream water quality to demonstrate the linkage between upstream catchment uses and downstream water quality impacts.
- 'Groundwater Health' – focusing on groundwater monitoring to demonstrate linkages between groundwater pollution from sanitation systems and water quality impacts in nearby wells.
- 'Leakage Watch', which involves flow monitoring at schools and other institutions to demonstrate patterns of water consumption and promote water conservation.

In each proposed pilot project, the key elements are:

- Community education and awareness-raising of the issue.
- Improvement of understanding of catchment (watershed) processes and impacts on freshwater quantity and quality through appropriate data collection and monitoring.
- Examination of factors which impact on sustainability and water quality of the freshwater resources.
- Demonstration of methods or technologies that can be used to resolve or improve current conditions.
- Discussion with communities and other stakeholders, and preparation of future management options and preferred approaches.
- Local and wider dissemination of results through appropriate media.

In addition, community-based projects related to sanitation, wastewater and solid waste management are presented in a parallel report for SPREP under their International Waters Programme on waste management (Crennan and Berry, 2002). These are also relevant to the water resources management theme, as many current waste disposal methods have a direct influence on freshwater pollution and degradation.

5.3 Water resources planning and development strategies

This section examines activities taken in small island countries to improve the sustainability of freshwater resources through effective and appropriate water resources planning and development strategies. It is not possible to present a comprehensive overview of activities but rather some specific examples are provided.

These strategies, which form part of an integrated approach to water resources management, include:

- Effective, long-term planning of water resources development.
- Drought management strategies.
- Conjunctive use of water sources.
- Protection of water sources and supplies.
- Water demand management and conservation.

Related topics dealing with appropriate water supply and sanitation technologies, primarily for rural water supplies, are considered in sections 5.6.

5.3.1 Planning of water resources development

Effective, long-term planning of water resources development must take account of many factors including the nature and extent of naturally occurring water resources, climatic and other impacts on these resources, economic conditions, type and location of water demand centres, and community attitudes and practices through consultation. Crucial to effective planning is the assessment of water resources potential and water demands. Initially, surface water, groundwater and rainwater resources need to be adequately assessed and sustainable yields estimated. 'Non-conventional' options, including desalination and importation and use of other water (e.g. seawater) should be considered only in special circumstances (e.g. where freshwater resources are very limited under normal conditions or during drought), but not before other simpler and less expensive options have been thoroughly investigated.

Planning for water resources development has, in general, occurred to a satisfactory degree for larger urban centres in PICs. Planning for water supplies in outer or rural islands receives generally less attention. In some cases, adopted solutions are non-sustainable, leading to shortages in droughts, saline intrusion or pollution of water supplies. Water planning is generally undertaken on an intermittent rather than continuous basis, often with external technical assistance from consultants and funding from bilateral or multi-lateral development aid projects. In many cases, there are only a few local staff who often have insufficient training and limited water resources data on which to base long-term plans.

An example of current water resources planning for the long-term future is the Sanitation, Public Health, and Environment (SAPHE) project in Tarawa, Kiribati. The ADB loan funded project aims to improve the development potential of Kiribati and the health and well-being of the people through improvements in water supply, sanitation, solid waste disposal and environmental awareness and conservation. The water supply com-

ponent involves a planning element to look at long term water supply options for South (urban) Tarawa. Options include increased groundwater abstraction from the current water sources (Bonriki and Buota freshwater lenses) and other islands in north (rural) Tarawa, and installation of additional rainwater collection and desalination facilities. Key planning components of this project have been a review of the sustainable yields of the Bonriki and Buota freshwater lenses including additional water resources assessments; trials of constant flow systems to households to control water demands; and economic appraisal of the available water development options. Additional assessments of groundwater resources potential in north Tarawa are planned. Further details of this project and other water planning and management issues in Kiribati are presented in Metutera (2002).

The water resources development for South Tarawa is an interesting example of water resources management in a small island context, where naturally occurring freshwater resources are very scarce. For many years, it has been recognised that the freshwater resources need to be conserved as much as possible. For this reason, water supply planning has been based on relatively low per capita consumption rates (40 litres per person per day). Reticulated sewerage systems, built 20 years ago for the main centres, have used seawater for flushing. Currently, other sanitation options, including dry composting toilets, are being trialled for less densely populated parts of South Tarawa. Further discussion of this technology, is presented in section 5.6.1.

5.3.2 Drought management strategies

Drought management strategies should be part of the long term planning for water supplies. While this is primarily an issue for the smaller islands with limited water resources, particularly those susceptible to long droughts, it is also important for islands with larger landmasses or where rainfall has a high variability. Examples of drought management strategies have included:

- **Water restrictions**. Such measures were taken in the 1997-1998 El Niño drought in several countries including PNG, Solomon Islands and Fiji (SOPAC, 1999a). Radio programmes have been used in some countries as a means of raising public awareness to reduce water consumption (e.g. Marshall islands, Kiribati, Tonga and Samoa).
- **Leakage control measures**. On the main island of Rarotonga in the Cook Islands, where surface water flows were less than half of normal flows at water intakes, the water supply agency used leakage control measures to reduce the loss of water (SOPAC, 1999b).
- **Groundwater pumping strategies**. To ensure sustainability of groundwater for public water supply during droughts, some island water supply agencies have adopted the philosophy that pumping rates should be set at a minimum constant rate, which has been designed to cope with worst historical drought periods. This approach is used for groundwater pumping from the islands of Bonriki and Buota in Tarawa. Another strategy is to pump at low rates once water salinity levels reach a threshold level but allow higher pumping rates when condition are favourable. This involves a detailed knowledge of the impacts of climate and pumping on freshwater lenses that can be gained only after sufficient monitoring data has been collected and assessed. An example of an island where such a strategy is in place is Home Island, Cocos (Keeling) Islands in the Indian Ocean (Falkland, 1999c).
- **Water conservation**. An important part of the drought management process is to recognise the effectiveness of rainwater catchments in supplying basic needs throughout droughts. In the Ha'apai group of Tonga, where significant droughts can occur, many households recognise that rainwater should be conserved only for potable purposes when regular rainfall ceases. In other islands where the impacts of droughts are very severe (e.g. Kiritimati, Kiribati), normal rainwater catchment systems cannot supply sufficient freshwater for even basic demands.
- **Larger domestic rainwater storages**. At present, in the northern atolls of the Cook Islands, the main water supply source is rainwater, although groundwater is used as a supplementary source during drought, especially for 'second class' water requirements. In 1997, Cyclone Martin caused inundation and major destruction of houses and community facilities on Manihiki atoll in northern Cook Islands. During the rebuilding programme, large in-ground rainwater storage tanks were included as integral elements of new household cyclone shelters.
- **Rainwater tanks for communal use**. In Tuvalu, rainwater collection is the primary source of water as rainfall is generally high and drought periods tend to be of relatively short duration compared with other parts of the Pacific. When water shortages occur, communal tank water is used to supplement private rainwater catchment systems. This water is rationed. As a further step towards improving the overall capacity of rainwater storage for the urban area on Funafuti atoll, public housing designs have incorporated separate underground cisterns for private household use and for communal use in times of drought (Taulima, 2002).
- **Importation**. Some small islands with limited or no fresh surface water and groundwater, and limited rainwater capacity, are reliant on freshwater imported from larger islands. This can involve local people canoeing to other nearby islands to collect water. In

greater emergencies, government funded boats or barges have been engaged to transport water to the islands (e.g. in some outer islands of Tonga and Fiji).

- **Desalination**. In some islands, desalination systems have been provided and installed as a response to severe droughts, and stored for emergency purposes when rainfall conditions have improved (e.g. Marshall Islands, Tuvalu). In the case of Kiribati, a desalination unit was installed during the long and severe drought in the late 1990's and was kept operational following the drought. The use of desalination systems to supplement potable water supplies in droughts is an appropriate response, provided that it is not a substitute for more effective and economical long- term water supply strategies.
- **Other sources**. Communities on small islands have long known methods appropriate for dealing with droughts. These have included collection of water from sustainable springs, digging shallow wells on beaches to extract groundwater and travelling by boats to nearby islands to collect water from more permanent sources. Other measures include the use of coconuts as a substitute for drinking water and using brackish or seawater for non-potable purposes. It is probably true to say that very few communities will be totally devoid of freshwater or substitutes (e.g. coconuts). Potential exceptions are islands that are reliant solely on rainwater or where population pressure is extremely high and available water resources are scare (e.g. Ebeye, Marshall Islands).

5.3.3 Conjunctive use of water sources

The conjunctive use of water from different sources for different purposes can provide an effective means of water resources management at the household and community levels. Conjunctive use of water from different sources enables consumers to exercise some control over the sustainability of the water supply and water quality.

Conjunctive use schemes on small low-lying islands typically involve using rainwater for 'first class' needs (e.g. drinking, cooking) and groundwater from wells for 'second class' needs (e.g. bathing and washing). There are many examples of this type of conjunctive use in PICs (e.g. for islands in the Federated States of Micronesia, examples are provided in Winter; 1995a, 1995b and FSM, 2002). The conjunctive use of surface water and rainwater is practised in a number of high islands. Rainwater tanks adjacent to houses provide a convenient means of supplying drinking water, while water for bathing and washing can be obtained from nearby streams (often used at the site). Sometimes three classes of water are available in urban or peri-urban areas. For example, in urban Tarawa some houses have access to local wells, rainwater and piped, chlorinated water.

Other forms of conjunctive use are evident in islands with limited freshwater resources in order to maximise the availability of these resources for potable purposes. As mentioned previously, seawater or brackish well water may be used for bathing in some islands where freshwater resources are limited. Seawater is also used for flushing water in reticulated sewerage systems in densely populated areas of Tarawa and in Majuro, Marshall Islands.

5.3.4 Protection of water sources and supplies

Measures to more effectively manage and protect water sources from (further) water quality degradation have been taken in some islands and are planned in others. These measures include a combination of catchment management practices, application of appropriate technology and procedures, and administrative arrangements.

- Measures to control land uses in surface water catchments that cause erosion, sedimentation and contamination from sanitation and solid waste disposal. For instance, controls are necessarily required for the cultivation of steep slopes, clearing of forests and construction and use of tracks and roads in sensitive water supply catchments.
- Siting of groundwater supply sources at sufficient distance from potential pollution sources. This may involve designating certain islands on atolls, or parts of islands, as exclusive reserves for freshwater extraction (e.g. Tarawa). Where this is not possible, large open spaces (e.g. playing fields) provide reasonable areas for the development of groundwater. A project was implemented on Lifuka, Tonga to install infiltration galleries at sports fields within the urban area, under which the only freshwater lens was located. The galleries were sited as far from human habitations and pollution sources as possible in order to minimise the threat of biological contamination.
- Disinfection of water supplies that are impacted by bacteriological contamination. Chlorination plants are installed in most urban water supply systems in PICs, with some using powder (calcium hypochlorite) and others using gas chlorination systems. They are rarely used in rural water supply systems.
- Filtration systems have been built and maintained to remove suspended solids and hence clarify the water. Examples are the roughing and slow sand filters used for the Apia water supply in Samoa. These require maintenance (e.g. replacements of sand) at more frequent intervals as catchment water quality becomes worse.

- Improved methods of sanitation to prevent ground and surface water pollution from wastewater. This could involve waterless (dry composting) toilets (e.g. Kiribati, Tonga). In the Maldives, other measures are planned to protect groundwater quality on very small islands through improved sewage treatment and disposal of wastewater (e.g. low gradient "small bore" pipe systems to gravel bed hydroponics or constructed wetlands for sewage treatment: Ibrahim, Bari and Miles, 2002).
- Controls on areas where animals can be kept and/or methods to deal with animal waste.
- Adequate bunding around fuel and other storage tanks.
- Impermeable membranes and effective leachate control and disposal systems at landfill sites, and installation of pollution monitoring boreholes to monitor impacts.
- Siting and selection of appropriate methods of groundwater pumping systems that do not cause saline intrusion. Siting of pumping systems in the central parts of coral islands, rather than near the edges, will ensure more sustainable freshwater supplies.
- National guidelines or site-specific guidelines, with similar measures have been prepared in some PICs in relation to groundwater protection, sometimes as part of draft or enacted national water resources (or water supply) legislation. These have been implemented to various degrees depending on local circumstances. In Tonga, for instance, legislation enables the Tonga Water Board to establish groundwater protection zones over freshwater lens areas used for water supply.
- To maximise groundwater availability, it may be prudent to selectively clear vegetation, particularly coconut trees, in designated areas, to reduce transpiration. Coconut trees on low coral islands act as phreatophytes (i.e. draw water directly from the water table) and may cause a reduction in available groundwater resources, especially during relatively dry periods. However, this suggestion should be treated very cautiously, as coconut trees are often a source of food and drink, shade and materials for building and other purposes. In some islands, areas that have been already cleared for other land uses, such as airfields, offer good opportunities for groundwater development, especially on low-lying coral islands (e.g. Tarawa in Kiribati, Aitutaki in the Cook Islands, Kwajalein in the Marshall islands).
- Develop contingency plans for occasions when surface or groundwater does not meet the required quality (e.g. use rainwater for potable water). This is a sound measure whereby water is used conjunctively, and is typical of approaches on some atolls where other options are not available.

Examples and further details are provided in other parts of section 5 and in the Case Studies for Kiribati, Tonga and Maldives. In addition, community-based measures to cope with water supply quality degradation in islands of Chuuk in the Federated States of Micronesia are outlined in the Micronesian Source Water Protection Coalition (2001).

5.3.5 Water demand management and conservation

Water utilities in urban and some rural centres in PICs utilise a range of demand management measures including metering and charging for water on a user-pays basis, leakage control, water saving devices and education and awareness about water conservation.

Metering and charging on the basis of water usage is an effective demand management tool, which has been implemented in a number of PIC urban areas (e.g. PNG, Solomon Islands, Vanuatu, Marshall Islands, Tonga, Samoa and parts of the Federated States of Micronesia). In some PICs, metering and charging has been previously implemented but temporarily stopped due to operational problems (e.g. Kiribati), or has not yet been implemented (e.g. Cook Islands). Water usage reductions have been noted following the introduction of these measures. An example is Apia, Samoa, where the consumption fell from an estimated 825 litres/person/day to 325 litres/person/day following the introduction of metering (Samoa Government, 2000).

In rural areas where water charging is applied, it is normally done on a flat fee basis and collected by the village water committees (e.g. Tonga).

Where pipe networks are used to distribute water, active leakage control can greatly assist in reducing losses. In recent years, a number of urban water authorities have instituted leakage control programmes (e.g. Fiji, Tonga and Samoa). The Pacific Water Association (PWA) is also involved in leakage detection promotion, as it is recognised as one of the main issues facing its members. SOPAC has been instrumental in raising awareness and dialogue on this topic through a regional workshop (SOPAC, 1999b). SOPAC has also conducted in-country investigations and associated pipe network modelling and training of local personnel, for example, Cook Islands, Fiji, Kiribati, Niue, Samoa, Solomon Islands, Tonga and Vanuatu (various SOPAC reports).

Measures to improve leakage in plumbing systems in houses and other buildings (e.g. offices, schools) can have a beneficial impact on operational costs for pumped systems. In Niue, it was estimated that a 55% reduction of water usage was achieved by conducting a survey of every house in each village and repairing leaks in taps, showers and toilet cisterns. This measure nearly halved operational costs for groundwater pumping (SOPAC, 2000b).

Water saving devices, such as spring-loaded taps for standpipes and improved household plumbing fixtures (low and dual flush toilet cisterns, low flow taps and shower heads) can assist in water conservation and have been installed in some islands. Recent water supply designs for Kiribati specify constant flow systems for inclusion in each household so as to restrict the total daily flow to a selected volume (e.g. for villages on Kiritimati and urban areas of Tarawa).

Education and awareness about water conservation is a most important part of overall demand management. These aspects are presented in Theme 3.

5.4 Participatory catchment management

Catchment management issues were briefly outlined in section 4.7. Government agencies are generally aware of the measures required to achieve effective catchment management. However, an ongoing problem in many countries, including PICs, is that insufficient attention has been given to the 'human activity system', or social dimension of catchments. In PICs, this means the recognition of traditional approaches and values, including land tenure systems and social structures (Falkland, 2002).

'Integrated catchment management' (ICM) has been introduced over the past decade to recognise the importance of the social dimension and to integrate it with the physical dimension in the process of catchment management. ICM has been defined as the 'process of formulating and implementing a course of action involving natural and human resources in a catchment, taking account of the social, political, economic and institutional factors operating within the catchment to achieve specific objectives' (Hufschmidt and Tejwani, 1993). ICM is effectively a component of integrated water resources management (IWRM) applied at the catchment, watershed or basin scale. IWRM is further discussed in the small island context in section 5.11.1.

'Participatory watershed management' (PCM) emphasises people's participation and action as the central element of ICM. PCM has often been recognised as a more effective means of achieving sustainable resource management, including protection of water resources, than the more commonly applied 'top down' approach (Hinchcliff et al, 1999).

PCM is not well developed in PICs. Worthwhile results have been achieved where it has been applied (e.g. Pohnpei and Tarawa, as outlined below). In other PICs, steps have and are being taken to enable the participation of communities in catchment management and the rational use and protection of water resources (e.g. "Water for All" national water policy in Samoa: Samoa Government, 2000). Another example is provided for the island of 'Eua, Tonga in Fielea (2002).

5.4.1 Surface water catchment management in Pohnpei

Early failed attempts at catchment management in the 1980s were introduced in section 4.7. Starting in the late 1980s, a number of measures were taken to rectify water quality degradation problems through participatory watershed management. This management process evolved over several years in Pohnpei with support from various agencies including US Forest Service, ADB, SPREP and The Nature Conservancy (TNC). A multi-agency Watershed Steering Committee (WSC) was established in 1989, with government and NGO representatives. This committee conducted an island-wide watershed education and consultation programme, visiting all local communities. An Integrated Watershed Management Strategy (WMS) was developed by TNC with assistance from SPREP and ADB, and approved in 1996 (Raynor and Kostka, 2001). The WMS was based on the participation of community members, traditional and civil leaders and the private sector. It recognised the authority of local villagers to manage their own forest and marine resources. One of the main objectives of the WMS was to develop a practical cost-effective monitoring programme to measure the status and trends of Pohnpei's watershed resources and to be used as a guide for community-based resource management. A monitoring programme was developed in 1997 (Crocker et al, 1997). TNC has assisted its local partner, the Conservation Society of Pohnpei (CSP), and others in community-based conservation monitoring and enforcement throughout Pohnpei. They have also assisted farmers to plant kava (*sakau*) in the lowlands, under the shade of commercial fruit trees ("Grow Low" campaign).

During this period, the Pohnpei Watershed Conservation Area Project under the South Pacific Biodiversity Conservation Programme (SPBCP) was also established. Its main objective was to protect and conserve the ecological functions and processes of the upland forest within the Pohnpei Island Watershed Forest Reserve area and the mangrove forests (SPREP, 2001). Over time, this project evolved from a defined watershed area to an island-wide conservation effort involving nearly 200 villages in the five municipalities, relying mainly on the work of the TNC and CSP. The project was generally successful in raising awareness of the need for conservation of the upland watershed. While not all aspects of this initiative were successful, the overall process of developing the participatory approach to catchment management has been successful (SPREP, 2001).

5.4.2 Groundwater catchment management in Tarawa

White et al (1999) presented a list of recommendations aimed at both the institutional and the community level,

which could assist in longer-term resolution of potentially ongoing issues. One concept advanced to the government, was to establish village-based committees for the continued protection and management of activities on the freshwater lenses (P. Jones, pers. comm., 2001), representing a step towards participatory catchment management.

Recent attempts to achieve better management of the Bonriki and nearby Buota freshwater reserves in Tarawa (refer section 5.7) have included the establishment of a Water Resources Protection Committee to enable the local community and landowners to participate in measures for the protection of the groundwater resource (Metutera, 2002). Landowners and others living within the freshwater reserve were encouraged to voluntarily move. A compromise solution was found where most could be resettled along a 50 m wide strip on the ocean side of Bonriki island, and effectively on the edge of the freshwater lens. After a series of land boundary adjustments, some of the people have moved. This solution was reached after consultation between the Bonriki landowners and government, recognising that the water reserve was a necessary long- term water supply for urban Tarawa.

5.5 Appropriate technology for water supply

5.5.1 Overview

Appropriate technologies for application in small island developing states to achieve sustainable development and management of water resources have been the focus of a major initiative in the past few years. UNEP and the International Environmental Technology Centre (IETC) sponsored a series of surveys, workshops and publications to evaluate and present a number of appropriate or alternative technologies for 'freshwater augmentation' in small island developing states. In the Pacific region, this work was undertaken largely by SOPAC with inputs from individuals in the Pacific, Indian Ocean and South China Sea regions. A workshop was held at SOPAC in February 1996 (SOPAC, 1996), which was followed by preparation and publication of a Source Book on Alternative Technologies for Freshwater Augmentation in Small Island Developing States (IETC, 1998). The purpose of the book is to provide information to water and environmental managers and planners about available methods for sustainable development of freshwater resources on small islands.

There have been other projects and reports aimed at providing useful methods, approaches and designs for sustainable water resources development and management. SOPAC has been a key agency in many of these initiatives, particularly in its role as a regional coordinator of workshops on relevant topics (e.g. hand pumps, solar pumps, demand management and appropriate sanitation for the management, conservation and protection of freshwater resources). A number of bilateral agencies including NZODA and AusAID have funded projects with a focus on providing sustainable solutions to water management.

As mentioned previously, the focus of this report is on rural water supply systems. Hence consideration is given to appropriate technologies applying to these systems. Urban water supply technology and approaches are considered in Theme 4.

5.5.2 Rainwater harvesting

In general, household rainwater tanks are one of the most appropriate solutions to improving potable water supplies and they also increase the level of community involvement and self-reliance in rural water supply schemes.

The vital importance of rainwater is evident in many islands. Rainwater may in fact be the primary, and in some cases only, source of freshwater (e.g. on many atolls in Tuvalu, and some very small islands in Cook Islands, Fiji, PNG and Tonga). In other islands, where average rainfall is moderate and where droughts can last for many months, rainwater can be considered only as a useful supplementary water source. The cost of building sufficiently large catchments areas and storage tanks to supply rainwater as a main water source in such islands would be prohibitive.

Household rainwater harvesting systems, involving rainfall collection from all or part of the roof and storing it in a small to medium sized tank, are common. There are many examples of such systems on small islands in the Pacific and other regions. Such schemes are currently being, and should continue to be, implemented. There have been many examples of communal projects to build ferrocement rainwater tanks throughout PICs. A variety of aid donors, NGOs and other groups have been involved in this work. In some cases, the projects aim at individual household tanks while others have built communal tanks near public buildings. Examples are provided in Annex B (Water resources management in the 14 participating countries) of a recent report under the International Waters Programme of SPREP (Falkland, 2002).

Methods for the design of rainwater catchment systems are the focus of a number of reports in proceedings of a series of international conferences on this subject and other specific references (e.g. Gould, 1991; Nissen-Peterson and Gould, 1999). Specific design guidelines for particular countries have been developed including Tuvalu (Chapman, 1986; SOPAC, 2001a) and Federated States of Micronesia (Heitz and Winter, 1996).

Rainwater catchment construction programmes in rural areas have been the focus of many aid projects in PICs. These programmes have been implemented with funding from a large number of international and bilateral donors and NGOs. Many involve the construction

of ferrocement tanks, which can be implemented in community-based construction schemes. In some cases, this may involve local contractors (e.g. Tonga) while in others, whole villages have been involved in the process. Various guidelines have been written, often in the local language, to assist in the training of persons to carry out construction work, examples of which are presented in IETC (1998). In some island countries (e.g. Cook Islands, Tuvalu, Maldives), plastic tanks are becoming more popular than ferrocement or fibreglass tanks.

In Tarawa, Kiribati, recent building regulations require that new buildings include gutters and a minimum rainwater storage of 5,000 L. This measure will assist in the longer term in relieving the water demand on the public groundwater supply system (Metutera, 2002). Similar measures have been previously taken in other islands. In Tuvalu, regulations regarding rainwater harvesting have been in place since 1990. Revision of the regulations based on recent analysis of rainfall data has been suggested (SOPAC, 2001a).

One issue that is not commonly considered in the planning process for rainwater harvesting systems is a means of preventing or minimising runoff containing leaf matter, animal and bird faeces and other debris from roofs and gutters into storage tanks. This is an important consideration as often the levels of bacteria in rainwater tanks can become quite high if no action is taken to prevent entry of potential pollutants. Most important is a "first flush" device to prevent pollutants and organic matter which wash from roofs and gutters during the first heavy rainfall after a dry period. Simple "first flush" measures are adopted by householders in some islands by removing the downpipe from gutters to tanks during long periods of no rain (e.g. rural areas of Tonga). This is very effective although more convenient approaches using a bypass pipe, T-junction and two valves are used for rainwater collection in some islands (e.g. Maldives). The main pipe to the tank can be closed while the bypass pipe diverts dirty water to waste during the 'first flush'. Under normal condition the valve to the tank is opened while the bypass valve is closed. Materials are quite inexpensive.

Recognising the scarcity and vulnerability of water resources on atolls islands, a project proposal has been developed by UNEP and SOPAC to promote rainwater harvesting in atolls (UNEP/SOPAC, 2001; SOPAC Water Resources Unit website). The proposed project, entitled Empowering Women in Rainwater Harvesting in Pacific Atoll Islands, has the goals of (a) increasing the quantity and quality of water available on vulnerable atoll islands, and (b) increase women's participation in the implementation of rainwater harvesting systems.

Proposed outputs from the project are:

- Rainwater harvesting scheme installed in one urban community and one rural community.
- Draft policy for promoting water harvesting in the project area.
- Committees on water management established at the local level.
- Training manuals and guidelines for rainwater harvesting projects.
- Report on water harvesting technologies and pilot study results.
- Video entitled "Empowering Women in Water Resources Management focussing on Rainwater Harvesting" and distribution of materials produced to other countries.

The island of Vava'u in Tonga had been selected for the project. Funding will be provided by UNEP and the project will be managed by SOPAC in association with a local NGO, the Tonga Community Development Trust.

A community-based rainwater harvesting project was also rated as a possible project to be funded under the International Waters Programme of SPREP (Falkland, 2002).

5.5.3 Surface water development

Surface water resources development methods on small islands include stream intake structures, dams and other storages, and spring cappings. Examples of the application of these methods are provided in UNESCO (1991) and IETC (1998).

Stream intake structures generally consist of in-stream weirs or buried collector pipe systems laid in or near the stream bed. In-stream weirs are often used in high islands with volcanic rock channels. There are many local designs, which generally take the form of a small concrete weir to impound the stream flow and a pipe to divert water to a village. Screens are often used to prevent entry of medium to large-sized floating objects. The largest issue is the entry of dirty (turbid) water following heavy rain and high flows. Water treatment systems are required to remove the small particulate matter and turbidity, but usually this is not done except in some of the larger water supply systems. A simpler method is to lay a network of PVC pipes in a sand filter bed behind the weir (AusAID, 2000). This method can remove fine particulate matter and turbidity but has the disadvantage of being subject to damage during floods, or becoming clogged requiring regular maintenance. In practice, water supplies affected by high turbidity require a day or more for the water quality to return to normal. During these times, supplementary rainwater is most useful for maintaining water supply.

Buried porous concrete collector pipes within streams have also been used on some islands (e.g. the Cook islands: Waterhouse and Petty, 1986).

Water retaining structures can be constructed as dams within the stream or as off-channel storages. Neither is very common on small islands due to unsuitable topography or geology, and high costs. Sometimes dams have been constructed in locations with unsuitable geological conditions. This has resulted in leakage problems (e.g. dam constructed for hydropower project on Upolo, Samoa).

Spring cappings, common in many small high islands, typically consist of an open or covered containment structure, generally constructed from concrete or masonry. Spring flows are contained by the structure and diverted to an intake pipe.

5.5.4 Groundwater abstraction using infiltration galleries

Groundwater abstraction methods on small islands generally involve bailing or pumping from dug wells, or pumping from boreholes (or drilled wells). Dug wells are common in villages and towns in low-lying islands and the coastal areas of high islands. Where extraction rates are small, this method of groundwater withdrawal is highly appropriate. Pumping from boreholes is also a common method on high islands and moderately high limestone islands. This method is used for supplying water to many villages in volcanic and limestone islands in Samoa and Tonga. Boreholes are also used to supply a number of urban centres (e.g. Port Vila in Vanuatu and Tongatapu in Tonga).

For freshwater lenses on small low-lying coral islands, moderate to high pumping from wells and boreholes can lead to upconing of brackish water, causing the pumped water to become saline. The reason for this is that the impact of the pumping is localised near the point of extraction.

A much more appropriate method of abstraction from freshwater lenses on small coral islands is to pump from infiltration galleries (also called “horizontal wells” or “skimming wells”). Infiltration galleries avoid the problems of saline intrusion because they spread the impact of pumping over a wider area of the freshwater lens.

Infiltration galleries generally consist of buried horizontal conduits which are permeable to water (e.g. PVC slotted pipes). These are laid in trenches dug at or close to mean sea level, thus allowing water to be drawn towards a central pump. The trenches are dug by hand or with the aid of a mechanical digger. Once the gallery pipes are laid, the area is backfilled and the only structure seen above ground level is a pump well and pumping system.

Infiltration galleries are successfully operating in a number of PICs including Tarawa, Kiribati (Falkland and Woodroffe, 1997), Kwajalein in the Marshall Islands (Hunt, 1996) and Lifuka, Tonga (TWB, 2000). On the island of Bonriki, Tarawa, a yield of about 1 million litres/day is obtained from 17 galleries, each 300 m long (White et al, 1999). There are other examples in PICs in the Marshall Islands (Majuro and Kwajalein) and the Cook Islands (Aitutaki). Open trenches, as previously used on Kiritimati atoll in Kiribati prior to recent construction of new galleries, are not recommended as these are subject to surface pollution.

On the island of Lifuka in Tonga, where groundwater pumped to the residents of the village of Pangai-Hihifo had traditionally been quite saline, improvements using infiltration galleries have significantly lowered the level of salinity of the water supply (TWB, 2000). The community has been acutely aware of previous attempts to improve the water supply by using wells and boreholes. They were made aware of the infiltration gallery project, partly through public information sessions, but also through involvement of local workers. After constructing the galleries, fitting the solar and electric pumps, building a new tankstand and tank, they were able to directly experience the improvements in reduced water salinity from the day the new system was commissioned.

Further consideration of infiltration galleries on Tarawa is provided in Metutera (2002).

5.5.5 Energy for pumping

At the household and village level, hand pumps are used in many islands. Most larger groundwater pumping systems use fossil fuel, predominantly diesel fuel, as an energy source. However, the use of alternatives, particularly solar pumping, is being considered more often for rural pumping systems..

Solar pumping for groundwater supplies has been found to be very useful in rural villages where the pumping heads are not too high. Solar pumping is used for many village water supplies in the rural islands of Kiribati. In Tonga, solar pumps have been used in tandem with electric pumps at galleries on the island of Lifuka. A recent water supply and sanitation project in Kiritimati Island, Kiribati has installed infiltration galleries with a solar and a wind pump at each gallery.

In general, solar pumping systems have been more successful than wind pumping systems due to the lower maintenance requirements (fewer moving parts).

5.5.6 Desalination – appropriate or not?

Desalination can be an appropriate solution for small island countries as an emergency measure during droughts, or where the limit of naturally occurring freshwater resources has been reached due to over use or major contamination. However, desalination should be

considered only when more conventional water sources are non-existent, fully utilised, or more expensive to develop.

In all cases, it is necessary to analyse the options, based on a good knowledge of alternative water resources and the economics of supplying water from each source. In the case of Nauru, for instance, there is potential for the selective use of groundwater instead of desalinated water. Despite some previous groundwater investigations, there is a need for a more comprehensive assessment of groundwater potential on the island (e.g. WHO, 2001).

It could be argued that desalination is the only option for Malé' in the Maldives and for Ebeye in the Marshall Islands, owing to the high population densities and the limited, polluted groundwater. Even in these islands, other options are available for supplementary water (e.g. rainwater and selective use of brackish groundwater). In the case of Malé', all three sources are utilised.

It is worth noting that the only operational desalination units for regular water supply in Pacific Islands are located in a few urban areas (e.g. Nauru, Ebeye and part of Tarawa), tourist resorts and military facilities. In these cases, funding and technical expertise to operate and maintain such units is generally available. Even then, major problems can and do occur (e.g. blockage of intake in Nauru in 2002).

Instead of desalination systems, which require energy from diesel-powered pumps or power stations, solar stills offer a "low technology" solution in certain applications (UNESCO, 1991; IETC, 1998). These systems have been employed, generally, on a temporary or research basis, for the production of small quantities of freshwater from seawater. With typical daily solar radiation levels in the humid tropics, freshwater yields of about 3 L/ m^2/day can be produced. While solar stills have major advantages in that they use readily available energy and produce high quality water, there are some significant problems for large-scale production of freshwater by this method. This technology has not been utilised in small islands, except at the experimental level. There is, however, scope for greater use of solar stills at the community level (e.g. to supply small quantities of drinking water in droughts).

5.5.7 Water disinfection

Simple, relatively low cost means of water disinfection using solar energy have been developed and are used in some parts of the world. Solar water disinfection (SODIS) uses a combination of solar radiation and elevated temperature to destroy pathogenic micro-organisms in water. The elevated temperature allows pasteurisation of the water.

The simplest form of this technology is to take transparent plastic bottles, fill them with water which may be polluted and leave them in the sun for several hours. The length of time required to disinfect the water is dependent on the amount of heat generated. An exposure time of 1 hour is sufficient if the temperature is above 50ºC but may need to be as long as two days in cloudy weather. The disinfection process can be improved by half-painting the bottles black or by placing the bottles on a reflective surface (e.g. roof made of corrugated aluminium or galvanised steel). Further detailed information is provided in the SODIS website (www.sodis.ch).

Commercial systems based on the same two mechanisms of solar disinfection are also available. These are often flat plate systems similar in appearance to those used by solar water heaters. They are available in sizes suitable for households and in larger sizes as required. Household systems can supply approximately 10 litres every 2-3 hours, while larger systems are capable of up to 1,000 litres in the same period.

Solar stills, mentioned above, which utilise the processes of evaporation and condensation also act as water treatment devices in addition to their function of desalination.

5.6 Appropriate technology for rural sanitation and wastewater

Improvements in rural sanitation systems are important from a water resources management perspective for two major reasons. Firstly, the type of sanitation system may impact on the availability of water resources for other needs. In particular, the use of freshwater for flush toilets may lead to supply shortages for other, more basic potable water needs. Secondly, sanitation systems can be a major source of biological and chemical pollution of water resources, as outlined in sections 4.3.

This section is primarily concerned with rural sanitation systems. Some of the technologies are also relevant to urban and peri-urban areas of small islands.

5.6.1 Compost (waterless) toilets

As outlined in section 4, major pollution can occur from septic tanks and pit toilets, especially in islands with permeable soils and shallow water tables. These types of sanitation systems are therefore considered inappropriate in many island situations.

One sanitation alternative that has great potential for use in rural and urban areas in PICs is the dry composting, or 'waterless' toilet. There are significant advantages associated with waterless toilets as follows (Crennan and Berry, 2002):

- They do not require water and hence help to conserve water resources.

- They prevent pollution of groundwater and surface water resources.
- They can provide more effective destruction of disease-causing organisms than common waterborne sewage treatment.
- They can be constructed cheaply from local materials.
- They can produce a beneficial soil improver.

Trials of dry composting toilets have been conducted under AusAID projects in Tonga (on the island of Lifuka), in Kiribati (on Kiritimati) and, more recently, as part of an ADB project in Tarawa. The trial in Tonga, involved 15 units at 13 households and two schools. Overall, the trial, completed in 1999 (Crennan, 1999), was successful and the Government of Tonga has indicated that they wish to see a greater use of this form of sanitation. A large component of the trial project was community education, awareness-raising and training. The largest impediments to the introduction of this technology are social rather than technical (e.g. initial scepticism about the viability of this sanitation approach, fears of bad odours, difficulties in obtaining sufficient bulking material (e.g. dry leaves) and important issues related to handling human waste, even after decomposition). However, these issues can be resolved with appropriate community education delivered before and throughout the course of a properly designed and conducted trial.

A composting toilet pilot project is included as one of the potential community-based project activities under the waste management theme for the International Waters Programme of SPREP (Crennan and Berry, 2002).

There is an urgent need in small islands for greater use of technologies such as waterless toilets to assist in the process of managing water demand and reducing the degradation of water quality. Further consideration of this technology is considered in section 6.6.

5.6.2 Other rural sanitation options

There are a number of alternative sanitation systems, which can be applied in small islands. These are applicable to rural areas and also to peri-urban and some urban areas.

Small community-based sewerage systems, employing flush toilets, can discharge to oxidation and evaporation ponds in islands where there is sufficient land area. Other options are well-constructed septic tanks discharging via 'small-bore sewerage' pipes (effluent only) to 'reed beds' (gravel bed hydroponics or constructed wetlands) for treatment prior to discharge at the edge of the island (Ibrahim, Bari and Miles, 2002). Separation of 'greywater' (from bathrooms) from water discharging from toilets can enable greywater to be treated on-site and discharged to groundwater or surface water. It is important on coral atolls that fresh groundwater which is only mildly polluted is not discharged to sea, as this is a loss of potential recharge to groundwater. It has been shown that on Malé, the capital of the Maldives, that discharging all wastewater to the sea contributed to the depletion of the freshwater lens underlying the island (Ibrahim, Bari and Miles, 2002).

Other sanitation options for small islands are presented in publications in SOPAC (1997a ,2000a).

A good practical example of an artificial wetland used as part of an overall sewerage treatment system for a concentrated population is located at the Fijian Shangri-La tourist resort on Yanuca island, (a small island adjacent to the Cuvu District of the main island, Viti Levu in Fiji). In this system, partially treated sewerage is diverted through a constructed channel where a variety of wetland species are used to absorb nutrients which would otherwise be discharged into marine receiving water causing degradation of coral reef ecosystems. Recent analysis of samples by the University of the South Pacific indicate a reduction of nutrients of up to 75% through the wetland system (FSP Fiji, 2002). This project called the "Wai Bulabula", or Living Waters project, was initiated by the Foundation for the Peoples of the South Pacific with funding from the resort and other donors. This project is part of an integrated approach that the community of Cuvu District is adopting to conserve its marine environment. Further details are provided in the Theme 3 paper and a case study and FSP Fiji (2002).

5.6.3 Regional meetings and publications

In recent years, at the regional level, there have been a number of important meetings and workshops to raise awareness and examine alternative approaches to sanitation. These include:

- Workshop on Appropriate and Affordable Sanitation for Small Islands, Tarawa, Kiribati, September 1996. Further work based on the workshop findings led to the publication "Sanitation for small islands. Guidelines for selection and development" published by SOPAC in conjunction with UNDP and WHO (SOPAC, 1997a).
- Regional Meeting of Stakeholders in Wastewater Management. Majuro, Marshall Islands, 10-15 October 2001, SOPAC (2001). This was an initiative under the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), which followed two planning meetings held in February and March 2001. The objective of the Majuro meeting was to discuss a draft policy statement on 'waste' water and to develop a

regional framework for action. The programme included presentations covering a range of public health and conservation issues related to waste water management. The major outcomes of the meeting were the Pacific Wastewater, Policy Statement and Pacific Wastewater, Framework for Action (SOPAC/SPREP/PWA/UNEP; 2001a; 2001b).

- Workshop on 'Environmentally Sound Technologies (EST) for Integrated Waste Management in Pacific SIDS', which followed the above-mentioned meeting in Majuro, Marshall Islands. The participants discussed suggested technologies and practices (IETC, 1999) for management of liquid, solid, and hazardous 'wastes' for a regional EST Directory.

SOPAC, in collaboration with other agencies, have published a number of guidelines and other reports on aspects of sanitation in the PICs including SOPAC (1997a, 1999c, 1999d and 2000c).

5.6.4 Regional wastewater management policy

The Pacific Wastewater, Policy Statement (SOPAC/SPREP/PWA/UNEP, 2001a) and the accompanying Pacific Wastewater, Framework for Action are significant as they present a regional policy and strategy for wastewater management in PICs. This policy is relevant to the water resources management theme because of the impacts that sanitation and wastewater systems have on water quality and water use.

Within the wastewater management policy, there are five guiding principles, which incorporate an overall objective leading to policies and actions. These guiding principles are:

- National wastewater management policies and regulations will be appropriate and acceptable to the people and cultures of the Pacific Islands.
- Appropriate national institutions, infrastructure and information will support sustainable wastewater management.
- Better access to funding will improve service delivery and develop the private sector.
- Community participation in wastewater management and sanitation will ensure equitable benefit with recognition of socio-cultural sensitivities.
- Viable and sustainable levels of skilled and knowledgeable people within the wastewater sector and communities will improve wastewater management.

Much of the content of the wastewater policy/framework for action is relevant to the wider water sector, and there is scope for it to be widened so as to incorporate other elements, including those pertaining to Theme 1, water resources management.

5.6.5 Bacteriological and other water quality testing

Bacteriological testing (for faecal contamination) of water supplies is generally difficult in PICs. Problems are often great enough to discourage, or prevent regular testing taking place. Current testing methods generally involve collecting samples in sterile bottles and sending these to central (hospital) laboratories on main islands. The procedures required for sampling and transporting samples are not easily undertaken, especially in remote islands, where flights are either irregular or not available.

Alternative, simpler methods for bacteriological testing are now available. Rather than using the more common membrane filtration test, a colour change indicator method has been developed (several types) which can indicate the presence or absence of bacteria (total and faecal coliforms). This test is suitable for rural water supplies as it is simple to use, does not require a laboratory or expensive equipment and provides sufficient information to show if water supplies are fit for potable use (according to WHO guidelines for drinking water: WHO, 1993). A cheaper presence/absence method is also available. This is the hydrogen sulphide report strip test, which detects hydrogen sulphide producers that inhabit the intestinal tracts of warm-blooded animals, rather than directly identifying total or faecal coliforms. Correlations with more conventional tests have shown good results (D. Sharp, pers. comm., 2001).

There is a range of field kits available for bacteriological tests using conventional membrane filtration and incubation methods. In addition, field kits for water chemistry are readily available to provide additional information about water quality, particularly for drinking water purposes. Water quality monitoring kits which include tests for physical, chemical and biological indicators are available for assessing 'stream health' (e.g. Streamwatch kits, Australia, New Zealand Stream Health Monitoring and Assessment kit ('SHMAK')).

The use of appropriate simple field kits is supported by WHO for monitoring of water quality for drinking water purposes, especially in rural areas (WHO, 2002).

5.7 Applied research projects

This section provides a summary of recent and current applied research projects. Future research needs are presented in section 6.8.

5.7.1 'UNESCO-SOPAC' projects

Three priority applied research projects were recommended at the Pacific Water Sector Planning, Research

and Training Workshop in Honiara, 1994 (UNESCO/SOPAC/UNDDSMS, 1994). These projects were:

- A groundwater recharge project with the aim of quantifying the key hydrological processes affecting the amount of water which recharges groundwater (freshwater lenses) on small coral islands. The island of Bonriki, Tarawa atoll, Kiribati was the selected project site.
- A groundwater pollution study with the aim of analysing the linkage between sanitation systems and groundwater pollution in nearby wells. The island of Lifuka in the Kingdom of Tonga was the selected project site.
- A 'catchment and communities' project on a small 'high' island, aiming to study the impacts of upstream activities (e.g., deforestation, mining) on downstream communities. An island in Melanesia was the preferred target area, but no site was selected.

In each case, it was recognised that community consultation, participation, education and awareness are as important as the scientific and technical issues. Other key elements to be addressed were the training of water professional and technical staff, and the discussion of test results with the local communities during and following the monitoring projects.

UNESCO provided a pivotal role and the initial funding to support the first two projects. Additional funding and logistical support were provided by SOPAC, the Commonwealth Science Council and a number of institutions in Australia. Literature surveys were completed in the early stages of both projects (White, 1996; Dillon, 1997). Reports with the findings of the research have been completed for both projects. Findings from the recharge project in Tarawa are presented in White et al (1999, 2002) with additional aspects, covering the integration of social and technical components, in Crennan (2001). For the groundwater pollution project in Tonga, findings are presented in Crennan et al (1998) and Crennan (2001).

The third mentioned 'Catchment and Communities" project has not yet been implemented. The project scope and location has been revised on a number of occasions, since it was originally suggested in 1994. An updated project proposal is provided in White, Overmars and Thulstrup (2000). The project is now proposed for Vanuatu where sites are being selected and a project document is being prepared jointly by the Department of Geology, Mines and Water Resources and NIWA, New Zealand for consideration by UNESCO for funding.

5.7.2 Groundwater and agriculture research project

Recently, another major research project entitled "Equitable Groundwater Management for the Development of Atolls and Small Islands" has commenced (ACIAR, 2002). This project, funded by the Australian Centre for International Agricultural Research (ACIAR), will study the groundwater management options for agriculture and other uses in Tonga and Kiribati. The project concentrates on groundwater as it is the major source of freshwater in many atolls and small islands and its availability, quality, management and allocation are central to their sustainable development. The main research organisation is the Centre for Resource and Environmental Studies of the Australian National University. Collaborating institutions are SOPAC and government agencies and the water authorities in Tonga and Kiribati. The project team aims to integrate hydrogeological, agronomic, social, economic and cultural information, to assist in setting broadly accepted, long-term goals for groundwater management and allocation, and to reduce conflict.

5.7.3 Other selected research projects and publications

Research into the impacts of droughts on different water resources (e.g. groundwater and rainwater) on small coral islands has led to the development of a broadly applicable 'drought index' (White, Falkland and Scott, 1999). This drought index approach, developed for Tarawa, but applicable to other drought-prone island countries, uses a relatively simple analysis of monthly rainfall data to identify the severity of various drought periods. Using this information, critical drought indices can be applied to trigger various water conservation or relief strategies, as appropriate.

At the ENSO Impact on Water Resources in the Pacific Region Workshop in Nadi, Fiji, in 1999 (SOPAC, 1999a), an additional priority project of drought assessment in small island nations was proposed. A project proposal is also presented in White, Overmars and Thulstrup (2000).

Further discussion of this topic of drought assessment is presented in the Theme 2 report.

In addition to the research mentioned above, which has involved largely 'South Pacific' countries, applied research has been conducted in the former US Trust Territory islands (i.e. Federated States of Micronesia, Marshall Islands and Palau) by US agencies, including the US Geological Survey, the Water Resources Research Centre of the University of Hawaii and the Water and Energy Research Institute of the University of Guam. This has led to a wide range of water resources studies on many of the islands in these countries. Examples include Mink (1986), Miller et al (1991), Spengler et al (1992), Hunt (1996), Peterson (1997) and Buddemeier and Oberdorfer (1997).

Other papers, which have extensive summaries of past

research into island hydrology, hydrogeology and water resources in the Pacific and other regions, are contained in a number of specific publications including UNESCO (1991) and Vacher and Quinn (1997).

5.8 Knowledge and information transfer

5.8.1 Previous meetings and workshops

A number of important regional meetings and workshops, specifically concerned with freshwater resources, water supply and related issues on islands, have been held in the Pacific Region over the past 20 years. These were organised in response to the water resource management concerns and needs of PICs. Major events since 1983 are listed below, and citations to proceedings of these meetings and workshops are shown in brackets:

- Meeting on Water Resources Development in the South Pacific, Suva, Fiji, 1983 (ESCAP, 1983).
- Regional Workshop on Water Resources of Small Islands, Suva, Fiji, 1984. (CSC, 1984).
- Interregional Seminar on Water Resources Management Techniques for Small Islands, Suva, Fiji, 1989 (UNDTCD, 1989).
- Workshop on Water Sector Planning, Research and Training, Honiara, Solomon Islands, 1994 (UNESCO/SOPAC/UNDDSMS, 1994).
- Workshop on Technologies for Maximising and Augmenting Freshwater Resources in Small Islands, Suva, Fiji, 1996 (SOPAC, 1996 and IETC, 1998).
- Small Island Developing States Working Group Meeting on Water, Suva, Fiji, 1997 (SOPAC, 1997b).
- Small Islands Water Information Network (SIWIN) Workshop, Suva, Fiji, 1997 (SOPAC, 1997c).
- UNESCO Water Resources Workshop, Suva, Fiji, 1997 (Sankey et al, 1997).
- Workshop on ENSO Impact on Water Resources in the Pacific Region, 1999 (SOPAC, 1999a).
- Workshop on Water Demand Management, 1999 (SOPAC, 1999b).
- Meeting of Experts on Hydrological Needs of Small Islands, Nadi, Fiji, 1999 (WMO, 1999).
- Meeting of Pacific Focal Group for Water Resources, Priority Issues in Water Resources, Christchurch, New Zealand, November 2000 (White, Overmars and Thulstrup, 2000).
- Workshop on Drinking Water Quality Surveillance and Safety, Nadi, Fiji, Oct-Nov 2001 (WHO, 2002).

Meetings of the Science, Technology and Resources (STAR) Network are held at SOPAC Annual Sessions, which often review water resources issues. In addition, annual meetings of the Pacific Water Association (PWA) have a strong focus on water supply in the urban sector and also consider wider water management issues.

5.8.2 Relevant publications

Publications are available, which cover aspects of island hydrology and water resources management in the Pacific and other regions. These include:

- Pacific island water resources (Dale, 1981).
- Groundwater in the Pacific Region (UNDTCD, 1983).
- Coral island hydrology: a training guide for field practice (Dale et al, 1986).
- Hydrology and water resources of small islands, a practical guide (UNESCO, 1991).
- Small Tropical Islands, water resources of paradises lost (UNESCO, 1992).
- Geology and hydrogeology of carbonate Islands (Vacher and Quinn, 1997).
- Source book of alternative technologies for freshwater augmentation in small island developing states (IETC, 1998).
- Tropical island hydrology and water resources: current knowledge and future needs (Falkland, 1999b).
- Synopsis of information on freshwater and watershed management issues in the Pacific Region (Falkland, 2002).

While some of the above references are somewhat dated, they contain useful background information about the water resources of PICs.

In addition, there are numerous reports on Pacific regional water activities, which also refer to specific PICs. These include reports by, or prepared for:

- Regional organisations (e.g. SOPAC, SPREP).
- International organisations (e.g. UNESCO, WHO).
- Donor and loan agencies (ADB, EC and various bilateral donors).
- NGOs and individuals about community-based water related projects in PICs.
- Educational and research organisations within the Pacific Region. These are too numerous to be listed but many are contained in the reference list.

5.8.3 PIC water working groups

In recent years, personnel from PICs involved in the water sector have met at various workshops and formed ad-hoc working groups on water resources. These groups have generally lasted only for the duration of the meeting and shortly thereafter. They have provided opportunities for useful dialogue between individuals about shared issues and potential solutions. Depending on availability, funding and other factors, representatives from PICs and other agencies and individuals within the Pacific region may attend. A summary of these water working and 'focus' groups is provided below.

At Science, Technology and Resources (STAR) Network meetings, which are held in conjunction with SOPAC Annual Sessions, an ad-hoc group called the STAR Water Working Group (or Technical Advisory Group on Water) is convened from attending delegates with an interest in water issues. This group normally reviews the recommendations of the previous year's group, reviews the work programme of SOPAC's Water Resources Unit (WRU) and other initiatives, and makes recommendations to the STAR chairman to take to the SOPAC Council.

For instance, at the October 2001 STAR/SOPAC meeting in Majuro, the Water Working Group reviewed the Water Working Group recommendations from the 2000 meeting, and the Pacific Wastewater Policy Statement and the Pacific Wastewater Framework for Action from the Regional Wastewater Meeting (also held in Majuro in October 2001). The 2001 Water Working Group endorsed the following recommendations that emanated from the Regional Wastewater Meeting:

- A Pacific Wastewater Focal Group to be established to continue the dialogue on wastewater in the region; and
- Pacific Island Countries to develop National Frameworks for Action and establish National Wastewater Focal Groups.

The 2001 Water Working Group also recommended that SOPAC:

- Take a lead in collaboration with SPREP and the Pacific Wastewater Focal Group to mobilise funds through the Global Programme for Action (GPA) to implement demonstration projects on wastewater in the region.
- Initiate further activities in the Pacific region on environmentally sound technologies.This would including research and dissemination of information emanating from a UNEP-funded workshop on Environmentally Sound Technologies for the Integrated Management of Solid, Liquid and Hazardous Waste for Small Island Developing States in the Pacific (also held in Majuro in October 2001).

A "UNESCO-IHP Working Group on Water Resources" was convened at the UNESCO Water Resources Workshop in 1997. This group reviewed the progress on two applied research projects in PICs and developed a revised list of research activities and priorities (refer Sankey et al, 1997 and section 5.7.1).

Another focal group for water resources was inaugurated at a meeting held in Christchurch, New Zealand in November 2000 (White, Overmars and Thulstrup, 2000). This meeting was held in conjunction with a wider Regional Steering Committee (RSC) Meeting of the UNESCO International Hydrological Programme (IHP) in the Asia-Pacific Region. It was attended by PIC delegates from Cook Islands, Kiribati, Niue, PNG, Tonga and Vanuatu, as well as Australia, New Zealand, UNESCO and SOPAC. The delegates recognised that many small island nations, although members of UNESCO, do not have their own International Hydrological Programme (IHP) committees and therefore are not formally part of the RSC network. It was proposed that an alternative group called the 'Pacific Focal Group for Water Resources' be established. This could convene in conjunction with STAR Water Working Group meetings, possibly every 2 years. The main purpose would be to review water resources activities including applied research, develop priorities and make recommendations for action. Recommendations could be taken to RSC meetings by a UNESCO or SOPAC representative. Details of the workings of the Pacific Focal Group for Water Resources have not yet been finalised.

At the Christchurch meeting, the applied research projects were again reviewed (refer White, Overmars and Thulstrup, 2000 and section 5.7.1).

For the 9 member countries of the World Meteorological Organisation, there is also the WMO Regional Association 5 (RA-V) Working Group on Hydrology. This group, with membership predominantly from the national Meteorological Services, meets at regular intervals. One of the most relevant meetings, from the viewpoint of this Theme, was the Meeting of Experts on Hydrological Needs of Small Islands in 1999, which identified deficiencies in current water resources assessment and monitoring programmes in PICs.

In addition to the above groups, there are many other avenues for networking and information dissemination/ gathering available to water personnel in PICs. One of these is through the Pacific Water Association (PWA). Another avenue is the Small Islands Water Information Network (SIWIN). From the above outline, it is evident that there are many current mechanisms and proposals for interaction and networking between delegates from PICs on water resources and wider aspects of water and wastewater. The main issue is the need for effective use of such groups for discussion of concerns and priorities leading to the development of recommen-

dations for action. There is scope for some rationalisation of the various groups to provide an effective, coherent voice, as discussed in section 6.11.

5.9 Education, training and capacity building

This section briefly considers current education, training and capacity building for personnel and institutions involved in water resources assessment and monitoring. These current opportunities partially satisfy the needs as expressed in section 4.5.

Possible future actions to more adequately address these needs are presented in sections 6.4 and 6.9.

5.9.1 Regional level

SOPAC's Water Resources Unit has provided and continues to provide technical support and training through a number of channels, including:

- Training workshops on specific water resources management topics (e.g. hand pumps, solar pumps, demand management and appropriate sanitation for the management, conservation and protection of freshwater resources). These are normally held at SOPAC headquarters, but have occasionally been held elsewhere.
- Direct technical support to technical and professional staff from PICs both at SOPAC headquarters and in-country.
- Provision of lecturers at the Hydrogeology course at the University of South Pacific to teach water technicians within PICs. This course forms part of the 3-year Certificate Course in Earth Science and Geology, which has been undertaken by significant numbers of geoscience and water resources personnel from PICs.

The extent and variety of the current training programmes is limited by the resources within the WRU of SOPAC.

In addition, training programmes for water supply technicians and professional staff have been co-ordinated by the Pacific Water Association. Further details concerning water supply training for water supply utility personnel is the subject of Theme 4.

5.9.2 National level

Training in water resources assessment and monitoring has been provided to national agencies involved in water supply or water resource management. Such training tends to be project based and may involve only limited staff. The most successful projects in this regard are those of long duration, enabling sustained training to be provided to a number of staff. An example of such a project was an AusAID funded institutional strengthening project of the Tonga Water Board from 1995 to 1999. A major component was the implementation of a technical training programme in groundwater resources monitoring and associated data processing. Other examples include training of surface water resources technicians in Vanuatu, the Solomon Islands, Samoa and the Cook Islands by NIWA staff under NZODA funded projects.

Educational opportunities at university level for water professionals are available through scholarships provided by donors. For instance, AusAID has funded educational placements for engineers and hydrogeologists at universities in Australia. More recently, distance-learning schemes for master's level courses in water and other related disciplines have become available.

5.10 Inputs by regional and international agencies and NGOs

There are a number of regional and international agencies involved in the water sector within the Pacific region. Agencies with significant present and past input in the water sector include:

- Regional agencies:
  - South Pacific Applied Geoscience Commission (SOPAC)
  - South Pacific Regional Environment Programme (SPREP)
  - Secretariat for the Pacific Community (formerly South Pacific Commission) (SPC)
  - Asian Development Bank (ADB).
- International agencies:
  - United Nations Educational, Scientific and Cultural Organisation (UNESCO)
  - United Nations Environment Programme (UNEP)
  - United Nations Development Programme (UNDP)
  - United Nations Children's Fund (UNICEF)
  - World Health Organisation (WHO)
  - World Meteorological Organisation (WMO)
  - Food and Agriculture Organisation (FAO)
  - Commonwealth Science Council (CSC)

- o Water Supply and Sanitation Collaborative Council (WSSCC)
- o World Bank.

The Pacific Water Association (PWA) is a regional association of Pacific Island water supply organisations, mainly in urban areas, operating in Pacific Island countries.

Additional to the agencies above, are many NGOs who have considerable input at community level into predominantly rural water supply schemes (e.g. household rainwater harvesting schemes), sanitation systems and associated education and community awareness programmes. Some of the relevant NGOs and their activities are presented in the Theme 3 report, and also in Crennan and Berry (2002) and Falkland (2002).

It is beyond the scope of this report to present an overview of the involvement of all these agencies in the water sector. Background information on the involvement of many of these agencies and bilateral aid agencies is provided in supporting documentation for the Pacific Regional Consultation Meeting. It is considered appropriate, however, to briefly mention the policies and selected activities of two of the key agencies, in the water sector within the Pacific region, namely, SOPAC and ADB.

5.10.1 SOPAC

At the regional level, SOPAC has the mandate for Water & Sanitation activities and support to member countries in the Pacific region. SOPAC's Water Resources Unit (WRU), established in 1995, provides the focal point for member countries in the water and sanitation sector. The WRU's policy and strategies are outlined in SOPAC (2001b) and cover the following key areas:

- Water resources management (applicable to this theme).
- Water demand management and conservation.
- Sanitation and wastewater management.
- Hygiene awareness and promotion.
- National policy and legislation advice.
- Regional representation, co-ordination, resource and information centre.

Each of these areas includes components of technical support, capacity building through training, public awareness, best practice guideline development and dissemination of information.

Within the water resources management area, the WRU is focused on the following strategies (SOPAC, 2001b):

- Provision of technical support and training to national institutions to strengthen capacity and promotion of sustainable management of water resources.
- Review and promotion of appropriate technology solutions incorporating multiple source use.
- Improved water resources management to reduce the impact of droughts.
- Water quality assessment and encouragement of resource protection.
- Close liaison with other agencies on specific water resources management topics and projects.

Specific examples of the involvement of SOPAC's WRU in water resources management activities in PICs are:

- Preparation of technical guidelines for rural water supplies and sanitation (e.g. guidelines for selection and development of sanitation for small islands (SOPAC, 1997a)).
- Specific water resources assessments, including a groundwater potential assessment of Rarotonga coastal plain, Cook Islands (SOPAC, 1998b) and a water resources assessment on Banaba Island (SOPAC, 2000a).
- Organisation of, and input to, technical workshops on a variety of water resources topics including Workshop on Technologies for Maximising and Augmenting Freshwater Resources in Small islands (SOPAC, 1996) and ENSO Impact on Water Resources in the Pacific Region (SOPAC, 1999a).
- Technical input to a report/proposal "A Programme to Meet Hydrological Training Needs of Small Island Countries in the Pacific" (SOPAC/WMO/UNESCO, 2001).
- Preparation of a Water and Sanitation newsletter and dissemination of information through printed reports and the SOPAC website.
- Key role in regional meetings of stakeholders in Wastewater Management culminating in the Pacific Wastewater Framework for Action in late 2001 (SOPAC/SPREP/PWA/UNEP, 2001b).
- Major involvement, along with ADB and other agencies, in the preparation for and facilitation of the Pacific Regional Consultation on Water in Small Island Countries, 2002.

5.10.2 ADB

In 2001, the Asian Development Bank adopted its policy on water ("Water for All": ADB, 2001) after several years of consultation with stakeholders in the Asia and Pa-

cific region. The principal elements of the water policy are as follows:

- Promotion of a national focus on water sector reform.
- Fostering integrated management of water resources.
- Improving and expanding the delivery of water services.
- Fostering conservation of water and increasing system efficiencies.
- Promotion of regional cooperation and increasing the mutually beneficial use of shared water resources within and between countries.
- Facilitating the exchange of water sector information and experience.
- Improving governance and capacity building.

Of particular relevance to this theme is the second element. Discussion of these elements is provided in Arriëns (2002).

Further detailed information on the ADB's Water Policy and activities in PICs is contained in the ADB website www.adb.org/water/ and in two papers presented at the Pacific Regional Consultation meeting by ADB representatives (Arriëns, 2002; Stubbs, 2002). One current project with a significant water resources management component is the Sanitation, Public Health and Environment (SAPHE) Project in Tarawa, Kiribati (refer section 5.3.2 of this report and Stubbs, 2002).

5.11 Other relevant initiatives

There are a number of water resources management initiatives that have occurred outside the Pacific region, which are of relevance to Theme 1. These are briefly discussed below.

5.11.1 IWRM and the Global Water Partnership

As outlined in section 5.1, integrated water resources management (IWRM) views water resources management from a holistic perspective to ensure that social, technical, economic and environmental factors are taken into account with the aim of sustainably developing and managing water resources. IWRM has been defined by the Global Water Partnership (GWP) as a process which promotes the coordinated 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 (GWPTAC, 2000).

Typically, IWRM is undertaken at the level of a surface water catchment (river basin or watershed), or groundwater catchment (groundwater basin), as these are natural units for managing water resources. In the island context, IWRM can be applied at 'whole island' scale, especially for low-lying islands or for those high islands with multiple small surface water catchments.

The Global Water Partnership (GWP) has integrated knowledge and experience into an "IWRM Toolbox" to enable water policy makers, water agencies, and other groups and individuals in the water sector to benefit from experience elsewhere, and assist in implementation of IWRM principles and practices. The aim of the IWRM Toolbox is to offer easy access to practical, non-prescriptive advice, information and guidance on how to establish IWRM in real situations. GWP consider that the IWRM Toolbox (available on the web at www.gwpforum.org/iwrmtoolbox) will become a vital aid to the successful implementation of sustainable water resources management worldwide.

It is noted that other agencies working in the Pacific region have an active interest in IWRM, including the ADB, WMO and UNESCO-IHP.

IWRM is further considered in section 6.3.

5.11.2 Bonn Conference on Freshwater

In December 2002, an International Conference on Freshwater was held in Bonn, Germany. This was a preparatory meeting on freshwater issues for the World Summit on Sustainable Development (Johannesburg, South Africa, September 2002) and the Third World Water Forum (Kyoto, Japan, March 2003). Outcomes of the conference included a Ministerial Declaration (endorsed by Ministers for water, environment and development from 46 countries), Recommendations for Action and 'The Bonn Keys' (a synopsis of the main findings).

6. ACTIONS TOWARDS SUSTAINABLE WATER RESOURCES MANAGEMENT

6.1 Overview

This section presents an overview of actions that could be taken to move towards more sustainable water resources management practices in the small island countries of the Pacific region. These are based on the issues, concerns and constraints raised in section 4 and the activities already undertaken, as presented in section 5.

At this stage, it is worth reiterating the aim of the Regional Consultation Meeting on Water in Small Island Countries (Information Note to participants, May 2002): "to help international, regional and country practitioners strengthen their policies, institutional arrangements

and projects through: enhancing public awareness of the need for better water and wastewater management; exchanging views and experiences, and developing a shared understanding about policies, institutional frameworks and approaches to sustainable sector development".

There is no single action that will improve the sustainability of water resources management in small island countries. Rather, an integrated approach to improving a range of factors is required at all levels in order for this to occur. Commitment and support from national governments is required. This needs to be backed by technical and financial support from bilateral, regional and international donor agencies, and others including NGOs and consultants. The capacities of national water agencies need to be strengthened in many areas, including water resources assessment and monitoring capabilities, water planning, appropriate technology in water, sanitation and wastewater. Regional agencies with interests and responsibilities in water resources management should also be strengthened so that they can provide technical support to water personnel from national agencies. Additional applied research is required in order to better understand some of the fundamental hydrological and water quality processes in small island environments. Communities should be enabled and supported to take a greater role in the management of water resources at the local level. This should include participation in the management of their own surface water and groundwater catchments to redress the water quality degradation that has occurred, and will continue to occur, unless appropriate steps are taken. This will require concerted efforts in the area of community awareness and education, and greater recognition of the importance of both genders in the water sector.

The information presented in this section, within the defined scope of Theme 1, is organised under the following headings:

- Commitment and support from national governments.
- Integrated water resources management.
- Water resources assessment and monitoring, and associated training and capacity building.
- Appropriate water supply and sanitation.
- Participatory catchment management.
- Applied research projects.
- Education and professional training.
- Knowledge and information dissemination.
- Networking and partnerships.

It is noted that some aspects are considered in more depth within the reports of the other five themes.

6.2 Commitment and support from national governments

The issues and concerns presented in section 4 of this report, within the other theme reports and in the country briefing papers for the Regional Consultation Meeting, highlight the critical need for greater and ongoing commitment and support from national governments in the area of water resources management and, indeed, in the wider water sector.

As sustainable and effective water resources management is fundamental to the health and social well-being of the people, economic development and environmental protection, it should be afforded a high priority in national policies and strategies.

Many of the requirements for more sustainable and effective water resources management such as water resources assessment, appropriate technology, effective institutional arrangements, committed and well-trained personnel and effective community participation will not be achieved unless there is the political will and support for these to occur.

6.3 Integrated water resources management

From the issues and concerns raised in section 4, there is a need in PICs for greater integration of effort within the water sector and a wider view taken on sustainable management of water resources. As mentioned in section 5, this requires that water resources management be viewed from a wide (or holistic) perspective to ensure that social, technical, economic and environmental factors are taken into account. In other words, there is a need for greater emphasis on integrated water resources management (IWRM) principles and practices.

To assist in the implementation of IWRM principles and practices, one method is the IWRM 'Toolbox' developed by the Global Water Partnership (GWP), as mentioned in section 5.11. The IWRM 'Toolbox' (available on the web at www.gwpforum.org/iwrmtoolbox) has been developed, and continues to be developed, to assist water policy makers, water agencies, and other groups and individuals in the water sector in the implementation of IWRM principles and practices. The Toolbox is divided into three categories, (in a similar fashion to our regional meeting schedule), and includes:

- Enabling Environment (policy, legislation, finance).
- Institutional Roles (organisational framework, institutional capacity building).
- Management Instruments (water resources assessment, IWRM plans, demand management, social change, conflict resolution, regulatory instruments, economic instruments, information management and exchange).

All aspects of the IWRM Toolbox have application within the various themes for the Regional Consultation Meeting. Specific to the defined scope of Theme 1 are a number of items, including water resources assessment and IWRM plans under the 'Managing Instruments' category.

To assist the implementation of IWRM principles and practices in PICs, one option is to establish a Pacific Water Partnership (PWP) Technical Advisory Committee. Membership would be open to all organisations with a common interest in the Pacific water sector for the promotion of IWRM.

In addition to the IWRM Toolbox, recent information provided by SOPAC has indicated that a year-long (250 hour) training curriculum on IWRM is to be developed under a new United Nations project. One of the first components will be established in the Pacific, and a coordinator will work with the University of South Pacific (USP) in establishing the IWRM Curriculum in the Pacific. This will be an internet-based "Virtual Learning Centre for Water" providing distance learning opportunities and information for practicing professionals in the water sector wishing to upgrade their knowledge of modern water management concepts and practices. It is intended that the curriculum will be disseminated through a global electronic network of regional and national training institutions.

Implementation of IWRM principles and practices in PICs, with appropriate support from relevant agencies and using relevant methods, should be considered as a priority matter.

6.4 Water resources assessment and monitoring

There is a need for a much greater emphasis on water resources assessment and monitoring in small island countries in the Pacific region. A detailed list of concerns and issues, together with associated training and capacity building requirements, are outlined in sections 4.4 and 4.5.

This can only occur through a commitment at national government level, supported by appropriate training, education and capacity building efforts at national and regional level.

This section outlines a number of suggested actions and it is noted that some of these topics overlap with other themes.

6.4.1 Pacific HYCOS project proposal for capacity building

Recently, two major reports, which highlight the inadequate capacity in PICs to collect good quality hydrological data and undertake water resources assessments, have been prepared:

- Hydrological Cycle Observing System for the Pacific Island Countries (Pacific-HYCOS), Project document, prepared by a WMO consultant (Mosley, 2000).
- A Programme to meet Hydrological Training Needs of Small Island Countries in the Pacific; jointly prepared by SOPAC, WMO and UNESCO (SOPAC/WMO/UNESCO, 2001).

Mosley (2000) emphasised the need for long-term water resources monitoring information in all PICs. Mosley (2000) recommends a project called Pacific HYCOS (Hydrological Cycle Observing System), which promotes capacity building and training through a regionally co-ordinated approach. The stated goal of the project is that participating PICs will:

- Attain a common capacity to assess and monitor the status and trend of their water resources, and to provide the water-related information and hazard warnings needed to support national social and economic development and environmental management.
- Have established databases and information archives, maintained to acceptable standards, that form the basis for sustained future data capture and information processing and dissemination.

To achieve the goal, the project has three stated purposes:

- To assist the participating countries to establish the human and institutional capacity to assess the status and trend of national water resources and to provide adequate warnings of water-related hazards.
- To establish basic hydrological monitoring and data capture systems, using technology that balances modernity, economy, robustness, and suitability for Pacific Island circumstances.
- To establish hydrological databases and information systems that provide users with the information they require, to the standards (including accuracy, timeliness, usability, etc.) they need, and that provide a secure repository of information for the indefinite future.

The project proposes to deliver six distinct 'technical' components and a project management component designed to meet the needs of PICs, as follows:

- Flood forecasting capability,
- Water resources assessment in major rivers,
- Water resources databases,
- Drought forecasting,

- Groundwater monitoring and assessment, and
- Water quality monitoring and assessment.

The project proposes investment in data acquisition systems, field equipment, communication systems, spare parts, databases, and development of procedures and training.

It is noted that this project proposal was strongly supported by members of the Working Group on Hydrology of the WMO Regional Association V (South-West Pacific) at their meeting in Wellington in January 2002 (WMO, 2002). PIC members of the working group, represented at the meeting, were Cook Islands, Fiji, Niue, PNG, Solomon Islands, Samoa and Vanuatu.

Many of the components of the Pacific HYCOS project proposal are directly linked to Theme 1 while others link to Theme 2.

6.4.2 Hydrological training needs at regional level

A proposal to meet the hydrological (water resources) training needs of PICs (SOPAC/WMO/UNESCO, 2001) outlines a training programme implemented through a regional body. The stated goal of the proposed training programme is:

- To provide, through a targeted course of training, a corps of technical staff in the National Hydrological Services of participating PICs who are competent to assemble, maintain and apply data and information on national water resources, and are able to pass on their knowledge and skills to others.

The stated objectives of the programme are:

- To have available a body of training material that is suitable for use by technical staff in the National Hydrological Services of PICs.
- To encourage representation from all small island countries to enable the development of staff competent in the essentials of operational hydrology, who are able to pass on their competencies to other staff.
- To ensure the long-term sustainability of the programme through implementation by an existing regional body (SOPAC) with an existing training framework.

It is noted in SOPAC/WMO/UNESCO (2001) that the 'National Hydrological Services' (NHSs) are at various levels of development, with different requirements, and training needs. In many PICs, NHSs do not exist and water monitoring, if done at all, is normally carried out by water supply utilities or agencies. The proposal recognises that training will need to be tailored to the individual situations and requirements for each PIC.

The training programme proposes a series of courses, initially over three years, to be held at the University of South Pacific facilities. The first and second year courses would be held over four-week periods and involve classroom instruction, laboratory exercises and fieldwork. Further details on the requirements for participants, possible venues and costs are identified in the proposal. SOPAC/WMO/UNESCO (2001) proposes that the training would eventually be incorporated into the Pacific HYCOS programme.

6.4.3 Capacity building and training through bilateral projects

It is recognised that bilateral donors have had, and are likely to continue, involvement in capacity building or "institutional strengthening" projects for water agencies. The agencies would be those normally responsible for urban water supplies and also those involved with rural water supplies. This contribution to the water management in PICs is valuable through the supply of equipment, installation of monitoring stations, database development and the training of staff.

It is important that water resources training components of such projects are co-ordinated with any future regional efforts to avoid duplication of effort and funding. At the same time, specific training and professional development components that complement regional training initiatives are important (refer section 6.9). Examples would be scholarships to universities for water engineers, hydrogeologists and other water related specialists, and on-site training in specific areas (e.g. groundwater modelling for sustainable yield and climate vulnerability assessments, design of water supply systems, etc).

In addition, it is suggested that donor-funded projects in water resources development and water supply and sanitation projects increase their level of funding for water resources assessment programmes and components. This can be achieved through the supply of monitoring equipment, installation of monitoring facilities and staff training.

6.4.4 Special needs of very small islands

There is a need for special attention to monitoring needs of 'outer islands' where there is often no water-related staff other than selected village people who may operate groundwater pumps, maintain surface intakes and use rainwater tanks.

In these often remote islands, there remains a need to monitor water resources used for water supply purposes, in order to assess their sustainability during droughts. Simple measuring equipment (e.g. salinity meters to test groundwater condition, flow measuring weirs (or pipes) in streams and simple bacteriological test kits) can be used with effectiveness. However, train-

ing and support are vital for the sustainability of such operations. The support and funding for such operations from national governments to outer island councils is a necessity.

6.4.5 Guidelines for water assessment and monitoring

The WMO has published operational guidelines for water resources assessment/monitoring in many different environments (e.g. WMO: 1987, 1994). Much of these are relevant to continental and larger island conditions, where large rivers and aquifers prevail. In addition, there have been some specific guidelines prepared for water resources assessments in small islands (e.g. Hydrology and water resources of small islands, a practical guide: UNESCO, 1991) and very small coral islands (e.g. Coral island hydrology: a training guide for field practice: Dale et al, 1986).

There is scope for developing contemporary practical guidelines for surface and groundwater resources assessment in very small islands by synthesising and updating previous guidelines. Experiences with different methods in different environments (including lessons learned), in the form of case studies, would be useful for small island water resources personnel.

6.4.6 Community based monitoring

Initiatives to involve communities, particularly schools, in water resources monitoring programmes were outlined in section 5.2.3. Such programmes serve a very useful community awareness role. There is further scope for cooperation between local communities and supporting NGOs with water agencies and national hydrological or meteorological services in this regard. It is important, however, that such programmes are not seen as a substitute for, rather than complementary to, regular water resources monitoring by trained technicians.

6.4.7 Bacteriological and other water quality testing

The testing of water supplies for indicator bacteria to assess the quality of water for potable purposes was considered in section 5.6.5. Current methods are often difficult to implement and often not done regularly, if at all. Simpler methods and field kits are available, and it is suggested that such methods be considered for use in small islands, particularly in remote outer islands where access to main islands with laboratory facilities is difficult.

6.5 Appropriate water supply and sanitation

This section considers appropriate water supply and sanitation strategies and technologies related particularly, but not exclusively, to rural communities.

6.5.1 Overall strategies

The following strategies are suggested:

- Water resources development should utilise naturally occurring freshwater resources before other options such as desalination and importation.
- Selection of water supply and sanitation technology should take account of all factors – technical, economic, social and cultural, environmental. Operational and maintenance requirements are most important factors that must be matched to the capability of local communities.
- The conjunctive use of water from different sources (e.g. rainwater and groundwater) is recognised as a most appropriate approach to water resources management in islands with scarce water resources, or where water quality has degraded.
- Strategies for water supply operations need to take account of 'normal' and drought periods. These procedures should be developed as part of long-term plans.

6.5.2 Rainwater harvesting

Rainwater harvesting, particularly at the household level should be seen as a high priority. Although in most islands, rainwater harvesting could not be viewed as a main or sole source of water, it is an excellent supplementary source for 'first class' water for potable purposes. The efforts of NGOs and some donors to support such programmes within community development projects are a valuable contribution to sustainable water resources management. Such systems enable households to take responsibility and have control over water availability and water quality. There is considerable scope for enhanced support of rainwater harvesting programmes in PICs and for incentives to households for maintenance of gutters, roofs and tanks.

Important factors for the design and implementation of rainwater harvesting systems are:

- Rainwater systems should be designed according to the prevailing rainfall patterns. Analysis methods used in previous studies of rainwater harvesting systems (considering roof area, tank volume, demand and risk of tank becoming dry) should be employed to develop guidelines for each PIC. As-

sistance should be made available, where required, from agencies with expertise in this type of analysis.

- Building regulations should be considered for introduction requiring new houses and buildings to be equipped with rainwater collection and storage facilities with minimum volume based on roof area.
- Financial incentives for individual household systems and communal systems should be provided through subsidised materials (e.g. tanks, gutters, roofing).
- Community education and awareness programmes to encourage greater rainwater harvesting should be commenced, continued or enhanced.
- To improve water quality in tanks, simple 'first flush' systems have been found effective and should be implemented. A technical guideline for the design and implementation of such systems would be useful for households with rainwater tanks.

6.5.3 Groundwater

Important factors for the design and implementation of groundwater pumping systems are:

- Pumping rates in small low-lying islands and the coastal zones of high islands should be designed carefully to avoid saline intrusion.
- Pumping from vertical boreholes is not an appropriate method in small islands with thin freshwater lenses. Alternative methods such as infiltration galleries (refer Figure 1, also Falkland and Woodroffe, 1997; Metutera, 2002) or scavenger wells (e.g. Zack, 1988) should be considered.
- A pilot project to study the relative merits of infiltration galleries and scavenger wells in small island situations (e.g. atolls, coastal zones of high islands) is encouraged.
- Alternative energy sources, such as solar and wind, have been found to be useful in a number of islands. This type of technology is suitable for rural villages and should be encouraged and supported where applicable.
- Groundwater monitoring systems to monitor the impacts of climate variability and pumping effects should be installed, especially where groundwater development is extensive on small islands. Appropriate systems should be installed for different applications. For instance, open boreholes should not be used for monitoring in small low-lying islands, as they tend to induce saline intrusion and yield incorrect results.
- Guidelines for the appropriate use of pumping systems, energy sources and monitoring systems should be developed for different island environments. These should be based on existing information and updated according to recent trends. Such guidelines would be enhanced with the inclusion of case studies, showing both appropriate and poor applications of pumping technology.

6.5.4 Surface water

The design and implementation of simple, inexpensive filtration systems to improve the water quality of small streams affected by high turbidity and suspended solids after heavy rain is a high priority issue for water supplies in many small volcanic islands. It is suggested that a review of relevant, applicable technology be undertaken and guidelines developed.

Perennial springs, where present, should be carefully developed and protected as priority water sources for use in droughts when other streams have ceased to flow. Adequate spring cappings should be designed, built and maintained for such applications.

6.5.5 Desalination

With the current focus on desalination as a technology to resolve water supply issues in small islands, there needs to be careful appraisal of all factors before investing in this technology. Such factors include costs (primarily pumping costs), ability of community to pay, operation and maintenance requirements, design of intakes to prevent fouling, availability of spare parts and chemicals, remoteness of island and transport routes, availability of skilled operators and training opportunities. It needs to be emphasised that there have been a number of 'classic' failures of desalination technology because some of these factors have not been taken into account.

The lessons of the past, where desalination systems have been installed in PICs and have failed, should be documented together with examples of sustainable systems. This would be a useful guide for governments considering the introduction of such technology for regular use or for emergency use in droughts.

There is scope for the use of simple 'solar still' technology for emergency requirements in rural communities, particularly in remote islands (refer section 5.5.6). Such systems are not difficult or expensive to construct, and could be implemented for basic potable water needs of households during droughts. Such systems have been used before, and it is suggested that efforts should be made to examine and consider currently available systems.

6.5.6 Demand management and conservation

There is an ongoing need for demand management programmes to ensure that the water from existing water sources is used wisely.

Water supply flow and leakage monitoring is an essential tool even in simple rural water supply distribution systems. Local personnel should be provided with basic training in monitoring methods.

Community education and awareness about water conservation and the wise use of water are an essential part of sustainable water resources management (refer Theme 3).

6.5.7 Water treatment

The use of simple, relatively low cost means of water disinfection using solar energy (SODIS) are encouraged in rural and peri-urban areas (refer section 5.5.7). Establishment of one or more pilot projects, including community education, to introduce this simple technology would be a useful step towards providing adequate and safe drinking water supplies where source water is polluted. Where the source water is saline and possibly polluted, the use of solar stills at the household level would be useful for the same purpose of providing drinking water in moderate quantities. Again, setting up one or more pilot projects would be a useful means of introducing this technology.

6.5.8 Sanitation and wastewater

The introduction in PICs of non-polluting sanitation systems, particularly in highly vulnerable coral island environments, is considered to be one of the highest priority issues for achieving sustainable water resources management. Major problems and issues associated with current, predominantly poor sanitation systems are highlighted in sections 4.3.3 and 4.6.3. As mentioned previously, present sanitation approaches using pit latrines and septic tanks, are definitely not appropriate in coral islands and many coastal areas of high islands.

It is recommended that steps be taken towards a "zero water pollution" policy, especially in the smaller islands, where water resources are limited and highly susceptible to contamination. In order to achieve this, possible solutions include low-technology and low-cost compost (waterless) toilets and relatively high-technology and high-cost reticulated sewerage systems with treatment and ocean outfalls. For rural and many urban communities in PICs, properly constructed sewerage systems that pump sewage (either raw or preferably treated) to sea, are not a realistic option, due to the financial and operational needs. This means that simpler, yet non-polluting, on-site systems are the most appropriate solution.

The following actions are suggested:

- Ongoing support for projects that are currently implementing appropriate solutions (e.g. compost toilets in Kiribati and Tonga and the proposed trial under the International Water Programme of SPREP: Crennan and Berry, 2002).
- Further carefully designed and monitored trials of compost toilets in PICs where such systems have not been tested or where previous attempts have been unsuccessful. Consideration of local cultural values is especially important, and adequate community education, awareness and training must accompany trial and implementation projects (Crennan and Berry, 2002).
- Dissemination of information from past compost toilets trials (reports, videos).
- Community education and awareness programmes regarding this type of sanitation.
- Development and periodic review of guidelines for this type of technology.
- Consideration of other alternatives that may be appropriate in certain situations (e.g. low gradient "small bore" pipe systems to gravel bed hydroponics, or constructed wetlands for sewage treatment, as planned in Maldives).
- Implementation and possible extension of relevant components of the Pacific Wastewater, Framework for Action (refer section 5.6.3).

It is noted that some of the above recommended approaches overlap with the scope of Theme 3 (Awareness).

6.6 Participatory catchment management

The principles of participatory catchment (watershed) management were introduced in section 5.4. The advantages of these approaches involving local communities in the management of surface and groundwater catchments are evident from a number of case studies. In some PICs, steps have been, and are being taken to enable the participation of communities in catchment management and the rational use and protection of water resources within the catchments.

It is suggested that:

- The participatory water catchment management approach be endorsed for use in PICs.
- Steps be taken to establish catchment management committees (alternatively called watershed management committees or water resources protection committees) with representatives from key stakeholders, including landowners, local commu-

nities, water supply agencies, government regulatory agencies, farmers (if present) and others as appropriate.

- Catchment management plans be developed to provide for the rational allocation, use and protection of water resources and downstream environments (e.g. coastal fisheries, reefs and mangroves).
- Community education and awareness programmes be implemented to encourage local communities to be involved in the process.
- Assistance and support to such committees be provided in the initial stages by governments and, if required, donors.

It is noted that some of the above recommended approaches overlap with the scope of Theme 3.

6.7 Applied research projects

While there has been significant commitment to island hydrological research in recent years (refer section 5.7), there is still a need for further commitment in this area. Such commitment to applied research and associated training and dissemination of results can provide great benefit to small islands in offering solutions to some of the fundamental hydrological issues (e.g. sustainability of water resources, impacts of droughts, pollution, etc.).

At a 1997 UNESCO Water Resources Workshop (Sankey et al, 1997) and again at the Pacific Focal Group for Water Resources meeting in 2000 (White, Overmars and Thulstrup, 2000), progress was noted on the groundwater recharge and groundwater pollution projects in Kiribati and Tonga, respectively (refer section 5.7.1). Delegates from Cook Islands, Kiribati, Niue, PNG, Tonga and Vanuatu, as well as Australia, New Zealand, UNESCO and SOPAC attended the meeting in 2000.

Further work on the first two projects, particularly in other PICs and commencement of work on other projects were recommended at both meetings. In order of priority, the projects for which additional funding was recommended were as follows (White, Overmars and Thulstrup, 2000):

- Catchment and communities project on a high volcanic island.
- Groundwater recharge and modelling (further work in initial and other sites).
- Groundwater pollution due to sanitation systems (further work in initial and other sites).
- Integrated island water resources study.
- Groundwater and surface water pollution due to chemicals.
- Rainwater catchment study.
- Appropriate groundwater abstraction systems.

Project proposals for these are provided in White, Overmars and Thulstrup (2000). For all projects, the workshop recommended that:

- Projects should have a regional application, achievable in terms of publications, training of locals, etc.
- Projects should be carried out through close liaison between the organisations – UNESCO, SOPAC, SPREP, WMO, and others.

At the ENSO Impact on Water Resources in the Pacific Region Workshop in Nadi, Fiji, in September 1999 (SOPAC, 1999a), an additional priority project of drought assessment in small island nations was proposed. A project proposal was also provided in White, Overmars and Thulstrup (2000).

6.8 Education and professional training

Training needs in relation to water resources assessment and monitoring are outlined in section 6.4.3. In addition, specific training and professional development components were mentioned, including scholarships to universities for water engineers, hydrogeologists and other water related specialists.

Additional training and professional development opportunities should be developed and implemented, including the following:

- In-country training workshops.
- Regional or in-country training workshops on specific topics related to water resources assessment, monitoring and management, and (rural) water supply and sanitation. Agencies including, but not limited to, SOPAC, UNESCO and WMO have greatly assisted with appropriate workshops on island water resources management.
- Postgraduate courses, by distance learning, in specific water resources areas.
- Possible twinning or interchange of professional and technical staff between different islands.
- Active involvement of island personnel in appropriate research and implementation projects undertaken in-country or in similar island environments.
- Pilot projects of regional significance.

6.9 Knowledge and information dissemination

There is an ongoing need for information dissemina-

tion in the water sector. It is recognised that there have been significant advances in this area in recent years with greater access to regional libraries such as the SOPAC library, email, and the ongoing developments of useful websites. The establishment of a 'virtual library' of technical reports and access to this information through the Internet is a welcome addition. However, not all personnel have access to electronic mail facilities and websites, and those that do have access suffer inevitable communications problems.

Areas where improvements are suggested include:

- The results of studies and research into water resources issues should be effectively communicated by the researchers and funding agencies to island governments, relevant agencies and local communities in order that the potential benefits of research work are realised. Where research results have a wider regional application, the information should be disseminated through regional agencies and appropriate institutions. The results of research, which are published only through scientific or technical journals, are of limited practical value and may not reach the wider community.
- Bilateral and other donors working in the water sector should be requested to submit relevant consultant reports on water resources management topics to the regional library (at SOPAC).
- Periodic regional and inter-regional workshops/seminars should be convened to summarise/evaluate progress and continue to seek new solutions (as per past practice). There should be a balance between being too frequent or too seldom. An interval of about 4 to 5 years is probably appropriate.
- Specific publications on small island water resources and water supply issues (e.g. Hydrology and Water Resources of Small Islands, a Practical Guide (UNESCO, 1991) and Source Book of Alternative Technologies for Freshwater Augmentation in Small Island Developing States (IETC, 1998) have provided valuable information. Where publications are out of print (e.g. UNESCO, 1991), steps should be taken to make such information available through alternative channels. Consideration should be given to updating such publications with modern methods, approaches and technologies.
- Newsletters on current and forthcoming activities can also be a useful means of transferring information (e.g. SOPAC WRU and UNESCO-IHP newsletters) and should be continued.

6.10 Networking and partnerships

6.10.1 Within countries

There is scope for greater co-ordination between agencies involved in the water sector in each PIC, as identified previously.

In WMO (2002), it was recommended that National Committees should be established to co-ordinate water-related activities of these organisations and to offer guidance in providing national input to regional programmes. The National Committee concept has been found to work well in countries outside the Pacific region (and stemmed from a need to coordinate UNESCO-IHP and WMO-OHP activities).

This aspect is considered in more depth in other theme reports.

6.10.1 Within the Pacific region

From section 5.8.3, it is evident that there are many current mechanisms and proposals for interaction and networking between delegates from PICs on water resources and wider aspects of water and wastewater. In summary these are:

- UNESCO-IHP Pacific Focal Group on Water Resources (7 PICs).
- UNEP/GPA/SOPAC Pacific Wastewater Focal Group (7 PICs).
- WMO RA V Working Group on Hydrology (9 PICs).
- SOPAC Science, Technology and Research (STAR) Water Working Group (16 PICs).

The number of groups and the membership of each indicate an interest and a need for information exchange on a variety of water-related topics. However there is an obvious duplication of effort between (at least) some of these groups. The main issue is the need for effective use of such groups for discussion of issues and priorities and for the development of recommendations for action. There is obviously scope for some rationalisation of the various groups to provide an effective, coherent voice.

One possibility to achieve greater co-ordination is the concept of a Pacific Water Partnership (PWP), with the aim of facilitating greater and effective interaction between the various agencies and groups involved in the water sector. Preliminary objectives for a PWP are as follows:

- Introduce Integrated Water Resources Management concepts in Pacific island countries.
- Strengthen collaboration on international and regional initiatives, through sharing of information between relevant agencies and focal groups (including those mentioned above).
- Exchange information with and between donor agencies including consultation on water policies, strategies and development programmes (AusAID, NZAID, ADB, World Bank, EU, JICA, France, USDOI, etc).

- Involvement and exchange of information between water utilities and water associations (AWA, NZWWA, PWA) and the private sector.

6.10.3 Inter-regional

Inter-regional networking between relevant agencies with an interest in small island hydrology and water resources management should be encouraged. A recommendation from the small islands working group at the Second International Colloquium on Hydrology and Water Management in the Humid Tropics (Panama City, March 1999) was that regional focal points should assist small island nations in the co-ordination of applied hydrological research, training and information dissemination. In the Pacific Ocean region, for instance, SOPAC, in conjunction with UNESCO and WMO, acts in this capacity to a large degree and provides an archive and clearing house of water resources information for the Pacific Islands.

7. SUMMARY OF PROPOSED ACTIONS

This section presents the Action Plan for Theme 1 as developed at the Pacific Regional Consultation Meeting on Water in Small Island Countries. It is noted that these actions are substantially similar to the actions presented in section 6 of this report.

In developing the Action Plan under Theme 1, three Key Messages were proposed as follows:

- Strengthen the capacity of small island countries to conduct water resources assessment and monitoring as a key component of sustainable water resources management.
- Implement strategies to utilise appropriate methods and technologies for water supply and sanitation systems and approaches for rural and peri-urban communities in small islands.
- Implement strategies to improve the management of water resources, and surface and groundwater catchments (watersheds) for the benefit of all sectors including local communities, development interests and the environment.

The Action Plan, with supporting statements for each of the three Key Messages, is presented on the following pages. In all, 22 specific actions were proposed under Theme 1.

KEY MESSAGE 1: Strengthen the capacity of small island countries to conduct water resources assessment and monitoring as a key component of sustainable water resources management.

Supporting statements:

- Many small island countries have noted significant deficiencies in their national and local capacity to conduct essential water resources assessment and monitoring in their country papers at this meeting and at previous regional and inter-regional meetings over the past decade and more.
- These deficiencies prevent small island countries from conducting proper planning, development and sustainable management of their limited and vulnerable water resources.
- Despite this fact, there continues to be no systematic, co-ordinated approach to addressing these deficiencies.
- Most small island countries do not have adequate baseline data that is readily available for planning and development and lack of reliable hydrological databases.
- There are similarities between needs which can be addressed at regional, as well as national level, through targeted training and capacity building.

Proposals for capacity building and training of technicians in Pacific island countries have been prepared in recent years by regional and international agencies with expertise in hydrology, water resources and water quality (e.g. SOPAC, SPREP, UNESCO, WMO, WHO and UNEP).

ACTIONS REQUIRED

No	Action	Responsible Parties
1	Implement actions to strengthen national capacity (equipment, training, etc) using the model outlined in the Pacific-HYCOS proposal (WMO, 2000) and recommendations regarding water quality in WHO (2002): refer notes (a) and (b).	• SOPAC with support from international agencies (e.g. WMO, UNESCO, WHO) (co-ordination of regional level effort) • National agencies (implementation and funding) • Donors (funding)

No	Action	Responsible Parties
2	Implement hydrological training for technicians in line with the recommendations presented in proposal to meet training needs in SOPAC/WMO/UNESCO (2001): refer note (c).	• SOPAC with support from international agencies e.g. WMO, UNESCO) (co-ordination of regional effort) • Donors (funding) • National agencies (implementation and funding)
3	Implement a programme of targeted applied research projects to address knowledge gaps in line with recommendations and priorities presented in White, Overmars and Thulstrup (2000) and SOPAC (1999): refer notes (d) and (e). Projects include the following: • Catchment and communities project on a high volcanic island. • Groundwater recharge and estimation of sustainable yield using modelling (further work in initial and other sites). • Groundwater pollution due to sanitation systems (further work in initial and other sites). • Integrated island water resources study. • Groundwater and surface water pollution due to chemicals. • Rainwater catchment study. • Appropriate groundwater extraction systems. • Drought assessment in small island nations. Applied research projects should adopt the following principles: • Have regional application • Include training for personnel • Consider technical and social issues • Incorporate community awareness and participation • Involve close liaison with relevant agencies.	• SOPAC, UNESCO in co-operation with other regional agencies (co-ordination of regional effort and assistance with implementation) • Donors (funding) • Regional research institutes (assistance with implementation and training) • National agencies (implementation and funding)
4	Develop and/or implement minimum standards for conducting island water resources assessment and monitoring.	• National agencies (implementation and funding). • SOPAC in co-operation with other agencies (assistance with implementation). • Donors (funding).
5	Support community participation in appropriate water quality testing programmes targeted at environmental education and awareness of communities, using existing and proposed programmes as models (e.g. DGMWR/SOPAC/UNESCO/ NIWA, 2002; Live & Learn, 2002; Falkland, 2002): refer notes (f), (g) and (h).	• Regional and other agencies (e.g. UNESCO, SOPAC, SPREP, WHO) (support and technical assistance). • NGOs (support and training). • Communities (implementation). • Donors (funding).
6	Implement appropriate water quality testing capability and associated training at local, national and regional level.	• National and local government agencies (implementation). • Regional agencies (e.g. USP, WHO) (assistance with implementation and training). • Other institutions and individuals. • Donors (funding of components).
7	Strengthen and enhance communication and information exchange between national agencies involved with meteorological, hydrological and water quality data collection programmes (including water supply agencies and health departments) and with users.	• National and local governments (policy). • Government agencies (co-ordination, communication and information exchange). • Water Utilities.
8	Enhance education and career development opportunities in the water sector, including: • Scholarships for advanced training courses, including distance learning. • Regional or in-country training workshops on targeted need areas. • Training courses in partnership with tertiary institutions. • Twinning or interchange of professional and technical staff between different islands • Active involvement in appropriate research and implementation projects	• National governments (policy). • Regional and international agencies (e.g. USP, SOPAC, UNESCO) (implementation of components). • Other institutions and individuals. • Donors (funding of components)

Documents cited in table:

(a) WMO (2000). Hydrological Cycle Observing System for the Pacific Island Countries (Pacific-HYCOS), Project document. Prepared for WMO by P.Mosley and R.Raj, May 2000.

(b) WHO (2002). Report on Workshop on Drinking Water Quality, Surveillance and Safety. Nadi, Fiji, 29 October – 1 November 2001.

(c) SOPAC/WMO/UNESCO (2001). A Programme to Meet Hydrological Training Needs of Small Island Countries in the Pacific, April 2001. prepared by SOPAC in collaboration with WMO and UNESCO.

(d) White, Overmars and Thulstrup (2000). Report on UNESCO IHP Pacific Focal Group for Water Resources, Priority Issues in Water Resources. Christchurch, New Zealand, November 2000. prepared by I. White I., M. Overmars and H. Thulstrup; Australian National University, SOPAC and UNESCO.

(e) SOPAC (1999). ENSO Impact on Water Resources in the Pacific Region Workshop Report. Proceedings of Workshop, Nadi, Fiji, November 1999, Miscellaneous Report 345.

(f) DGMWR/SOPAC/UNESCO/NIWA (2002). Draft proposal, Catchments & Communities Project, Vanuatu.. Department of Geology, Mines and Water Resources, SOPAC, UNESCO and NIWA, New Zealand.

(g) Live & Learn (2002). River Care, Live & Learn Environmental Education. Report prepared for Pacific Regional Consultation Meeting on Water in Small Island Countries, Sigatoka, Fiji , 29 July – 3 August 2002.

Falkland T. (2002). A Synopsis of Information on Freshwater and Watershed Management Issues in the Pacific Islands region. Prepared for the International Waters Programme. IWP Technical Report 2002/02. **In** Wright A. and Stacey N. (eds). Issues for Community based sustainable resource management and conservation: considerations for the Strategic Action Plan for the International Waters of the Pacific Small Island Developing States. The International Waters Programme, South Pacific Regional Environment Programme. 132pp.

KEY MESSAGE 2: Implement strategies to utilise appropriate methods and technologies for water supply and sanitation systems and approaches for rural and peri-urban communities in small islands.

Supporting statements:

- Climate and water resources conditions vary considerably between and even within islands depending on location, size, geology, topography and other factors.
- Water supply for local communities (and tourism in some island countries) is the most important water use, although some islands have sufficient water resources for other uses (e.g. industry, mining, irrigated agriculture and hydropower).
- Approaches to provision of water supply vary according to availability and sustainability of water resources.
- Human factors such as population density, land use and measures used for sanitation, wastewater and solid waste disposal have a large impact on the availability of water, the microbiological and chemical quality of water supplies and downstream impacts on the near-shore and marine environment.
- Operational and maintenance factors, and social and environmental acceptability, are particularly important in the selection of appropriate solutions for water supply and sanitation.
- Raw water quality is most important for rural populations, as, in most cases, water treatment is not affordable.

ACTIONS REQUIRED

No	Action	Responsible Parties
1	Conduct effective water resources planning and implement sustainable water resources development by: • Utilising naturally occurring resources before more expensive solutions are adopted. • Accounting for technical, economic, social and environmental factors. • Recognising the importance of conjunctive use schemes. • Developing and implementing 'drought strategies' in long-terms plans including the use of drought indices.	• National and local government agencies • Regional agencies as required (technical support) • NGOs (assistance) • Donors (funding)
2	Update and disseminate relevant information on appropriate water supply and sanitation technologies and methods from regional and international agencies (e.g. guidelines, standards).	• Regional and international agencies (support and technical assistance) • NGOs • Donors (funding)
3	Support rainwater harvesting programmes by: • implementing at household level through financial incentives and building regulations. • developing design guidelines using available rainfall data. • improving water quality through 'first-flush' devices. • supporting community-based projects in poorer communities. • investigating appropriate materials (e.g. water quality tests on polythene tanks).	• National and local government agencies • Regional agencies (technical support) • NGOs • Private sector • Donors (funding)
4	Implement pilot projects for: • enhanced groundwater recharge from surface water streams. • use of scavenger wells and infiltration gallery for pumping in small low-lying island situations. • use of simple solar distillation and treatment systems.	• National and local government agencies • Regional agencies (technical support) • NGOs • Communities • Donors (funding)

No	Action	Responsible Parties
5	Incorporate the use of renewable energy sources for pumping into water supply planning and development processes.	• National and local government agencies • Regional agencies (technical support) • NGOs • Communities
6	Conduct further research into desalination technologies particularly in relation to operation and maintenance costs.	• National government agencies • Private desalination companies • Research institutes • Donors (funding)
7	Implement demand management and water conservation measures including: • training in simple methods of leak detection • community awareness and education	• National and local government agencies • Regional agencies (technical support) • NGOs • Communities • Donors (funding)
8	Develop and implement national guidelines for water quality, particularly drinking water quality.	• National and local government agencies (implementation) • Regional and international agencies (e.g. WHO) (assistance with implementation) • Donors (funding of components)
9	Implement minimum standards for water quality monitoring, surveillance and mitigation measures.	• National and local government agencies (implementation) • Regional and international agencies (e.g. WHO) (assistance with implementation) • Donors (funding of components)
10	Implement sanitation systems which aim to prevent pollution of water resources including: • further pilot projects in different island environments to determine appropriate low-cost, on-site sanitation technologies (e.g. compost toilets, gravel bed hydroponics or constructed wetlands). • further applied research to establish guidelines for 'safe distances' (buffer zones) for existing sanitation options in different island environments (e.g. septic tanks, pit toilets) • increase government, donor and community awareness of poor sanitation impacts on water resources and public health.	• National and local government agencies (implementation) • Regional and international agencies (assistance with implementation) • Research institutions • Communities • NGOs • Donors (funding of components)
11	Expand community awareness programmes on health issues and support community participation in the water supply and sanitation sector (e.g. WHO Healthy Islands Programme).	• National and local government agencies (implementation) • Regional and international agencies (e.g. WHO) (assistance with implementation) • Communities • NGOs • Donors (funding of components)

KEY MESSAGE 3: Implement strategies to improve the management of water resources, and surface and groundwater catchments (watersheds) for the benefit of all sectors including local communities, development interests and the environment.

Supporting statements:

- There is a need for a wider view (holistic approach) to water resources management in many countries to ensure social, environmental as well as technical and economic factors are taken into account (Integrated Water Resources Management, IWRM).
- Many small islands have very limited and vulnerable water resources and there is a need to conserve these resources and protect them from contamination.
- There are demonstrated examples in Pacific small island countries that participatory approaches to catchment (watershed) management are more effective and sustainable then regulatory approaches, particularly in the context of customary land ownership and use, which is prevalent in most Pacific small island countries

ACTIONS REQUIRED

No	Action	Responsible Parties
1	Implement IWRM principles and practices in small island countries through: • co-ordination between all relevant agencies. • long-term planning and commitment for the implementation of IWRM. • appropriate support and training from relevant regional and international agencies.	• National and local governments • Water Utilities • Power utilities (where hydropower is utilised) • Local communities • NGOs • Regional agencies (e.g. SOPAC, SPREP) • International agencies (e.g. GWP, UNESCO) • Donor agencies (funding in initial stages)
2	Draft, enact and apply appropriate national water resources legislation and plans for the rational allocation, use and protection of water resources.	• National governments • Regional agencies (technical support)
3	Implement catchment management practices as follows: • Endorse participatory approaches in water resources management within catchments • Establish water catchment management committees with representatives from key stakeholders • Develop catchment management plans for the rational allocation, use and protection of water resources. This may include the establishment of catchment management, protection and buffer zones. • Apply best management practices to minimise impacts from activities such as logging, cultivation and mining. • Implement community education and awareness programs for water resources protection and water conservation, as an integral part of health promotion and sustainable water resources and environmental management. • Identify water pollution sources and undertake preventative and corrective steps, including financial penalties for environmental and water resources degradation. • Conduct environmental impact assessments as an integral part of planning for development projects to ensure environmental values and objectives are properly considered.	• National and local governments • Private sector • Local communities • NGOs • Donor agencies (funding in initial stages)

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THEME 2

VULNERABILITY AND DIALOGUE ON WATER AND CLIMATE

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1. INTRODUCTION

The vulnerability of Small Island Countries has received increasing attention since 1994 when the Barbados Conference on the Sustainable Development of Small Island Developing States called for recognition of their ecological fragility and economic vulnerability. The particular vulnerability of islands is often described in terms of their remoteness, small size and exposure to climatic instability. The significance of the climatic component of vulnerability has drawn particular attention to the impacts of climate variability and change and the Association of Small Island States has been successful in gaining international recognition for those concerns.

The declaration emerging from the UNDP Global Roundtable on Vulnerability and Small Island Developing States (http://www.undp.org/wssd/docs/Declaration–Roundtable-on-SmallIslandDevelopingStates.doc) noted that vulnerability provides a useful context for understanding how comprehensively economic, environmental and social challenges are faced. While recognizing the interplay of the many factors contributing to vulnerability the Roundtable declared that it is the element of limited capacity that makes Small Island Developing States most vulnerable. This perspective was reflected in the plenary session of the Pacific Regional consultation when it was suggested that 'poverty of opportunity' was a significant issue for Pacific SIDS.

The Asian Development Bank's Pacific Strategy for the new millennium (http://www.adb.org/Documents/Policies/Pacific_Strategy/pacific_strategy.pdf) addresses the challenge presented by increasing poverty in several Pacific Island Countries and suggests that poor economic performance together with rapid population growth and urban drift are putting traditional support mechanisms under strain. The strategy notes the close link between poverty and vulnerability and refers to the development of a composite vulnerability index based on economic measures and susceptibility to natural disasters.

The Commonwealth Secretariat/World Bank Joint task force on small states (http://www.wbln0018.worldbank.org/html/smallstates.nsf/) also considered the characteristics that contribute to the vulnerabilities of small states and made particular reference to Small Island Developing States where the limited public and private sector capacity is compounded by large distances and dispersed populations.

Efforts to develop measures of vulnerability have conventionally focused on the economic and social components involved. Growing recognition of the significance of environmental vulnerability has led to efforts to establish an Environmental Vulnerability Index (SOPAC, 2001) focusing on risks to the natural environment. The issues involved in managing environmental vulnerability include several natural and anthropogenic hazards relating to water resources (SOPAC, 2002).

This multi-faceted nature of vulnerability is reflected in the scooping of the Pacific Regional Consultation on Water in Small Island Countries:

- issues associated with environmental vulnerability are considered largely in relation to Theme 1 (Water Resources Management) and Theme 2 (Island Vulnerability) within which the particular relationship between water and climate are emphasized;
- issues associated with social vulnerability are largely considered within Theme 3 (Awareness) and Theme 5 (Institutional Arrangements);
- issues associated with economic vulnerability are considered in the context of Theme 4 (Technology) and Theme 6 (Financing).

The World Water Council has acknowledged the vulnerability and particular needs of Small Island Countries by including the "Water in Small Island Countries" theme in the 3rd World Water Forum. The Pacific Regional Consultation planning meeting held in Port Vila identified "Island Vulnerability" as a major theme that should receive particular attention and noted that this should encompass disaster preparedness and hazard management as well as the vulnerabilities associated

with climate change and climate variability. Benson and Clay (2000) point out that most disasters are recurrent rather than one-off events, and so can have a significant cumulative effect on the rate and nature of development. This is particularly true with respect to those disasters resulting from climatic hazards.

Despite broad acceptance of the special needs of Small Island Countries there has been some concern that vulnerability may have been given undue emphasis. For example, at a recent Fiji National Multi-Stakeholder consultation workshop it was noted that vulnerability had become a contentious issue at UN meetings on Sustainable Development because everyone is saying they are vulnerable. Campbell (1997) suggests that the term "vulnerability" should be used sparingly and that the adaptive capacity of Pacific Island communities should not be underestimated. Barnett and Adger (2001) note that the emphasis on vulnerability focuses on weaknesses and shortcomings rather than on inherent strengths and opportunities. They suggest that work on coping and adaptation should be framed in terms of resilience and that emphasis should be shifted from impact assessment to risk assessment.

The Netherlands based International Secretariat of the Dialogue on Water and Climate has recognised the significance of water and climate to Small Island Countries by providing support to collaborative projects from the Pacific and Caribbean Regions which will provide further input to the 3rd World Water Forum. The Dialogue on Water and Climate implicitly recognises inherent resilience in its stated goal:

"to improve the capacity in water resources management to cope with the impacts of increasing variability of the world's climate, by establishing a platform through which policymakers and water resource managers have better access to and make better use of information generated by climatologists and meteorologists."

2. VULNERABILITY IN RELATION TO WATER & CLIMATE

Vulnerability refers to the risk of being harmed by unforeseen, or unusual, events. There is a wide range of hazards with the potential to impact upon Water in Small Island Countries; a simple classification of these is presented in the following table:

Natural hazards	Climate (Meteorological)	Drought Flood Cyclone Storm surge
	Non-climate (Geological)	Volcanic Seismic
Human hazards		Civil unrest Land tenure Land use Human resources

The range of physical environments encountered within Small Island Countries in the Pacific Region are often categorised in terms of low and high islands. The Ministerial Conference on Environment and Development in Asia and the Pacific (ESCAP, 2000) recognised the social and economic dimension by proposing three distinct zones based on resource endowments, size, and the state of economic development:

- Melanesian countries with rich natural resources and relatively large human populations. Though there are distinct socio-economic conditions within this zone these countries share environmental problems resulting from land degradation, unsustainable forestry, water pollution from mining and significant problems in the rapidly growing cities including limited access to adequate water supplies and sanitation in peri-urban settlements.
- Mid-sized islands of Polynesia and Micronesia and the small high Island Territories of the United States. These countries have limited land resources, minimal or no commercial forestry and no commercial mineral deposits. The predominantly rural and agrarian economies of these countries are sustained by external inputs from remittances from expatriate islanders or from territorial authorities (United States and France). These countries share problems of a growing scarcity of land, loss of forest areas and pollution of groundwater and coastal areas.
- Small, low island states. These countries have very limited land resources and rapidly growing populations. They share particular vulnerability to storms and droughts and face acute problems of fresh water availability and pollution of groundwater, particularly in the rapidly growing urban areas.

2.1 Natural hazards – Climate

Climate (or meteorological) hazards occur over a very wide range of spatial and time scales. Nevertheless, they generally occur frequently enough in human terms to have allowed the development of traditional coping strategies. In addition, the improved scientific capability to observe and describe the interaction of the ocean and atmosphere is now providing for useful forecasts of some of these hazards.

2.1.1 Drought

Drought is an unusual hazard as, by its very nature, its onset is gradual. It has the capacity to have a broad range of impacts and as a result it can be defined and quantified in a number of different ways. White et al. (1999) list the four most common definitions of drought as:

- meteorological or climatological drought

- agricultural drought
- hydrologic data
- socio-economic drought.

The nature and severity of any particular drought episode is dependent on the duration and magnitude of the rainfall deficit. The sequence of drought impacts is felt first in systems with small water storage capacity: shallow soils may be affected by a relatively short period of below average rainfall whereas an extensive aquifer may have sufficient storage to be little effected by a drought duration of the order of years.

Drought is one of the major natural hazards facing Pacific Island countries with agricultural drought presenting a particular problem for the atoll nations and the leeward side of larger islands. The most vulnerable communities are impoverished peoples occupying marginal rural and urban environments (ESACP, 2000). When associated with an ENSO event drought can have severe impacts throughout the region as occurred in the 1997/98 El Niño as illustrated by the following examples:

- this event resulted in some of the worst droughts on record in the Northern Mariana Islands, Guam, the Marshall Islands, Nauru, Papua New Guinea, Fiji, Tonga, Samoa and American Samoa.
- in the Marshall Islands only eight percent of normal rain fell over the period from January to March 1998 which led to the government declaring the country a disaster area and resulted in the controversial installation of desalination plants to provide drinking water on Majoro and Ebeye.
- the highlands of PNG experienced one of the worst droughts on record which, together with associated low temperatures, caused significant crop failures and resulted in a national crisis with a need for airlifting of emergency food and water supplies.
- in Fiji the extended drought was regarded as the worst in the 20th century and resulted in serious restrictions in water supplies for crops and hydropower production. The impacts of the drought were most marked on the leeward sides of the main islands where existing water supply limitations were exacerbated and many of those dependent on agriculture for their livelihood received emergency food supplies.

The drought impacts of the 1997-98 ENSO event have been extensively documented (Glantz, 2001). Lessons learned from Fiji's experience of that drought demonstrate the need for:

- effective and timely forecasting and warning systems,
- drought-response strategies,
- information on quantitative measures of drought,
- awareness and education programs for drought preparedness,
- improved water management, and
- improved crop and stock management.

Country briefing papers prepared for the Regional Consultation meeting revealed that American Samoa, Palau and Fiji are each involved in the development of drought manuals. During the meeting participants from those countries expressed willingness to share relevant information with others. The Tuvalu Country briefing paper recorded that a survey of water storage capacity was required to improve water management during dry spells and noted that the Water Authority will need Government assistance to implement the survey programme. The New Caledonia Country briefing paper noted that the country was very sensitive to the ENSO cycle and that some irrigation projects were in place or planned to manage drought impacts on agriculture.

A wide range of possible drought management strategies used in Pacific Island countries is presented by Falkland (2001). These include coping strategies such as those used in traditional subsistence situations and measures that can be taken at the individual household level to conserve freshwater supplies and seek substitutes where possible. Reliable and timely warnings of drought would be of assistance to people who are reliant on these measures.

At a larger scale, other short-term measures are resorted to e.g. bulk cartage of water and desalination. Ideally, however, water management plans should address the inevitability of climate variability so that droughts do not necessarily require an emergency response (SOPAC, 1999). However, it should be noted that this requires adequate hydrological data for analysis and design as well as the financial resources for implementation. A WMO workshop on reviewing national capabilities for Water Resources Assessment in the South Pacific countries (Nadi, September/October 1999) indicated significant constraints and led to the development of a proposal for a Pacific Hydrological Cycle Observing System (HYCOS) project (Mosley, 2000) to address the needed capacity building.

Regardless of the measures taken to safeguard the security of water supplies it is almost certain that other sectors will remain susceptible to the impacts of drought. Over the last decade the ability to observe and predict the behaviour of the coupled atmosphere-ocean system has improved to the extent that useable forecasts of drought conditions are becoming available. The benefits that the agriculture, forestry and environment sectors could gain from reliable monitoring and predicting of drought conditions could justify the application of suitable forecasting techniques.

2.1.2 Flood

Floods are a significant hazard in those Pacific Island countries with high islands. The hazard is greatest when these islands are within the zone affected by cyclones and their associated extreme precipitation intensities. Floods can result in loss of life and extensive property damage, especially when river floodplains have been settled and/or cultivated. In cyclone conditions the effects of floods are often exacerbated by high-intensity rain induced landslide and resulting debris which can obstruct river channels and create potentially hazardous temporary dams.

The hazards that floods present to any structure also threaten water supply infrastructure (e.g. damage to intake works, treatment plants or distribution networks) and river flow monitoring stations. Floods can also threaten water supplies in a less direct way by compromising water quality. This range of hazards has been demonstrated in recent flooding in various Pacific Island countries:

- in 1986 Cyclone Namu caused widespread property damage in the Solomon Islands and floods which resulted in the destruction of several highway bridges and the loss of river flow monitoring sites.
- in 1991 Cyclone Val devastated the islands of American Samoa. Water supplies were adversely affected when flooding caused by the accumulation of debris resulted in the inundation of wellheads.
- in 1987 Cyclone Uma hit Vanuatu where it was reported as being the worst cyclone in living memory in South Efate. The resulting widespread damage included the destruction of hydrological stations.
- in 2001 flash floods in Samoa (Upolu) caused by extreme rainfall intensities associated with an unpredictable micro-weather system resulted in widespread damage including the contamination of potable water supplies and destruction of river flow monitoring sites.
- Typhoon Chata'an in 2002 completely destroyed or badly damaged all 11 flow monitoring sites in the Guam streamgage network.

The unavoidable susceptibility of river monitoring sites to flood damage compromises efforts to establish adequate flow monitoring networks. This has the potential to discourage capital investment in structures exposed to flood hazards (e.g. bridges, dams, floodplain developments) since these generally require sufficient hydrological information to allow estimates of flood magnitude of a specified probability.

In most situations the practical approach to managing flood hazard is to manage the landuse in those areas subject to flooding. A perception of increasing flood hazard may result if landuse controls are poorly enforced and these areas are allowed to become informal settlements. Landuse in river catchments can also have a significant affect on flooding risk. This range of factors points to the desirability of Integrated Water Resources Management concepts to assist with hazard management.

As with the hazard of drought, it is possible to take advantage of flood warnings in some situations. Flood warning systems require near real-time data on precipitation rates and/or upstream water levels or flows. In the relatively small and steep catchments encountered in Pacific Island countries telemetry systems are likely to be necessary to provide for timely flood warnings. A flood forecasting system has been operated on the Rewa River in Fiji since the late 1980's despite the difficulties encountered in finding replacements for obsolete equipment and maintaining a telemetry capability. A flood warning system installed on the Sepik River in Papua New Guinea is no longer functional. The New Caledonia Country briefing paper revealed that a flood warning system was currently in operation for a hydropower dam and that a programme to map flood hazard was underway for selected areas of the country. This involves the use of hydraulic methods and simpler geomorphological methods. New Caledonia also referred to future plans to develop flood-warning systems including the acquisition of weather radar and the use of telemetry to provide observational data for rainfall-runoff models.

2.1.3 Tropical Cyclone

Tropical cyclones are a serious hazard in most Pacific Island countries but are more frequent in the western and central Pacific than in the eastern Pacific. The very high wind speeds of tropical cyclones are often accompanied by extremely intense rainfall and storm surge that is likely to be amplified by the associated low atmospheric pressures. This combination of factors can result in destruction of buildings and gardens, damage to tree crops, flooding, coastal inundation, and erosion, pollution of water supplies and destruction of coral reefs.

Tropical cyclones are particularly damaging for low-lying islands:

- in 1983 a sequence of five cyclones which struck French Polynesia had a devastating effect on many atoll villagers with storm surge conditions submerging or totally removing some villages. Groundwater resources were contaminated by seawater inundation, boats and fishing equipment were destroyed and vegetation and tree crops were extensively damaged.
- in 1980 Cyclone Ofa caused extensive damage to the atoll islands of Tokelau. Public buildings and houses were extensively damaged, gardens and tree crops were destroyed, and inundation of seawater washed away or contaminated the remaining topsoil.

Changes in land use practices have tended to reduce the natural resilience of subsistence life styles and increased the risk of soil erosion:

- in Pohnpei (Federated States of Micronesia) large-scale forest clearing for commercial kava plantations resulted in massive landslides after a severe cyclone in 1997. The landslides caused loss of life, the plantations, and damaged coastal coral reef communities.
- Cyclone Ofa also caused devastation in both Samoa and American Samoa where the widespread property damage was exacerbated by flooding problems resulting from the accumulation of debris in streambeds.

It is considered likely that global warming may result in an increase in cyclone wind speeds and more damaging storm surges. Climate modelling may be able to provide some indication, in a particular cyclone season, of the probability of experiencing more or fewer cyclones than normal. These indications, though still somewhat experimental, may be helpful in reinforcing the efforts of disaster management offices to promote public awareness of cyclone response plans.

However, the main focus of cyclone warning systems is at the near-time scale and depends upon a capacity to observe and track the spawning and evolution of individual cyclones: a capacity which has been transformed by the use of weather satellites which provide meteorologists with real-time views of weather systems. Recent progress in computer modelling of atmospheric systems has made it possible for meteorologists to predict cyclone, wind speeds, expected sea level rise and wave heights for several days in advance.

Several Country briefing papers reported on initiatives to develop disaster management plans. These had often been undertaken or reinforced in response to particular disasters e.g. the creation in American Samoa of the National Disaster Preparedness Plan following Cyclone Tusi in February 1987. Samoa noted that the creation of a permanent National Disaster Management Council to coordinate early warning programmes and respond to extreme events was a huge improvement from the earlier ad hoc Disaster Management Committee which apparently only became active in times of extreme events. The Papua New Guinea National Disaster Management Office coordinates all reports and any responses to major disasters in conjunction with Provincial Disaster in each Province. However, as the Country briefing paper notes, despite many disasters hitting PNG the country is poorly prepared largely as a result of resources constraints and the lack of a coordinated National Response Plan.

A regional network of disaster management teams exists to develop and promote suitable emergency responses. This disaster management effort is supported by the Nadi Tropical Cyclone Warning Centre in Fiji which was designated as a WMO Regional Specialized Meteorological Centre in 1995 to provide advisory services on tropical cyclone detection, monitoring and forecasting to the National Meteorological Services of the South Pacific. Better storm prediction should reduce the risk of loss of life and damage to property by enabling governments to mobilise emergency response teams to assist communities with food, medicine, and shelter. The vulnerability of water supply systems to damage by cyclones makes it a priority for water utilities to have appropriate risk management plans in place.

2.2 Natural hazards – non-climate

Non-climate natural (or geological) hazards include volcano, earthquake, tsunami and landslide. Apart from landslide (which is often associated with high intensity rainfall during tropical cyclones) these hazards have a relatively low frequency and are difficult to predict with useful reliability.

Volcanic activity can produce a range of hazards to water supplies including contamination resulting from the spread of ash from volcanic eruption to catastrophic damage from volcanic blast. Under some circumstances vulcanologists are able to provide a warning of increased risk of volcanic activity and this can allow evacuation of people and possessions in advance of an eruption as occurred in Rabaul (Papua New Guinea) in 1994.

Many parts of the Pacific Region are subject to seismic activity which is generally localised and unpredictable but can result in very severe damage. The destructive potential of seismic activity was demonstrated in 1998 when an offshore earthquake produced a tsunami which devastated the low sandy islets at Sissano in northwest Papua New Guinea killing thousands and causing complete villages to disappear. In more developed areas seismic activity has the potential to affect water supply catchments and to do extensive damage to water supply infrastructure.

Though monitoring and prediction of these hazards may improve in future, from the perspective of the Island Vulnerability – Water & Climate theme these geological hazards are similar to cyclones in that they require development of appropriate risk management plans.

2.3 Human hazards

There is a wide range of hazards created by human activity which are capable of causing considerable harm to water supply infrastructure and to have negative impacts on water quality. Some of these hazards can be unpredictable and difficult to manage. Others are quite predictable but may require measures that are difficult

to implement. Examples relevant to Pacific Island situations include:

- Civil unrest (e.g. in East Timor following the popular vote for independence in 1999 an outbreak of violence resulted in widespread damage including the destruction of water supply and sanitation facilities)
- Land disputes (e.g. vandalism of water intakes located on customary land)
- Land use (e.g. inappropriate planting practices, use of agricultural chemicals, poor sanitation and waste disposal methods).

The degradation of water quality though inadequate sanitation and waste disposal is arguably the largest hazard to Pacific Island water resources. The need for public education and effective land use controls to deal with these issues was noted in the Country briefing papers of Vanuatu and American Samoa.

Another category of human hazard is created by what might better be called ***human inactivity*** where a lack of resources creates a risk. Examples include:

- Inadequate human resources or technical capacity (e.g. loss of trained personnel may compromise delivery of a critical service)
- Inadequate information may limit investment in water resources development or expose projects to poorly understood risks
- Budgetary limitations (e.g. communications disrupted though lack of financial resources)
- Institutional (e.g. lack of legislative or administrative control.

Finally, it is worth noting the point made by Campbell (1997) that the emphasis given to vulnerability in climate change research may result in a loss of confidence in Small Island Countries since it focuses on weaknesses and shortcomings rather than inherent strengths and opportunities. Barnett & Adger (2001) suggest that that can be countered by framing such research in terms of resilience rather than vulnerability. They argue that there should be a shift of emphasis from impact assessment to risk assessment with explicit quantification of uncertainties.

3. RESPONDING TO HAZARDS

The terms coping and adaptation are often used to describe alternative types of response to hazards. Coping tends to be used in the sense of “coping with” and may imply a reactive approach whereas adaptation tends to be expressed as “adapting to” implying a more proactive approach. These distinctions are, to some extent, rather arbitrary and there is considerable overlap between the two terms. An alternative classification can be based on consideration of whether or not the response is based on a forecast. The following examples of systematic responses to hazards illustrate both types of approach. They are chosen to represent the broad range of responses at a strategic level.

3.1 Application of seasonal and inter-annual climate forecasts

Research into the interaction of the ocean and atmospheric over the last two decades has resulted in an impressive ability to observe and account for many of the factors governing climatic variability at the seasonal and inter-annual time scale. This has led to the development of techniques that are able to produce climate forecasts of modest skill (Ropelewski and Lyon, 2002?). A number of initiatives are underway within the Pacific region to provide useful information from the available forecasts to support decision makers:

- The Pacific ENSO Applications Center (PEAC), which was established in 1994 to conduct research and produce information on climate variability for the U.S. affiliated Pacific Islands, produces a quarterly bulletin (the Pacific ENSO Update) providing a summary of conditions, forecasts and local variability summaries (http://lumahai.soest.hawaii.edu/Enso/subdir/update.dir/update.html). PEAC has taken an active role in disseminating critical climate forecasts to decision makers, an activity that has depended upon good understanding of local climate variability and how it relates to larger scale climate cycles. PEAC’s role in warning governments in the U.S. affiliated Pacific Islands of the expected impacts of the 1997-98 El Niño contributed to the interest in developing a similar capability in the South Pacific.
- In response to a recommendation made at the Sixth SPREP Meeting of Regional Meteorological Services Directors the Australian Bureau of Meteorology collates and disseminates a South Pacific Seasonal Outlook Reference Manual. This document is directed at National Meteorological Services and provides a summary of current observations and seasonal and long-range forecasts of sea surface temperatures and rainfall.
- The National Institute of Water and Atmospheric Research, New Zealand (NIWA) publishes a monthly climate bulletin for the Pacific region which provides an overview of the present climate with an outlook for the coming three months. The Island Climate Update (ICU), which is distributed in hard copy and made available on the web at http://www.niwa.cri.nz/NCC/ICU, is designed to be useful to users of climate data as well as to National Meteorological Services.

From the perspective of water resources management the principal interest in long-term climate forecasts is their potential to provide early warning of the onset, severity and persistence of the precipitation anomalies leading to drought conditions. The SOPAC workshop on ENSO Impact on Water Resources in the Pacific Region (SOPAC, 1999) demonstrated the growing demand from users of climate information for seasonal and inter-annual forecasts. However, as Stern and Easterling (1999) note "the effectiveness of forecast information depends strongly on the systems that distribute the information, the channels of distribution, recipients' modes of understanding and judgement about the information sources, and the way in which the information is presented". They reinforce PEAC's conclusions regarding the significance of local knowledge by suggesting that forecasts will be most effective when "organised to meet recipients' needs in terms of their coping strategies, cultural traits and specific situations; that participatory strategies are likely to be most useful in designing effective climate forecast information systems".

These requirements place demands on the users of climate information (water resource managers, disaster managers) as well as the developers and distributors of forecasts. Without an adequate appreciation of the nature of a forecast and an effective response strategy it is likely that timely warnings will go unheeded. For example, Glantz (2001) records that in May 1977 the Fiji Meteorological Service provided a drought forecast that gained little response from users. He suggests that this was most probably because of the difficulties of using information presented in meteorological terms. However, it is also likely that a lack of effective response strategies would also have played a role.

Such needs are widespread. In a review of Regional Climate Outlook Forums IRI (2001) reported for the Caribbean, Pacific Islands and Southeast Asia that "capacity is needed to develop and enhance the application of climate information. Currently, climate information users include disaster managers, hydrologists and water managers, and, in the case of Southeast Asia, environment ministries. Pilot projects and workshops are needed to develop better understanding of user needs and to develop an understanding of the value of climate forecasts and information in agriculture, water resource management, health and other sectors."

3.2 Hazard and risk management programmes

The recognition that vulnerabilities should be addressed by risk management has been reflected in two guidelines recently developed by SOPAC:

- Guidelines for water and sanitation utilities risk management planning (Mearns and Overmars, 2002) provides a framework for identifying and analysing the hazards to utilities and promotes the development of specific plan required to prepare for, mitigate and respond to disasters. The Regional Consultation meeting will provide an opportunity for feedback on the implementation of these guidelines.
- A more comprehensive set of guidelines for Comprehensive Hazard and Risk Management (CHARM) has been developed as part of the SOPAC Disaster Management Unit's work programme. CHARM is defined as a comprehensive hazard and risk management tool and/or process within the context of an integrated national development planning process.

3.3 Vulnerability and adaptation assessments

Vulnerability and adaptation assessments in relation to climate change are required of signatory countries to the United Nations Framework Convention on Climate Change (UNFCC). The Pacific Islands Climate Change Assistance Programme (PICAPP) was developed to assist with the reporting, training and capacity building required under the convention. Climate Change Country Teams established under PICAPP undertook to:

- prepare inventories of greenhouse gas sources and sinks;
- identify and evaluate emission reduction strategies;
- assess vulnerability to climate change;
- develop adaptation options; and
- develop a national implementation strategy for mitigating and adapting to climate change over the long term.

Ten Pacific Island Countries have concluded preliminary national vulnerability assessments. In a synthesis of these assessments Hay and Sem (2000) note the following adaptations with relevance to water resources:

- Improved management and maintenance of existing water supply systems has been identified as a high priority response, due to the relatively low costs associated with reducing system losses and improving water quality.
- Centralised water treatment to improve water quality is considered viable for most urban centres but at the village level it is argued that more cost-effective measures need to be developed.
- User pay systems may have to be more widespread.
- Catchment protection and conservation are also considered to be relatively low cost measures that would help ensure that supplies are maintained during adverse conditions. Such measures would have

wider environmental benefits, such as reduced erosion and soil loss and maintenance of biodiversity and land productivity.

- Drought and flood preparedness strategies should be developed, as appropriate, including identification of responsibilities for pre-defined actions.
- While increasing water storage capacity through the increased use of water tanks and/or the construction of small-scale dams is acknowledged to be expensive, the added security in the supply of water may well justify such expenditure.
- Development of runways and other impermeable surfaces as a water catchment is seen as possible, but an extreme measure in most instances. Priority should be given to collecting water from the roofs of buildings.
- Measures to protect ground-water resources need to be evaluated and adopted, including those that limit pollution and the potential for salt-water intrusion.
- The limited ground-water resources that are as yet unutilised in the outer islands of many countries could be investigated and, where appropriate, measures implemented for their protection, enhancement and sustainable use.
- The development of desalination facilities is considered to be an option for supplementing water supplies during times of drought, but in most instances the high costs are seen as preventing this being considered as a widespread adaptation option.

Amongst the many assessment findings summarised by Hay (2002) the following are most relevant to the Island Vulnerability – Water & Climate theme:

- climate variability, development and social changes and the rapid population growth being experienced by most PICs are already placing pressure on sensitive environmental and human systems; and these impacts would be exacerbated if the anticipated changes in climate and sea level (including extreme events) did materialise;
- land use changes, including settlement and use of marginal lands for agriculture, are decreasing the natural resilience of environmental systems and hence their ability to accommodate the added stresses arising from changes in climate and sea level;
- given the limited area and low elevation of the inhabitable lands the most direct and severe effects of climate and sea level changes will be increasing risks of coastal erosion, flooding and inundation; these effects are exacerbated by the combination of seasonal storms, high tides and storm surges;
- other direct consequences of anticipated climate and sea level changes will likely include: reduction in subsistence and commercial agriculture production of such crops as taro and coconut; decreased security of potable and other water supplies; increased risk of dengue fever, malaria, cholera and diarrhoeal diseases; and decreased human comfort, especially in houses constructed in western style and materials;
- groundwater resources of the lowlands of high islands and atolls may be affected by flooding and inundation from sea level rise; water catchments of smaller, low-lying islands will be at risk from any changes in frequency of extreme events;
- the overall impacts of changes in climate and sea level will likely be cumulative and determined by the interactions and synergies between the stresses and their effects; and
- the current lack of detailed regional and national information on climate and sea level changes, including changes in variability and extremes resulted in most assessments being limited to using current knowledge to answer “what if” questions regarding environmental and human responses to possible stresses.

The first of these findings is particularly significant since it implies that in most parts of the Pacific region present problems resulting from increasing demand for water and increasing pollution of water may be much more significant that the anticipated affects of climate change.

The final finding is also significant in that it refers to climate variability. The UNFCC reporting obligations referred specifically to climate change (rather than to climate variability and change) possibly reflecting the perspective of climate change science current at the time the convention was drafted. A greater appreciation of the role of variability has developed and it is now generally recognised that the impacts of climate change are likely to be experienced through changes in variability has been realised. These considerations suggest that managing water resources for variability and extremes is fundamental to the issue of adapting to climate change in the longer term.

That conclusion is also supported by the vulnerability and adaptation assessments completed for Fiji and Kiribati (World Bank, 2000) which provide examples of climate change impacts on water resources on high islands and low islands and reach the conclusions that:

- Pacific Islands countries are already experiencing severe impacts from climate events;
- island vulnerability to climate events is growing independently of climate change;
- climate change is likely to impose major incremen-

tal social and economic costs on Pacific Island countries; and

- acting now to reduce present-day vulnerability could go a long way toward diminishing the effects of future climate change.

Some key recommendations derived from these conclusions include:

- the adoption of a "No Regrets" adaptation policy;
- development of a broad consultative process for implementing adaptation;
- require adaptation screening for major development projects; and
- strengthen socio-economic analysis of adaptation options.

These recommendations reflect the need for the mainstreaming of climate change adaptation policies.

4. IDENTIFICATION OF PRIORITY ACTIONS

Recommendation for action emerging from the Bonn Conference include several which are particularly relevant to the Island Vulnerability theme and these are listed below. In addition, existing proposals for capacity development in relation to water resources assessment and climate information and prediction are outlined below along with some additional potential priority actions.

4.1 Recommendations for Action from Bonn Conference

The International Conference on Freshwater (Bonn, 2001) adopted a comprehensive set of recommendations for action many of which are particularly relevant to Island Vulnerability and Water and Climate as listed below:

- Water management arrangements should take account of climate variability and expand the capacity to identify trends, manage risks and adapt to hazards such as floods and droughts. Anticipation and prevention are more effective and less expensive than having to react to emergencies. Early warning systems should become an integral part of water resources development and planning.
- Knowledge is the foundation of understanding and decision -making. Shared knowledge, and respect for different forms of knowledge, are the basis for building consensus and resolving conflicts. Decisions can only lead to effective management actions if the actors have the right knowledge and skills. Enhancing human capacities at all levels is a key for wise water management. This needs to be based on integrating the distinct and complementary contributions of local, traditional knowledge, knowledge from different professionals and disciplines and the hands-on experience of practitioners. All can and should learn from each other. Practical actions to build partnerships and create channels for sharing information at all levels are a key first step in developing integrated water management.
- The knowledge and skills needed for water management change as new knowledge is generated and new needs emerge. Mechanisms to disseminate knowledge, change curricula, exchange teaching materials and create partnerships between educators and trainers around the world should be developed and funded.
- Knowledge must be shared globally and packaged appropriately for in-tended target audiences. This includes the provision by all countries of basic data for research and assessment. Information management must provide information to decision makers at the right time and in a form they understand.
- Capacity building and technical assistance are among the essential elements for institutional change for integrated water management. This is a long-term process, which should be based on gradual, practical steps. It must be flexible, as needs are constantly changing. Collaboration and international partnerships are particularly needed in many developing countries, where reform is most needed but resources are most limited.
- There are many positive experiences of institutional change throughout the developing world. Specific initiatives to develop models of good practice and improve South-South sharing of experiences are needed.
- The wealth of available experience in all countries and sectors needs to be tapped in a systematic fashion. Donor agencies and industry need to cooperate for the transfer and adaptation of the best available technologies. South-South technical transfer is also important.

4.2 Pacific HYCOS

The development of a Hydrological Cycle Observing System for the South-West Pacific region (Pacific HYCOS) was considered at a meeting of experts on "Hydrological Needs of Small Islands" held in Nadi, Fiji in October 1999. A project proposal, developed in collaboration with the countries and in consultation with Regional organizations, was circulated in February 2001 to the countries concerned in the region. The project has been endorsed for implementation by eight coun-

tries and territories (Cook Islands, Fiji, Nauru, New Caledonia, Niue, Papua New Guinea, Solomon Islands and Vanuatu).

The Pacific HYCOS has been developed on the basis of a detailed needs analysis and has a strong emphasis regionally coordinated capacity building. The stated purposes of the project are:

- To assist the participating countries to establish the human and institutional capacity to assess status and trend of national water resources and to provide adequate warnings of water-related hazards.
- To establish basic hydrological monitoring and data capture systems, using technology that balances modernity, economy, robustness, and suitability for Pacific Island circumstances.
- To establish hydrological databases and information systems that provide users with the information they require, to the standards they need, and that provide a secure repository of information for the indefinite future.

The project proposes to deliver six distinct components which are designed to meet the range of needs of Pacific Island countries as follows:

- Flood forecasting capability;
- Water resources assessment in major rivers;
- Water resources databases;
- Drought forecasting;
- Groundwater monitoring and assessment; and
- Water quality monitoring and assessment.

This project addresses one of the critical areas relevant to Island Vulnerability and in recognition of this a working group will be constituted during the Regional Consultation meeting with the objective of formulating an endorsement for consideration to be included in the meeting declaration.

4.3 Pacific Climate Information and Prediction System

The potential for a regional approach to the provision of climate information and predictions has been recognised for several years. Basher (1997) developed a comprehensive proposal to build Pacific Island countries' capacity for management and application of climate data with multiple objectives including support for the application of climate forecasting in the region. Though that proposal failed to gain support, interest in the potential for climate systems has continued to grow and an Informal Working Group on a Pacific Climate Information and Prediction System was organised under the auspices of SPREP in 1999. At its initial meeting the group adopted the goal "to combine the unique assets and special expertise of a number of national, regional and international institutions and programs to develop and strengthen a Pacific Climate Information and Prediction System designed to support practical decision making in the context of climate variability and change".

The experience of the 1997-98 El Niño developed much broader appreciation of the value of climate information and forecasting and a Regional workshop on ENSO impacts on water resources (SOPAC, 1999) called for the development of appropriate programmes to deliver climate information and forecast services. The meeting, which was attended by representatives from 23 Pacific Island countries with backgrounds in water resources management, disaster management and meteorological services, highlighted the need for more interaction between national agencies and urged WMO and SPREP to work closely with SOPAC and the Pacific ENSO Applications Centre (PEAC).

The concept of a regional climate system gained some support, initially from the Italian Government and subsequently from NZODA, which has provided for the production of The Island Climate Update. This climate bulletin is produced by NIWA (National Institute of Water and Atmospheric Research, New Zealand) and provides an overview of present climate in the tropical South Pacific with an outlook for coming months (http://www.niwa.cri.nz/NCC/ICU). The possibility of sustaining and developing this service received attention at the recent meeting of the WMO Regional Association for South-West Pacific (RA V) which recorded support for the establishment of Regional Climate Centres in the region. Development of a Pacific Climate Information and Prediction System may be promoted by its adoption as a priority action by the Pacific Regional Consultation meeting. It should be noted that this is likely to require the close collaboration of SPREP and SOPAC.

4.4 Drought assessment and response

A drought forecasting capability is one of the components of the Pacific HYCOS. Nevertheless, if that project does not proceed or is delayed, it would be quite feasible to undertake an independent project to implement procedures to monitor and forecast drought in Pacific Island countries. Relevant preliminary work has already been undertaken in a case study of Tarawa Atoll, Kiribati (White et al., 1999) and led to the following recommendations:

- standard, broadly applicable drought indices be developed for all small island nations subject to drought as a method of identifying the severity of drought and as a trigger for water conservation and relief strategies;

- the characteristics of the various water storages in small islands be assessed and that the demand functions for those storages be identified;
- the relation between agricultural productivity and drought be examined particularly for coconut trees;
- the use of the decile rainfall ranking method to provide warnings of droughts be examined;
- the relation between the Southern Oscillation Index and ranked accumulated rainfalls be examined for periods longer than 12 months;
- a risk analysis be undertaken of small island water supplies in dry periods in relation to power failure;
- that routine monitoring of the salinity of a range of domestic water wells and large freshwater lenses be undertaken to test the assumptions in this analysis; and
- given the frequency of drought relevant to rain water tanks and domestic water wells, educational and planning policy be developed to minimise use and maximise storages.

The potential value of developing procedures and extending their application to other island countries was recognised at the ENSO workshop in Fiji (SOPAC, 1999) and a draft project proposal has been prepared.

5. OUTCOME OF CONSULTATION ON ISLAND VULNERABILITY THEME

The working group established for the Island Vulnerability theme adopted three key messages.

Key Message 1: Strengthen the capacity of small island countries to conduct water resources assessment and monitoring as a key component of sustainable water resources management.

Because of the significant overlap between the Water Resources Management and Island Vulnerability themes this key message was adopted in collaboration between the two theme working groups. Supporting statements recorded for this key message are all immediately relevant to the Island Vulnerability theme as follows:

1. Many small island countries have noted significant deficiencies in their national and local capacity to conduct essential water resources assessment and monitoring in their country papers at this meeting and at previous regional and inter-regional meetings over the past decade and more.
2. These deficiencies prevent small island countries from conducting proper planning, development and sustainable management of their limited and vulnerable water resources.
3. Despite this fact, there continues to be no systematic, co-ordinated approach to addressing these deficiencies.
4. Most small island countries do not have adequate baseline data that is readily available for planning and development and lack of reliable hydrological databases.
5. There are similarities between needs which can be addressed at regional, as well as national level, through targeted training and capacity building.
6. Proposals for capacity building and training of technicians in Pacific island countries have been prepared in recent years by regional and international agencies with expertise in hydrology, water resources and water quality.

Amongst the priority actions proposed in response to this key message the following are particularly relevant to the Island Vulnerability theme:

- Implement actions to strengthen national capacity (equipment, training, etc) using the model outlined in the Pacific-HYCOS proposal (WMO, 2000) and recommendations regarding water quality in WHO (2001).
- Implement hydrological training for technicians in line with the recommendations presented in proposal to meet training needs in SOPAC/WMO/UNESCO (2001).
- Develop and/or implement minimum standards for conducting island water resources assessment and monitoring.
- Strengthen and enhance communication and information exchange between national agencies involved with meteorological, hydrological and water quality data collection programmes (including water supply agencies and health departments) and with users.

Key Message 2: There is a need for capacity development to enhance the application of climate information to cope with climate variability and change.

Supporting statements adopted in support of this key message were as follows:

1. There has been growing recognition of the importance of climate variability and the impact of extreme climatic events and the need for climate forecasting to respond to these events.
2. Significant progress has been made in the develop-

ment and dissemination of climate information and prediction in the Region based, in part, on observations of the coupled atmospheric/ocean system (e.g. GOOS).

3. WMO/CLIPS (Climate Information and Prediction Services) Program has established a framework of CLIPS focal points within National Meteorological/ Hydrological Services.

4. A Pacific Climate Information and Prediction System has been proposed and endorsed at the Regional ENSO workshop (SOPAC, 1999).

5. Pacific Island Countries have recognised the significance of drought as a major hazard that needs to be planned for and that climate prediction allows a much more effective response.

Priority actions proposed in response to this key message are to:

- Enable WMO CLIPS/HYCOS with regional partners to develop and enhance the application of climate information and to strengthen links between meteorological and hydrological services by:
  - working with existing climate information services in the region,
  - formalising efforts to build climate information and forecasting capacity,
  - ongoing development of analysis, forecasting and application tools,
  - including participation by end users (e.g. water providers, hazard managers, health officials, agriculture and public).

- Develop rainfall and drought prediction schemes for Pacific Island Countries by:
  - adaptation of existing models to Pacific Island countries,
  - future development of drought monitoring and prediction methods.

- Enable regional support to develop water applications of Climate Information and Prediction through:
  - training
  - applied research
  - technology transfer

Key Message 3: Change the paradigm for dealing with Island Vulnerability from disaster response to hazard assessment and risk management, particularly in Integrated Water Resource Management.

Supporting statements adopted in support of this key message were as follows:

1. A shift is taking place in disaster management generally from a disaster response approach to hazard assessment and risk management.

2. Most disaster management has not addressed the risk of droughts and few governments have attempted to manage the risk of droughts in the Pacific Islands.

3. Climate change may result in more climate variability and the risk of extreme weather and climate events may increase. SPREP's current work on climate and PICAPP have provided a framework for assessing the potential impacts of climate variability and change.

4. Population growth and development are going to increase the vulnerability of island societies to droughts and other climate and extreme weather events.

5. The Disaster Management Unit at SOPAC has made strides in the development of CHARM. It provides an approach to shifting the approach to vulnerability to hazard assessment and risk management.

6. WMO, SPREP, SOPAC, ADB and other regional and international organization can contribute a shift to hazard assessment and risk management.

7. There are similarities between needs which can be addressed at regional, as well as national level, through targeted training and capacity building.

Priority actions proposed in response to this key message are to:

- Implement actions to strengthen national capacity to use hazard assessment and risk management using CHARM and other vulnerability assessment and risk management tools.

- Provide high-level briefings for political leaders from the region on the value of CHARM as a tool for planning and decision-making.

- Implement a programme of climate analysis for regional countries that can assess the risk of climate-related extreme event, particularly droughts and floods, and tropical cyclones.

- Develop and/or implement minimum standards for conducting island risk and vulnerability assessments and development of drought mitigation and response plans.

- Build on the climate analysis and forecasting capacity provided by Fiji Met Service, the Pacific ENSO Applications Center, the Australia Bureau of Meteorology, and the National Institute for Water and Atmospheric Research to develop risk reduction strategies through the use of climate forecasting in conjunction with risk management.

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APPENDIX

Notes on actions discussed at plenary listed by category

1. Policy, legislation, planning, advocacy, funding

- Appropriate legislation
- Planning and rehabilitation
- Political/government commitment
- Link to national plan
- Legislation to protect groundwater
- Identify vulnerable groups
- Drought manual
- Policies and guidelines on adaptation
- Regional bodies advise on risk to resources and systems
- Linkages between the actions – strategic planning
- Pre, during, post plans

2. Hazard analysis and risk management

- Mitigation measures
- Link to economic savings
- Link to disaster management
- CHARM (Drought)
- Hazard mitigation plans
- National disaster management office established and further funded (including location legislation funds)

3. Water and climate assessment and monitoring

- Assessment of climate variability
- Monitoring impact on water resources
- Assessment of resources
- Capacity building (USP training course on climate adaptation)
- Drought forecasting
- Hydrological data (extremes)
- Pacific HYCOS proposal funded: links Met/Hydro + regional
- Link rainfall prediction to water resources to drought preparedness
- Availability of prediction tools
- Link Met to water (National Mel Service/National Hydrological Service)

3. Responses to hazards

- Disaster/drought response plan
- Actions to address environmental health issues
- IPCC actions
- Storage for drought periods
- Drought management techniques
- Adequate insurance
- Wastewater actions

4. Information systems, dissemination, participation & awareness

- Information available for public
- Closer links between Met Office and water resources
- Establish and disseminate water resources information
- Awareness: schools: conservation of water (include sanitation)
- Participatory approaches to be included in actions
- Community needs assessments
- Bring poor into the actions

5. Non-climate hazards to be considered in vulnerability studies

(e.g. Over population, Pollution of water resources, Damage by humans to water supplies, Health problems, volcanic, seismic)

- Land use planning and development – vulnerability analysis
- Watershed management (IWRM)
- Adequate compensation schemes
- Enforcement of groundwater protection zones

6. Procedures

- Reference to Bonn Declaration
- Need to avoid duplication

THEME 3

AWARENESS

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EXECUTIVE SUMMARY

This report, which examines "Awareness" in sustainable water management, was prepared for presentation at the Pacific Regional Consultation Meeting on Water in Small Island Countries, Sigatoka, Fiji, 29th July – 3rd August 2002. After the conference, the report was reviewed and finalised to include input from Delegates and some commentary on consultation process. The aim of the meeting, organised by the Asian Development Bank (ADB) and the South Pacific Applied Geoscience Commission (SOPAC), was to discuss key water management issues, raise the level of political commitment, and to develop a Ministerial Declaration and regional action plan, in preparation for the 3rd World Water Forum to be held in Kyoto, Japan, in March 2003.

A Planning Meeting held in Vanuatu in February 2002 identified Awareness as one of six major themes for the Regional Consultation Meeting. The other five themes were Water Resources Management, Island Vulnerability, Technology, Institutional Arrangements and Finance.

The Theme 'Awareness' covers complex and broad ranging issues of advocacy, political will, community participation, gender equity, and environmental understanding. The following Overview summarises some aspects of these issues, which apply to small island countries in the Pacific region.

Awareness, in this context, encompasses activities in support of sustainable water management in small islands, which are made possible through communities and organisations being fully informed, and having the capacity and opportunity to act appropriately. The process of generating awareness can be considered at three levels: Community, National, and Global. Examples and case studies describing various strategies aimed at enhancing Awareness are referred to in the Overview, and recommendations are suggested for further direction and activity.

On the **Community** level the target groups/institutions include schools, youth, women and men responsible for maintenance of domestic life, and village authorities. In the Pacific Islands, the following organisations are involved in creating awareness in relation to water and sanitation: Utilities, Public Health and Environment departments and other government units, NGO's, theatre groups, media, schools, and churches. A range of existing activities include community consultation and participation programs, community and private sector collaboration in resource management, newsletter dissemination, TV and radio programs, theatrical performances, curriculum development and events such as World Water Day, World Earth Day and World Food Day. To be effective, the activities need to address the priorities of the target audience, and support communities to identify and solve their own problems.

On the **Local and National Government** level, attention is directed to politicians, permanent secretaries and department heads. Raising awareness at this level is admittedly difficult because politicians tend to have short-term tenures. Institutions and parties that are beginning to be involved in creating Awareness include: donors, lending institutions and investors; high level fora; the media; utilities; and national water partnerships/committees/focal groups. Awareness raising initiatives include setting conditions for financing, creating dialogue on policy, showcasing good and bad examples (through case studies) and establishing agendas for action, and national water partnerships.

On the **Global** level, the Pacific Island "voice" is being developed to increase understanding and attention to the specific needs of the Region. This voice is being directed at donors, international water colleagues, country representatives, and delivered by creating a comprehensive message to present at the 3rd World Water Forum in Kyoto, Japan, in 2003. This process will be undertaken through representation of the Region by a Pacific Delegation at the Forum, and the "voice" will also include presentation of the Pacific Vision, Action Agendas, Case Studies, Videos and Performances. It is intended that the Videos explore stories from Polynesia, Melanesia and Micronesia, which illustrate typical threats to water management in the Pacific, and

community-based strategies to sustain natural assets. These stories evolved out of case studies presented at the Regional Consultation on Water in Small Island Countries held in Fiji in July/August 2002.

Awareness material and activities developed in preparation for the World Water Forum will be utilised and available for ongoing promotion of sustainable water management in small islands, both at an international and local level.

1. INTRODUCTION

To be human, is to be water. Over half the weight of a human body consists of water. The biological significance of water in human life transcends its importance as an essential resource, and perhaps explains the deep emotional and mythological meanings associated with water (Robinson 1978). On a more functional level, the vital nature of water as a resource can be illustrated by referring to the various purposes to which it is put by humans. Different perceptions of water and its appropriate functions can help explain conflicts, which arise over its allocation and use. Separate and specialised planning and management of water for different uses can increase that conflict and lack of co-operation. For example, "water for municipal and industrial use appears to have a separate value from that used in agriculture, while water which sustains ecosystems or fisheries, is often not valued at all. The move towards integrated water resources management can be interpreted as a call to re-develop shared water values" (Prince of Orange 2002).

To bring about a sustainable water and sanitation sector in small island countries, a three-pronged strategy of advocacy, social mobilisation and communication is advisable. This approach can break down power structures and encourage dialogue between all partners, allowing the voiceless to speak, modifying the influence of those who are usually dominant, encouraging group spirit and devolving planning and decision-making down the hierarchy. The increased participation in planning and training can help avoid chaotic duplication of efforts and increase ownership in program goals. This three pronged strategy in sanitation, hygiene and water programs can have a significant impact on public health, sustainable development and protection of natural assets. The terms 'advocacy', 'social mobilisation' and 'program communication' are explored in Section 1.1-1.3 so that a shared understanding exists for the purpose of the discussion in this report.

While the concept of sustainability has been in vogue for some time, there appears to be an absence of a "logical and universally acceptable definition of sustainability" (Hill 1998). The lack of a definitive interpretation has created a situation where the word can be applied to vague environmentally oriented notions of which nearly everyone approves, whilst failing to address the underlying causes of environmental degradation.

'Sustainable' when applied to water supply and sanitation should include the protection and maintenance of human health and well being while contributing to the preservation and productivity of biological systems – "measured as biomass per unit area per unit time, over many decades" (Hamblin 1991). For example, it has been observed that "the criteria for a sustainable sewage system is the efficient recycling of nutrients from sewage back to agriculture, the efficient use of physical resources with only limited use of non-renewable resources, and the non-significant impact (no deterioration in ecological productivity or diversity) on the surrounding ecology" (Fane et al. 1999).

Sustainability is also intended to include the socio-cultural acceptance, use, and capacity for maintenance, of appropriate water supply and sanitation systems. Creating sustainable systems will, in many cases, require significant behaviour changes on the part of individuals and communities. Proposals that promise to deliver environmentally sustainable management, without altering current behaviour related to resource and energy consumption or environmentally destructive practices, are either dishonest or uninformed.

1.1 Advocacy

The word advocacy has its origins in law and is defined by most dictionaries as the process of 'speaking on behalf of someone'. It has evolved to include work undertaken by development agencies, civil society groups and individuals to bring about change. This has been described as 'the process of using information strategically to change policies that affect the lives of disadvantaged people'.

Another definition of advocacy could be 'advocating on behalf of the voiceless' or 'assisting the voiceless to develop and use their voice'.

Advocacy in this context encompasses a range of activities, all focusing on a process of change toward an improved quality of life, which is sustainable. This change may be in policies and laws, in the implementation of these policies, or even in people's awareness of the policies and their own rights. For example, advocacy work could be undertaken to change the policy of a national government to take greater account of communities' rights to participate in the design and management of their water supply and sanitation services. In another case, such a policy may exist but government agencies and their contractors may not be implementing the policy or may not adhere to standards of implementation agreed, a situation again requiring a

process of change through advocacy to ensure enforcement of policies. On the other hand, local communities may not be aware of a change in policy and therefore may not be claiming the rights that they are entitled to, in which case advocacy work could be directed at changing levels of awareness and understanding about existing policy.

This process of change which advocacy aims to bring about can occur at different levels, from the local community level to the national and international levels. Change at one level may be necessary for change at another. For example, it is recognised that influences on national government policies comes both from within the country and from external sources such as international funding bodies. Therefore advocacy work is undertaken at the local, national and international levels in order to achieve change in national policies, practices and programs. A groundswell of change at the local level may lead to a corresponding change in policy at the national level. Change can also occur at different stages in the decision-making process. Therefore advocacy involves addressing the following questions and working for change where required.

- ***Who makes the decisions?***: what is the participation of civil society and representation of community, what is the dialogue between civil society and government?
- ***What is decided?***: what is the scope and impact of legislation, policies, budgets, programs, practices?
- ***How are decisions made?*** Is the process accountable and transparent, what is the participation of local communities to be affected?
- ***How are decisions enforced or implemented?***: who is accountable, how do people become aware of decisions?

An important aspect of advocacy work is the involvement of communities themselves in advocating for change. This is referred to by some agencies as 'rooted advocacy' or 'people-centred advocacy'. Effective advocacy needs to include, not only the promotion of positive water development initiatives ('good practice' advocacy), but also the four following dimensions if it is to begin to address the policies and practices that perpetuate poverty and inequitable access to resources:

- bringing about change in policies and programs (the 'policy dimension'),
- strengthening the skills, organisation and power of civil society and its involvement in decision-making (the 'civil society dimension').
- increasing the legitimacy of civil society's participation and improving the accountability of public institutions (the 'democratic space dimension').
- improving the material situation of the poor and expanding people's self-awareness as citizens with responsibilities and rights (the 'individual gain dimension') (WaterAid 2001).

1.2 Social Mobilisation

Social mobilisation is the process of bringing together all feasible inter-sectoral social allies to raise people's awareness of, and demand for, a particular program or behaviour, to assist in the delivery of services and reinforcement of behaviour, and to strengthen community participation for sustainability and self-reliance.

Social mobilisation should result from concerted advocacy. When a society is mobilised for a behaviour change, or program, such as improved sanitation and water supply various communities at various levels become active partners in advocacy, communication, training and service delivery. This includes representation from grass roots, inter-ministerial, non-government, utilities, voluntary groups, village organisations, professionals, artists, entertainers, the private sector, schools, and religious bodies. The Case Study, prepared by Floyd Robinson , which describes the Waibulabula/Coral Gardens program, provides an example of a local society mobilised to address integrated water resource management.

1.3 Program Communication

Program Communication is the process of identifying, segmenting and targeting specific groups/audiences with particular strategies, messages, or training through various mass media, and traditional and non traditional inter-personal channels.

For sustained behavioural change the message must strike a chord in the receiver through appropriate credible channels. Some kind of enlightened self-interest needs to be stimulated, whether the targeted audience are politicians, government personnel, entrepreneurs, farmers, fisherpeople, or householders. Field workers require training in inter-personal and communication skills and the backing of creative support materials to establish productive dialogue with the target audience. To feel moved to change behaviour and attitudes, the target audience needs to be engaged and empowered by the communication process. It has been observed that people remember:

- 20% of the information they hear
- 30% of the information they see
- 40% of the information they hear and see
- 70% of the information that they hear, see, and talk about

- 90% of what they hear, see, talk about, and do (SPACHEE/Ecowoman 2000)

Passive lectures are least likely to stimulate change, and even messages conveyed in an entertaining media, may be remembered, but may not be acted upon. People need to be inspired to care about what is happening. They need to be aware that something is wrong, they have to believe the information they are receiving, they need to feel it affects their welfare, and they should be allowed the space to formulate their own solutions. Most importantly, there has something within their power that they can do to change the situation.

2. ISSUES, CONCERNS AND CONSTRAINTS

There are many inter-related factors that impact on the development of a sustainable water and sanitation sector in small island countries. As this Overview covers eighteen Pacific Island Countries (PICs) with significant differences in physical conditions such as rainfall patterns, geology, vegetation, hydrology, and in socio-economic circumstances, the issues raised are general, and will be more relevant to some communities than others.

2.1 The need for investment in behaviour change

In relation to water supply and waste water management, there has been a preoccupation with 'coverage' and technical solutions without understanding the need for equal investment in behaviour change. The number of people who theoretically have access to water supply or sanitation systems is not the only measure of success. Water may have been supplied to a community with no indication of improvement in health, or reduction in poverty. Toilets may have been built but are not being used, or are being vandalised. Sewage or waste water may be contained, transported and/or treated but not sufficiently to control pollution, or the system is not adequately maintained. Rainwater tanks may have been provided but gutters and downpipes are not maintained. People have reasons for not using a service provided or misusing a resource. These reasons need to be understood and can cover a broad range of socio-cultural and practical factors, which may be internal to the particular household or the community, or the result of external influence.

For example, it has been suggested that over the last 50 years a small technical elite, in developed countries, has developed "a powerful, appealing, intellectual paradigm of water resource planning" (Winpenny 1994). Water resource management has been equated with the construction of water supply projects and statistical measurements of water flows, and the engineering dilemmas of building water supply structures and their associated costs. However, it was assumed that there were plentiful water resources available, and that governments would absorb "the major portion of costs when water was publicly supplied at rate structures that favoured consumption rather than constraint in use" (United Nations 1976). This approach has been imported into Island communities through donor funded infrastructure programs and has often replaced independent on-site water sources, such as private wells. With centralised supply there has been a loss of the traditional household responsibility and concern for water conservation and protection. This is reflected in the careless use of reticulated water, the failure to report obvious leaks, reluctance to pay water bills, illegal connections, the degradation of water reserves and a general disinterest in the condition of the communal resource.

Similarly, the introduction and promotion of excreta management systems and practices such a flush toilets has replaced traditional strategic use of bush areas and the beach, without taking into account local vulnerabilities, such as pollution of groundwater from these technologies. Traditional practices of excreta management, while no longer appropriate in urban and semi-rural developments, did at least recognise the need to separate water supply from point sources of pollution, and this indigenous understanding should have been built upon rather than ignored.

In recent times, there has been some shift away from supply orientated approaches toward an emphasis on understanding and controlling demand. However it will take some effort to reverse the habits and attitudes of the past. This will involve time and patience, and skilled dialogue with and between all stakeholders, so that those affected can identify their own concerns and contribute to the development of solutions.

2.2 Resource protection and effective hygiene requires comprehensive information exchange

Environmental and health education often focuses on increasing knowledge, assuming that when people receive information, they will stop undesirable behaviour. Information may not be relevant, complete or realistic if it fails to take account of local insights, customs, circumstances and priorities. In PIC communities, it appears that the recognition of environmental problems is directly related to an individual's experiences and her/his pre-occupation with survival. People are often more concerned with the 'social environment' ie family and community responsibilities, alcohol related problems, over-population, and the availability of land and cash-in-hand.

So, while many people are concerned with having enough water and its taste, and colour (few people are concerned with pathogenic pollution because they can't see it), only those who own land adjacent to the coast are particularly concerned with erosion or sedimentation. Fishermen are more aware of the decline of certain species of fish than fish consumers and women notice the decline of shellfish because the collection of shellfish is commonly their task (Saito 1997).

Many environment and health related messages are given in the form of lectures or one-way mass media. People are told 'what to do' without opportunity to discuss and identify their own concerns, so do not remember or apply the information. Even if the media is entertaining such as theatre, video or song, there is often a need for exchange of information and direct experience for the message to become relevant. Hence the usefulness of demonstrations, inter-active workshops and community operated pilot projects.

Even if people have access to good quality water, there may be minimal improvement in health, because of poor personal and household hygiene. Hygiene programs are sometimes limited to information and promotion, and fail to include and address the actual risks of transmitting diseases. Pathogenic pathways include the inappropriate management of faeces (especially children's), fluids, flies and food, in the home, in public places, in the bush and on the beach. Effective communication about these sensitive issues usually requires ongoing intensive fieldwork to achieve altered behaviour. Health programs should address the appropriate treatment of used water as being of equal importance as adequate supply of water.

Education relating to public health and environmental protection from external promoters can be insignificant. People tend to adopt or discard practices for which they get approval or disapproval from important others (respected relatives, peers, opinion leaders, informal leaders, friends). People need to understand/experience why the new behaviour has more benefits than the old one (easier life, obvious improvement in health, increased or protected income generation, more status, approval from respected persons).

Surveys undertaken in PICs indicate that only a small percentage of people fully understand or are interested in the adverse affects of their behaviour on their natural assets (A-N-D 2000). There does not appear to be a sense of urgency, perhaps because communities are no longer solely dependent on natural resources for their survival. Some communities do not appreciate the direct and indirect cost (time, inconvenience, anxiety about sick children) which they have already been 'paying' because of environmental degradation. For example: having to boil water because it is contaminated; tolerating skin irritations from excessively chlorinated water; suffering from various illnesses related to inappropriate sewage and solid waste disposal; and needing to travel greater distances in order to catch an inadequate amount of fish (Saito 1997; Saitala and Paelate 1996; Pers. comm. Fonua 1999).

Although there is an ongoing effort to promote conservation and protection of water resources and other natural assets in PIC communities, the well-funded and powerful commercial promotion of consumerism often conflicts with the conservation message. Successfully persuading people to purchase and consume as much as possible is perceived by many economic analysts as the sign of a healthy economy (Roseland 1999). These two trends of persuasion are on a constant collision course, and have been for many decades in developed countries. There is increasing pressure on young families in PICs especially in the urban areas with exposure to media advertising, and the proliferation of supermarkets. The use of packaging and manufactured goods has greatly increased in recent years, generating vast quantities of non-biodegradable waste that is often discarded in rivers, bays, and on beaches, or is burnt in household and municipal dumps thus leaching pollutants into groundwater (Raj 2000).

2.3 Behaviour change requires time, opportunity and ability

Even if people have changed their attitudes and become convinced that different activities are desirable, they may lack the possibility or opportunity to change their behaviour. They may have insufficient time, skills, flexibility or viable alternatives. For example, cane farmers in Fiji whose farming and clearing methods cause turbidity and sedimentation in surface waters may be unaware of other possible techniques, or may be unmotivated to change because they are on rented land. They require information/ assistance with alternative practices. People may have become aware of the groundwater pollution and threat to public health caused by inappropriate disposal of solid and hazardous waste, but there may be no obvious or convenient options available for safe disposal.

Changes in behaviour can be limited by issues of autonomy, such as who in the household or community controls the facilities, equipment and supplies. Specific strategies are required to assess whether women and men have different needs, priorities and resources and to involve both in generally accepted solutions. Inclusion of young people in decision-making and problem solving also contributes to the sustainability of programs to conserve natural assets and improve quality of life.

Government personnel who have been inspired by training, which they have received in-country or overseas, can become demoralised if there are no resources available, or if initiative is not encouraged. In some cases, Government Departments in PICS do not have sufficient money even to pay for petrol for transport to field-

work, or there is institutional resistance to any change in procedures. This lack of opportunity to use newly acquired skills can also contribute to 'brain drain' to more interesting and better-paid jobs in developed countries, such as Australia, New Zealand and the United States.

2.4 Cultural and structural barriers to information exchange

As the issues around water and sanitation are so complex and diverse and touch on many practical and personal aspects of people's lives, experience and skill is required to engage stakeholders in identifying their concerns and working toward sustainable solutions. "Message carriers" require capacity building. Field workers need training in inter-personal and communication skills, backed up by relevant support materials and media, in order to become effective communicators on water, sanitation, hygiene, and environment issues. Traditional channels of communication and decision-making, and respect for local taboos, needs to be understood and integrated with non-traditional methods.

Government personnel who have been trained in specific skills or participated in workshops, conferences, or monitoring programs require strong incentives to pass on information to their colleagues. This sharing of information is resisted for a number of cultural and institutional reasons. As one public servant commented:

"People here don't poke their nose into other peoples business…and it happens in the office too, we don't usually know what other sections of the Division are doing. When the head of the Division or others go to a conference, nobody knows where they have gone or what happened when they came back. There is no exchange of information" (Pers. comm. Kamauti 1999).

There are often no clear roles or functions for the various agencies regarding the management of water and waste water, nor a single agency or committee designated to co-ordinate their projects and activities. For example, the Ministry of Health may deal with supervision, the Utilities Board may be responsible for maintenance of infrastructure, and the Ministry of Lands and Survey may control land use. It is often difficult to have personnel from the various agencies to communicate about inter-related problems and solutions, much less co-operate (Pers. comm. Helu 1999). Inter-sector and inter-department communications need structural facilitation (eg between water resource management, water and sanitation service providers, health and environment, and agriculture agencies).

The lack of co-ordination among government and non-government organisations can also result in donor funded programs being conducted with one agency without awareness of related programs being funded with some other relevant agency. This can lead to duplication of efforts, wasting of resources, and unsustainability of water and sanitation programs (Raj 2000). Donor agencies could assist by maintaining accessible networks/database to avoid duplication of projects and activities. Regional organisations also need to share information about related activities, and combine resources to address inter-related challenges. On all levels, reluctance to co-operate and share information is partially related to 'protection of turf' and competition for limited funds. Somehow this needs to be overcome so that the organisations themselves remain viable, while the overall purpose for their existence is efficiently achieved.

2.5 Stakeholders need to be involved in decision making and management

The recently acknowledged requirement to involve stakeholders in decision-making and management is based on decades of failures in programs that have been conducted 'from the top down'. The 'Integrated Water Resource Management Approach', which is now being advocated, requires that decision-making processes be devolved to the lowest appropriate level capable of handling such tasks, such as local government and community-based institutions.

An inclusive process can be time consuming, difficult and expensive, and there is no fixed format on how it should be done, or to what degree. However, there are some obvious inequities which require attention. For example 90% of PIC population use on-site sanitation systems therefore these people, who build and maintain their own systems, should be represented at Water & Sanitation fora and policy making events. Usually the delegates are public servants who only represent the 10% of the population who use reticulated systems, and these delegates are usually men, even though it is women who are commonly responsible for water and sanitation management in the home.

Training programs are usually focused on government or utility personnel. Training in the implementation of water and sanitation technology should include the users of on-site water and sanitation systems. These major stakeholders require demonstrated instruction so that they know why and how to properly locate, build, and maintain septic tanks, toilet cisterns, pit latrines, private wells, raintanks, and composting toilets.

One of the difficulties of stakeholder participation in decision-making and management is that 'communities' are differentiated and do not have one voice, therefore time and patience is needed to use traditional and non-traditional methods of communication, conflict resolution and decision making. Donors may have to adjust funding mechanisms to these time frames.

While government institutions, (or the private sector) may be responsible for planning and operating central-

ised water and sanitation facilities, a pre-requisite is the acquisition of suitable land. In PICs most land is customary owned, (or Crown owned as in Tonga) and land use decisions are often community-based. This may lead to difficulty and expense acquiring land for any public utilities such as reticulated water or sewerage systems, or water reserves, as governments may not be in a position to make the necessary land use decisions or afford compensation (Jones 1995; SPREP:SKM-Kiribati 2000; Dever 2000; ADB 2000; Jones 2001). Customary lands are diverse in their tenures and cultural past. Problems encountered by government and private developers include protracted negotiations for land leasing and acquisition, unresolved land disputes and demand for ad hoc increases in rent by indigenous landowners (White et al. 1999; ADB 2000). Therefore thorough strategic consultation and assessment prior to acquisition of land is highly desirable and maintaining community 'ownership' of these facilities could replace conflict with empowerment.

A further reason for stakeholder involvement is that communities need to understand and accept what a service costs to operate. If reticulated water or sewerage, or municipal waste management, is highly subsidised it is unlikely to be sustainable in the long-term. Strategies need to be developed with stakeholders that can be sustained at the local level, and create the necessary skills and capacity for local production and procurement. User-pays is a good incentive to conserve water but resistance to payment will continue if there is no sense of common ownership and responsibility for water resources.

Any funding of centralised water and sewerage services in PICs will have to take into account the likely inability of some low-income families to make regular cash contributions (SWA 1997; Raj 2000). Even with services that are considered essential, such as reticulated water, some householders in PICs do not pay their utility bills, despite the low charges and threat of disconnection if payment is not received (Crocker 1996). Government organisations, and middle class families are also inclined to be slow to pay. This indicates an economic imperative to develop low-cost options for improved sanitation and to encourage community responsibility for water and waste management, in order to reduce pollution loadings.

In a recent UNEP report, which advocates urgent reduction in sewage emissions in order to protect marine and fresh waters, it was pointed out that "there are numerous, alternative, low-cost techniques available. These include dry sanitation and natural sewage filtering systems, such as ponds, reed beds and mangrove swamps, and possibilities for re-use" (Van de Guchte 2002). Some of these methods are being explored in PICs and are referred to in Sections 3.3 and 3.4.

It is expedient to build on the traditional sense of self reliance. Partnerships between government and civil society to manage water resources is the most feasible strategy in a limited economic base, and customary land tenure conditions.

2.6 Political will required to support water management depends on many factors

It is increasingly apparent that local governments cannot tackle urban and peri-urban environmental problems alone. Coping with problems in densely populated areas in PICs will require that responsibilities be shared and actions taken by a host of actors, including national governments, local governments, non-government organizations (NGOs), community-based organisations (CBOs) the private sector, international donors, and other external support agencies. A high priority should be placed on strengthening the institutional capacity of local administrators to develop and maintain these partnerships – to create the necessary political will to move toward sustainable strategies.

Respected politicians can be useful advocates, but as tenure is short, senior public servants are also an important focus for awareness raising and incentives for conservation and sustainable management. While water supply development can be popular with politicians in PICs, sanitation is often encumbered with taboo and avoidance. Water supply can drain a community's resources leaving little funds to attend to appropriate, treatment, disposal or use of waste water. When calculating the economic cost and effort required in undertaking pollution control, it is also necessary to include the costs of doing nothing. These calculations involve community as well as government.

Various reports cite 'waste' from domestic sources as the dominant contributor to pollution in PICs (Convard 1993; UNEP 2000). The serious threats to the environment and consequent affect on livelihood have been identified. Similarly, studies show that one of the most significant health costs globally is due to the impact of infectious disease. The context of greatest importance in the spread and control of infectious disease is the household environment, which is where the majority of susceptible people (especially small children) spend most of their time (DFID 1998; Pers. comm. Biran 2002). Children are the most vulnerable to poor water quality, inadequate sanitation and solid waste disposal, and poor hygiene, but they do not have a political voice.

Diarrhoea is a common infectious condition in many PIC communities (Dahal 1994; Saitala and Paelate 1996; ADB 1996; SWA 1997; ADB 2000; Beatty 2001; Pers. comm. Fonua 1999, Karawaiti 1999, Tim 1996). Diarrhoea is not a disease in itself but a debilitating symptom of diseases caused by viruses, bacteria and parasites. As such, addressing the problem lacks the focus of a single organism disease such as AIDS or Tuberculosis. However similar interventions are re-

quired to address the prevention of diarrhoea, irrespective of the organism, and these interventions mainly focus on improving the household and communal living environment.

Health officials in PICs report that many children in their communities under five years of age have diarrhoeal diseases, and it is a leading cause of death in the population (Pers. comm. Fonua 1999; Dahal 1994; Saitala and Paelate 1996; ADB 2000; Beatty 2001). There are also studies throughout the region which demonstrate water supplies are contaminated, which is considered to be one of the main causes of enteric illness and many other infectious diseases (Brodie et al. 1984; Lau and Mink 1987; Detay 1989; Miller et al 1991; Crennan et al. 1999; Anderson et al. 1999; TSP undated). Apart from the human suffering involved, these preventable diseases have an indirect as well as a direct impact, which can be estimated in monetary terms. Politicians and decision-makers need to be made aware of the real costs of mismanagement of water.

Tourism is often used as an incentive to address local water and sanitation needs, but the industry can create stressful demands on limited water services and a burden on fragile ecologies, eg, golf courses, swimming pools, effluent discharge, high water use for laundry and bathrooms, and concentrated usage of cleaning chemicals. It is necessary to engender a desire to preserve and enhance the island environment for the islanders, not just for the tourists.

While political support is necessary to initiate and maintain appropriate water management, political interference can result in technology choices that are not sustainable, and lead to inappropriate bi-lateral aid programs. This type of interference from vested interests happens in many countries but in the fragile ecology and limited resources of PICs, the outcomes can have long term disastrous effects that impact on the most vulnerable in society. It could be argued that there is a need for autonomous agencies, involved in water management, which respond to the requirements of clients rather than governments.

Where conservation legislation does exist, enforcement can be weak in PIC communities where many people are related and/ or interference in the private domain is not welcomed. Hence the need for self-regulation at the community-based level. Donor agencies, lending institutions and investors can stimulate dialogue on policies for sustainable resource management and set constructive funding conditions and this can be a powerful incentive. However the most effective political will often comes from the communities themselves. The essential role of NGOs in advocacy, mobilisation and communication, requires recognition and support.

3. ACTIVITIES IN ADVOCACY, MOBILISATION AND COMMUNICATION

There have been many activities undertaken in PICs to develop and support a sustainable water and sanitation sector. Examples are provided in this section. It is important to learn from the successes and failures of those processes, although approaches that have 'worked' in one context may not necessarily work in another. Some of these initiatives are covered in detail in the Case Studies to be presented at the Regional Meeting, and are highlighted below.

3.1 Environmental understanding and information exchange

Environmental understanding and program communication is increasingly becoming a significant component of bi-lateral aid programs, NGO and Regional Organisation activity, and Government unit agenda. Some examples are provided here.

TEMPP in Tonga

The Tonga Environmental Planning and Management Strengthening Project (TEMPP) undertaken between 1997 and 2001, and funded by AusAID, was primarily a national capacity building program covering a wide range of environmental concerns, including the protection of water bodies from pollution. Capacity building was provided in Strategic Management Planning, Environmental Planning, Environmental Management, Information and Community Participation, and Project Management (Dever 1999). NGOs were supported to be involved in advocacy, mobilisation and program communication, focusing on such concerns as lagoon restoration, control of pollution from domestic pigs, and women's development issues (Marsh 2001). 'Message carriers' undertook media and environmental management training, and an indirect outcome of TEMPP is discussed in the Case Study "Village Mobilisation for Catchment Management" prepared by Haouli Vi where a 'message carrier', inspired by her training, independently worked with her Village Committees to minimise waste, protect the lagoon foreshore, and enhance civic pride (Pers. comm. Vi 2002).

SAPHE in Kiribati

In 2000 the Sanitation, Public Health, and Environment Improvement Project (SAPHE) began in South Tarawa, funded through an ADB loan. SAPHE aims to improve

the development potential of Kiribati and the health and well-being of its people through a sustained program of improvement in water supply, sanitation, solid 'waste' disposal, and environment conservation (Coffey 2001)

The ADB is also providing two technical assistance grants, for the Management and Financial Advisory Services for Restructuring the Public Utilities Board and for Community Development and Participation Initiatives (CDPI). The community education component of the CDPI is known as the South Tarawa Community Education and Awareness Project which is implemented by FSP-Kiribati, in co-operation with the Kiribati Housing Corporation (KHC).

The CDPI addresses community water supply such as wells and rainwater tanks, environmental sanitation and public health, and this is linked to the pre-existing Kiribati Environmental Education Program (KEEP) conducted by FSP-Kiribati. Activities include community consultation, village mapping, designing materials for use in education and awareness and consultation activities, trailing compost toilet (CT) designs and conducting CT construction workshops, and strengthening the capacity of project staff and counterparts from relevant agencies and organisations in community development and participation skills. The CDPI mainly focuses on the communities in South Tarawa that will not be serviced by the reticulated water and sewerage systems ie 70% of the population. The Case Study prepared by Danfung covers the "Community Development and Participation Initiatives". The program promotes the concept of community management of water resources.

KEEP in Kiribati

The Kiribati Environmental Education Programme (KEEP) which began in 1996, and which is now linked to SAPHE-CDPI activities, is implemented by FSP-Kiribati in co-operation with the Environment Unit of the Kiribati Ministry of Environment and Social Development (MESD).

The overarching goal of KEEP is to improve the environmental management of the people of South Tarawa. It is intended that the overall goal of KEEP will be realised by the following objectives:

- Increasing public knowledge and understanding about behaviours that are helpful or harmful to the environment.
- Increasing the range and frequency of environmentally friendly behaviours of the general public and specific interest groups (KEEP 2001).

Ecovan in Fiji,

The EcoVan operated by the Department of Environment in Fiji and it's agency, the Education and Awareness Unit (EAU), is a mobile multi-media environmental education facility. Activities include participation in Environment Awareness campaigns conducted by other organisations. For example, the Ecovan is extensively used in the National Tidy Towns Competition, National Environment Campaign, International Ozone Day, World Water Day, Clean up Days, University Open Day, National Arbour Week and National Food Day Celebrations. The exhibitions display material provided by different organisations which highlights their environmental activities and includes video shows, and 'hands on' activities.

EQPB in Palau

The Environmental Quality and Protection Board (EQPB) under the Office of Environmental Response and Coordination Office of the President in Palau has initiated a number of community-based environmental management programs. The EQPB is the environmental regulatory and enforcement agency in Palau with a current staffing of 22 personnel. The EQPB is mandated under the Environmental Quality Protection Act of Palau to provide environmental education (EE) to the general public on the protection and conservation of natural resources, public health and the environment. The EE division of EQPB focuses on school curriculum education in addition to outreach programs in the Palauan community

Live & Learn Environmental Education

Live and Learn is non-profit organisation, which understands that it is the young generation who have to face the challenges and long term threats to the environment including urbanisation, outbreak of disease and decline in biodiversity. The approach focuses on developing analytical skills for people to identify their own concerns and builds on local knowledge and perceptions. Live and Learn works with the Curriculum Development Unit/ Fiji Teachers Association in the Green Schools Program which recognises that teachers provide a vital role in creating a sustainable environment through education (Nielsen and Rabici 2000)

River Care is one of Live and Learn's programs and this challenges communities to discuss, debate and ask the hard questions about the links between the river environment and poverty, health and equality. *River Care* aims to:

- Develop an effective water quality-monitoring network throughout individual target countries which specifically aims to promote health conditions.
- Identify pollution 'hot spots' and create public action to improve river and health conditions.
- Initiate a learning process that links critical thinking to direct action in protecting and improving rivers in the South Pacific, and reduce hardship and poverty.

Ecowoman/SPACHEE

Ecowomen is a collective of Pacific women engaged in science and technology, which aims to strengthen linkages between professionals in science and technology and their urban and rural counterparts in communities. The collective's stated objectives are to:

- advance equity and empowerment;
- foster respect for traditional knowledge;
- facilitate access to education and skills;
- promote concern for and care of the environment for present and future generations; and
- lighten the load for women.

Ecowoman was established as an long-term initiative of the South Pacific Action Committee for Human Ecology and Environment (SPACHEE) initially supported by the South Pacific Peoples Foundation of Canada (SPPF). SPACHEE provides a central point for expert knowledge on environmental issues and has worked to raise government and popular awareness of environmental topics. This has included projects in urban and peri-urban settlements on developing gardening and yard cleaning services, the production and sale of compost, and improving sanitation.

Participatory environmental workshops are conducted enhancing livelihood and quality of life for women (OFANews 2001; OFANews 2000; Ecowoman 1998; Pers. comm. Lechte 2002).

SOPAC Water and Sanitation Unit

SOPAC is involved in various communication programs such as producing the Pacific Freshwater Education Kit. The kit was developed in collaboration with SPREP and it contains a series of fact sheets with corresponding activities that deal with a wide range of water issues eg. water resources, water conservation and pollution, wastewater and sanitation. The kit is suitable for several different age groups and is used as a tool in schools.

SOPAC have also taken the lead role for World Water Day (WWD) activities in the Pacific region. WWD, a UN initiative is an annual event and celebrated globally on the 22nd of March with a different lead global agency each year and different themes. Past themes have included Water for the 21st Century (2000), Water and Health (2001) and Water for Development (2002). SOPAC's WWD campaign activities for the region in the past have included development and dissemination of publication material, and regional school competitions.

In 2002, SOPAC collaborated with Live and Learn Environmental Education to include the WWD message and other water issues in the school curricula and to conduct teacher training workshops using the material developed for WWD 2002. This "training the trainers" was considered a more sustainable approach.

Collaboration has also been undertaken with the National Centre for Health Promotion (NCHP) which is the Awareness section of the Ministry of Health in Fiji. SOPAC is represented on their Environmental Health Advisory Committee, which is concerned with promotion of Health Awareness in rural communities. The main goal of the committee was to improve the health status of rural communities in regard to preventable diseases that are associated with water and sanitation. SOPAC's main involvement was to provide support in the development of publication material namely, posters, leaflets and fact sheets with clear messages.

SIDAPP in the Solomon Islands

SIDAPP/Peoples First Network in the Solomon Islands seeks to improve connectivity through e-mail system while dramatically reducing the costs of communication, making it affordable and sustainable over time for low-income users. Particular attention is being given to gender equity and democratic governance. The network can be used to promote eco-friendly business, disaster prevention and mitigation, and sustainable resource management.

3.2 Institutional strengthening of Water Utilities

The programs to institutionally strengthen water utilities, which have been conducted in a number of PICs, have included activities to improve relations with the public, and to promote understanding of resource vulnerability and demand management. An example of this trend was demonstrated in the involvement of the Tonga Water Board in a groundwater pollution study and composting toilet trial, which was monitored by government personnel, householders (mainly women) and

students and teachers. This inter-disciplinary program is covered in the Case Study "Community involvement in groundwater protection" prepared by Lokuvalu Leha from the Department of Central Planning in Tonga.

There have also been education programs aimed at encouraging the public to report leaks thus inviting 'ownership' of the resource, and weekly radio programs and occasional TV specials on the water cycle and conservation. Improved metering and billing systems has increased the public's awareness of consumption in Samoa and Tonga, but not necessarily the willingness to pay.

3.3 Increased attention to household-centred water supply and sanitation

Some attention is being given to on-site household-centred water supply and sanitation systems, which increases ownership and supports self-reliance. This approach also provides direct experience of benefits of sustainable practices and provides local opportunity to innovate. Examples include the following:

- rainwater harvesting programs in Tuvalu, Tonga, FSM, and Kiribati;
- improved maintenance of private wells in Tonga;
- dry sanitation trials in Tonga, Kiribati, Palau, FSM, Tuvalu, Fiji, which promote the use of low-tech, site-built systems which do not use water to transport or treat waste, and do not pollute groundwater or catchments;
- the proposed community-based pilot projects through the International Waters Program (Crennan and Berry 2002); and
- the large scale ADB Water and Sanitation project in PNG includes an on-site sanitation component designed with the intention of collaborating with communities and local-level government institutions at all phases of project planning and implementation. The Low-Cost Sanitation-Community Awareness and Health Education (LCS-CAHE) component of the project will be implemented to provide affordable options for on-site sanitation, and a community awareness and health education program for low-income households (ADB 2000; ADB 2001).

3.4 Inter-related resource management

Initiatives that foster integrated and participatory catchment management can enhance the capabilities of people to manage their lives and resources. The management of sustainable water and sanitation systems cannot be addressed in isolation. It is important to understand and demonstrate that outputs of one system are inputs to other systems, and that actions taken now have unpredictable effects for decades to come. There are a number of programs that reflect this multi-disciplinary, cross-sector approach to conserving natural assets and enhancing quality of life.

Women in Business, Samoa

Women in Business (WIB) is a non-government organisation which encourages and trains women in business ventures. It has a close working relationship with Ecowoman in Fiji (Refer to Section.3.1). The Foundation is currently focusing on the development of organic farming. Women in Business Foundation have assisted five villages to gain organic status for their products from the National Association of Sustainable Agriculture, Australia Ltd. Five other villages have achieved conversion status for organic products.

There are significant potential implications of organic certification in PICs as follows:

- allows villages to compete in the niche world market for organic products produced without artificial fertiliser, chemically synthesised weedicides, pesticides, fungicides, fumigants or growth promotants;
- organic farming requires organic fertiliser including compost and mulch from bio-degradable material, so an opportunity is created to separate organic material from the waste stream and recycle or reprocess it in bulk for organic farms. Heavy mulching also reduces the need for water consumption, and reduces run-off and potential sedimentation of water ways;
- organic farming avoids the environmental and public health impacts associated with the use of agricultural chemicals, and mineral fertilisers, which contribute to pollution of freshwater catchments and the marine environment (Convard 1993).

Many manufactured fertilisers provide only one or two elements in a water soluble form, making them prone to leaching into waterways, especially if incorrectly applied. Nutrients held in organic soil improvers are released slowly thereby greatly reducing potential for leaching; and

- in addition to conserving carbon and nutrients, organic fertilisers also avoid the high input of non-renewable energy required to produce chemical, mineral or non-organic fertilisers.

Women in Business are also involved in promoting the use of composting toilets in villages with very low rainfall, and close proximity to lakes and sensitive water bodies.

Waibulabula/Coral Gardens, Fiji

Community-based activities are being undertaken in Cuvu, South Western Viti Levu in Fiji, a coastal district consisting of 8 villages with a population of approximately 2500-3000. Two inter-related projects are being conducted at Tikina Cuvu as a collaboration between the community, a five-star tourist resort, government departments and NGOs, and co-ordinated by the Foundation for the Peoples of the South Pacific (FSP-Fiji). The program address the issue of land-based pollutants and their impact on marine and freshwater environments, and adopt a 'grass roots' rather than a 'top down approach' to environmental sanitation and resource management. A significant feature of the project is the process itself, which seeks to empower communities to better understand, and solve their own problems and enhance their livelihood.

The program provides the communities and the resort with simple technologies for treating wastes naturally before they get into the marine or stream environment, while at the same time providing useful products. Waibulabula (Living Waters) ecological treatment systems include native wetland plant species and trees that absorb and use waste, resulting in a cleaner environment and increased local resources.

Matuaileoo Environment Trust Inc. (METI) Samoa

METI is an independent Environment Trust established to achieve the following objectives:

a) undertake, promote and carry out in Samoa such environmental works to support sustainable development through (inter alia): rainforest, lagoon and reef protection and conservation; protection of the quality and supply of fresh water; development of improved land use practices; development of human resources; and promotion of environmentally friendly economic development.

b) undertake and promote a holistic approach to environmental management in Samoa with integrated projects that collectively achieve the objectives of the Trust.

c) Provide training of the necessary management skills and promote capacity building to achieve sustainable living in Samoa through self-reliance, particularly of grassroots communities.

METI's approach to environmental management is based on the following two premises:

1. "One can only rally the support of the communities on whom one depends to safeguard their Environmental assets, if three important conditions are met: that people's health needs, educational aspirations and livelihood security needs are taken note of and action is taken aimed at satisfying them."

2. In addition, "it is only when a bond exists between the communities and the NGO in question that is based on TRUST, that a meaningful dialogue can take place and an effective collaborative action leading to the development of spirit of self-reliance can succeed."

Personnel from METI have trained with FSP staff and community groups at the Waibulabula/Coral Gardens project in Fiji and plan to duplicate that program in coastal villages in Samoa.

3.5 Advocacy and leverage for stakeholders: regional consultations

Non-Government and Regional Organisations play an important role in providing advocacy and leverage in a variety of macro and micro contexts.

NGOs facilitate consultation

The FSM Alliance of Non Government Organisations (FANGO) was requested by the Pacific Concerns Resource Centre to help organise national multi-stakeholder consultation in the Federated States of Micronesia as part of the Rio+10 review process. The consultation involved key government, NGOs, private sector and civil society organisations and would lead to development of policy for sustainable development, including management of water resources. A similar process took place in Palau directed by the Palau Conservation Society and the Office of Environmental Response and Co-ordination, funded by the Earth Council in Fiji. In Tonga, the agency responsible for co-ordinating the involvement of civil society organisations in the consultation was the Tonga Trust, working in collaboration with the Department of Environment. In 2002, the World Wildlife Fund undertook consultation to provide input from civil society organisations to the Regional Consultation on sustainable water management, in preparation for the World Water Forum in Kyoto in 2003.

Waste Water Consultation in Majuro

During 2001, SOPAC, SPREP, and the Pacific Water Association conducted government consultation through a series of fora to assist with development of a Framework for Action for Waste Water in the Pacific, in conjunction with the UNEP Global Programme for Action for the protection of the environment from land based pollution (GPA).

Regional Consultation in Fiji

The Regional Consultation, organised by SOPAC and ADB, which was held in Fiji July 29th -3rd August, 2002, was preceded by in-country consultation between government and civil society to determine priorities for action, and to prepare Country Papers, including actions on a national level, which would all contribute to the development of a Ministerial Declaration to take to Kyoto. The meeting provided the opportunity for all stakeholders, including representatives from governments, NGOs, support agencies and the private sector to discuss and expand on the issues that were raised in the Six theme presentations and case studies. Discussion took place both in the Plenary context and in small working groups, and strategies were suggested for action. In the discussions concerning the theme of Awareness, country representatives made broad ranging suggestions including:

- water conservation, appropriate sanitation, and effective hygiene should be included in teacher training and introduced into school curricula at an young age, through to tertiary levels, supported with technical advice from regional organisations and the development of localised, targeted awareness kits;
- as religious involvement is central to Island life, religious bodies should be utilised and included in water awareness activities;
- the media should be targeted for education;
- partnerships should be forged across all sectors in early stages of project planning and design;
- the private sector should be educated through development of approval processes;
- there should be greater recognition of the community as a change agent, particularly the role of women; and
- community 'ownership' of resource use and solutions to environmental problems should be promoted

To be effective, it is important that international fora of this kind are conducted to maximise the input of all stakeholders, particularly reticent contributors, and with due recognition that business is conducted in English, which is a second language to most participants. The contribution of women and other minority representatives should be facilitated, and pre-conceived agendas, particularly those of the host organisations, should not be allowed to dominate proceedings. These basic principles of inclusion, transparency and facilitation apply at all levels of consultation whether it be in community gatherings or high-level international meetings.

Cultural differences in public meeting procedure should also be taken into account, where feasible. For example, disagreement is often expressed in circumspect terms at formal Islander gatherings, so a mild objection should be heeded as a potentially strong statement. Some Delegates objected to the use of the term 'the poor' and preferred 'disadvantaged' in the Island context. The inclusion of 'the poor' in an official document, despite these objections, could result in the document not being ratified.

There are differing understandings of other terms, which are used internationally, such as the usage of 'sanitation' and 'wastewater'. These differences were apparent in the discussions regarding the Action Plan for the Awareness Theme. This needed to be clarified and an acceptable compromise should be facilitated, without diluting the relevance of the document. 'Wastewater' is not the common term for sanitation that is used in the South Pacific (including Australia and New Zealand). However some PIC representatives from US protectorates prefer to use 'wastewater' to refer to sanitation issues, and several water management programs are funded by organisations within the US sphere of influence. Consequently, the American English usage 'wastewater' was retained in the Awareness Action Plan while 'sanitation' was used in most of the other Theme Action Plans. However, as language reflects and informs attitude, and one of the basic objectives of these programs is to separate 'waste' from water, then at least the term should be constructed accordingly i.e. waste water.

Although there may have been good reasons to select exemplary case studies for further promotion at the World Water Forum, it did not appear to be conducive to meeting harmony, or general participant empowerment, to request a competitive assessment of the merit of case studies. Preparation of case studies is undertaken in various conditions in-country, in terms of language proficiency, professional experience, and available resources such as computer programs, and everyone should be equally encouraged and recognised for their efforts.

In the working groups that were established for discussion of each Theme, the opportunity was provided for input from participants who were reluctant to speak in the Plenary session, or who were not official Country Delegates. The Awareness working group was attended by representatives of NGOs, personnel from ADB who are engaged in international Awareness initiatives, and a number of personnel from PIC government departments. Issues raised included the following:

- there is a need for co-operation between NGOs and Government departments in community-based programs to maximise use of respective skills, to fairly allocate resources, and to avoid duplication;
- across the Pacific, some NGOs are large, internationally based, and well resourced while others are small, with limited funding, but a strong grass-roots base. Their different roles and capacities should be

recognised and utilised by donors and government departments;

- access should be provided to widely established participatory tools, while recognising the value of encouraging local innovation and skill development; and
- a Pacific Water Network should be developed which includes government, civil society, and the private sector to disseminate information on water management issues. However this information source should not be seen as a substitute for inspiration within communities to develop their own strategies for management of natural assets.

The Action Plan for the Awareness Theme was developed through ongoing meetings of the working group and then submitted to the Plenary meeting for discussion and ratification. The working group also endorsed a number of Guiding Principles from the Framework for Action for Waste Water in the Pacific which was developed at the regional meeting at Majuro in 2002. The included principles are as follows.

- Guiding Principle 4: Community participation in water management and sanitation will ensure equitable benefit with recognition of socio-cultural sensitivities
- Guiding Principle 5: Viable and sustainable levels of skilled and knowledgeable people within the water sector and communities will improve water management.

During the development of the Action Plan, there was a strong representation at the working group of NGO's from throughout the Pacific. At times Government personnel were somewhat outnumbered and constructive debate occurred regarding the wisdom of advocating more recognition and authority for NGOs in Awareness activities. During Plenary meetings, some anxiety was also expressed by Government representatives, regarding the potential problems that could be caused by increased community participation and NGO involvement in water management. This is an issue that requires ongoing dialogue and building of mutual trust. NGO and government representatives in the working group were engaged in a wide range of activities, including curricula development, theatre and radio productions, environmental monitoring, and teacher training.

The Action Plan outlined guiding principles or messages to facilitate Awareness rather than providing details of how this should be undertaken in-country. The Action Plans for some of the other Themes gave detailed suggestions for specific activities. Although some programs were suggested in the Awareness Action Plan, it was decided to allow each country to develop its own response to the key messages, as the approach needed to be specifically tailored, with the input of the target communities.

There was also some confusion during the Regional Consultation Meeting as to what was required for the development of the Action Plans. Some of the organisers appeared to be advocating the inclusion of specific programs and activities, which could be easily identified for funding and implementation, while others were recommending a more general approach. It was pointed out that there had been regional fora in the past which had formulated desirable policy and principles, and that this was now an opportunity to promote and facilitate direct action.

The Awareness Action Plan is summarised at Section 5.1

3.6 Regional Organisations support applied research and training

In addition to advocacy work, Regional Organisations support applied research and training. For example, from 1996-1998, UNESCO and SOPAC provided funds and assistance to conduct a groundwater pollution study, which included a community survey of water and sanitation practice and attitudes. The project aims were to establish more comprehensive evidence of the rate and direction of flow of groundwater, the degree of groundwater pollution in the village context, and where pollution was coming from. The overarching question was whether or not there is a safe distance in a village context for the siting of wells and sanitation facilities in relation to each other. This aimed to review the standard criteria that had been imported to the Pacific that 30m was a safe distance between a water supply source such as a well and a source of pollution such as a toilet. That standard had been based on European soils and groundwater characteristics, and had not been adapted to local conditions since its introduction to the Pacific in the 1960s (Dillon 1997). The process involved the collaboration of government personnel from the Ministry of Lands Survey and Natural Resources, Ministry of Health and the Tonga Water Board and involved school children in the monitoring process. These activities are described in the Case Study prepared by Lokuvalu Leha.

UNESCO and SOPAC also supported a groundwater re-charge study in Kiribati, in which a similar process of counterpart responsibility for ongoing conduct of research was incorporated into training of government personnel (White et al.1999). Both these studies stressed the integration of technical and social science in wise water management.

3.7 Intersector co-operation

In recent times, there has been some evidence of emerging intersector co-operation and communication in water management. For example in the Waibulabula/ Coral Gardens program in Fiji, Government departments, NGOs, CBOs, and the private sector are co-operating in practical programs to find sustainable solutions to conflicting resource requirements.

As previously mentioned, the various sectors are being brought together through national consultations and regional workshops, and through strengthening of focal departments for environmental management, for example, the Department of Environment in Tonga, and the Office of Environmental Response and Co-ordination in Palau.

4. FUTURE NEEDS AND ACTIVITIES

Some areas have been identified where more focus and creative activity is desirable.

However, the National Papers and Action Plans that were developed during the Regional Consultation clarify and prioritise what is required and which strategic actions need to be taken.

- **Water source and catchment conservation gains recognition but requires further work.** Comprehensive collection and integration of local knowledge is needed, with attention to customary laws and traditional norms for governing resource access, use, and management. The impact of certain polluting activities (eg inappropriate sanitation systems and waste disposal) and links with poverty, and chronic illness especially in children, needs to be practically demonstrated. Viable non-polluting alternatives require promotion and innovation

- **The framework to allow management at the lowest appropriate level is often not available**. Clear legal frameworks are needed to enshrine rights and responsibilities. While community-based approaches are currently accepted as desirable, the necessary capacity to support them does not generally exist at the higher levels (district, regional and catchment).

- **Capacity building is promoted but not at all levels and its effectiveness is not monitored.** Too little emphasis is placed on providing an enabling institutional environment for individuals to whom new tasks and responsibilities are given. This means trained people often cannot fully apply what they have learned, and they become bored and apathetic. In some instances public servants have had insufficient funds to provide fuel for field work. Local authorities also require more support to be able to properly cope with their changing roles and responsibilities eg Town Councils, Village Committees. Farmers, loggers and business people should be targeted to encourage engagement in sustainable resource management

- **Stakeholder involvement is growing but is still too limited and too narrow in focus.** Communities can remain uninterested in taking part because of lack of ownership or control over decisions, lack of real power to make allocation and use decisions, and poorly developed frameworks by which the views of large diffuse communities can be represented at stakeholder fora. National and regional level fora sometimes use community involvement in a purely consultative or "window dressing" role, leading to disillusionment and withdrawal of collaboration. In addition, even where involvement is more meaningful, decision-making processes frequently lack the transparency to engender trust, or skills to handle conflict.

- **Efficient water use is gaining attention but requires much more emphasis.** Water use efficiency (and demand management) is gaining attention, particularly where water is seen as a scarce resource or tariff structure makes waste expensive. However inefficient water use is frequently linked to an exclusively individual or local focus, which ignores the cumulative effect of 'small' losses; people concentrate solely on their own tap, standpipe or leaking cistern and see only a small 'insignificant' leak. As a result poor behavioural practices continue unchallenged.

- **Water service providers need to be more responsive to consumers**. To encourage co-operative resource management utilities could establish, public relations units, mechanisms for quick response to customer problems and conduct publicity campaigns, which highlight the benefits of conservation and economic water use.

- **Creating a gender balance is more than enhancing women's involvement.** A narrow view of 'gender' operates. It is often understood to mean 'women's issues' and the focus has been primarily on the role of women, with minimal attention to the roles of men and women separately. Other important and inter-related aspects of community dynamics such as wealth, age, class, are often not accommodated in program strategies. Education, training and capacity building to create gender equity is necessary at all levels. Involvement of women in projects should avoid overburdening them with further responsibility. Attention to gender equity must be integrated into all stages of program cycles, beginning from project identification, through design, implementation and evaluation.

In assessing gender needs in project identification the following questions can be asked.

1. What needs and opportunities exist for increasing women and men's productivity or production?
2. How will these affect women and men's labour time, workload?
3. What needs and opportunities exist for increasing women and men's equal access to, and control of, resources. Will this involve structural or operational changes?
4. What needs and opportunities exist for increasing women and men's access to and control of resources?
5. How do these needs and opportunities relate to the country's other general and sectoral development needs and opportunities?
6. Have both men and women been directly consulted in identifying such needs and opportunities?

Gender analysis should also be applied to policy changes such as public sector reform. Programs to 'institutionally strengthen' water utilities have often involved job losses, particularly for clerical staff when computerised billing is introduced. Many of these retrenched clerical staff have been women. In Pacific communities where one cash earner may be supporting many family members, this can have a significant domino effect and benefits and costs to the community of this retrenchment should be anticipated. In this case the following questions could be explored.

- What options for alternative earning will be available for people who lose their jobs, and will those options be equally available for women and men? What alternative cash earning activities might women and men be forced to undertake in low employment contexts?
- Will public servants who keep their jobs be under increased pressure to provide financial support for unemployed relatives?
- Will there be any programs to keep track of laid off workers and their families?
- How will the government monitor and value changes to the quality of life, health, stress and family violence experienced by retrenched workers and those who keep their jobs?
- If retrenched clerical workers return to rural subsistence, how will this affect government commitments to promote economic growth and development and to support economic empowerment of women? (South Pacific Forum Secretariat 2002).
- **The facilitation of information exchange needs creative strategy and support.** Sector personnel should be provided with incentives and institutional facilitation to share information with colleagues and personnel from other relevant departments and organisations, and not just during donor funded programs. There is also a need for a centralised accessible information management system and clearinghouse database on research process and outcomes, aid programs, NGO and CBO activities, private sector contribution, government agenda and resources. Many programs are duplicated, and a lack of ready information on work already undertaken, constrains development planning, policy and decision making efforts.
- **Government personnel /departments should be seen to practice what they preach,** and set a good example on conservation and sustainable resource management issues. This could include establishing a policy for government offices and services that recycled products will be preferred when it is possible to use them, and waste paper will be segregating and recycled. Water efficient systems and appropriate sanitation technology should be used in office facilities and government accommodation (especially in new buildings), and personnel should demonstrate exemplary water use at work and at home.
- **Squatters and disadvantaged families in urban and peri-urban settlements require adequate provision of water and sanitation.** These communities, which are mainly to be found in Tarawa, Port Vila, and Suva, need to be consulted to determine their various needs and potential solutions.

5. RECOMMENDED PROGRAMS AND ACTIVITIES

During each of the Themes discussed during the Regional Consultation, it was advocated that 'Awareness' principles and initiatives, including attention to gender equity and poverty reduction, be integrated into all aspects of water management in PICs. The Action Plans of the other five Themes contain some recommendations toward this goal.

5.1 Summary of Awareness Action Plan

The Awareness Action Plan contains key messages, required actions and suggested organisations and society sectors who could contribute to implementation.

Key Message 1. A high quality participatory framework should be adopted at the National level to allow for open participation of communities in sustainable water and

wastewater/sanitation management. This could be achieved through the following activities:

- establishing a water education fund which is accessible to government agencies, and civil society groups to ensure effective community participation in sustainable water management;
- requesting donors and governments to adjust funding mechanisms to ensure sustainable implementation of water management (for example, donors co-operating to serial-fund an extended program);
- ensuring quality community participation that leads to community ownership and sustainability; and
- improving water and sanitation conditions of squatter settlements and rural dwellers through the participatory framework.

Key Message 2. Access to, and availability of information on sustainable water and wastewater/sanitation management should be provided to all levels of society. This could be achieved through the following activities:

- developing a "toolbox" to support targeted water education for each level of society including politicians, government personnel, civil society and private sector (the toolbox could include an easily accessible regional and in-country database on relevant information and education materials for sustainable water management, support strategies for local theatre and media, and mobile training programs for householders and tradespeople for building and maintenance of appropriate on-site water and sanitation systems);
- strengthening the capacity of community based organisations, Non governmental organisations (NGO's) and government departments to disseminate information on sustainable water management; and
- strengthening the capacity of trainees and dialogue builders.

Key Message 3. Water and sanitation education should be mainstreamed into the formal education system. This could be achieved through the following activities:

- governments adopting water education as part of the curriculum; and
- strengthening the capacity of curriculum developers and teacher trainers to provide water education.

Key Message 4. Improve communication and coordination of all stakeholders in sustainable water and wastewater/sanitation including government, civil society and the private sector. This could be achieved through the following activities:

- defining roles and responsibilities of government, civil society groups, private sector and communities in the sustainable management of water;
- sharing information between project/program stakeholders; and
- improving awareness of policy and legislation through education and community based learning.

5.2 Suggested Awareness Programs for PICs

The following specific programs could further the development of a sustainable water and sanitation sector. However, as Awareness programs are best designed locally for site-specific application, these practical suggestions are in no way comprehensive and simply provide examples that could be adapted and implemented in any island country. The focus is on interactive participatory programs, and pilot projects, which develop local capacity at all levels, improve quality of life and conserve natural assets.

Sanitation Park

The project emphasises a multi-disciplinary, cross-sector approach to water and sanitation management. Proposed activities aims to create awareness of sustainable sanitation or waste water technologies through demonstration and information exchange. This approach allows the community to make fully informed selections of systems, which are appropriate for their needs and limitations.

Suggested partners: the Fiji School of Medicine Environmental Health Unit, (FSM-EH), the Ministry of Health personnel involved with improvements in community water and sanitation systems, WHO providing technical assistance and SOPAC co-ordinating the project.

The program has 3 inter-related components.

1. Technical:

- range of designs of low cost on-site sanitation technology with cross sectional working models displayed at FSM
- operation and maintenance documentation provided
- construction assistance (materials, designs, costs) provided

- guidelines developed for technical choice
- indicators of operational efficiency demonstrated

2. Community Mobilisation:

- ensuring communities understand why they need an effective sanitation system, to protect public health and the environment including water resources
- providing access to criteria for choice (technical issues, cost, community acceptance)
- developing community acceptance through monitored trials.
- ensuring requirements for occupational health and safety are addressed

3. Training:

- practical experience provided at village level, in community mobilisation techniques, and construction of sanitation systems
- multiplier effect achieved through FSM-EH programs

The program could be linked to country wide pilot projects trialing and monitoring low-cost, low-impact sanitation technologies, especially dry sanitation options and natural treatment systems such a wetlands and evapotranspiration beds.

Sanitation Park could also support, or be linked to, mobile training programs for householders and tradespeople for building and maintenance of appropriate on-site water and sanitation systems.

Household management of pigs

Domestic animals can also contribute to pollution of water bodies in small island countries, and in addressing this problem, attention needs to be given to the long standing and traditional value given to pigs in PIC communities.

If pigs are to be raised in pens for family use in the urban and peri-urban compound, then the pens should be well away from human habitation for reasons of nuisance (odour and insects) and to keep animal faecal matter out of the human living environment. It is useful to remember that there is a number of diseases that can be transmitted between pigs and humans, and *vice versa*. In the past, a common place for pigpens was at the narrow end of an islet where the lack of fresh groundwater prevented human habitation. The pressures of 'modern' living have brought the pigs back to the family compound to prevent theft and for convenience of care.

At the household level, awareness needs to be raised of the potentially contaminating aspects of pig raising practices. There may be an opportunity for Town Councils or Village Committees to be involved in regulating the standards of pigpens, proximity to housing and water catchments, and other protective measures. The aim should be to contain the animal excreta in as safe a manner as possible. In other words, the pigs need toilets as much as humans. If the pen has a concrete floor with a raised edge to contain liquids and a drain to take wastes to a storage and treatment area, then this would be adequate. It has been noted that the food given to pigs in PICs is usually solid, so there is not a great deal of spillage as happens where hogs are fed with grain mashes and similar sloppy food.

A slight slope on the floor of the pen would assist in either washing or, preferably, scraping the wastes to a composting chamber or small septic tank with wastewater garden disposal. A simple cheap system using plastic lined trenches filled with sand and gravel would accept the liquid wastes which could then be mulched with dried or composted solid wastes. Clumping bamboo and the "Drumstick Tree" could be trialed. They grow quickly, can provide fodder for the pigs and both plants have other uses. Where the pens are sited near a wetland area, then effluent could be discharged to areas of heavy grass growth (not directly to free-standing water) for further treatment.

A pilot project to develop a standard practice for household pig pens could involve a single household, or a number of neighbouring households from an extended family could co-operate, rather than attempting the complication of wider village involvement. However, a village committee could supervise the project and assist with ideas.

Minimising solid waste and its impact on water catchments

In addition to human and animal waste, inappropriate disposal of solid waste also has an impact on the quality of water resources.

In some PICs, the introduction of disposable diapers has greatly increased the paper-based volume of waste, which is being littered on beaches, in lagoons, and dumped at landfills. Some estimates indicate an increase of more than 70 % in domestic solid waste due to used disposable diapers. If they are not dumped they are burnt, and as the diapers have a plastic backing, this strategy is also not advisable. There are suggestions that diapers should be banned, which is not likely to happen. A pilot project, which addresses this controversial issue, could be developed with local community education specialists.

Certain issues need to be understood such as:

- why families use disposable diapers instead of washable nappies or whatever was used traditionally;
- what ideas people have for reprocessing or appropriate disposal; and
- what incentives might encourage the use of alternatives.

Despite being expensive, and a drain on the family budget, diapers are popular because they are very convenient (and possibly prestigious), so an imaginative campaign is required to reduce their use and/or impact.

Composting sludge and green waste

Septic tank flush toilet systems which are not maintained, and the inappropriate disposal of septic sludge, can lead to catchment pollution.

Village co-composting of sludge from septic tanks with green waste could be a useful pilot project .This would produce a soil improver, reprocess green rubbish, and could encourage increased maintenance of septic tanks, as there would be somewhere nearby to empty the sludge and some ulterior motivation to do it more regularly. Pig manure from household pens could possibly be included if a consistent supply of septage was not available.

The pilot project would involve developing a methodology for treatment which ensures protection of public health, a co-operative effort between householders and a village committee, and institutional support from Public Health and other relevant authorities who were trained to undertake monitoring. A science class at a local school could assist with the monitoring of composting indicators such as temperature. Many social issues would also need to be addressed in a comprehensive participatory education and information exchange program. Training in the proper construction function and maintenance of septic tanks could be included in the program.

If a small-scale project is successful it will expand naturally as other householders see the results and join the scheme. The sustainability of the project depends on involving the community in the cost-recovery/cost-sharing process.

Integrated Pacific EcoHome

Rather than addressing single issues in a pilot project, it could be useful to apply the principles advocated in this Overview and consider as many inputs and outputs of the household compound as is feasible.

This could include some or all of the following interrelated systems:

- properly maintained rainwater tanks…
- properly maintained and protected well (if applicable)…
- convenient system for separating household waste, including hazardous residues…
- compost enclosure for organic household waste and pig manure
- a composting toilet with drainage trench into food trees, and/or into..
- simple greywater recycling system feeding into…
- demonstration organic food garden using household compost…
- and nursery garden to produce seeds and seedlings that are adapted to local conditions (and possibly sold to public) with…
- pig pen constructed to contain run-off and filtration, and maximise convenient, hygienic use of manure and effluent for gardens.

If the EcoHome pilot could be established at a residence that is in the process of being built then breezeways and energy efficient design could be incorporated into the structure and layout of buildings and compound. If the compound is already established then the above suggestions could be adapted to existing conditions, where practical. A possible location for this pilot could be at the home of a priest or religious leader, adjacent to a church, as this is often 'owned' and maintained by the community, is a semi-public venue, and has a rotating residency. Of course, this would involve extensive pre-project consultation with the church community, and the engagement of the resident pastor and family.

If appropriate, the EcoHome could provide educational material on issues such as alternatives to plastic bags and disposable diapers, managing household chemicals, and producing nutritious food on-site from household waste. Demonstrations of various waste minimisation and pollution prevention strategies could be included in meetings that occur at the church compound, including kava groups, womens' groups and youth. The EcoHome could include a drop off facility for cans and other recyclables from the community, and any funds raised from activities could go to the church.

There are many indicators that could be monitored in this pilot project including:

- user and community response to the various systems in place;

- changes in quality of groundwater, or surface water in the vicinity of the compound;
- changes in attitudes to water use, and general environmental awareness;
- changes in the status of the soil at the garden site; and
- evaluating the growth performance of various food and tree crops amended with the compost.

The EcoHome could be linked to government and NGO and CBO information services such as the Ecovan in Fiji, and the People's First Network in the Solomon Islands. Perhaps an e-mail station could be established at the EcoHome using a simple system consisting of a short-wave radio, a low-end computer, and solar energy. This may increase the interest of young people in the overall activities of the pilot project, and the church and community may be attracted by the benefits of accessible inexpensive networking.

Promotion of local e-mail services

Long distance communications and travel are a perennial challenge to communities in the PICs. To increase connectivity and information exchange, a program could be established such as the People First Network in the Solomon Islands, to create a network of e-mail stations located in remote islands. The stations can use a simple, robust and well-proven technology, consisting of a short-wave radio (already ubiquitous and well-known in the South Pacific), a low-end computer, and solar energy.

The system can be used to promote eco-friendly business, disaster prevention and mitigation, sustainable resource management, and involve churches and CBOs in information exchange programs. Training should be provided to women, men and youth in the use of the system.

Centralised information service

An adequately funded program should be provided, which establishes in-country and regional database providing information on research process and outcomes, aid programs, awareness tools, NGO and CBO activities, private sector contribution, government agenda and resources. Easily accessible information is required on interrelated subjects such as bio-diversity, climate change, coastal management, sanitation and solid waste management, water and air quality, and links to the agencies engaged in this work.

This service is provided to some extent by organisations such as SOPAC and SPREP through personnel assistance and access to their website reports. However a designated, well advertised, comprehensive regional system is required, supported by a formalised service in each country which allows hard copy and/or telephone, and electronic access to information on local activities.

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THEME 4

TECHNOLOGY

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1. INTRODUCTION

The Pacific Ocean covers some 18 million km^2 or about 36% of the earth's surface. Scattered throughout the Pacific are over 30,000 small islands and a number of larger islands (each over 2000 km^2 in area) that emerge from the sea floor of which about 1,000 islands are inhabited.

The natural environment throughout the Pacific Island Countries is extremely fragile and is highly vulnerable to both natural and human impacts. Natural hazards like cyclones, droughts, earthquakes and tsunamis may strike at any time and at most places within the Pacific Region. Human impacts include rapid urbanisation and waste and wastewater generation.

The availability of potable water and proper disposal of human waste are key elements to the health of any civilization. Contaminated drinking water is one of the primary causes of death and illness throughout the world. Thus it is one of the responsibilities of local governments to assure the availability of potable water and the proper treatment and disposal of human waste. In order to provide these services the local government is obligated to install sanitation facilities, and to properly manage, operate and maintain these facilities.

A successful Water and Wastewater Utility is designed, built, managed, and operated to:

1) Protect public health,

2) Protect the environment,

3) Meet customer needs.

Well run utilities have clearly defined and up-to-date set objectives and action plans for improving their service through monitoring their performance. Such monitoring is targeted at lowering unnecessary production and distribution costs, enhancing billing and revenue collection, improving customer relations, reducing unaccounted-for-water and generally increasing the level of service. Unfortunately many utilities in Pacific Island countries are not run as such. In fact, many of them rarely collect data systematically to assess their own performance in order to design operational improvements. As a consequence, both those responsible for service delivery, and those willing to support them, lack the information needed to design measures and investments to improve the delivery of service. There is therefore a need to address this weakness.

This requires a staff that manages, operates, and maintains these facilities to have certain skills that are not readily available within most local governments. This is especially true of the governments of the Pacific Islands. The lack of required knowledge and skills is not the fault of the local government. Rather, these short comings are due to the lack of funds, in some cases the lack of an understanding of the need for the knowledge and skills, and the lack of knowledge of available resources to obtain the knowledge and skills.

Human Resource Development

One case study following this overview is "The Micronesia Water and Wastewater Training Program" which was developed to address these and other issues. This program has operated since 1997 and has provided a significant amount of training and technical assistance which has resulted in observable improvements in the operation and maintenance of the targeted utilities, not without roadblocks which have been identified and are discussed in the case study.

External Bilateral Assistance

A developing Water and Wastewater Utility often needs financial assistance from outside the country. Bilateral development assistance has been an important resource to Water and Wastewater Utilities. Among the providers of bilateral assistance, the most prominent is Australia. The goal of Australian assistance to the Pacific Islands is to promote self-reliance through better governance, stronger growth, greater capacity, better service delivery, and environmental integrity. In addition, Australia will provide about $20 million to support the network of regional organizations and institutions that assist the Pacific Islands countries. Japan, the United States, New Zealand and United Kingdom are

the other prominent providers of bilateral assistance. Japanese funding focuses on agriculture, forestry, fisheries, and basic infrastructure, including hospitals, schools, and water supply facilities. In 1998, the net disbursement of Japanese official development assistance to the Pacific Island countries was about $130 million. The US funds are almost completely focused on the FSM and RMI, primarily through Compact Funds. Others such as New Zealand's assistance focuses on health, education, environment, human resource development, and private sector growth. Total assistance from New Zealand to the Pacific is about $40 million per year. The United Kingdom contributes about $6 million per year to the Pacific region. Others such as the European Union (EU) and the World Bank are significant other multilateral contributors to the Pacific. UNDP coordinates the activities of various UN agencies.

The Asian Development Bank (ADB), a major multilateral donor in the Pacific region, operates in 12 Pacific Island countries. Annually, ADB approves between $100-$150 million in loans and $15 million in Technical Assistance grants for the region.

With all this multilateral funding potentially providing improvements to the Pacific Island countries, why is the development of a successful **sustainable** Water and Wastewater Utility so difficult to achieve?

The Case study of Ebeye demonstates that the ADB has recognized some limitations in the way projects have been developed in the past, and are committed to major change. In this case, the ADB has made a strategic shift in their special approach to assistance to the Pacific. Coordination of aid programs is improving and ADB is requiring the Pacific Island governments to take a more proactive role in aid coordination. Sustainable change must be evolutionary in nature, allowing time for internalization and institutionalization of new modes of behavior and operation. The ADB is willing to commit to program reforms over the longer term. This cannot be overemphasized, for too often in the pacific, a project upon completion and immediate after the ribbon cutting ceremony, begins to fail due to the lack of a sustainable Water and Wastewater Utility.

Water Demand Management and Conservation

The ADB recently funded a regional technical assistance for "Performance Benchmarking" for Pacific Water Utilities. The Pacific Water Association and its' members consisting of small Pacific Island countries, have adopted the establishment of appropriate operational, institutional, and financial performance evaluation criteria and benchmarks within the utility organization. The technical assistance provided by the ADB is assisting in the development of appropriate regulatory, managerial, and technical services through the consultation between the water utilities within the Pacific region.

The main role of the benchmarking and Performance Indicator project is to provide a management tool for self evaluation for the operators, benchmarking for utilities with similar operating environments, promoting experience sharing between the utilities and documenting and sharing information on emerging best practices and lessons on water supply and wastewater (sanitation). It will also promote accountability and transparency in the operation of the utilities leading to higher efficiency and effectiveness.

The Pacific Water Association was established in recognition that the key to significant progress in water and wastewater service provision rests with the improved performance of the water and wastewater providers, and in realising that well functioning water and wastewater utilities are the best models and providers of help for less experienced ones. Underlying this is the knowledge that not only does the Pacific Island countries provide a range of well functioning utilities but also, to a large degree, holds the key to best practice for application within the region.

One early indicator of the benchmarking exercise clearly identified the problem the water utilities had with managing their water resources. This is a direct result of the leakages in the system, and this large amount of unaccounted for water was included in the amount of finances uncollected. The Pacific Water Association on behalf of its members has stepped forward with this initial action item to be implemented as a direct result of the benchmarking exercise. Specific leak detection equipment and training will be provided to a group of islands to share in the training and application of the equipment on a full-time basis. The Pacific Water Association will provide the administration and oversight to correctly administer this project along with the continuation of the "Performance Benchmarking" exercise administered formerly by the ADB and continued by the PWA.

SOPAC is the regional leader in this field. The Water Resources Unit of SOPAC previously employed a water supply engineer whose prime responsibility was to improve the capacity of member countries to reduce unaccounted for water, concentrating on technical support and training. However, with only one person, and a limited amount of equipment, there are limitations built in to this very important program.

The Pacific Water Association (PWA) has developed a case study to provide a regional on-going (sustainable) joint project on leak detection.

Leak Detection Program

It is undeniably true that the nations in the Pacific have any number of problems that only aid programs, from

loans to grants, can begin to solve. It is also true that these nations must have the will to solve as many of these problems as they can themselves and be able to reduce their dependence on aid in as many areas as possible. This itself however, requires aid. In the water sector numerous efforts have been made in some countries by aid agencies to reduce Unaccounted for Water by employing contractors who unfortunately often leave little behind other than a completed job, but without training local personnel with the expertise to follow through on what has been done. In other cases many water managers simply throw up their hands and treat UFW as too hard to solve and only ask for more aid to provide greater production capacity, which already leaking systems cannot in any case carry.

One of the biggest obstacles to self-dependence in the Pacific Region is human resources. The Pacific Island nations must have trained and skilled personnel to be able to conduct as many functions as possible in order to achieve a level of self-dependence. The problem with this however is that the island nations with small populations have in many cases very low staffing levels, and these staff are limited in the number of jobs they can do. Consequently, even many routine housekeeping duties done by larger or more affluent water companies, cannot be performed by many Pacific Island water utilities.

In the water sector this often results in high levels of leakage. Obviously, older systems will suffer from higher leakage, but with the exception of aid-funded consultants, little has been done to help utilities in the Pacific region control their own leakage problems. Anecdotal evidence indicates that many consultants involved in leakage related problems seem more interested in proving that renewal of water systems rather than rectification of leakage is necessary, requiring further aid programs. At best, locating leaks without a follow-up to prove the effectiveness of a leakage detection survey is common, as repair crews cannot work fast enough to keep up with the consultants' findings. As leakage reduction and control has to be a long term activity and should be considered as part of good distribution management, short bursts of activity are not likely to produce lasting results because of inevitable system deterioration. Niue working with the engineer from SOPAC developed an effective leak reduction and control program. The Niue Leak Detection case study will discuss the successes and limitations of the program.

This overview "thematic" paper will look at what a truly sustainable Water and Wastewater Utility should look like in the Pacific to protect the Public Health, protect the Environment, and meet the customers needs.

Through a number of consultative meetings both in preparation for the recently developed Regional Wastewater Policy and this Regional Water/Wastewater meeting, the issues, concerns, and constraints that prevent the development of sustainable Water and Wastewater Utilities have been identified.

Measures which might be taken to manage and overcome some of the constraints are developed for both the specific island needs and also at the regional level, along with the development of future actions which would be needed to address the problems of the water sector as a whole.

It is important to state that often it is not the engineering of a water and wastewater project that is lacking. We have the capability and technical expertise to put a man on the moon and bring him back safely. What is important, is the development of affordable and appropriate water and wastewater infrastructure, that can be properly operated and maintained by the local population without expensive consultants, or specialized equipment and training.

A successful sustainable Water and Wastewater Utility is contingent upon its "Capacity Building" efforts, and the appropriate "Technology Transfer" along with the effective use of human, financial, and technical resources

In conclusion, this excerpt from the report, Small States: Meeting Challenges in the Global Economy, 2000. Commonwealth Secretariat/World Bank Joint Task Force on Small States, Washington, DC: World Bank, in a nutshell portrays what makes small states different and seems appropriate to include at this point to set the base line definition.

Developing small states share characteristics that pose special development challenges. They are especially vulnerable to external events, including natural disasters, that cause high volatility in national incomes; many of them are currently facing an uncertain and difficult economic transition in a changing world trade regime; and they suffer from limited capacity in the public and private sectors. More specifically, the following characteristics define the special development challenges and vulnerabilities that many small states face.

- **Remoteness and isolation**. Of the developing small states, three out of four are islands and in some cases widely dispersed multi-island states; others are landlocked, and some of them located far from major markets. For many small states, like those in the Pacific, high transport costs make it harder for them to turn to world markets to compensate for the drawbacks of the small size of their domestic markets. And small domestic markets combine with large distances from other markets to reduce competition and its spur to efficiency and innovation.

- **Openness**. A high degree of openness to the rest of the world brings benefits. But it also means that small economies are heavily exposed to events in global markets, and developments in the global trade regime, over which they have little if any influence. They also tend to rely more heavily on taxing imports as a source of revenue, leading to difficulties as tariffs are reduced.
- **Susceptibility to natural disasters and environmental change**. Most small states are in regions susceptible to natural disasters such as hurricanes, cyclones, droughts, and volcanic eruptions, which typically affect the entire population and economy. Some are threatened by global environmental developments. Since most of such adverse events affect the entire population, risk pooling at the national level is not feasible.
- **Limited diversification**. Because of their small domestic markets, many small states are necessarily relatively undiversified in their production and exports. Where one dominant activity has declined, it has tended to be replaced with another. This adds to vulnerability to changes in the external environment.
- **Limited diversification**. Because of their small domestic markets, many small states are necessarily relatively undiversified in their production and exports. Where one dominant activity has declined, it has tended to be replaced with another. This adds to vulnerability to changes in the external environment.
- **Poverty**. There is some evidence that poverty levels tend to be higher and income distribution more uneven in smaller states. Where this is so, income volatility can create additional hardship as the poor are less able to weather negative shocks to their incomes.
- **Limited capacity**. While weaknesses in both public and private sector capacity are a key problem for most developing countries, smallness of size adds a further dimension to the challenge. This is compounded in states, like the Pacific islands, where the internal distances are large and the population is scattered. In the public sector, small states face diseconomies of small size in providing public services and in carrying out the business of government, and tend to have relatively larger public sectors than other developing countries. In the context of globalization, small states also find they do not have sufficient institutional capacity to participate fully in international finance and trade negotiations—the outcomes of which can profoundly affect their economies. In the private sector, lack of diversification and domestic competition can hold back successful development. Many of these factors combine to make small states' economies especially vulnerable; in particular they affect incomes and access to capital.
- **Income volatility**. Overall, the range of per capita income and rate of growth is not significantly different in small and large developing countries. However, the residents of small states experience higher volatility of their incomes—the standard deviation of annual real per capita growth in small states is about 25 percent higher than in large states. This reflects several of the factors listed above—their high levels of exports and imports and low diversification in production and trade, which leaves them exposed to fluctuations in world markets, as well as their susceptibility to natural disasters.
- **Access to external capital**. Access to global capital markets is important for small states, and is one way to compensate for adverse shocks and income volatility. But the evidence is that private markets tend to see small states as more risky than larger states; hence spreads are higher and market access more difficult.

2. WHAT SHOULD A SUSTAINABLE WATER AND WASTEWATER UTILITY LOOK LIKE?

Successful Utilities and the Pacific Islands

This chapter is divided into two components. The first is an overview of a model of a successful utility. This is followed by a discussion of how specific Pacific island utilities compare to this model.

Sanitation facilities (water and sewer systems) are installed to protect public health, protect the environment, and satisfy customer needs. One of the keys to the effectiveness of these systems is the management of the organization responsible for the facilities. In this Thematic overview paper this organization is called the utility. The management functions of this utility can be placed into five categories:

- Organizational management
- Planning management
- Personnel management
- Operations management
- Financial management

Utilities may be public, non-profit, or privately owned. Public utilities may be owned by any of the common forms of local governments. In addition, there are a wide variety of organizational structures that could be set-

up within the local government to manage the utility. It is the structure of the organization, rather than the ownership that determines the effectiveness of the utility.

Effective utilities share three common key traits. First, they are organized as an enterprise [An enterprise is a public service, often a utility, that is budged and operated as though it were a separate business. Typically most, of the costs of providing the utility's services are recovered through user charges rather than subsidies from the General Fund]. Second, there is a single manager responsible for the operation, maintenance, and management of the utility. Third, this manager has a clear vision of the purpose and function of the organization and is able to communicate that vision to staff, customers, vendors, and regulatory agencies.

These three elements are combined in a manner to assure that the utility has the managerial, technical, and financial capacity to protect public health, protect the environment, and meet customer needs.

While all five of the management functions are critical for the successful effectiveness of a utility we commonly start with the organizational management issues. We have observed that utilities that do not have these components in place will fail in their development and implementation of the other four.

Organizational Management Overview

The functions of organization's management can be divided into seven basic sections that provide information on organizational management and administration of the utility. The seven sections are:

- Determining the level of service
- Organizational structure
- Defining key stakeholder roles, responsibilities, authority, and accountability
- Utility rules and regulations (ordinance)
- User agreements
- Workspace management
- Records Management

Level of Service

Level of service must be designed to meet all the utility goals and the needs of the customers. Therefore level of service can be viewed as the goals for the utility. Without first defining the utility goals, it is not possible to design an effective utility organization.

The level of service provided by a utility, controls quantity and quality of service provided by the utility. Level of service includes the frequency that tasks such as utility billing and preventive maintenance are performed, responsiveness of the utility in satisfying customer needs, availability of the operations staff to respond to emergencies, and office hours.

Defining the level of service is a key to determining the cost of operating the utility. In a small utility 70 to 80 percent of the annual operating cost may be labor related. A change in the efficiency and/or frequency of performing tasks can have a significant impact on the cost of providing service.

Organizational Design

The organizational structure is reflected in the organizational chart. Having a clear and well-defined organizational structure clarifies lines of authority and lines of communication.

Developing clarity lines of authority and communication allows the utility to define the roles and responsibilities of each position identified in the organization.

Roles, Responsibilities, Authority, and Accountability

When the organizational structure is clearly defined, each employee and stakeholder has a clear understanding of their individual and collective roles and responsibilities. These roles and responsibilities are based on the position within the organizational structure rather than on the individuals' capabilities.

By clarifying the roles and responsibilities of each position (stakeholder), it is easy to clarify the authority assigned to the position.

Once responsibility and authority have been established, it is possible to clarify how each stakeholder will be held accountable for their individual area(s) of responsibility.

In order to complete all of the activities of a utility, work must be delegated. The lines of authority in the organizational structure clearly define which positions can delegate responsibilities and to whom.

Rules and Regulations (Ordinance)

The utility rules and regulations, often called the utility ordinance, is the most useful and important document in the utility. This document provides the legal authority for the utility to exist and outlines the philosophy and structure of the organization. It provides the rules and regulations that govern and guide the operation and management of the utility.

User Agreements

There are two general agreements between the utility and the customer. One is an application to connect to the utility the second is an agreement describing the responsibilities of both the customer and the utility.

The authority to provide these agreements, as well as the content of the agreements, are described in the utility ordinance.

Administration

A major part of organizing an organization is contained in administrative functions. The procedures and processes used to administer a utility must be consistent with the level of service and utility operational philosophy as described in the utility ordinance. Administration consists of at least the following:

- Public relations
- Processing of user agreements
- Records management
- Workplace management
- Working with other organizations and agencies

Utilities exist to serve the needs of the customers. When customers do not understand the operation, purpose, and function of a utility, they will not support the utility. In addition, when customers do not feel properly treated, they may rebel by not paying their utility bill on time.

Quality user agreements are a part of providing good customer service. In addition, the processing of these agreements can be impacted by workplace management. This text provides guidelines for establishing and maintaining quality customer communication through the user agreements.

Poor records management practices cost utilities a significant amount of money and lost time. Typically these poor practices are the result of not knowing what records to keep, how to store them, and how they should be organized. This text provides a model record keeping system for a small utility.

Workplace management is the organization and operation of the customer service area, manager, clerk, and operator offices; equipment, tools, and parts storage; and the general day-to-day workings of the utility. This text provides guidelines for how to organize these workplaces.

Successful utilities have positive working relationships with other utilities and regulatory agencies.

Major Considerations

Key Components

What are the key components of an effective utility? Looking at effective and ineffective utilities we can see some differences. The following is a brief description of six of the key differences between successful and unsuccessful utilities.

1. While a utility can be successful when operated as a governmental function, most successful utilities are operated as a semi-independent enterprise (propriety function). Why an enterprise?

Here are five good reasons:

a) Enterprise-budgeting, once set up, is much easier than a governmental budget to maintain. Updating the annual budget is easier than updating governmental budgets. Enterprise accounting systems provide the manager with a clearer view of the cost of performing each function of the utility. Revenues remaining at the end of a budget year can be carried forward, thus, removing the end-of-the-year spending frenzies.

b) In most cases, a successful utility is managed by a single manager who has a clear view of the purpose and function of the utility and can communicate this to the staff, customers, and regulatory agencies.

c) Managers communicate their vision for the utility by paying attention to the details that reinforce their vision. The staff of an organization will respond to what a manager pays attention to. Thus, a manager must pay attention to the details that support his/her vision. A manager must be careful, therefore, what they pay

d) Successful utilities are focused on meeting the customers' needs. They do this by developing good public relations and customer service systems. These systems allow them to listen clearly to the customer, providing the organization with information about customer satisfaction, wants, and needs. Based on this information, the utility makes necessary changes.

e) Well managed utilities, are proactive with customers, staff, and regulations. They do not wait for problems to arise before taking action. The utility takes active steps to determine customer needs, staff needs, and the impact of proposed regulations, and then they respond to these needs.

2. Successful utilities are financially stable. They obtain this stability by establishing and maintaining clear financial systems. These include:

- Fair and easy to understand utility rates and charges
- Budgets that are realistic and functional
- Accounting procedures that allow the utility to determine the cost of providing service to each customer class
- Adequate reserve funds
- Proper planning procedures that focus the utility on meeting future customer needs
- Effective customer accounting and collection procedures
- Management and planning that deals effectively with regulatory demands and their costs

3. Successful utilities use written guidelines for the management and operation of the utility. These guidelines are based on the utility ordinance and include every major aspect of the utility from personnel to finances.

4. Well run, and successful utilities typically have a single central office where the customer can make applications for new service, obtain information about the utility, register a complaint, or pay a bill. In addition, this office provides a central dispatch for all routine and emergency maintenance crews.

5. Well run and successful utilities have a viable maintenance management system that includes: asset management, work orders, preventive maintenance scheduling, consumable and spare parts inventory control, routine data collection, data analysis, and reporting. The asset management system includes current value, replacement value, and life expectancy for all assets.

   Separate crews are responsible for new construction, preventive maintenance, and repair. (In a small organization, crews may be assigned preventive maintenance on specific days, repair on specific days, and new service installation on specific days. However, those functions should be performed by separate crews if possible.) This allows each crew to develop the necessary skills and prevents repair and new construction from diluting preventive maintenance.

   In these organizations preventive maintenance and routine operations account for 80% of the labor requirements while emergency repairs account for not more than 20% of the labor requirements (excluding new construction).

   These crews, to be successful, must have the proper tools and required spare parts.

   To protect the health and safety of the workers a viable safety program is an integral part of any successful utility.

6. In successful run utilities, training and skill needs are identified and an action plan is in place to provide all necessary skills. In these organizations training is not an additional activity it is part of the job.

The Model and the Pacific Islands

For the last eight years, we have been involved in assisting utilities in the Pacific islands in the improvement of their utilities. As a result we believe we have a perspective on how these utilities compare to the model. While we will not relate information about specific utilities the utilities referenced include those located on, American Samoa, Majuro, Kosrae, Pohnpei, Chuuk, Saipan, Yap, and Palau.

The following is a discussion of how these utilities compare to the model and our observations of the results of not following the model.

In the beginning of this project each and every manager requested assistance in one or more of the following areas; operator certification, operator skills, and implementation of a preventive maintenance program. While these are all valid request they did not in any case address the true and immediate need of the utility. This is an excellent example of the manager paying attention to the wrong area.

While most managers of the above utilities believe their staff needs technical skill training we found that most of the issues associated with dysfunctional utilities or departments within the utilities were management problems not operator technical skill problems. Here are some supporting thoughts.

Overview of Utilities. There are eight utilities involved in this review. Of these two are of significant size, that are serving populations of 40,000 or more. Two are government operation (they do not utilize the enterprise model), one of which serves a very small customer and has no operation budget (less than $2000 US for the year). The second servers a much larger customer base and is very dysfunctional.

In only three of the eight is the water considered potable. Due to high chloride levels in one, significant sanitary deficiencies in a second, and questionable water treatment process controls in the third I recommend bottled water be used by visitors to these three as well as all of the others. In addition, two of the remaining five utilities do not provide 24/7 water.

General Considerations. In most cases these eight utilities fail to meet the model in the following area:

- In at least one utility there is no attempt to provide potable water. The customers do not demand potable water and in fact obtain most of their drinking water from roof catchment systems. In additional, due to the low level of income on the island, the customers have no interest in paying for service.
- There is little or no interest in meeting customer demands. The focus is on the needs of the utility not the needs of the customer.
- With minor exceptions, these utilities are not proactive in their approach to regulations, meeting staff needs, or meeting customer needs. A part of this is due to the lack of enforcement of existing regulations and in some cases the lack of regulations. Regulations or not, a prudent manager would focus attention on providing potable water.
- Only two of the eight utilities are financially stable. One other is in good shape and the remaining struggle on a monthly basis. In many cases, customers are allowed to get months behind in payment of their bills. Political influence and personal biases prevent adequate collection rates. In some of these utilities the collection rate is less than 50%. In one it is 104%, which of course is the exception.
- Written guidelines do not exist in most of the utilities for key components. Lacking in most are personnel policies, annual operations plans, utility master plans, renewal and replacement plans, capital improvement plans, accounting procedures, and budgeting. While some of the utilities have good examples of one or more of these written guidelines none of them have them all.
- A central office exist in six of the eight utilities.
- A functioning maintenance management system that includes asset management, work orders, and preventive maintenance scheduling does not exist at any of these utilities. However, the preventive maintenance scheduling is being utilized by three of the eight utilities. A functioning work order system is being utilized by one utility. Asset management is 70 to 80% implemented at one utility.
- Only one division of one utility utilizes designated crews for operations & preventive maintenance, repair, and construction. It turns out this is the most effective component of all of the utilities.
- Only one utility has an active safety program. This program is approximately 70% complete and is actively applied to only one division of the utility.
- Skill training for all staff is not designed into the personnel advancement program at any of the utilities. However, one utility is in the process of implementing this concept. In addition, most managers do not expect or require staff to implement the skills and knowledge gained in training. Training is looked upon as a benefit. When the participant returns to the job they are expected to go back to doing things in the same way they were before the training. Thus there is no benefit to the utility or the staff.

Organizational Structure. While all of the utilities have some type of organizational structure, they are all lacking defined roles, responsibilities, and authority for each position. This lack of clear definition of responsibilities and authority, causes a number of problems, among them are the following:

- Supervisors fail to discipline employees for violation of work rules. This is due to lack of clarity of the work rules and the lack of understanding by the supervisor of their responsibility in discipline. In addition, most supervisors have had little or no training in how to properly administer discipline.
- Required spare parts are not on-hand because those in charge do not know who is responsible for obtaining the parts. In most cases, the utility is able to respond to an emergency by air shipment of parts at increased shipping cost.
- In one case a staff or 30 to 40 has three to four managers. Each gives daily direction, which often conflict. This results in staff confusion. In addition, these conflicting managers do not agree on priorities and often pull staff from a previously assigned crew to work on an entirely different project.

In one case, where the utility is operated by the government, the organizational structure is so confused as to be a major influence on the very poor effectiveness of the utility. For example, to obtain a new service connection requires the customer to find a specific person, to start the sequence of events and then travel to three different offices seeking a specific person in each. The individual in each of these offices, reports to different departments of the government.

Management Focus. Organizations develop organizational cultures. The organizational culture development is a direct result of the attention, or lack of attention the manger pays to the details of the day-to-day operation of the utility. Thus it is important that a manager be careful about what they pay attention to. They should pay attention to those items that reinforce the vision the manager has for the utility. Thus, if the manager does not have a clear vision they cannot determine which items to pay attention to.

When reviewing these eight utilities and observing the manager it is clear that the utility takes on the personality of the manager. If the manager practices a high degree of integrity then all is well. However, if the manager uses the utility for personal gain the staff responds in a similar manner. Simple actions such as not com-

ing to work on time, using the utility equipment for personal use, excessive travel, routinely over indulging in alcoholic beverage, can be the most damaging. The staff will look upon these actions as being supported and approved by the utility.

When managers do not provide direction for the utility it, the utility, will seek its own direction. Most of the time this is not a good direction to be heading. In most of the Pacific island utilities we have worked with, the managers pay very little attention to the water and sewer division. This is partly due to the fact that most of the managers were hired because of their electrical experience and they have very little understanding or appreciation for the public health aspects of the water and sewer utilities. This is the case in all but one of the non-government run utilities. This has resulted in the hiring by the manager of a division or department manager to run the water and sewer utility who has very limited technical knowledge. The result is an ineffective utility and considerable personnel dissatisfaction resulting in poor operations and poor maintenance of the utility assets.

Crews. All but one department of one utility functions in a crises management mode. In this mode, crew assignments are made daily, and often changed during the day. In many cases the crews are not able to complete the tasks assigned due to the lack of tools, parts, staff, or equipment.

The idea of the same crew routinely inspecting the facilities of the utility is such a foreign idea that it is very difficult to implement. Responding to problems, and building new facilities gets more management attention, funding, and positive feedback. Thus, it becomes the organizational culture. The result is a continuous deterioration of the utilities assets with more and more failures. This continues until the deteriorated facility is replaced and then the cycle starts all over. This is very evident when viewing some of the recently completed ADB projects. Keeping the poor design, selection of improper equipment and lack of involvement of the local staff out of the picture we still observe a rapid deterioration of these new assets due to the lack of routine inspection and preventive maintenance.

In some cases we have been told that the equipment has not given any trouble since it was replaced. This is true of most new equipment for the first three to five years of its life then it begins to fall apart due to the lack of routine preventive maintenance.

Tools, Parts, Communication, and Transportation. The lack of needed spare parts and tools are one of the most common and most severe departures from the model. This contributes to the lack of maintenance, failure of equipment, robbing one asset to make another one function, and the inability to apply skill training to the job.

To assist reducing the impact, the lack of tools had on training, the Micronesia Water and Wastewater program provided tools to six of the eight utilities. The other two were considered large enough to be able to furnish their own tools. After four years the tools have disappeared in three of the utilities. They can all be found in the one island, where the tools were given to a local community college. In one utility the manager purchased several sets of the tools, one for each crew. In this instance the tools issued to individuals are still available. However, the tools issued to the utility cannot be found. We concluded that when no one is responsible the tools will disappear.

While most of the utilities have parts to fix line breaks and make major system repairs, all but one lacks the repair kits needed to perform preventive maintenance on key equipment such as chlorinators, altitude valves, and fire hydrants. This lack of repair parts has been a major roadblock to the application of training and technical assistance.

In addition, many of these utilities lack sufficient vehicles for the field staff. In one case a staff of 16 is required to share two vehicles in an attempt to inspect and maintain over 45 lift stations. Add to this the lack of internal communications between the field crews and the crews and a central office. One utility utilizes cell phones as a means of communication. While this appears progressive, each crew must be called individually. With a radio system multiple crews can be summand from a single command point.

The Conclusion. After five years of activity in Micronesia and seven years in American Samoa, a number of problems have been resolved and there are measurable improvements in all of the utilities.

In order for any technical assistance and/or training program to be the catalyst for significant improvements in these utilities the utility managers must be willing to change they way the operate their utilities. If the managers and staff are happy with the current status of the utility then providing technical assistance, grants for construction, and/or training will not make a long term significant positive impact on what quality and thus on public health.

The lack of support by the public health agencies and the lack of enforcement of existing water quality regulations also sends a message to the managers of these utilities that there is no problem and thus change is not needed.

3. SUMMARY OF ISSUES, CONCERNS, AND CONSTRAINTS

Consultation

Over the last couple of decades dating from the water decade, there has been greater attention paid by Inter-

national Forums, Regional organizations, NGO's, and government agencies to the issues of Water Resources, and Water Pollution. One of these efforts by the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) identified the priority for action on sewage. In the Pacific region, a consultation process was facilitated by SOPAC, SPREP, PWA and the UNEP/GPA Coordination Office on wastewater management.

A Regional Wastewater Management Meeting was held 10-15 October 2001 in Majuro, Republic of Marshall Islands and was the latest in the consultation process, which included preliminary sessions in February and March 2001 in Auckland and Apia. The Majuro meeting was sponsored by the Governments of Belgium, New Zealand and Taiwan/ROC.

The meeting brought together representatives from 15 Pacific Island countries (American Samoa, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, New Zealand, Niue, Papua New Guinea, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu), technical experts from inside and outside the region, regional and international organisations (SOPAC, SPREP, SPC, PWA, WHO, UNESCO, UNEP/GPA), potential donors and NGO's, to complete the Pacific Wastewater Policy Statement and the Pacific Wastewater Framework for Action. Both documents were submitted to governing bodies of regional organisations for their endorsement by the respective governing council national representatives.

The Pacific Wastewater Policy Statement sets out a framework of guiding principles and policies to guide future development and co-operation by the Pacific Island Countries (PICs). The Pacific Wastewater Framework for Action comprises a list of proposed actions to be undertaken at national and regional levels to achieve the goals that are laid out in the Pacific Wastewater Policy Statement and which refers to the GPA Strategic Action Plan and Guidance Document on Wastewater (UNEP/GPA, WHO, UNCHS-Habitat & WSSCC).

In the opening statement by the Hon. Tadashi Lometo, Acting Ministry of Health and Environment at the Regional Meeting for Stakeholders in Wastewater Management in Majuro, he stated that:

"Wastewater management is one of the more pressing concerns of each of our countries as we are faced with the challenge of meeting the demands of a wide variety of economic and development activities, while at the same time, taking into careful consideration the potential adverse effects of such activities on the well being of our people and environment."

"…a very important issue that the Marshall Islands constantly battles is sewage problems. It has been indicated in studies that sewage is a major source of pollution in almost every country in the Pacific, affecting the marine, coastal and freshwater environments. And this serious matter has "pooled" us together in cooperation with our regional organizations such as SOPAC and SPREP, as well as international initiatives like the Global Program of Action, to find ways to improve and enhance the situation. Our difficulties in dealing with the issue arise from problems such as economies shaped by distance and isolation, a shortage of fresh water, cultural sensitivities and financial issues…"

"In this regard, wastewater management is an essential issue that needs decisive steps for improvements. We need to develop or strengthen policies and measures that will stimulate further improvements and understanding."

"In addition, the health of our people is considerably dependent on the issue at hand. Poor wastewater disposal contributes to both water resource pollution and seafood contamination. Therefore, new initiatives must be taken in addition to institutions already in place. Long term national and regional policy framework to move towards zero sewage problems must be created to achieve sustainable development."

"Our goal is to work together to ensure a speedy process that will produce a Regional Wastewater Action Plan that is tailored to the special needs of each of our countries, while at the same time reflecting our unique ability to come together as one "Pacific Family" in the spirit of promoting regional coordination and cooperation."

Russell Howorth, Program Manager for the South Pacific Applied Geoscience Commission (SOPAC) also at the Regional Meeting for Stakeholders in Wastewater Managment shared these opening remarks with all the meeting organizations from off island. He thanked the CROP regional organisations, SOPAC, SPREP and SPC, and the utilities group PWA who provided regional technical support and advice on wastewater and waste to Pacific Island Countries. The UNEP Global Programme for Action for the Protection of the Marine Environment from Land-Based Activities, GPA for short, who had provided the framework for strategic action plans to be developed at a regional level.

Russell noted that the Majuro meeting represented the latest chapter in the regional consultation process involving the Pacific Island member countries of both SOPAC and SPREP, resource persons from Fiji, Australia, New Zealand and the USA, and the technical staff of both agencies. Preliminary consultations in New Zealand and Samoa earlier in the year had developed the groundwork upon which the Majuro meeting was based. Working groups consisting of Pacific Island delegates in conjunction with SOPAC, SPREP and a wide variety of resource persons had identified the constraints facing sustainable wastewater management and developed initial responses.

It was now the responsibility of the delegates in Majuro, to finalise and endorse a regional policy on wastewater management and develop a strategic action plan to

focus regional, national and local activities. Russell acknowledged that there were many hours that many of the delegates had spent on the task of developing the draft texts, during the previous 10 months and that all of the Pacific Island Countries and Organisations represented in Majuro had given of their free time to be there. In conclusion, the local Pacific Island governments and organisations had expressed their commitment to the task before the Majuro meeting by directly contributing to the total funding of the process, along with the supporting generous direct financial support shared by Belgium, New Zealand and Taiwan ROC.

The results of that Majuro meeting were in fact the development and the endorsement of a regional approach towards the sustainable management of wastewater through an appropriate set of recommendations and actions, which are included later in this paper.

Although the Hon. Tadashi Lometo, and Russell Howorth were specifically addressing Wastewater at the Regional Meeting, the same constraints, concerns, limitations, issues, and proposed actions which will be discussed at this Regional meeting apply equally to Water.

The consultative approach was continued and used extensively in preparation for this Pacific Regional Consultation on Water in Small Island Countries. At the recent Pacific Water Association, Annual General Meeting in Port Vila, Vanuatu in April, 2002. SOPAC facilitated a day session with phenominal feedback and participation from the utilities in attendence that identified the following constraints which limited the ability of organizations to be successful providers of Urban Water and Wastewater services to their customers. These constraints are identical to those constraints identified during the Wastewater Regional Meeting.

In January/February, 2002 also in Port Vila, Vanuatu, the ADB "Planning Meeting for Water in Small Island Countries Theme" in preparation for the 3rd World Water Forum identified similar constraints.

Constraints, Concerns, Issues

The consultative process has identified the following national constraints to achieving sustainable Water and Wastewater management. These constraints are not specific to these two sectors and are true of most sectors functioning in the Pacific. The constraints can broadly be divided into three groups: Institutional capacity of national agencies; governmental support; and public support.

- **Insufficient institutional capacity**: lack of data & information systems; insufficient or inoperative equipment; poor maintenance of equipment, limited technical expertise; weak institutional bodies; often demoralized and unmotiveated staff; insufficient training opportunities; poor staff retention; lack of finances; lack of a single manager responsible for all aspects of the utility including: planning, construction; operations, maintenance, management, and financial management. The Manager lack a Vision and is unable to articulate a clear vision to the staff; high cost of service; water quality; water conservation; poor public relations; No value given to water (meter) or the establishment of a proper tariff .
- **Lack of Government Support**: lack of political will but often too much unwanted political interference; legislation inappropriate or absent; lack of regulation and no capacity for enforcemnet, often no coherent national policies on integrated water resource management; land issues; fragmented multiple government agency involvement resulting in poor regulatory or policy links between the various sectors, often inadequate share of the National annual budget and conflict between public service and sustainable utility; political instability, lack of national long term planning and commitment, no value given to water (meter) or the establishment of a proper tariff.
- **Insufficient public support**: inadequate public awareness; insufficient community participation and involvement; and associated lack of appreciation of socio-cultural issues.

Additionally, the Pacific Island countries environment itself (outside of the national capacity) often results in further constrains due to the isolated and fragmented nature of multiple island states within a vast ocean expanse. These are common to most countries in the region.

These regional constraints include: restricted land area; competing land uses; small population base; increasing population density on "capital" islands, and de-population on outer islands; isolated communities; high transport costs; limited economic development (above factors unattractive to industry); limited tax revenue generation; poor and costly communication, electricity, and water supply systems (Due to low economies of scale); high vulnerability to natural disasters; climate variability, El Niño-Southern Oscillation (ENSO) and sea level rise issues; and lack of coordinaton between donors (unreasonable donor restraints), international organizations, and receiving countries.

Other National and External Constraints which Hamper Sustainable Management of Water and Wastewater Utilities!

Environmental problems are increasing. Several factors such as high population growth, poverty, urbanization, economic growth and the use of imported inappropriate technologies are creating environmental problems. Partly as a result of these pressures, traditional ways of managing the environment are now disappear-

ing. Some pressing concerns include contamination of water resources, rapid deforestation, unsustainable and destructive exploitation of marine and mineral resources, poor waste management, inadequate sanitation, and urban pollution. In addition, the Pacific Region include many small-island countries with vast geographic, ecological, and sociocultural diversity. The smaller the islands, the more immediate and severe are the consequences of inadequate environmental management and the greater the risks of cumulative collapse or catastrophic damage from climatic events. The most crucial environmental issues are in the areas of (i) natural resource conservation, (ii) waste disposal/ management and pollution prevention, and (iii) climate change and sea level rise.

Natural resource conservation must become a priority. Pacific island people rely on natural resources to meet their traditional needs and increasingly to generate cash income, e.g., tourism. Rising material expectations and, in many cases, high population growth are placing considerable pressure on the limited land and coastal marine ecosystems and the biodiversity they contain. The Pacific Island countries have high levels of species diversity that is among the most threatened in the world. Poor natural resource management, and poorly planned and implemented development projects and programs, (including inproperly operated and maintained infrastructure development for water and wastewater activities) are depleting and compromising the natural resource base.

Waste management and pollution prevention are becoming increasingly important priorities. Many Pacific Island countries share the problems of waste disposal and urban pollution. High population growth, particularly in urban areas, combined with limited land area and specific programs to stimulate economic growth are exacerbating these problems. Disposal of solid waste is a particular problem in very small islands where there is no space or infrastructure for safe disposal. Even in the larger islands recycling is rare, and most disposal is done through landfill. Wastewater pollution is also increasing with negative impacts on freshwater systems, enclosed coastal waters, aquifers, and groundwater lenses. Human sewage disposal is also a major problem and poses serious risks to human health and inshore fisheries.

Climate change and sea level rise remain major potential problems. The majority of the Pacific peoples live in low-lying coastal areas that are particularly vulnerable to climate change, climate variability, and sea-level rise. The increased frequency and intensity of storms and cyclones, combined with even minor increases in sea level may cause major disruption to economic and social life, and even threaten the very existence of these countries, particularly the atoll nations. One very serious effect of a rising sea level would be its impact on freshwater lenses underlying atolls. The risk of saltwater intrusion will rise as the sea level rises, lateral leakage will increase, the groundwater lenses will become thinner, and saltwater will move within reach of pump intakes. Limited freshwater resources will be lost or at grave risk. In addition, as the sea level rises, saltwater will reach the roots of pit-grown taro, coconut palms, and other tree crops with clear negative effects on their production.

Political stability is perhaps the most significant factor currently influencing water and wastewater development projects. A variety of recent events have underscored the importance of political stability. Recent political changes in the Cook Islands and Vanuatu indicate the need for reform governments to be far more inclusive and participatory in their reform initiatives, thus ensuring that the momentum of reform continues despite changes in government. Political upheavals in the Fiji Islands and the Solomon Islands point to the need for governments to be more sensitive and responsive to growing inequities between various segments of society. In fact, in a span of 12 months, 7 of the 12 Pacific Island countries have had changes in government. The volatility of political changes in the Pacific appears endemic and must be taken account of when working with governments to plan and implement reform and development strategies.

Good governance also significantly influences the achievement of developing sustainable water and wastewater goals and objectives in the Pacific. A good example of early benefits of good governance policies is the recent case of PNG. With the adoption of a strong governance reform agenda by the new Government in late 1999, and supported by multilateral and bilateral development institutions, PNG has quickly managed to substantially reverse its fast-declining economic performance, and substantially improve its access to international finance. This is a clear signal to Pacific governments to become more transparent and disciplined in the management of their financial sectors.

The shortage of managerial and technical skills is a major development constraint. The human resources and institutional capacity in the Water and Wastewater Utilities, specifically, and in the Pacific Island countries generally, remain extremely weak, which is in large measure caused by the small labor market and limited local education opportunities. Weak human and institutional capacities are perhaps the most significant stumbling block to achieving not only sustainable water and wastewater utilities, but efficient social and economic systems. Weaknesses range from the weak capacities of parliaments to debate policy issues and to effectively oversee government administration, to the limited professionalism of the civil service, the weak capacity of sectoral agencies to regulate and manage critical public services, and the ability of the private sector to engage the necessary business and technical skills. The shortage of skills in the smallest and remotest Pacific Island countries is to be expected, and there is no easy solution. However, while much effort

has been expended in building skills in the larger Pacific Island countries such as the Fiji Islands and the Melanesian countries, durable capacity is still lacking. The important lesson from capacity building efforts in the Pacific so far is that it is a long-term task requiring sustained attention and investments. There are serious risks in being overly ambitious, given the weak base in most countries.

To some extent, providers of external assistance have contributed to the problem of low capacity. Multilateral and bilateral donors design complex projects and programs, and then field a battery of consultants to implement these because local capacity cannot cope. Capacity building programs are often resourced by long-term consultants who often are technical rather than capacity building specialists, and who end up doing the work themselves rather than transferring skills. Governments compound the problem by not adhering to a policy that allows trained incumbents to stay in place over an adequate period of time to have an impact on institutional operations. Finally, while bilateral programs have devoted much investment to overseas education and training, these programs are plagued by the consequent emigration of trainees, seeking more attractive overseas employment.

Many Pacific cultures are substantially tribal based, adhering to a value system that elevates tribal and family allegiances above all else. While this value system has served the Pacific people well over time, it also influences the water and wastewater utilities in particular ways as they modernize and adopt global trends. The tribal system influences the stability of management (particularly when managers are selected not on the basis of policy mandates or knowledge, but on tribal allegiances), the openness of governments to external investments, the ability of external investors to access land for commercial operations, the capacity of indigenous entrepreneurs to initiate and manage successful businesses while coping with extended family demands, and the ability of staff to reliably give time to employment rather than family matters.

Access to land, so critical to private investment, is substantially influenced by local custom. Most land remains under complex traditional ownership structures that do not provide formal ownership but provide access to land for family and community members. This prevents the use of land for developing water and wastewater projects without paying a high price for the use of the land. However, with rural populations growing there is not enough available land for subsistence living. Rural people need to move into the cash economy and to bring customary lands into the cash economy.

The influence of cultural traditions must be considered seriously when designing development strategies. It is not suggested here that there should be a concerted effort to change these sociocultural traditions. Many traditions are extremely valuable even from an economic point of view, particularly to protect natural resources and provide social security safety nets. Their influence in addressing the major development challenges are real and significant. This needs to be recognized in the development of strategic approaches to water and wastewater developments in the Pacific Island countries.

The rate of population growth continues to be worrisome. In most Pacific Island countries, improved health conditions have added to longevity. Populations in Melanesia and parts of Micronesia continue to grow rapidly because of high fertility. For instance, the growth rate of the RMI is 3.6 percent and that of the Solomon Islands is 3.3 percent. In most of Polynesia, (although population birth rates are high) population growth remains largely stable reflecting substantial migration to New Zealand, Australia, and the United States.

The single biggest challenge is to generate wage- and income-earning opportunities for rapidly growing labor forces. Given no expansion in public sector employment, and the inability of the private sector to absorb new labor force entrants, current population growth rates will result in ever-increasing levels of unemployment. This in turn will have adverse impacts on poverty levels as is already happening in the RMI and the Solomon Islands, and is beginning to occur in PNG. This migration into more populated urban centers for employment opportunities, places a burden on the water and wastewater utilities need to continually develop resources to serve the growing population.

At the root of the population problem is the inability of education services to reach out to the people, particularly the women. This is particularly the case in Melanesia and Micronesia. Admittedly, providing the necessary education services, particularly to females in the rural areas, is not easy. Government budgets continue to be strained. The capacity of education agencies is weak. The topography of many Pacific Island countries makes the task doubly difficult. NGOs do play an important role, but their number and resources in the Pacific Island countries remain seriously limited. Government commitment to this problem and innovative methods and approaches are urgently needed if population growth is to be addressed.

Physical, Technological, and Financial Infrastructure

Undeveloped infrastructure severely constrains economic development. Combined with remoteness and high transportation costs, undeveloped water and wastewater utilities, and other infrastructure ranging from roads, ports, wharves, navigation aids, power generation and distribution, and telecommunications, remains a significant constraint to both external and internal investments in most Pacific Island countries.

Often productivity is low, and in many cases the rich natural resources of the Pacific Island countries cannot be exploited due to the lack of efficient access. Where infrastructure has been built, often this infrastructure is not maintained because skills or public finance is lacking. Thus, future efforts to improve infrastructure must take account of skill and financial capacity to maintain the same.

There are opportunities for Pacific Island countries to harness Information Technology (IT) to overcome some of the economic constraints and vulnerability related to their isolation and smallness. An important development worldwide is the availability of new and powerful IT. While there is the threat that Pacific Island countries may be largely excluded from the economic gains enjoyed by participants in the new information-knowledge society, IT has the potential to increase the size of markets, reduce the costs of distance, enable access to sources of learning and advice, and bring jobs to skilled people even in remote locations. Of particular relevance to small states is the fact that the IT industry generally does not require much land and has low environmental impact. To enable Pacific Island countries to bridge the so-called digital divide, they will need, at a minimum, to improve and expand their infrastructure for IT, set-up appropriate regulatory regimes, and enhance computer literacy. The potential for the water and wastewater utilities to benefit from the development of IT, is the opportunity to generate information from around the globe, and access information that is currently not available.

Undeveloped financial sector infrastructure remains a major disincentive to financial investment in the Pacific Island countries. The financial sectors of the Pacific Island countries are dominated by a few foreign-owned banks that concentrate their operations in the urban areas, are extremely risk averse, and have no interest in servicing the rural areas where the bulk of the population resides. A local capital market does not exist for all practical purposes. The financial investment into the development of the water and wastewater utilities is considered too risky, so that local financial resources and investments are not a viable option.

Are the constraints in achieving sustainable services – new?

The issues that have prevented water and wastewater utilities from being sustainable are not new. They are recognized and have been around for some time.

Ten years ago when Tony Falkland published the UNESCO report entitled "Small Tropical Islands – Water Resources of Paradise Lost", printed in May 1992, it clearly identified Major issues and problems relating to Water Resource Development and Management. He identified the following problems of water administration, and I quote:

> **"On many small islands, the water resources are administered either by a governmental department concerned with much broader responsibilities or by a number of departments. Inevitably, there is intense competition for the very scarce funds and manpower. (This phenomenon, however, is not unique to small island communities.) Such a fragmentation of responsibility among a number of organizations also can lead to long delays in reaching decisions which may not necessarily be based on sound technical or economic grounds."**
>
> **"There also is often insufficient expertise to properly administer the many-faceted functions of a water supply utility, regardless of how small it may be. This problem is due to insufficient training, inadequate resources – particularly funds for operation and maintenance tasks – and inappropriate technology."**
>
> **"Often there is little or no co-ordination between a multiplicity of agencies including water and health authorities, non-governement organizations, bilateral and international aid agencies and United Nations organizations."**
>
> **"Difficulties of transport and communications due to large distances from supply and information sources are common. This often results in long delays in obtaining necessary supplies. Large distances between islands of an archipelago add to this problem."**
>
> **"Reliance, in many cases, on short-term expatriate advisory and management staff often leads to lack of continuity in projects, with a consequent wasteage or resources and inefficiency."**
>
> **"There is often incompatibility of materials and equipment supplied from different sources. This is especially true for the many islands in developing countries where project assistance is obtained from different aid donors. The problem is made worse if aid donors have conditions requiring the purchase of materials and equipment from the donor country."**
>
> **"The largely unskilled work-forces on many small islands can result in water development and water supply projects not being operated and maintained correctly."**

This very nicely sums up a number of issues which contribute to Pacific Island Water and Wastewater Utilities being less than successful in their ability to provide 24 hours-7 days a week of potable water to their customers, while protecting the environment and improving Public Health.

4. MEASURES TAKEN TO MANAGE WATER AND WASTEWATER UTILITIES

During the consultative process, after the constraints were identified, appropriate measures and actions that might improve the service delivery and reliability of water and wastewater utilities were suggested and perhaps if appropriate will be developed.

1. Political will and financial affordability are prerequisites for adequate water and wastewater management.
2. Environment, health and economy are important indicators for action.

3. Stepwise implementation of measures is essential to reach long-term management goals.
4. Demand driven analyses and prognoses are to be adopted to ensure effective investments.
5. Sustainable solutions for wastewater management build upon pollution prevention at the source, efficient water management built upon use and best available technologies, addressing economic aspects, social aspects and low-cost alternatives when appropriate.
6. 'Water User Pays' and 'Polluter Pays' are basic principles to consider.
7. National and local governments are to take their responsibility in creating an enabling environment for sustainable solutions.
8. Commitment and involvement of all stakeholders are to be assured from the start.
9. Public Private Partnerships and other new financial mechanisms are to be explored.
10. Linking municipal water and wastewater management systems to other sectors, for example tourism, ensures better opportunities for adequate cost-recovery. Rates are to be established solidarity wise and at social equity.
11. Innovative alternatives and integrated solutions are to be fully explored before final decisions on action are taken.
12. Water and wastewater utilities can only become truly sustainable when they have developed within the organization, the capacity building of human resources to provide the necessary skills, which are locally unavailable.

Some Key Measures on the Management of Urban Water and Wastewater:

1	Political will and financial affordability are prerequisites for adequate water and wastewater management	In order to safeguard human and ecosystem health, and to avoid the degradation of water quality and other coastal and marine resources, the two most important prerequisites for adequate water and wastewater management are: i) The political will to assign a high priority to wastewater management among other pressing public investment needs, ii) Financial affordability.
2	Environment, health and economy are important indicators for action	Human health, economic functions and environmental integrity within the catchments are all essential indicators and driving forces for adequate urban water and wastewater management. The non-action alternative imposes great costs on current and future generations.
3	Stepwise implementation of measures is essential to reach long-term management goals	Long-term management objectives direct the priorities of issues and measures to be explored. However, stepwise implementation of measures may be needed to address the needs identified in an affordable way. Immediate small-scale, site-specific solutions, following realistic timeframes, may be preferred above holistic planning efforts to actually serve the long-term management goals.
4	Demand driven analyses and prognoses are to be adopted to ensure accurate investments	Rather than supply driven investments, demand driven approaches give 'value for money'. Demand driven approaches need proper analyses of the societal demands now and in the near future.
5	Sustainable solutions for water and wastewater management build upon pollution prevention at the source, efficient water use and best available technologies, addressing economic aspects, social aspects and low-cost alternatives when appropriate.	The high costs of water and wastewater management warrants a very careful search for low-cost and thus more sustainable technologies and approaches that target waste prevention and minimization, pre-treatment water conservation, and the efficient use of water. More cost-effective technologies comprise e.g. lagoons, natural systems, anaerobic treatment and potential for re-use instead of costly high-tech wastewater treatment plants.
6	'Water User Pays' and 'Polluter Pays' are basic principles to consider	The principles "the water user pays" and "the polluter pays" are basic to achieve sustainable water and wastewater management systems. These principles can very well be applied in a way to ensure equitable sharing of costs by the rich and the poor.
7	National and local governments are to take their responsibility in creating an enabling environment for sustainable solutions	A country's central government plays a significant role as a facilitator and initiator of appropriate water and wastewater management in developing systems to ensure good and sustainable governance.
8	Commitment and involvement of all stakeholders are to be assured from the start	Water and wastewater management is pre-eminently an effort that involves many stakeholders (governmental and non-governmental) who all must be willing to co-operate and contribute to the overall result. Thus, the investment in awareness creation, demonstration of "win-win" situations and development of commitment are essential to foster successful water and wastewater management. In many countries, however, institutional restructuring and strengthening (capacity building) at the local level is required to ensure the good performance of water and wastewater management systems.

Some Key Measures ... continued		
9	Public Private Partnerships and other new financial mechanisms are to be explored	New partnerships between the public sector and the private sector are important options and useful tools to assist local governments in financing and operating the infrastructure for water and wastewater management. To improve managerial performance, to find synergy and to get access to additional investment capital, often first an adequate regulation is required to avoid negative consequences.
10	Linking municipal water and wastewater management systems to other sectors, for example, tourism, ensures better opportunities for adequate cost-recovery.	Water supply, and sustainable wastewater management systems require very high initial investments and, consequently, long term contracts to cover financial risks and sufficient recovery of costs. As profits are likely to be more prominent in other sectors, linking up to these reduces the risks involved and thus enhances the feasibility of new, prospective partnerships.
11	Innovative alternatives and integrated solutions are to be fully explored before final decisions on action are taken	Comprehensive stepwise approaches in decision-making on urban water and wastewater management are needed to explore alternatives before making final decisions on action. This should support adequate, tailor made and cost-effective measures, integrated with other sectors such as water resources and urban and rural planning in catchments, as domestic water and wastewater management are not an isolated problem.
12	Water and wastewater utilities can only become truly sustainable when they have developed within the organization, the capacity building of human resources to provide the necessary skills, which are locally unavailable.	Utilities have a critical need for suitably trained professional and technical staff. These high level professionals are required for the proper, safe and efficient operation of water, and wastewater services. National or Donor requirements also may require personnel with certified professional credentials in a number of key positions to protect public health and safety. All such positions require specialized education, a supervised internship, and some type of professional license. This type of professional certification can only be obtained through recognized academic and professional training programs.

A Pacific Island Example of Human Resource Investment in developing local staff

ASPA Professional Training and Apprenticeship Program

Brief Program Description

This is a personnel development program designed to improve ASPA's long term capacity in critical O & M areas. ASPA currently has a shortage of high level professionals in a number of technical areas. This program will provide education and professional certification for selected personnel in areas of critical need. These include engineers, water treatment plant operators, electricians, linemen, and others.

The program will enable selected employees to obtain professional license or certification in specific technical fields. They will attend appropriate education or technical training schools, as well as complete apprenticeship or internships requirements, necessary for certification.

The training institutions and courses of study are chosen based on ASPA's needs. They are selected to provide ASPA with essential expertise it currently lacks in areas critical to its operation. In addition, the program will help provide staff with the necessary professional credentials required by Federal regulations for a number of positions.

Program participants will be selected among current employees, whenever possible, who have demonstrated sufficient intelligence and dedication to excel at the profession. They will provide ASPA with a potential pool of engineers and technical specialist well into the future. Thus, the program is a long term investment in ASPA's future.

The Need

ASPA has a critical need for high level professional employees. These include engineers, treatment plant operators, electricians, computer network specialists, and certified linemen. The requirements of utility operations, as well as compliance with U.S. Federal regulations, demand suitably trained and certified professionals in a number of technical areas. Unfortunately, ASPA has a shortage of such personnel. These professional positions require specific technical expertise, advanced education, and professional credentials.

There are a number of factors which contribute to this shortage. Among these are:

1. High personnel costs

Individuals with high level professional credentials, and work experience, (justifiably) command salaries commensurate with their qualifications. This is particularly true in public utilities. There is a worldwide shortage of electrical engineers, water treatment personnel, and other professions essential to utility operations. Consequently, salaries are high for these positions, and competition for experienced professionals can be intense.

Unfortunately, small island utilities like ASPA find it difficult to recruit and hire qualified professionals in this climate. It simply does not have the financial resources to offer salaries competitive with those offered by large utilities in the US mainland and elsewhere. Even when it is able to attract such employees, it is seldom able to retain their services for very long. Few contract professionals stay more than a year or two, lured by better salaries and working conditions elsewhere.

Given its limited financial resources, and the economic climate of American Samoa, ASPA will never be able to offer the level of professionals salaries available in Hawaii or the mainland. This fact, more than any other single factor, accounts for ASPA's current shortage of professional staff. Despite its continual recruitment efforts, many key positions remain unfilled.

2. Number and scope of professional expertise required.

Contributing to ASPA's staffing woes is the scope of expertise it requires. The vast majority of utility organizations in the US specialize in a single utility service (i.e., power generation, power distribution, solid waste disposal, water treatment, etc.). ASPA provides power, water, wastewater, and solid waste services. Each of these utilities require unique and specialized expertise. Furthermore, each of these utilities must comply with its own set of specific Federal regulations. This requires a broad range of education, experience, and professional credentials among its staff. It requires ASPA to employ many different types of professional engineers and technicians. Far more, in fact, than most large utilities in the United States (in type if not in number).

This need to recruit various types of professionals compounds ASPA's difficulty. Fewer financial resources can be devoted to recruiting and retain any single type of engineer or technician. Furthermore, even if fully staffed, ASPA's technical expertise may be broad but is never very deep. It cannot afford to employ more than a single sanitary engineer, for example, or more than one (Level III) Treatment Plant Operator. Thus, ASPA always remains especially vulnerable to staff turn-over and attrition.

3. Lack of suitable educated and trained Samoans in many technical fields.

Low salaries and other inhibiting factors make recruiting (non-Samoan) licensed professionals very difficult. Many of these difficulties might be overcome with a talent poor of trained and experienced Samoan (and/or Pacific islander) professionals. For islanders, the selection of career and employment are influenced by many factors (e.g., culture, family, etc.) in addition to salary. Thus professional salaries, less than those in the US, are less of a disincentive for indigenous professionals.

Furthermore, Samoan professionals are preferable for all technical positions at ASPA . Technical expertise is important, even necessary, for proper utility operations. However, a knowledge of the Samoan language, culture, and an understanding of the local (social, political, and physical) environment are essential to operate effectively in American Samoa. No outside (non-Samoan, non-islander) contract worker can be as effective, in certain situations, than a similarly trained Samoan professional.

Unfortunately, there currently are few Samoans, or other Pacific islanders, in many engineering and technical fields. Extensive searches by both the American Samoa and (Western) Samoa governments reveal few, if any, Samoans working in a number of key "high tech" fields, including those needed in the islands. Furthermore, they have found that few young Samoans are currently pursuing education or careers in these areas, despite the need and promising job prospects. Consequently, like other local organizations, ASPA has found it difficult, if not impossible, to recruit qualified Samoans with professional credentials and expertise in key technical positions.

4. Dependence on non-Samoan contract workers

The lack of licensed Samoan professionals, in several engineering and technical fields, forces ASPA (and all other island utilities) to rely on non-indigenous contract workers. As mentioned above, turn-over among these non-indigenous employees is high, and recruitment of replacements difficult. Consequently there are almost continuous vacancies and shortages in key professional positions.

5. Work in Ebeye and Micronesia

We believe ASPA is justifiably proud of the work its staff has done in Ebeye. Since assuming the operations of the power and water utilities in Ebeye, we have made great strides in improving utility services on the island. This has lead to an improvement in the quality of life for all the people of Ebeye.

At the same time, there is no denying that this work has been a challenge for ASPA. It has placed additional demands on its staff and management. Some of the greatest demands have been on the engineers, technical specialists, and middle managers called upon to assist in Ebeye. They have been able to provide a level of professional expertise and experience heretofore lacking at KAJUR (Kwajalein Atoll Joint Utility Resources). With their help, KAJUR has made great strides. Unfortunately, these are the same type of engineers and technicians which ASPA itself has a shortage.

The staff used in Ebeye are typically those with more than their fair share of work and responsibilities back at ASPA. A shortage of engineers and other profession-

als already placed additional demands on their time and talent, even before assuming their roles in Ebeye. Their work in Ebeye has made this shortage even more acute.

Unable to fully staff its own professional positions, let alone KAJUR's as well, ASPA has had to compensate. Work on some existing projects as been delayed; new projects postponed. Some in-service training, and routine maintenance, has been deferred. While this may work in the short-term, this is not a long term solution. Unless a method is found to increase the number of these key professional staff, both the ASPA and Ebeye operations will eventually suffer.

The same is true of ASPA's regional training programs in Micronesia. Much of this work is conducted by the same middle managers and engineers needed in other parts of its operations. While ASPA remains dedicated to this regional work, shortages among these key personnel sometime results in delays and postponements of projects both at ASPA and in Micronesia. A solution to this problem, as proposed in this paper, would benefit not only ASPA but Ebeye and the rest of Micronesia as well.

6. U.S. Federal regulations

Federal regulations require utilities to employee certain numbers and types of professional employees to help ensure public health and safety. Federal law mandates specific levels of professional training and certification for many positions within public utilities. For example, water and wastewater utilities have stringent requirements as to the number, type, and level of professional certification of treatment plant operators. Failure to comply with these regulations can lead to a closure of the treatment facility, fines, and/or a loss of Federal funding.

Unfortunately, the one-size-fits-all approach of Federal regulations often leads to regulations inappropriate for small island utilities such as ASPA. They can place an unnecessary and costly burden on the utility, and exacerbate an already difficult staffing situation.

For example, ASPA is currently being required by EPA to employ the same number, type, and level of treatment plant operators as large US metropolitan area. It is required to recruit and hire a highest level (Level III) professionally certified plant operator, even though that degree of expertise is unnecessary for safe and effective operation of ASPA's small and relatively unsophisticated system. Nevertheless, ASPA is mandated to hire an expensive and high level operator, whose expertise and cost is well beyond what is truly needed.

Since ASPA operates power, water, wastewater and solid waste services it is subject to a wide range of Federal regulations. Compliance with all these rules requires experience, expertise, and technical sophistication in a number of area. ASPA, therefore, must recruit, employ, and retain qualified professionals in a number of key positions. To do so has been extremely difficult, given its size and resources.

7. Need for education and professional certification.

Because few job applicants in American Samoa have had (or had access to) previous technical training, ASPA has had to develop a number of in-service training programs. In order to provide quality services, ASPA has devoted an extraordinary amount of time, effort, and funding to staff training. Many of these programs were made possible with Federal matching funds through Operation Maintenance Improvement Program (OMIP) grants from the U.S. Department of the Interior (DOI). Much of what ASPA has been able to accomplish has been the result of its continuous training efforts, and the support from DOI which has made this possible.

While this type of short term skills training has been effective for many jobs within ASPA, most professional positions require an academic degree and/or high level professional training. Furthermore, many require some amount of supervised work experience or apprenticeship. Some also require license or certification from a recognized professional organization or certifying board. This level of professional development is well beyond what can be accomplished with short term, in-service training.

As described above, few local applicants have to necessary education and training for the key professional positions needed at ASPA. Therefore, ASPA must find a way to develop and educate suitable individuals for these positions, much as it had done with its lower level trade and technical employees. It must expand its training programs to include professional education and development.

Impact of Staff Shortages

The impact of this shortage of professional staff is considerable. The lack of design and engineering expertise inhibits ASPA in many ways. Major construction projects are regularly delayed or postponed. Project costs are often prohibitively expensive due to the necessity of contracting outside engineering. Badly needed systems improvements, such as SCADA, stall for lack of local expertise. ASPA remains vulnerable to fines and loss of Federal funding due to non-compliance with regulations requiring certified treatment plant operators. New technologies, which could improve efficiency and profitability, cannot be adopted due to a lack of appropriate expertise.

Propose Solution

Developing local expertise is the only long term solution to the continuing dependence on expensive, short term non-Samoan consultants and contract workers.

Since no pool of suitably qualified Samoa professionals is available, it becomes necessary for ASPA to "grow its own". It must develop a long term professional development strategy to get their most promising employees trained in these key technical and professional fields. A program to train, and retain, these local professional is the only cost effective way to ensure ASPA has the critical technical expertise it needs now, and in the future.

Plan of Action

The training project proposed in this request is not new. In fact, it is a continuation of ASPA's on-going professional development and apprenticeship training approach. Nor is it new to OMIP sponsorship. The program began in 1995 with the assistance of OMIP funding. An additional OMIP grant was received in 1999 in support of this program. Since then, however, the program has continued solely funded out of ASPA's customer revenues. Consequently, it has become increasingly difficult for ASPA to maintain and operate. It has been necessary to reduce the number of professionals being trained, at a time when the need for such employees becomes ever more acute. For this reason, ASPA is once again requesting funding assistance from OMIP.

Past and Present Experience

In 1995, ASPA received an OMIP award to initiate the Professional Training and Apprenticeship Program. At that time, the program focused on upgrading the organization's expertise in electric generation and distribution technology. Thirteen young Samoans were sent to the New Zealand for training in these areas. The result of this training program was dramatic.

Those trained in New Zealand provided an immediate and impressive benefit to ASPA upon their return. At the time, ASPA was installing a new switch gear at its Satala power plant. Expensive outside contractors had heretofore been necessary to install, test, and commission all new generation equipment. However, with their newly acquired expertise, the recent graduates were able to conduct this work themselves with no outside assistance. By having this new in-house expertise, ASPA saved several hundred thousand dollars on this one project alone.

In 1999, another small OMIP award enabled ASPA to send two linemen to the US mainland to begin linemen certification and apprenticeship training. Like the (New Zealand) training mentioned above, it has proven both beneficial and cost effective. Previously, ASPA was dependent on expensive outside contractors to conduct hazardous "hot line" work. Now, this work can be conducted by ASPA's own crews, under the direction of the newly certified Journeymen linemen. This represents a significant savings, and greatly improves ASPA capacity to upgrade and maintain its power distribution system. Furthermore, these linemen are now used as instructors for the Pacific Linemen Training Program in Micronesia. Consequently, the power utilities in the other Pacific insular areas are benefiting from this program as well.

Given the obvious benefits of this program, ASPA has continued sending promising local employees to professional training programs, like those described above. However, this has proven very difficult without OMIP assistance. (ASPA has received no OMIP funding for this program since 1999). The cost of this professional training limits the number of individuals it can send each year. Thus, ASPA has not been about to keep up with the need, and the shortage of key professional staff remains.

Program Design

This program, in operation since late 1995, has proven cost effective in developing appropriately trained professional employees. Since that time, little modification has been needed in its approach or organizational design.

Briefly the program operates as follows:

ASPA has numerous technical and professional positions for which there are no suitably qualified local employees or applicants. Often, there are several ASPA employees with the potential to fill these positions, given the appropriate professional education. Usually they have worked in this field or specialty for some time (albeit at a lower professional level). They have demonstrated skill and understand of the work involved. Candidates for the advanced training are chosen from these employees. Those selected are those that demonstrate the intelligence, maturity, and work habits to perform well in these position, but lack the formal professional credentials.

When no suitable candidate can be found among existing employees, ASPA recruits applicants from outside the organization. Candidates are extensively screened for qualifications and ability to successfully complete the training. They are then placed under contract and begin their professional education.

Each potential program participant is selected to fill a specific position within the organization. The training program for each participant is chosen specifically to fit the needs of that position. The educational institutions attended are those which offer professional degree and certificate programs for the specific technical areas needed. ASPA works closely with each institution to ensure the curriculum and course of study fits the needs of the organization and the student's ability.

Most of the training programs attended include some form of professional apprenticeship or supervised work placement, in addition to classroom instruction. Participants stay to complete this work experience, necessary to receive certification or license, before returning to Samoa. Those in more traditional academic programs return to Samoa and continue to work at ASPA during holidays and school breaks (e.g., summer, Christmas).

Each employee participating in the program is required, by contract, to continue working at ASPA for a designated minimum number of years. This ensures a return on the organization's considerable investment. The contract also includes possible penalties and pay-back schemes for poor performance. Likewise, exemplary performance is rewarded with pay and position incentives.

Anticipated Benefits

ASPA believes this program has the greatest potential long term benefits of any OMIP project, to date. By providing professionally educated career employees, the program expands the capacity of the organization. It can improve the long term operation and maintenance of ASPA, as no other (short-term) training program can. It offers true institutional strengthening.

The program can provide numerous and wide spread benefits. In addition to those already mentioned above, there are: Improved operational standards and practices; better compliance with Federal regulations; better overall supervision, particularly on middle management; improved maintenance of various utility systems (generation, power and water distribution, wastewaster collection, computer networks, etc.); improved water treatment quality; more economical operations with indigenous, in-house professionals; etc.

In most cases, a temporary replacement employee will need to be hired to assume their work responsibilities for the time the regular staff member is away. As most of the training is 1-2 years in length, ASPA will need to hire temporary replacements for many of the participants in the project. At this time, we estimate at least eight (8) temporary replacements will needed. Since these are higher level technical and professional positions, it may be necessary, in some cases, to recruit non-indigenous "contract employees" from the US or elsewhere. This will significantly add to the cost of operations for the time the program participants are being trained, over the next two years.

We estimate the costs replacement worker could run to more than $180,000. This additional cost to ASPA is not reflected in the budget. However, it will represent a significant added cost of the program.

As mentioned above, regular employees will continue to receive their salary during their participation in the project.

Project participants recruited for these training positions, not previously employed by ASPA, will be paid a stipend during their training, rather than a salary like the regular employees

Summary

ASPA has a critical need for suitably trained professional and technical staff. These high level professionals are required for the proper, safe and efficient operation of power, water, wastewater and solid water services. Federal regulations also require personnel with certified professional credentials in a number of key positions to protect public health and safety. All such positions require specialized education, a supervised internship, and some type of professional license. This type of professional certification can only be obtained through recognized academic and professional training programs.

What are other actions, utilities have undertaken to improve service delivery/reliability?		
1	Developing appropriate standards regardless of whether on island/off; same tools; rules;etc.	Developing or adopting appropriate and affordable standards would allow the sharing of resources between island countries. It would reduce the amount of inventory carried by individual utilities, and perhaps allow centralized purchases. At the least, it would allow for standardization of materials, and tools, and set forth some guidance for externally financed donor assistance in the development of water and wastewater projects.
2	Metering (also conservation)	Benchmarking the water utilities has identified that accounting for the water produced is the major issue facing all utilities. Too much water produced ends up not reaching the customer. This is wasteful, and by attacking this one specific area, may result in reducing or deferring the need for future water development.
3	Limited Water - Leak Detection & Repair (FSM: Kosrae)	The lack of customer meters, makes it nearly impossible to place a value or limit the water leakage or wasted. This not only increases the cost of the water utility, but much of this wasted water ends up in the wastewater system, increasing their pumping costs. Critical need is to establish a standard sustainable leak detection program for the Pacific Island countries, which can be shared and is continuous. One week training by some off-island consultant, doesn't provide the long term benefits.
4	Human Resources – need to invest in local talent, for long-term sustainability.	– ASPA: 12 young students sent off-island, 9 came back. Recognized that even if gone for a while or if costly, still saves money and saves long term action because of proper thinking (local view points that are accepted by customers); Issue after training is salary not enough; work conditions not good enough in Samoa v. New Zealand (therefore—recognize for talents and abilities and pay them for being special). Long Term Human Resources Development (ASPA) – See following small case study

What are other actions ... continued		
5	Land Issues - (ownership access)	*** SOLOMON ISLANDS: Landowners again Threaten to Cut Water Supply The Solomon Islands landowners who own the catchment area for the capital city Honiara's water supply are threatening once again to cut the water off. The Solomon Islands Broadcasting Corporation reports that the Kongulai community in west Honiara say they're frustrated that their compensation claims for property lost during the ethnic war have not been paid. Many houses and other property in West Honiara were burnt down or severely damaged at the height of the ethnic crisis. The Solomon Islands Government has borrowed AUD 45 million (EUR 25.7 million) from the Export-Import Bank of Taiwan to pay compensation claims, but the Kongulai community says its claims, totalling about AUD 530,000 (EUR 303,000), haven't been met. ABC Radio Australia News, 24 Jun 2002
6	Geographical Site & Isolation – also climate/ rust	The Bank-Netherlands Water Partnership Water Supply en Sanitation Windows (BNWP-WSS) of the World Bank has started research on the potential of franchising as a means of providing water and sanitation services to the poor in small and medium sized towns and in marginal urban areas. The study looks at franchising as a means of (i) developing the domestic private sector in water supply and sanitation service provision and (ii) enabling new international and regional operators, both public and private, to enter the market. Preliminary findings were presented at the International Conference on Town Water Supply and Sanitation in Addis Ababa.
7	Contract Operations to Professionals i.e. Vanuatu. Improve Water Quality	*** On 1 Jul 2002, Ondeo began a US$ 4 billion (EUR 4 billion), 10-year waterworks operations and maintenance (O&M) contract for Puerto Rico Aqueduct and Sewer Authority (PRASA). The contract, awarded to Ondeo in conjunction with its US subsidiary United Water in May 2002, is the largest O&M contract for water services ever awarded, with the venture beating the Water Company (a subsidiary of Vivendi Environnement) and Thames Water to win the deal. The terms of the contract include an extension provision and cover the production and distribution of drinking water for all four million of Puerto Rico's inhabitants. It also includes the collection and treatment of wastewater for the entire island. Ondeo is responsible for operation, maintenance, and renovation of the infrastructure, client service, and human resources management. (Frost & Sullivan, 3 Jul 2002,
8	Lack of Legislation - Corporate Library of Good Water Legislation, and Visits with Legislation and constant communications	*** ARMENIA: New Water Code Introduced The Armenian Parliament has approved the new Draft Water Code, which is to replace the outdated code of 1992. The new code and related laws outline reforms to be implemented within the next 15-20 years. It also calls for the creation of a National Water Council under direct supervision of the Prime Minister. The Water Code defines water resources as national property and regulates the rules for water use. The code stipulates that both water resources and the water catchment area cannot be privatized. It does permit the right of exploitation of water resources under concession agreements. Armenia could face serious water shortages within the next 20 years if there a no significant investment in water systems. Related Web Site: Water Legislation Reform Working Group, http://www.magistros.am/ecocenter/workgroup/index_eng.htm (Golos Armenii Daily, 17 May 2002)
9	Lack of Education – Training for existing staff (to pass to customers, too)	*** HANDWASHING: Soap and Water Could Save a Million Lives a Year Diarrhoea is the second-biggest killer of children in the world. Scientists at the 2nd conference of the International Scientific Forum on Home Hygiene (IFH), declared that old-fashioned handwashing with soap and water could save a million lives a year. In India alone, handwashing can contribute to saving 250,000 lives. Appropriate handwashing can cut diarrhoeal diseases by 43% according to a review by the London School of Hygiene & Tropical Medicine. While most households in developing countries have soap of some sort, only 15- 20% routinely use it to wash their hands after going to the toilet, cleaning a baby etc. A World Bank-supported handwashing programme* involving governments and soap companies is being carried out in Ghana and Kerala (India). Soap companies think sales could grow by 40% in each market. The programme has discovered people's preferences for types of soap products, when best to influence mothers' hygiene behaviour (directly after a baby is born), and when and how often to advertise to achieve the maximum impact. There are plans to extend the programme to China, Nepal, Peru, parts of Central Asia and Senegal. *Global Initiative for Public-Private Partnerships (PPP) in Handwashing,
10	Unreasonable Donor Restraints	*** SUMMIT: USA-led Countries Block Commitments on Water and Sanitation, Say NGOs The USA, Australia, Canada and Japan are blocking a target on sanitation and the programme of action on halving the number of people without access to safe drinking water by 2015, according to WaterAid and Tearfund. The two UK NGOs were reacting to the disappointing outcome a preparatory meeting (Prep Com IV), held from 27 May - 7 Jun 2002 in Bali, Indonesia, for the World Summit for Sustainable Development. Some delegates have said success - or failure – on water programmes could be a roadmarker for the Summit as a whole. The Summit's proposed water and sanitation targets are being supported by a recent European Union (EU) initiative endorsed by EU Environment Ministers. The initiative calls for coordinated action through partnerships with governments, non-governmental organizations and the private sector to tackle water problems. The EU already spends about EUR 1.5 billion a year on water projects, mostly in Africa. There is still some hope that the USA will support action for safe water if US Treasury Secretary Paul H. O'Neill succeeds in lobbying for more aid, especially for drinking water. In a highly publicized visit to Africa with rock star Bono, O'Neill repeatedly stated that it would be possible to provide the poor with clean water in "a short period of time" with a "reasonable amount of money". Several development agencies were critical of his "back-of-the-envelope calculations" that only looked at costs for construction, without taking into account allocations for maintenance and training.
11	No value given to water (meter) - correct tariff established	ARMENIA, YEREVAN: Consumers Should Pay for Water Despite the fact that the city's water company, Ervodocanal CJSC, supplies twice the required volume of water (250 litres per capita per day), the Armenian capital Yerevan stills suffers from water shortages. The de facto free distribution of water has led to widespread wastage. Ervodocanal does charge a symbolic amount of AMD 1 (0.18 Euro cents) per cubic metre of water, but virtually no revenue has been collected from consumers for decades. There are no water meters and water consumption is not properly monitored. Nevertheless, the government has decided to ensure uninterrupted water supply by 2004. According to Ervodocanal's press secretary, M. Sargsyan, this goal can be achieved with an investment of US$ 400 million (EUR 399 million) to modernize the water supply network, together with the implementation of economic incentives to conserve water. (Business Express Weekly, 8 Jun 2002)

What are other actions ... continued		
12	Lack of Appropriate Technology and Public – Private Partnerships. ** PRIVATE SECTOR	(1): Can it Help Provide Water to the Poor? Research* by the International Institute for Environment and Development (IIED) suggests that inappropriate forms of private sector participation (PSP) that are inadequately regulated are unlikely to be of much value to poorer households or the environment. Findings include: At the regional level, there are concerns that PSP will not benefit the poorest as they are less attractive to investors. Within countries, PSP in water and sanitation services is concentrated in urban areas where economies of scale can be realized and potential returns likely to be higher. Even within urban areas, there are concerns that poorer households may not benefit from any gains in efficiency, either because they live in areas where costs of provision are relatively high or because their demand is relatively low. Households in expansion areas will often be unwilling to pay connection fees when existing users, usually richer, did not do so when they were first connected to the network. Policy implications include the need for: the social and environmental benefits of water supply and sanitation to be incorporated into strategies for service provision; community participation in formal decision-making on forms of provision, and in the management and operation of provision; governments to serve as regulator and guarantor of a certain level and quality of provision; bidding procedures and contract design to allow sufficient flexibility for innovative solutions, without undermining the accountability of the firm; service contracts to stipulate the use of high quality, low cost, intermediate technologies to expand service coverage to reach low-income areas. * Thompson, J. (2001). Private sector participation in the water sector: can it meet social and environmental needs? URL: http://www.iied.org/pdf/wssd_16_water.pdf Contact: John Thompson, IIED, UK, fax: +44-20-73882826, mailto:john.thompson@iied.org (ID21, 11 Mar 2002, http://www.id21.org/urban/s3bjt1g2.html)
14	Lack of Consumer Support	LOCAL WATER MANAGEMENT: Lessons from the Developing World Experience, especially in developing countries, shows that local water management, properly supported by senior levels of government and integrated across the watersheds, is commonly more effective and more equitable than top-down alternatives. Centralized approaches as well as decentralization without proper capacity building often fail. A tragic example of the letter was the E-coli outbreak in Walkerton, Canada in 2000*. Hard evidence, gathered both in poor countries and in rich countries, shows that local approaches that genuinely engage local people in management decisions can be more effective than top-down policy commands. In fact, local people truly in charge of their own resources commonly prove to be reliable stewards of their own environment - and they can be prudent guardians of public health. ** Canada, Walkerton: Ministry Blamed for E. Coli Tragedy, Source, 28 Jan 2002
15	*** CHINA: Water Infrastructure Development Facility	The Asian Development Bank (ADB) has approved a US$ 35 million (EUR 34.9 million) loan to the China Water Utilities Group (CWUG), an investment holding company to be established in Shanghai by the China Water Company (CWC), to serve as the vehicle for a water infrastructure development facility in the People's Republic of China (PRC). CWC is a water infrastructure development and investment company that operates out of Hong Kong, China. The facility - with a total size of around US$ 150 million (EUR 149.5 million) - will fund relatively small water projects that ADB would have difficulty to assist directly. CWUG will use the facility to partner with different municipalities to develop water resources, water supply, wastewater treatment, and other water-related infrastructure. The facility will give municipalities access to financing to expand potable water supply as well as improve wastewater treatment to arrest the growing pollution of water resources. CWC will contribute US$ 75 million (EUR 74.7 million) in equity to the facility. ADB, together with two bilateral financial institutions, will provide loans totalling US$ 75 million (EUR 74.7 million). Contact: Pamposh Dhar, mailto:pdhar@adb.org (Press Inquiries Only) (ADB, 3 Jul 2002, http://www.adb.org/Documents/News/2002/nr2002111.asp)

Water Supply and Sanitation Collaborative Council (WSSCC), the IRC International Water and Sanitation Centre and the Source web site: http://www.wsscc.org/source.

5. FUTURE NEEDS

Part of the consultation brainstorming session at the Pacific Water Association, annual general meeting, led to the development of the following table which are actions that might be further developed to address some of the constraints faced by utility managers and employees. However, this is not the end but only the beginning of actions and future needs that need to be developed in this regional meeting to assist in the way forward for developing a sustainable water sector as it relates to the Urban water and wastewater utilities.

What are some future actions needed to address the problems of the water sector as a whole?	
Improved & Consistent Customer Education	Water Education Materials (Kids; Hydrology; Political Leaders; Community Groups; Civic Groups; highest educational levels)
Community Consultation	Improved participation within utility by community
Utility Donor Aids Programs:	i) Design w/ local interest in mind; sustainable; protects investment of local islands ii) Learn from previous mistakes to make sustainable, looking from a donor side, look at the long term interest—customer receiving end of how it will be maintained in order for the donor to be paid in long run, even if donor has to do the program differently than it is accustomed. Lifecycle costs: can't walk away. iii) "Increased stakeholders consultants ensuring sustainability." (ADB TO UTILITY; or other donors that deal ONLY W/COUNTRY, whereas OMIP, as an example, talks directly with utility)

What are some future actions needed ... continued	
Increased Transfer of Training & Training (within education levels; utility levels; from consultants or contract workers to indigenous)	Utilities need to invest in their own people, take advantage of training opportuinites, utilize the training in the way work is accomplished, and the Manager needs to pay attention.
Donor aid utilized for study after study:	i) Too much studies; not fast enough to the end product. ii) No examples of "parts in the ground." Stop studies; do the projects.
Utilities agreed; but, They asked, "How?"	i) Get engineers and utilities together, fewer accountants / political people, even consultants that simply want to continue to have a job; write another report. Keep Foreign affairs / high-level people out of the contractual process.
Legislative Interference:	i) Can legislate action if there is interference ii) Have donor agencies provide grants/funding only if legislators/politics stay out of the process; stay out of rates or disconnections, etc.
Sustainable Leakage Management:	i) Allied member asked why utilities complain about leaks, yet, never do anything or never follow through later? ii) Answers are: money / costs / employees (or write entire package) iii) Answer is that YOUR UTILITIES and YOUR POLITICIANS never get your agendas pushed when the outside agencies and organizations come to your countries. Therefore; this points to WHY the utility must speak early and often with Each and Every Legislature (it's small island, and basically, you're related to all politicians anyway, says Mr. Neil, PWA).
High Level Advocacy / access:	i) Fisheries, Agriculture; Tourism; Health; Education ii) 3 of 4 hospitalizations due to water-born disease, then money comes to you, more regularly.
National Task Force for Water	Develops a Plan for Advocacy
Strong Legislation that is enforceable:	Developed between Legislatures and the utility with any fees generated going to sustain the utility
Greater Forcibility of Loan Packages:	Bank Policies: Why loan money for Studies; if no money is given for the follow up / implementation, sustainable.

Additional Commentary

Governance – Political commitment to and ownership of the reform program are essential. However, reform is a destabilizing process and no government undertakes such a process without some risk of becoming so unpopular that it loses its mandate to rule. Thus, much courage, patience, and commitment on the part of government are needed. The importance of political stability and firm commitment to reform from top political leaders have been underlined by events in Vanuatu and the Solomon Islands in 1999 and 2000.

Involve Key Stakeholders. It is critical for water and wastewater utilities to involve key stakeholders in the design of programs and projects, and to maintain their commitment by keeping them continually informed of the process and envisaged impacts. This serves the dual purpose of involving the customer, and by doing so, more deeply committing the utility to the path of sustainability. Presenting convincing arguments and evidence on the merits of appropriate tariffs and reform remains a challenge in the Pacific Island countries, especially because of the relative importance of the public sector as an employer and uncertainties in some cases about the opportunities for private sector development.

Account for Local Culture. Utility programs and projects must take careful account of the local culture. Some cultural factors may be used to advance the rprocess; others may need to be managed so that they do not hinder the process; and some may display features that both help and hinder the process. One example of a social institution that may constrain the anticipated project is the Polynesian family system, which can make demands of politicians and public officials that conflict with the requirements of their formal, national roles. On the other hand, that same system may be a source of useful social support for those entrenched in the old way of doing business. Another example is the varied customary land tenure systems, which are often seen as a constraint to optimal land use and a deterrent to foreign investment, but which are valued in their own right by Pacific islanders. Utilities need to recognize and understand such cultural factors, address them overtly in a participatory manner, and manage them sensitively. Participatory approaches to the introduction of new improved programs or projects, particularly those that are culturally sensitive, are essential to ensure sustainable solutions.

Focus on Outcomes and Impacts. It is essential to maintain a continuous focus on outcomes and impacts. Utility projects and reform programs often, and necessarily, includes various levels of actions, influencing and building on each other. However, in the final analysis, the water and wastewater utilities must be able to demonstrate to their customers that the impacts of these actions (some of which may initially be painful) are actually beneficial through better service provision, or lower prices, or improved employment and other in-

come-earning opportunities. Thus, the utilities must establish and manage an information system that tracks reform implementation, and permits the analysis and publication of the resulting impacts as and when they occur. Analysis of impacts needs to extend to an assessment of who benefits and who loses, so that the utilities may address any inequities. This area has received inadequate attention. Information is one of the most critical inputs in the reform process, and the one most commonly inadequate in the Pacific.

Design Within Local Capacity. Simple scope ensures that the infrastructure project and program content is clear, realistic, and within local capacity. Some programs have been too complex and too ambitious in terms of time targets. Project design must pay careful attention to pace and sequencing of actions and activities, with the objective of resolving conflicts that arise. For example, in terms of realistic sequencing, it is of little value to attempt introducing performance based budgeting into a utility if basic costing and accounting systems do not provide timely feedback, or for that matter, if basic accounting skills are not available to the utility.

Keep it Simple. Some key design principles learned through experience over the last few years are (i) keep it simple, (ii) tackle a few though significant and relevant improvements at a time, (iii) think through the sequencing with the implementers, and (iv) allow for testing and adjustments. It is important to lay out a sequence of actions that leads to tangible and specified outcomes and impacts. Follow-up and repetitive implementation may be required to implement change. For example, one week training in a particular skill is not the best method to implement change. However, repetitive actions, slowly reinforced over the long term, will become the standard if the Manager pays attention to the need for change, and keeps it simple.

Use Consultants Carefully.The use of consultants and external advisers must be more carefully designed. First, given the constrained human resource capacity in the Pacific, the need for consultants is often inevitable. However, there are options for how they can be used: as long-term advisers in line positions; or as providing short-term, periodic inputs. These options must be carefully evaluated, keeping in mind that the utility program must remain locally owned and managed. A key indicator of consultant effectiveness should be the extent of local ownership he or she is able to engender. Second, it is important to clarify whether the consultant is fulfilling a line function or whether the mandate is to build capacity. If it is the latter, technical expertise is not a sufficient qualification for the job. Proven success in transferring skills and supporting participative capacity building are essential requirements. For example, the ADB must assure the government and the utility that the consultants it offers have the right breadth of experience and demonstrated exposure to a variety of approaches. Otherwise, there is the substantial risk that project implementation and approaches adopted by the country are dictated not by disciplined analysis of needs and assessment of options, but by the narrow experience of the long-term adviser, and the foreign affairs or finance ministry, with little or no imput from the water and wastewater utilities. The larger issue is the need for donors of external assistance to strengthen its policies and systems for the engagement and management of consultants. Consulting contracts should be drafted not only in terms of expected inputs and tasks, but also in terms of precise and tangible outputs and expected outcomes. Consultants' performance must be more closely monitored by government and providers of bilateral assistance, on the basis of the outputs delivered. And sanctions for inadequate performance should be specified in contracts, and enforced. Staff must have adequate time to supervise consultants and should be held accountable for technical assistance (TA) outputs and outcomes.

Maintain Continuing External Bilateral Assistance Support. ADB and others must maintain effective engagement in the program or project process beyond the two to three-year program loan time frame. First, communication channels between Bilateral Assistance Support staff with the highest levels in government must be cultivated and nurtured, and through them, a relationship of trust and partnership developed. Second, and consequent to the first lesson, Bilateral Donors must seek to ensure high quality staff inputs and greater staff continuity in operational assignments. Third, the package of assistance must combine a mix of loan and TA, as well as follow-up project loans and TAs, that help the government and in particular the water and wastewater utilties address spillover and sequential needs. Fourth, coordinated inputs from external agencies in a long-term framework that supports continuity of the process is invaluable for ensuring continuing commitment to reform. Fifth, the water and wastewater recipient of support must have a closer relationship with the External Bilateral Aid agency, to have positive input into the programs or projects. 5 to 10% of the project cost must be set aside to protect the initial investment, and assist in the longer term operation and maintenance. Too often, it is the National Finance Ministry or Foreign Affairs Office who is the contact and too often they have unrealistic goals or perceived needs that are not in parallel with the water and wastewater utility.

Amongst the leaders in external bilateral assistance, the ADB has recognized that a new Pacific strategy is required to take into account the experience and lessons acquired over the previous years of operation. This overview paper calls for other providers of bilateral assistance to evaluate their programs and operations, and to make changes as necessary to address the following in light of their previous experiences:

The ADB is on record within their new Pacific strategy to support deepening of government and public commitment to the reform process. Assistance will focus on building public awareness and support for improve-

ments through continued dialogue with water and wastewater utilities, and promoting stronger linkages with the private sector, NGOs, and community organizations that have vested interests in these improvements. ADB will give priority to awareness raising, coalition building, and public information activities, where local support for governance reforms is weak. Thus, local ownership of the reform process is a key aspect of the strategy.

The need is for the external bilateral donors or aid agency's to emphasize enhancing efficiency and effectiveness of the public service. While major achievements have been made in downsizing the public service, the same cannot be said of the quality of public services. These remain poor, inadequate, and well below acceptable standards in most Pacific Island countries. Of particular concern is the ability of governments to pay for their appropriate portion of the utilities they consume. Governments need to be financially able to pay just as the individual customer is expected to pay for services rendered. Since the strategy will also emphasize poverty reduction and improvement of quality of life for the people of the Pacific, the improvement of efficiency and effectiveness of the public sector will be a key focus.

The private sector should replace the public sector as the engine of growth. The water and wastewater utilities will be financially strengthened by a diverse private sector rather than depending on only the public sector to be the engine of growth. The ADB has noted that the reduction in size and scope of the public sector over the last five years of reforms was not associated with a corresponding growth of the private sector; this left a gap in output and employment. Furthermore, the expected efficiency advantages through private operations also did not accrue to the Pacific Island countries. The limited growth of the private sector is explained by both the immutable constraints on economies, as well as the inadequacy of various factors required for growth of a dynamic and healthy private sector.

Technical advice and investment support needs to be provided to the water and wastewater utilities. Given the small size of potential investments and high cost of project development, external bilateral aid needs to be collaborative to support technical projects and provide feasibility advice services throughout the Pacific Island countries.

Gender issues need to be brought into the mainstream. Gender equity and the role of women is unimportant in the sense that most Pacific islanders don't treat women as chattel as some of these other countries do, where they and children are assigned the arduous task of hauling water while men sit on their haunches. But, gender issues remain significant and important on the social front, such as in relation to health, hygiene, education, and population control, a breakthrough is necessary in recognizing the potential role of women in politics and the economy. Barriers to women's participation as equals in the political and economic sphere need to be gradually eliminated. Education is perhaps the most powerful tools in this regard.

Water and wastewater utilities will ultimately be the beneficiaries from promoting the role of women in the control of population growth, broadening the reach of education, and improving health indicators. These remain critical issues in the Pacific, and the most effective strategy to address them remains through women, and strengthening women's social and economic role in society. Ways of directly influencing population growth rates through population policy, family planning, and improved access of women to health and education opportunities need to be explored and supported with governments and other providers of external assistance.

Fragile environments will be actively protected through policy support and investments. Given the narrow resource base of the Pacific islands, and the limited economic opportunities for investment, the pristine environment of many of the Pacific Island countries remains our most important comparative advantage. External bilateral aid organization need to underscore this issue while providing assistance for improving infrastructure, regulatory and management frameworks to ensure the protection and sustainable management of these environments, and support community awareness and education projects where broad-based action and public support are required. The Pacific Islands countries hold some of the world's richest sites in terms of biodiversity, and there are opportunities for attracting cofinancing, e.g., from the Global Environmental Facility, for conservation and protection projects, while providing infrastructure assistance to improve the water and wastewater utilities and the services they provide. However, it is critical that local national agencies share the same desire to preserve and protect the environment, when contemplating economic development projects. Any Pacific island project for development should consider not only the economic benefits, but the environmental, and culturally sustainable benefits.

Water and wastewater utilities must support the reduction of Poverty amongst their customers. At the country level, the three pillars of poverty reduction strategy (pro-poor sustainable economic growth, social development, and good governance) should underpin the design of infrastructure development projects and capacity building measures. In particular, enhancing the quality of governance is critical to poverty reduction, which explains the continuing focus on public sector and governance reforms. Customers cannot pay for their utility services if they don't have tne social and institutional programs in place with which poverty reduction can occur.

External bilateral aid project investments should emphasize poverty reduction. At the island level, aid should be given priority in (i) investments in the social sector,

i.e., education, health, population, social protection, and water supply and sanitation; and (ii) development of physical infrastructure with an emphasis on enhancing accessibility of the poor to essential services. In addition, measures to protect and conserve the fragile environment will be supported to protect the resource base of the poor.

Strategic Objectives Supported by Water and Wastewater Utilities

Gradual but systematic and long-term capacity building will be emphasized. In terms of capacity building, there is a need for the water and wastewater utilities to work within the region (SOPAC, PWA) and other Pacific Island countries to formulate long-term plans for building the required skills by combining training, exposure to other systems, consultancy, learning-by-doing, and institutional twinning arrangements. Such plans should identify the milestones for each stage of skill development, emphasizing small but successful steps at the start and moving progressively to larger ones. Such plans can guide the activities of various external funding agencies over time, and ensure better aid coordination and planning. At the project level, consultants' terms of reference should routinely include skill transfer as part of the expected output, with clear indicators for accomplishment of this result. Accordingly, consultants will need to be selected not only for their technical qualifications, but also for their ability to guide, coach, and mentor local counterparts. Domestic consultants should be used more often, for example, as long-term understudies of international consultants.

Infrastructure development and efficient operation and maintenance will remain a basic priority for the water and wastewater utilities. Better infrastructure improves access of the poor to private markets and public services, weakens monopolistic exploitation, and facilitates the flow of information and awareness. Infrastructure development is critically linked to private sector development and economic growth as it helps reduce market imperfections and stimulates the free play of the market. Based on lessons learned from past experience, special attention will be paid to maintenance of infrastructure, as it brings significantly higher returns on investments compared with investments in new infrastructure. Given the small size of markets and geographic difficulties, the public sector will have a continuing role in infrastructure development and operations. However, to obtain higher operational efficiencies, Public-private partnerships in infrastructure development will be supported where feasible. Private sector participation in infrastructure development will be promoted by unbundling infrastructure operations, wherever possible, improving availability of required long-term financing, and developing appropriate policy and regulatory environments. In terms of reform of public sector agencies involved in infrastructure, emphasis will be on increasing managerial and financial autonomy, accountability, and long term operation and maintenance including renewal and/or replacement.

Water and wastewater utilities need to support infrastructure development which focuses on telecommunications, and IT. In view of the dispersion and remoteness of the Pacific Island utilities, the development of telecommunications and IT will help improve access and business communication, and reduce costs. The Pacific Island countries should also be harnessing the power of telecommunications and IT for health and extension of services, distance education, and monitoring of technical activities that might be supportive of utility infrastructure development and management.

Strengthen the interface and collaboration between Pacific Island utilities and NGOs and civil society groups. Infrastructure development must be participatory and inclusive. This is particularly so if the benefits of water and wastewater development are to be shared more equitably than in the past in the Pacific. NGOs have demonstrated the critical role they can play in facilitating grassroots feedback and advice, improving transparency, generating community awareness, and harnessing people's power effectively. NGOs and civil society groups have widely established their capability to mobilize communities, generate community participation and develop community movements, particularly for addressing poverty. It is therefore essential that utilities come to view NGOs and civil society groups as partners in development, and make strenuous effort to improve information sharing, education, communication, and participation in utility-led development activities and programs. Water and wastewater utilities, on their part, should seek to consult more widely with NGOs and civil society groups in the development programs and projects it supports in each Pacific Island country. They should also assist governments (where possible) to work more actively with NGOs in the delivery of essential water and wastewater services particularly to rural communities, where NGOs generally have a better comparative advantage than governments in service delivery. Water and wastewater utilities may often have expertise in urban sectors which are directly transferable to rural applications.

The success of any programs must be judged over the longer term. Sustainable change must be evolutionary in nature, allowing time for internalization and institutionalization of new modes of behavior and operation. The programs must also be a continuous learning process, adjusting to and coping with local, regional, and global changes. Major changes are indeed taking place in many of the Pacific Island countries, and utilities, and this is partly evidenced by greater fiscal discipline, more openness to external investment, greater professionalism in public service, and governments withdrawing from areas that are better left to the private sector.

Water and wastewater utilities must be prepared to address these six common variables. (i) vulnerability of the Pacific island economies, because of our remote locations, narrow resource base, susceptibility to natural disasters, and the influence of the global markets; (ii) political instability and good governance; (iii) limited availability of skilled human resources; (iv) the wide range of socio-cultural factors influencing politics and productivity; (v) rising population growth rates; and (vi) inadequacy of physical, technological and financial local infrastructure necessary to have sustainable growth.

Implementation of any Water-Wastewater development strategy must incorporate the following lessons. The most significant are the need (i) for the Pacific Island utilities to have stronger ownership of policy reform and investment programs, (ii) to design development projects, and programs taking into account the local culture and local capacities, (iii) to pace and sequence technical, managerial, and economic reforms to ensure effective institutionalization, and (iv) to use external consultants judiciously without creating dependencies.

6. STRATEGIC ACTION PLAN

GUIDING PRINCIPLE 1: National water and wastewater management policies and regulations will be appropriate and acceptable to the people and cultures of the Pacific Islands.

Policy 1.1: Governments will consider the water and wastewater sector as a priority for improvement and investment.

Policy 1.2: Governments will develop national water and wastewater policies and regulations that are consistent with international and national laws, regulations, technical standards, and obligations.

Policy 1.3: Governments will develop and implement appropriate water and wastewater - and associated - regulatory frameworks, compliance and enforcement requirements that benefit the specific cultures, customs, economies and environment of the people of the Pacific.

Policy 1.4: Government regulations will require regular system performance reporting.

Policy 1.5: Governments and regional organisations will co-operate to develop and sustain regional and national capacities in compliance monitoring, including technical and financial resources and data acquisition.

Policy 1.6: Government and service provider decisions on water and wastewater management will be transparent to improve accountability, donor and investor acceptance.

Policy 1.7: Governments and regional organisations, the private sector and NGOs will actively co-operate to ensure that water and wastewater management policies and plans are integrated into the national development policies and plans and other cross-sectoral initiatives.

OVERALL OUTCOME:

Appropriate and acceptable integrated national water and wastewater management policies and regulations in place.

Proposed Actions	Responsibility
1. Prepare policy or issues paper on the need for prioritizing water, and wastewater sector for improvements, cross -sectoral actions and integration into national development plans.	Government departments Service providers
2. Education and awareness on policies and regulations across all sectors with special focus on decision makers.	Governments
3. Identify and review policies and regulations on regional and national level and involve stakeholders and regional organizations	Regional organizations Governments
4. Review regulations from other countries and identify those suitable as models for Pacific Island Countries.	Regional organizations
5. Organize a review meeting involving all sectors, to agree on the need or otherwise, for national regulations and to recommend appropriate actions.	Governments
6. Implement recommendations.	Governments
7. Establish appropriate guidelines and systems for reporting on service delivery, and enforcement of regulations.	Governments

GUIDING PRINCIPLE 2: Appropriate national institutions, infrastructure and information will support sustainable water and wastewater management.

Policy 2.1: Governments will review and specify roles of, and facilitate coordination between existing agencies, and where appropriate, create specific responsible agencies for water and wastewater management.

Policy 2.2: Governments will ensure that water and wastewater technologies and related infrastructure are appropriate to meet national and local priorities and needs, within the constraints of available finance and other resources, while recognizing the need for protection of human health and the environment.

Policy 2.3: Governments, service providers, institutions and regional organizations will collaborate throughout the region to improve timely access vo and sharing of available data and research on appropriate water and wastewater technologies and the dissemination and implementation of wise practice guidelines.

Policy 2.4: Water and wastewater reduction (water demand management and conservation, zero discharge toilets) and reuse strategies will be developed and adopted by governments without compromising public health.

Policy 2.5: Governments and regional organizations will co-operate to develop and sustain regional and national water and wastewater quality monitoring programs and the use of this information (e.g. benchmarking) to improve water and wastewater management and environmental protection.

Policy 2.6: Governments, regional organizations and other stakeholders will cooperate to develop integrated water and wastewater management plans to effectively address the impacts of contingencies, emergencies and disasters.

OVERALL OUTCOME:

Sustainable water anf wastewater management through the use of appropriate institutions, infrastructure and information.

Proposed Actions	Responsibility
1. Identify: • the key agencies /stakeholders involved with the management of water and wastewater, and environmental health • their roles and responsibilities • activities they undertake in water, wastewater, and environmental health • lead agencies for specific national activities.	Governments
2. Establish mechanism for maintenance of data collection, on water and wastewater management (standards, regulations, and monitoring) and environmental health impacts.	Governments Regional organizations UN and donor agencies NGO's
3. Develop national guidelines on wise practice approaches to assessing and managing water and wastewater system requirements, that incorporate sound environmental health principles.	Governments Regional organizations
4. Review existing water and wastewater technologies and infrastructure and recommend strategies for improvement.	Governments Service providers NGOs Regional organizations
5. Develop a national monitoring capacity, building on existing and new resources, to provide initial baseline data, and long-term quality assurance.	Governments NGOs Regional organizations
6. Promote awareness of links between and means of integration of, water and wastewater management plans to effectively address contingencies, emergencies, and disasters.	Governments NGOs Regional organizations

GUIDING PRINCIPLE 3: Better access to funding will improve service delivery, and develop the private sector.

Policy 3.1: Governments, regional organizations, donors, the private sector and NGOs will co-operate to develop innovative approaches to existing funding structures and establish mechanisms to improve cost-recovery.

Policy 3.2: Where appropriate, governments, regional organizations and NGOs will cooperate to attract the private sector to invest in water and wastewater management through private public partnership and other mechanisms.

Policy 3.3: Governments, donors and regional organizations will co-operate to develop appropriate service delivery and funding mechanisms to equitably address the water and wastewater management needs of both the urban and rural community.

OVERALL OUTCOME:

Improved service delivery through increased access to funding and involvement of the private sector.

Proposed Actions	Responsibility
1. Carry out a review of systems currently used throughout the region and internationally, for funding water and wastewater services. Report findings in a form suitable for use by government decision makers.	Governments Regional organizations
2. Develop and implement awareness raising programs across all levels, on the need for funding mechanisms.	Governments
3. Choose and adopt the most appropriate mechanisms (from above review).	Governments
4. Identify stakeholders, and especially possible private sector partners and establish a national working party (or similar) for discussions/decision making over privatization of water and wastewater systems.	Governments
5. Review current water and wastewater systems and identify areas/aspects that could be improved through the involvement of the private sector.	Governments
6. Invite proposals from the private sector, review and implement.	Governments
7. Establish appropriate guidelines and reporting systems for monitoring service delivery, including financial efficiency, service quality, and service distribution across different sectors of the community (e.g. urban vs. rural).	Governments Regional organizations

GUIDING PRINCIPLE 4: Community participation in water and wastewater management and sanitation, will ensure equitable benefit with recognition of socio-cultural sensitivities.

Policy 4.1: Governments, regional organizations and NGO's will co-operate to promote and develop education and awareness of water and wastewater and sanitation issues within national and local government, while incorporating existing social and cultural values.

Policy 4.2: Governments, regional organizations and NGO's will co-operate to promote and develop community education and awareness of public health and environmental issues as related to water and wastewater while incorporating existing social and cultural values.

Policy 4.3: Governments, service providers and NGO's will in partnership with community agencies determine their respective roles and responsibilities, and will develop and implement culturally appropriate strategies and activities to ensure the implementation of water and wastewater programs.

Policy 4.4: Governments, service providers and NGO's will ensure rural and urban communities will be given opportunities for active participation in the choice, development and implementation of water, wastewater and sanitation projects and on-going operation and maintenance of its facilities.

Policy 4.5: Planning of water and wastewater facilities will ensure acceptable access for all, with special regard to women, the disadvantaged, the disabled and those in rural and remote communities.

Policy 4.6: Service providers will take into account traditional knowledge and practices complemented by new approaches to water and wastewater management.

OVERALL OUTCOME:

Equitable benefit to the entire community that incorporates social and cultural values through active community participation.

Proposed Actions	Responsibility
1. Conduct survey and collect information / data on the social and cultural aspects / characteristics of the community population.	Regional organizations National government Local government Community
2. Develop and implement national and local public awareness and education campaigns.	Regional organizations National government Local government Community
3. Use local theater groups and media in raising awareness programs.	Regional organizations National government Local government Community
4. Identify key stakeholders to determine their roles and responsibilities within the community.	Governments Service providers NGOs Community / Women
5. Create a task force that has representation of all stakeholders that will facilitate the development and implementation of cultural appropriate strategies and activities of water and wastewater management programs. The task force will have a fair representation that will include women, disabled and disadvantaged.	All key stakeholders
6. Enhance or improve participation of community in the development and implementation of community-based strategies and activities through/by: • holding regular meetings/seminars/workshops • identifying and reviewing existing systems • developing where appropriate wise alternatives • establishing community capacity building programmes • identifying and securing assistance and funding for community involvement.	Community Governments NGOs Regional organizations
7. Include public information components in costing for all development programs.	Governments
8. Promote the use of community consultative committees in development programs.	Community
9. Perform gender assessment studies in water and wastewater management and where appropriate stress the need for gender issues to be included into project planning.	Governments Regional organizations
10. Conduct research into the traditional practices and determine whether or not these can be adapted to suit the present situation and new development programs.	Governments Regional organizations NGOs

GUIDING PRINCIPLE 5: Viable and sustainable levels of skilled and knowledgeable people within the water and wastewater sector and communities will improve water and wastewater management

Policy 5.1: Governments, regional and international organisations will cooperate to develop and implement effective human resource development programmes for water and wastewater management and related personnel (including planners, management and enforcement professional) with particular attention to up-skilling the local workforce.

Policy 5.2: Governments, local institutions, regional and international organisations will work together in the development of regional and national training courses in support of human resource development programs.

Policy 5.3: Governments, regional organisations and NGOs will promote and facilitate the development and training of communities and individuals to strengthen and assist their participation in water and wastewater management.

Policy 5.4: Governments, regional organisations, donors, the private sector and NGOs will work together to secure funding in support of human resource development policies and training programs.

OVERALL OUTCOME:

Water and wastewater management has improved, as a result of a viable and sustained level of skilled and knowledgeable people within the water and wastewater sector and communities.

Proposed Actions	Responsibility
1. Review the need for increased capacity and management training in human resources development and planning.	Governments Service providers Regional organizations Co-operating agencies International counterparts
2. Carry out training needs analysis (TNA) for workforce and community groups to identify gaps in existing training, including communities and individuals. This should include reviews of current programs, who needs training, the type of training required, and resources needed.	Governments Service providers Regional organizations Co-operating agencies International counterparts
3. Identify funding sources for training program development.	Governments Service providers Regional organizations Co-operating agencies
4. Develop island specific training programs and pilot projects, identify resources for delivery (e.g. staffing, equipment etc.), secure funding and implement them.	Governments Service providers Regional organizations Co-operating agencies NGOs
5. Evaluate performance of human resource development planning based on improved water and wastewater management.	Governments Service providers Regional organizations Co-operating agencies International counterparts
6. Periodically go back to Actions 1 and 2 to assure sustainability.	Governments Service providers Regional organizations Co-operating agencies International counterparts

7. CONCLUSIONS

Vision

Protect the health of the people and safeguard our fragile environment through improved, effective and efficient management of water and wastewater.

Overview of the Guiding Water and Wastewater Principles

GUIDING PRINCIPLE 1: NATIONAL WATER AND WASTEWATER MANAGEMENT POLICIES AND REGULATIONS WILL BE APPROPRIATE AND ACCEPTABLE TO THE PEOPLE AND CULTURES OF THE PACIFIC ISLANDS.

National Pacific Island country governments are required to place high priority on water, wastewater and sanitation issues in order to direct sufficient attention and resources to these areas in national development plans. Regional and national policies should define responsibilities leading to better co-operation between agencies and increased recognition of the linkages between good sanitation, improved public health, economic development, and a cleaner environment. An updated and consistent regulatory framework, combined with effective enforcement, will result in compliance with good practices, reduced pollution, equitable allocation of resources, and increased investment.

GUIDING PRINCIPLE 2: APPROPRIATE NATIONAL INSTITUTIONS, INFRASTRUCTURE AND INFORMATION WILL SUPPORT SUSTAINABLE WATER AND WASTEWATER MANAGEMENT.

Clearly defined responsibilities for all stakeholder organisations in water and wastewater management can prevent fragmented and uncoordinated plans and actions and improve linkages to other sectors. A specific national agency responsible for water and wastewater management can be considered to enhance performance. Strengthened institutional capacities and the collection and dissemination of data and information will support appropriate technology selection, increase system performance, increase the understanding of subsequent environmental and public health impacts, and demonstrate the need for water conservation and natural disaster preparedness.

GUIDING PRINCIPLE 3: BETTER ACCESS TO FUNDING WILL IMPROVE SERVICE DELIVERY, AND DEVELOP THE PRIVATE SECTOR.

Adequate government financial support, alternative financing mechanisms and improved internal cost-recovery are prerequisites to sustain maintenance and attract external investment.

GUIDING PRINCIPLE 4: COMMUNITY PARTICIPATION IN WATER RESOURCE DEVELOPMENT, WATER SUPPLY MANAGEMENT, WASTEWATER MANAGEMENT AND SANITATION, WILL ENSURE EQUITABLE BENEFIT WITH RECOGNITION OF SOCIO-CULTURAL SENSITIVITIES.

Water and Wastewater management and sanitation issues should receive a higher public profile. Public awareness by the community of socio-cultural, economic, environmental and public health impacts on wastewater management will ensure ownership.

GUIDING PRINCIPLE 5: VIABLE AND SUSTAINABLE LEVELS OF SKILLED AND KNOWLEDGEABLE PEOPLE WITHIN THE WATER AND WASTEWATER SECTOR AND COMMUNITIES WILL IMPROVE WATER AND WASTEWATER MANAGEMENT.

Appropriately trained and experienced urban and rural water and wastewater professionals are needed to develop projects and operate facilities, at both the technical, managerial and community participation levels. Increased training enables communities and individuals to take responsibility for operating and maintaining their systems.

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THEME 5

INSTITUTIONAL ARRANGEMENTS
LEGAL, PLANNING & POLICY AND INSTITUTIONAL STRENGTHENING

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1. EXECUTIVE SUMMARY

To achieve the goal of sustainable water resource management, strong and appropriate institutions and institutional arrangements are essential. In the Pacific generally, we have too often set lofty national policy goals without putting in place the necessary operational and policy support frameworks and instruments – which are either absent or insufficient for the task – and the goals are not reached.

At the same time the water sector [which involves a complex relationship of environmental, social, economic and cultural activities, rights and responsibilities] has not been brought under a single focus so that the beneficial gains from integrated management [efficiencies of planning and operation, conservation of water and aquatic environments, equitable access arrangements, financial savings in capital infrastructure works, and so forth] can be realised.

A great deal of attention has previously been given to establishing water utilities and other models of service providers. This was justified in terms of getting better and more efficient water supply networks in place. However other parts of the water sector – wastewater, stormwater, catchment and river control, aquatic ecosystems, flood hazard mitigation – have progressed less well.

At the Sigatoka Regional Consultation Meeting in 2002 broad agreement was reached by participating delegations on a series of themes relating to the objective of sustainable water management in the Pacific. One of these themes concerned institutional arrangements [legal, policy and planning, and institutional strengthening]. The resulting Regional Action Plan emphasised a number of key messages regarding this theme:

1. Work together through a comprehensive consultative process, encompassing good governance, to develop a shared National Vision for managing water resources in a sustainable manner.
2. Develop national instruments including national visions, policies, plans and legislation appropriate to each Pacific Island Country taking into account the particular social, economic, environmental and cultural needs of the citizens of each country.
3. Promote and establish appropriate institutional arrangements resourced sufficiently to enable effective management of water resources and the provision of appropriate water services.
4. Recognise and share the water resource management knowledge and skills of all stakeholders at a National and regional level in the process of developing and implementing the National Vision.
5. National and regional leadership in water resource management should be recognised and encouraged.

Together with a series of action elements and statements these constitute a sound basis for developing more efficient and effective water sectors in Pacific island countries.

The following Theme report discusses issues relating to institutional arrangements and supports the general move toward better integration of institutional processes and objectives across the public / private sector divide. It also reinforces the need to incorporate customary structures and institutions where practicable, and to actively involve the community in the development of the driving vision, objectives and action plans. Only in this way are we likely to reach a vision of sustainability. A vision that will almost certainly require the realignment of personal and collective rights and responsibilities if we are to be successful.

2. INTRODUCTION

"Water, water every where.
Nor any drop to drink."

This well-known part-couplet from Samuel Taylor Coleridge's *The Rime of the Ancient Mariner*, is not only a suitable sub-theme for the conference held in Sigatoka, Fiji during August 2002 but is also illustrative of the power that the concept of "water" has in art, literature and legend throughout the world. The plot is straightforward – a sailor adrift in a glassy sea. It is hard to imagine a more absurd state to be in than a situation where one is thirsty and surrounded by undrinkable water – of course if Coleridge had known of the tales of survival of canny Pacific islanders adrift for months in their boats he might have rethought those lines! Be that as it may, this is the stark prospect for many where water sources are contaminated, or diverted, or access otherwise precluded through inappropriate tariffs or other barriers, or simply lost or wasted through poor management. Many of those who inhabit Pacific island countries' poorer urban areas are similarly awash with unusable water at times of flood, or bear dry witness on parched atolls as isolated rain showers pass tantalisingly to seaward.

Fortunately, and for reasons addressed at the conference, the small island Pacific Ocean countries, surrounded as they are on all sides by Coleridge's paradox should be able to avoid this fate. Indeed the paradox for us in the Pacific is that we needed to have this conference at all, situated as we are in the largest body of water on earth with the smallest total oceanic dryland mass.

Whatever water supply options are opened up for us by future technology, our common future and common responsibility must be geared toward sustainably managing and developing our water resources in, on and under each and every island in the Pacific – from the smallest water lens underlying our necklace atolls, to the mighty aquifers and surface water systems of a Fly or Sepik river catchment.

The theme of the conference – Towards a Sustainable Water Sector in the Pacific – is no less than the theme of a sustainable Pacific. Quite simply, without a sustainable water sector there can be no Pacific as we have known it. Water connects and inter-connects in ways that no other single natural resource does – it binds both natural and social systems. Water is liquid power as many nation states around the world have realised over time. Water is one of those taken-for-granted resources, until the day it is restricted. Deny or unreasonably limit access to water and the political and social consequences are often immediate. Similarly, if we fail to exercise proper control over the power of water then destruction, disease and deprivation soon follow. Water *is* the essence of life. It is a basic right – or so we think. Strange then that no less an instrument than the 1948 UN Universal Declaration of Human Rights fails to mention the right to water!

However it is this very taken-for-granted status of the resource that is its most problematic part. Resource managers are very familiar with the concept of resources as "commons" or, more specifically "common-pool resources"; that is, those resources that have no single identifiable "ownership" structure, either belonging to everyone or being widely accessible by a defined group. The theory of the "commons" argues that it is largely because the resource belongs to everyone, and individual property rights are undefined, that no-one takes responsibility for monitoring the state of the resource and its ultimate care and protection. There are notable exceptions to this thesis but it has been very persuasive as a concept in driving institutional reforms in the area of public good commons – probably the best Pacific example being the tuna fishery and the UN Convention on Straddling Stocks [those wide ranging commercial fish species that move through the High Seas into the territorial sea and exclusive economic zones of coastal and archipelagic states]. The Pacific, however, has a number of interesting variations on this theme, involving the allocation of specific guardianship responsibilities [either by clan or lineal inheritance or by appointment] for the health of resources, even where these are commonly available. In New Zealand, for example, the Maori concept of *kaitiaki* or guardian applies in this way to those charged with responsibility for ensuring that the health of water [*waiora*] is maintained. Kaitiaki use such traditional devices as *rahui* or bans which limit activities that can be undertaken with respect to the resource for periods of time. This is mirrored throughout the Pacific by councils of chiefs and village headmen restricting the taking of fish and shellfish from inshore reefs so that the reefs can recover periodically from overuse.

The unbundling of common rights and responsibilities has proven difficult depending on their traditional structures. For example, much of the western world has adopted variations on the riparian land ownership model. That is, ownership of land includes the riparian banks of streams, lakes and rivers [and sometimes the bed of the water body out to a certain point] but does not include the water that is contained or flows over or past that land. A body of law has therefore developed for the allocation of water rights, which is known as the *Doctrine of Prior Appropriation*. This doctrine allows the principle of "first in time, first in rights". That is, the first person to divert water and put it to beneficial use is entitled to continue that use without interference from other users who might make subsequent claims. In some jurisdictions the use is time-limited and can be reviewed and amended; in others it remains in place as long as the use does not change. However within this doctrine there has been little room for concerns about the water ecology, its *in-stream* values. Indeed in parts of the Pacific USA, for example, the struggle to reduce old appropriations in favour of sustainable

aquatic needs remains a significant battle – as it does in many countries where the desire for water appropriations exceeds sensible abstraction limits. In the Pacific this doctrine is a very good approximation to customary resource law in many small island countries, and the resource rights issues associated are similarly comparable. It is a particularly difficult problem for those larger river systems that flow through many villages and/or the land of many custom owners such as, for example, the Fly River in PNG where the health and quality of the river system is not the responsibility of any group of, or single land owner. A management outcome that relies upon the sum of the practices of traditional resource responsibilities – in the case of surface water systems the sum of all sub-catchment management practices – may be appropriate where traditional inputs are the main source of contaminants. However, where modern agri-chemicals, industrial waste products, and/or concentrated forms of human effluent are a significant source of contamination, the more traditional resource management structures requires deliberate and careful modification.

The even more difficult issue of continental transboundary rights to water – that is major rivers or other waterbodies that lie or run under or between countries - fortunately, is not generally an issue for the Pacific. This issue – as far as it is relevant in the Pacific - is reserved for that body of water that was not the subject of the Sigatoka meeting, the High Seas [within which area conventions such as the United Nations Convention on the Law of the Sea ["UNCLOS"] and economically important conventions relating, for example, to tuna [i.e. straddling fish stocks] apply].

As difficult as the exercise in unbundling traditional or customary land and natural resource rights might be – and in some Pacific countries this is made easier both by the size and geography of the country and by the way in which society is stratified – it is an essential part of the process for sustainable institutional reform. It is also inextricably wrapped up in the related issue of land tenure because water either passes through [surface water] or beneath [groundwater] land that is often still held [or asserted] under customary "title".

Whether an identifiable Pacific-way approach to institutional arrangements for water is feasible remains to be seen. Certainly a unifying characteristic for Pacific nations is their relatively small population bases, comparative lack of economic wealth, institutional and infrastructural capacity, and their geographic nature.

The cry for institutional reform in many areas of life has been a constant message in the Pacific and elsewhere for the past few decades. In part this has been driven by changes in the various public / private sector paradigms that have developed internationally over that period. The institutional world has recognised the value of combining the best elements of public and private sector management models. There is now a considerable literature detailing examples of ways in which beneficial outcomes can be achieved through the careful application of appropriate incentives, principles and controls. In the area of water and sanitation this is also the case. Central to this is the clear articulation of resource allocation and access rights, and the instituting of socially acceptable ways of determining and resolving conflicts over those same rights. Because this fabric of rights is so specific to every culture, each country and many individuals within those countries will have a different view as to where, if anywhere, reform is appropriate. While *blueprints* for water industry reform, for example, do exist – and these are discussed in section 2 of Michael Dworsky's Theme 4 paper on Technology – an *off-the-shelf* approach to problem solving is not recommended. The Sigatoka meeting confirmed the merit of a common process approach that recognises the inter-relationships and dependencies of the water sector with the natural and social worlds.

By themselves new institutional arrangements – whether *instrumental* in terms of legislation and policy, *operational* in terms of water departments and utilities, or *technical* in terms of the science and technology – cannot guarantee solutions to problems. Without a broader unifying and commonly agreed objective or series of connected objectives, new arrangements are highly likely to do a number of things. They will probably:

a) Recreate the old patterns of inter-agency behaviour – which presumably are one of the reasons for the reform in the first place; or

b) Establish a new set of personal initiatives that are not necessarily any more worthy than those they replace; or

c) Create a new set of regulatory compliance costs and requirements that are not necessarily more rational or cost-effective than those they replace; or

d) Over time become as disconnected as they were before the reform; or

e) Remain non-strategically directed.

The risks of this for the water sector are extremely high. At first sight this might not seem the case because water supply is, as we know, a reasonably pure monopoly – unless you dispense with the delivery reticulation system and only permit water sales from trucks and stores! However, water supply has various sources and as soon as we take institutional reform up the supply chain and start thinking about managing catchments for headwater protection, aquifers and water lenses for contamination, and water bodies for their biological diversity, then the breadth of the scope of our consideration encompasses most of the significant activities that occur within our islands. Overlay this with human health and sanitation considerations and few areas remain untouched by our concerns. Because it raises constitutional, ethical and social issues, institutional water reform is a matter of community politics. It is therefore

appropriate that the process through which institutional options are refined and decisions are made is also community-based.

There is an old planning adage that says: "*If you don't know where you are going then, sure as anything, you won't get anywhere!*".

One of the risks to institutional reform programmes is that too little attention is given to agreement on the road map [i.e. where we are trying to go], and too much attention is paid to the "*how*" of getting there [in the absence of that road map and agreed destination]. Institutions should always be the *instruments* for the journey, not the journey itself. With difficult sectors like water, which cross all sorts of jurisdictional and administrative boundaries, we can easily lose sight of the big picture of what we are trying to achieve by tripping over the important but secondary matters of structure and function. A well constructed and agreed vision or direction, on the other hand, will often suggest structure and function and provide its own answers to the more intractable questions of rights and responsibilities. Most countries have a broad vision of clean and plentiful drinking water accessed by all at affordable prices – for example. Often the road map starts and stops there. This is not particularly helpful in terms of getting from today's reality to the vision's promise. In general terms we need to fill out the road maps better and with more community agreement if we are to achieve these visions.

What follows is a general discussion on some of the themes and elements that arise out of deliberations about the sort of institutional arrangements that might be appropriate for Pacific island countries.

3. THE SOCIAL GEOGRAPHY OF PACIFIC ISLAND WATER

While Pacific island countries share a number of common elements that derive from their relative isolation in a vast sea, the differences are equally important – particular with respect to the water sector.

With the exception of continental landforms, the Pacific contains a wide variety of island types, ranging from the large, high volcanic islands of Papua New Guinea to the tiny low coral atolls of Micronesia; from states with relatively few inhabited islands to those with many hundreds of the same; from those states, such as Papua New Guinea, with mighty river systems that run through many linguistic systems, to those that have no natural surface water systems, such as Niue, and are completely dependent upon rainwater and groundwater catchment.

Similarly the social structure of Pacific communities ranges from highly stratified, constitutional resource "ownership", such as throughout Polynesia [for example in Tonga, and to a lesser extent Samoa], to quite decentralised sub-clan / family tenure systems evident throughout the catchments of Melanesia. Land tenure systems and customary ownership / guardianship of and for natural resource, including water, are equally variable – and while some states have either implicitly or explicitly sought to codify these rights in their modern constitutions, custom disputes remain a significant source of tension in many. The resulting issue of compensation payment for the extinguishment of rights, or access, to land and resources is an acute issue presently throughout Melanesia, but also poses significant questions for the implementation of effective institutional arrangements more widely.

At the same time all countries share the experience of increasingly dense primary settlements, particularly around the capital towns, with increasing numbers of under- or un-employed, and consequential degrees of urban poverty. These settlements, particularly when associated with informal "squatter" settlements, bring a quite different set of problems for the water sector than those associated with rural supply.

The result is that many Pacific island countries have adopted a water service delivery distinction between the urban and rural or outer island areas. This has been based on a number of readily apparent reasons in urban areas. For instances:

- In most cases the state has centralised the control and ownership of town land and is able to secure easements and other forms of tenure for water catchment and reticulation infrastructure;
- The alternatives to a co-ordinated and controlled urban water supply delivery mechanism run significant public and environmental health risks;
- Economies of scale can be applied;
- Many commercial and tourist operations require certainty of quantity and quality;
- Population densities in the main towns result in small lot development unsuited to individual abstraction from surface water or groundwater sources;
- Raw surface water sources close to main towns are often below international health standards for drinking water.

Table 3 in section 5 below provides a list of Pacific island country urban water supply agencies. This range includes government departments, metropolitan local councils, water and sewerage boards / authorities / utilities, and power utilities.

In the rural areas where smaller scale and cost operations are feasible, community owned and managed facilities are more common – often with the involvement of local government bodies, churches, NGOs, and other donors – although access to surface water supply, maintenance, and operational [i.e. recurrent] cost issues are ongoing concerns.

The above, very simplified, overview of differences suggests that institutional solutions to the particular social – geographic configurations of Pacific island countries will have to be tailored to suit. A one-model-fits-all solution is unlikely, although this does not preclude the prospect of adopting common service level standards and overall management frameworks and principles. Consequently, while a single model Pacific water law might be a useful device for wrestling with common legal issues surrounding indigenous "Pacific" rights to water resources, each country will need to develop its own specific codes and institutions.

4. SUMMARY OF ISSUES, CONCERNS AND CONSTRAINTS

At the 1994 UNESCO/SOPAC/UNDDSMS sponsored Pacific Water Sector Planning, Research and Training meeting in Honiara, SOPAC's Director, Alf Simpson observed:

"*We know well what the needs are, the relevant point for discussion is how to satisfy them."*

The discussion below covers some of those needs with respect to the institutions[1] used throughout the Pacific.

4.1 Protection, management and development of water resources – Integrated management and control

The nature and state of the existing water resource – including surface and ground waters – is the point at which all other considerations should start. If, for example, an island's water resource is in good health [both in terms of natural quality and quantity] then the need for regulatory intervention is clearly less urgent. If, on the other hand, demand/abstraction is exceeding recharge/replenishment requirements, or groundwater is exhibiting significant organic nitrate contamination, then intervention needs to be considered.

Often, however, the health or otherwise of our water resource is not so clear-cut. This for a number of reasons that might include the following:

- the base quantity and quality data are incomplete; or
- inputs and contaminant pathways are incompletely understood and/or mapped; or
- our technical capability is insufficient and/or overcommitted; or
- access to appropriate sites for research and/or monitoring is difficult.

Completing and maintaining the water resource record is a difficult, time-consuming and expensive exercise. Yet despite this many Pacific island countries have a quite comprehensive appreciation of at least those water resources that are at risk of failing basic quality and quantity standards for potable supply, and those upon which the larger population centres depend.

At the same time, water professionals are acutely aware of the need for vigilance to continually monitor the health of these resources and to ensure their sustainable abstraction, replenishment and use – and to develop "proxy" indicators for aquatic ecosystem health. In this regard we are becoming increasingly adept at identifying and using relatively inexpensive aquatic biological organisms as indicators of the ecological health of surface water bodies. However, recognising these signs and being able to protect the pathways that determine or influence these conditions is a different story. And this is even truer for groundwater resources, where the adverse influence of land use practices over lengthy periods of time are particularly significant – of which among those currently the subject of concern, the most important are probably residential sanitation and farming and agri-chemical practices.

While professionals recognise the need to manage all aspects of the water cycle in as integrated a manner as possible [discussed comprehensively in Tony Falkland's Theme 1 Overview Paper : Water Resources Management], the key policy question relates to the level of risk management that Pacific island countries consider appropriate to achieve whatever water quantity or quality standards are put in place. The policy goal of absolutely protecting all water sources/resources is often not a practical option. For a variety of reasons – primarily economic and social - countries often have to make difficult calls with respect to acceptable levels of contamination / pollution. In order to be able to set these parameters at sustainable levels, countries need good information, good technical monitoring, and good institutional cooperation. In effect one of the principal public policy gains from well-integrated water resource management – apart from the obvious ones of more efficient understanding and management of the subtle interconnections – is that of being able to permit activities more confidently to approach the limits, and therefore maximise use and minimise overall compliance costs. In order to give effect to these opportunities, it is essential that powers, rights and responsibilities are identified for all parts of the water sector.

4.2 Water, wastewater and stormwater [the 3 waters] – Integrated management and control

Water supply is the commonest form of water service

[1]The term "institution" is used throughout to refer both to operational arrangements [such as a water department] and instrumental arrangements [such as a water act or sanitation master plan].

provided throughout the Pacific. The main towns of all Pacific island countries provide this service to varying degrees and standards. In the rural areas water supply is more commonly through small-scale community schemes – often community funded.

Sanitation and wastewater services are generally limited to providing pump-out facilities. Most Pacific island countries rely in urban areas on pit or flush toilets with subsequent disposal via septic tanks through land. More sophisticated treatment facilities tend to be required for larger water users such as hotels or breweries / bottling plants / canneries.

One of the issues confronting Pacific island countries, particularly with respect to their main towns, is the extent to which management of the three waters – water supply, wastewater collection, treatment and disposal, and stormwater collection and disposal – is integrated. While Pacific island countries do not generally have a water shortage problem in terms of absolute rainfall, droughts are part of the water cycle in parts of the region. The potential for more efficient interception of rainwater – and a consequential reduction in stormwater requiring management, particularly in urban areas – is a matter of growing awareness regarding the merits of water conservation.

At the same time the practice of simply diverting stormwater – particularly road run-off – directly into coastal water and streams, without any form of treatment or sediment settlement, is coming under scrutiny. This issue is more acute in those main towns that are experiencing significant urban growth, much of which takes place in less desirable locations, often low-lying and flood prone. In these situations, stormwater tends to become contaminated both by wastewater from inadequate sanitation treatment devices, and by motor vehicle by-products washed from roads [such as mercury, lead, chrome, polyaromatic hydrocarbons, oil, rubber and so on].

Where urban settlements have a common wastewater treatment facility [and this is not particularly common] the argument for integration of water supply and wastewater is often made because of the relationship between water supply and the resulting volume of influent received at the plant.

One of the areas in which a great deal of attention has been focused with respect to integration – although it is arguable whether integration has been consistently achieved – is in the cross-over between water supply, wastewater disposal, sanitation and human health. This is an area where it is particularly important that the formal regulatory, standards setting, and monitoring responsibilities are well defined and co-ordinated. This is not just for reason of administrative efficiency and public confidence and certainty, but more particularly for the very practical reason that building, maintaining and replacing infrastructure involves substantial costs. Sensible statutory planning is not just a community *feel-good* exercise. Integrated asset management planning and development can stretch scarce resources to make significant side-gains. Setting the requirement for comprehensive public asset management planning in statute – even if the actual service is provided by private sector agents – has proven beneficial in many "developed" jurisdictions. Furthermore integration is more likely to lead to better water conservation, with the beneficial result that the available potable water, for example, goes further and is cheaper in real terms.

In deciding whether to adopt such an integrated approach it is important that countries identify whether *integration* is a *process* principle or an *agency* principle. In other words whether to establish a unifying process through which all relevant information is assembled [similar to the process many countries already have for bringing together their capital development budgets for Cabinet approval and funding allocations], or alternately, defining clearly agency roles and responsibilities in such a way that there are no conflicting or overlapping jurisdictions and management objectives are transparent. Put simply, integrated management does not necessarily mean one single agency – indeed that situation will almost certainly frustrate progress. The best fit for integration must be defined in terms of a country's particular pattern and needs – and then legislated. The Pacific is full of draft legislation that fails the crucial test of social or cultural relevance and is consequently either not passed into law or is neither observed nor enforced.

4.3 Legal framework for water

All Pacific island countries have some form of legal policy for water [refer to **Table 2**, section 5].

Where explicit legal policy has not been not codified [and often even where it has] traditional common law/ lore is everywhere at hand – in itself a significant issue throughout the Pacific. Unfortunately, nowhere does this wider body of Pacific law appear to have been systematically brought together in a single database. If this occurred the creativity of Pacific law drafters and lawmakers [good law, after all, responds to real perceived problems] could be used to further refine and develop individual country expressions.

Water law internationally seldom recognises the unity of the hydrological cycle. It tends to be either sectoral or resource-based – e.g. energy and water are often dealt with separately even where hydro-generation is involved; forestry and water are often poorly integrated; agriculture and groundwater often overlap; etc. Either way, water is split between many statutes – even where this is an explicit water law. There are distinct schools of thought regarding whether laws dealing with *fugitive resources* – that is resources [like water, air, or pelagic fish] that move around otherwise essentially stationary resources for which rights are defined [such as land or

crops or buildings] - should be sectoral [i.e. user-based] or resource based. Indeed, few Pacific island countries have specific water legislation that seeks to integrate the allocation and management of water *as an environmental resource* – it is much more common to find public health-based legislation. In light of the fact that water is such a pervasive resource, a fully integrated single water statute – what is known as *omnibus* legislation - dealing with all of its implications is not usually realistic. And even if such legislation were to be enacted, all manner of practical problems in terms of keeping the legislation up-to-date and relevant would arise.

For this reason, Pacific island country jurisdictions will likely end up with a mix of sectoral and resource-based legislation. Because of this it is important to address the question as to how best to facilitate the integration of all the bits and pieces without creating a bureaucratic or regulatory nightmare, while maintaining as the overall objective the sustainability of water as a resource.

Historically most Pacific island countries have started their water legislation from a human health rather than a natural resource perspective. This makes eminent good sense as water-related public health issues have been, and continue to be, a significant area of concern. Furthermore, the move to develop legislation for the protection of water bodies for their intrinsic values [aquatic biology, quality, quantity] is, internationally, a more recent trend as it has become appreciated that looking after water sources and their associated environments actually gives us more flexibility for use [including carefully managed treatment disposal options], while addressing public health issues at the same time. Other legislation can be found that deals with water-related matters as a subsidiary issue. For example, mining legislation often focuses on the extractive, processing and commercial/royalty aspects of the activity while relying on other or subordinate legislation to manage groundwater diversion, discharge, and post-closure events.

In terms of some sort of idealised legal framework for water, the following elements are, to some extent or another, found in the Pacific:

- **Constitution**: The constitutions of Pacific island countries vary in the degree to which natural resource rights generally and water rights specifically are articulated. In some constitutions, rights are clearly identified with the Head of State – as in the Kingdom of Tonga – and with others their allocation by the State is guaranteed for the benefit of the people – as in the Republic of Vanuatu and PNG. While it might be desirable for constitutions to stipulate the respective state, corporate and individual rights of ownership, use and access to surface and groundwater features, this is not common. In the absence of this it is left to the courts to determine based on particular codes or the common law, or to chiefly and big-men structures to interpret and administer local remedies.

  While the question of the ownership of natural water is a very difficult and complex matter, this is less so for ownership of water-related assets, for access, or for traditional usage.

  The constitutional definition of water rights is a particularly important issue in those situations where limitations are being imposed – as for example in the establishment [and removal] of informal or squatter settlements in strategic water resource areas, or the expansion of urban areas into non-government land.

- **Statute law**: A body of law dealing with the protection, regulation, management use of water, including the definition and allocation of property rights relating to water bodies; minerals and living organisms contained in water bodies; limits to property rights with respect to resource rentals, transfer of rights, and interference with the rights of other instream user; cultural and traditional use rights; powers and functions governing the administration of legislation; procedures for establishing national water priorities; provisions for the promulgation of regulations and standards for such matters as water quality, public health and hygiene, and environmental assessment; compliance and law enforcement; and a comprehensive court system.

  Inevitably this body of law is comprised of both primary and subsidiary legislation – for example it must mesh with and be consistent in such areas as building codes/standards, by-laws for local government, water supply for fire fighting, regulations for discharges from ships and other vessels, the application of pesticides and fertilisers to land, drainage from highways, treatment of mine wastes and discharges, and so forth.

- **Custom framework**: The customary framework [or common law] for the holding, use, allocation, stewardship and dispute resolution of water resource matters should be accurately described and, where practicable and appropriate, incorporated into the formal legal framework.

  This includes traditional uses of water sources and areas surrounding water sources for bathing, washing, healing, as well as those customary practices of prohibition and closure so necessary for resource conservation and the observance of particular rites. It is also important to capture the different gender roles and responsibilities surrounding water.

  One of the more difficult areas for legal policy in the customary framework is that of due and proper compensation for the loss of resources or access to resources. Expectations of compensation are held by many to have become escalated out of all sensible

proportion. In the absence of government policy direction on this question, a "free market" process that escalates to the point of mutual dissatisfaction is increasingly likely. For example, in Port Vila water supply is unable to be provided directly to some members of a community because the compensation demanded by adjacent landowners for permitting the laying of pipes is beyond prudent investment or project budgets [UNELCO: Chaniel *pers comm*.]. Other instances will come to mind of occasions where claims are lodged stating that compensation was paid to the wrong person, or other interested parties lodge secondary demands for compensation on the grounds that insufficient was paid initially. Some Pacific island countries have tried to manage this issue by outright state purchase of urban land and associated rights – only to find that the same compensation issues surface as a result of inadequate land lease drafting. Failure to provide specific provisions in legislation relating to default leasehold easements for water supply and drainage, for example, can quickly lead to similar problems as communities grow.

Consideration also needs to be given to the role that village and chiefly councils can play in helping to settle resource disputes – for example Vanuatu enacted a Customary Land Tribunal Act 2001 in which traditional chief-based hearing panels make binding decisions on matters voluntarily referred to it by the parties, and thus effectively bypass the more formal administrative and civil court jurisdictions [except on constitutional or natural justice matters]. This model works by combining traditional decision structures with contemporary legal process – although its success has yet to be assessed.

- **Policy**: While policy is often a sub-set of statute law, it is a key area in its own right. By itself legislation rarely provides sufficient direction. It may, and often does, give a general direction as to the requirement for a national water policy for example, but the details remain to be determined. The purpose of statute law is more often to state functions and powers, and occasionally principles, rather than detailed policy.

  Policy has both a national and an international focus. An increasing emphasis on international conventions and treaties, such as those that have derived from the 1992 UN Conference on Sustainable Development in Rio, is also putting expectations on Pacific island countries for the development of appropriate domestic policy. Closer to home, for example, the 2001 Majuro *Pacific Wastewater Policy Statement* elaborated guiding principles that included the expectation that national policies, regulations, institutions etc. appropriate to the Pacific and supportive of sustainable wastewater management will be developed.

  Policy does not, of course, require legislation for effect – except where it contravenes existing legislation. Indeed, as can be seen from **Table 2**, Pacific island countries have a range of informal and formal policy instruments covering the water sector. The development of domestic policy on water should not depend upon legislation – although legislation will often be necessary once the policy is developed – particularly where enforcement or the limiting of informal or traditional/customary rights is concerned.

- **Plans and Planning**: Integrated water sector planning implies that policies are translated into operational plans, institutions are developed in accordance with those plans, implementation targets and benchmarks are established, and review mechanisms are put in place. If these stages are mirrored in legislation and supported by awareness raising and compliance and law enforcement, the public can then be more confident about achieving sustainable outcomes.

  While there is no agreed special recipe for planning success, it certainly helps if the evolving process is guided by a clear set of policy objectives and principles, which are then codified into a national or regional plan in such a way that all sectors are involved in the definition of the approach and begin the important step of *ownership*. Furthermore the plan – whether it is a national water strategy, a delivery services plan, or an urban drainage plan – needs legal force if it is to be effective in those very difficult situations where property or custom rights are challenged. Too often plans remain in an unapproved draft form, resulting in uncertainty and open-ended discretion for government [both central and local] officials, which reduces public confidence in outcomes. Statutory plans are, in this sense, more appropriate than non-statutory ones because they create a more certain framework for dealing with the relationship of rights held or presumed. They also limit the discretion that government officials otherwise have, and will usually provide for third party adjudication of disputes by the courts or special tribunal.

  At the same time it is important that plans foster integration between and across planning sectors – for example with respect to building controls, health standards and environmental regulation and planning in urban areas.

- **Contracts:** As Pacific island countries move to adopt business models for service delivery and asset management, the matter of establishing legal contracts for services or for asset leasing, for example, becomes critical. From the Sigatoka meeting it was noted that the various Pacific water authorities all have different contractual relationships with the governments of their respective countries. Some are short term, others of significant duration [for example UNELCO in Vanuatu has a 40 year contract,

which reflects a number of factors including the state of the asset at commencement, capital investment requirements, and profitability requirements].

In an ideal world, contracting-out would be the final step in the establishment process, and would follow from clearly articulated national water policy, resource information databasing, institutional reform, legalising of rights, duties and functions, and so on. Ideally both parties to a contract need certainty and clarity as to what it is they want from the other party and what they can reliably give to each other. If this is unclear then the contract cannot be specified with sufficient particularity, and later conflicts over interpretation or expectations or matters unstated but assumed, are likely to arise. For example, a crucial issue in urban water supply is whether a "pro-poor" cross-subsidy or some other form of contra payment for connection or supply is to be adopted – and who should pay, and for how long, and how this is to be calculated.. Fiji, for example, has in the past used the not unusual device of cross-subsidising water supply from power charges. It was able to be this because the utility operated both water supply and electricity generation – itself a common utility combination. Obviously such options must be part of the contract negotiation process. While issues arising can be "retrofitted", it is advisable to have a "no surprises" policy approach to contracts of this sort.

However, it is not sufficient to simply specify a series of present-day issues for contractual purposes. A contract whose legal term is for 20, 30, or 40 years will bear witness to issues that we have not yet thought about. Contracts therefore need a degree of flexibility – for example by the provision, contained in many water contracts internationally, for governments of the day to confirm forward capital asset development plans or to approve Statements of Corporate Intent. Another matter over which governments characteristically want to exercise some form of control is unit charges. If the contract fails to specify the mechanism for this process, considerable downstream tension between operator and owner can ensue. Businesses require a degree of certainty in their operating environment in order to be efficient. Unless contracts provide this it is unlikely that the anticipated outcomes will be achieved.

Customer contracts and charters are the other important part of this arrangement. Time spent in establishing appropriate contracts with customers is usually repaid with fewer subsequent disputes.

With the emergence of water and other utilities throughout the Pacific over the past 20 years, we now have a considerable body of knowledge about contract specification. That needs to be shared more widely – mindful that issues of commercial confidentiality sometimes make this difficult.

- **Enforcement**: It almost goes without saying that legal mechanisms and institutions require enforcement at the end of the day. If breaches of regulation and law with respect to water, including the abuse of assets, remain unchecked or unanswered, then confidence in the network and its authorities can be rapidly eroded. In the Pacific, with its relatively small population bases and close communities this is a very sensitive matter. Enforcement agencies tend to be "civil order" rather than natural resource orientated, and while water utilities can turn off supply to payment defaulters relatively easily, the removal of squatters from protected water reserves or pursuing someone who has deliberately cut a supply line or polluted a watercourse, is quite a different matter. This relative lack of enforcement capability is one further reason for pursuing the maximum degree of private and community ownership of water sector infrastructure and goals – because this places ownership, accountability and the incentive to manage prudently closer to the actual users. Reliance upon the force of law to achieve water sector sustainability in most Pacific island countries is not likely to be a successful strategy.

Of course legal structures are one thing, implementation is quite another.

4.4 Governance arrangements for regulation and service delivery

One of the lessons that has emerged from the water sector internationally, particularly over the past 20 or so years, is that increasing competition for water requires much more comprehensive and integrated management if sustainable triple bottom lines [that is, the three elements of social welfare, environmental/ecosystem integrity and economic productivity] are to be achieved.

In order to make this happen operationally, a number of fundamental actions are necessary. These have been well characterised by the ADB as follows:

- *stakeholder participation in all stages of the project cycle;*
- *attention to the complementary roles of the public and private sectors, recognition of the special contribution of women, and incorporation of economic instruments to improve allocative efficiency;*
- *integration of pro-poor strategies into project formulation to ensure that services are extended to poor areas and that rights of access are assured for the poor and other disadvantaged groups;*
- *strengthening of regulatory and control functions to maximize opportunities for private sector participation in service delivery;*
- *environmental protection and enhancement as an*

integral part of every new project, with each project being evaluated in the whole river basin context; and

- *acquiescence of directly affected communities prior to committing investment funds.*[2]

If the above are to be properly incorporated into the water sector then attention to the *structure* of governance is crucial.

The mix of water governance arrangements evident in Pacific island countries [refer **Table 3**] is generally a variant of a kind on the following components:

- **Line Ministries**: Water resource issues are generally concentrated in the key ministries/departments responsible for health, public works and natural resources. Hydrogeology is commonly associated with natural resource agencies [for example lands or mines].

  However many other agencies are involved – for example finance and commerce departments with respect to water tariffs; and ports and marine departments with respect to structures in navigable waterways, navigation and safety, wharves and jetties.

  While overlapping jurisdictions pose a real risk of unco-ordinated action, these are a necessary reality in Pacific island countries with relatively small bureaucracies. The challenge is to make co-ordination happen without tying up the administration or introducing unnecessary delays in the processing of applications and licences.

- **National Water Committees:** A number of Pacific island countries [e.g. Vanuatu and Tonga] developed national water committees to improve co-ordination and to prepare national water resource policy. While these tend to be controlled by line ministries they typically include representation from utilities, major consumers, and sometimes civil society groups. These committees vary in their functions and powers but tend to be recommendatory /advisory, with a limited decision-making role.

- **Local Government**: The role of local government in the water sector is a developing one – somewhat paradoxically as the traditional political units in many Pacific island countries is at the village and sub-village level.

  Typically in the urban towns the role is limited to building standards/bylaws for sanitation and water supply, and some stormwater / flooding responsibility [often shared with the country's public works department through which development assistance may be routed].

  In rural areas oversight of the provision of community water supply systems and some sanitation responsibilities are commonly merged. In many respects the development of a Pacific island country local government sector is yet to emerge fully – partly because the traditional developed-world model is based on a revenue-generating land rate/tax system that is not usually in place to support decentralised infrastructure programmes [especially for recurrent maintenance and operational costs].

- **Local Water Management Committees:** For the purpose of supervising the operation and maintenance of rural community water supplies local water management committees are emerging as a means of facilitating ownership of systems – examples of these were presented to the Sigatoka meeting from Tonga, Samoa and PNG. With these committees it is very important to specify the respective obligations and responsibilities between national and local service providers, regulators and the community – particularly with regard to ongoing issues of maintenance and operation. Too often schemes reportedly fail because of differences in expectation with respect to the future cost burden. An area in which these committees seem not to have been used too readily is in the development of broader water management policy - particularly where the assertion of customary rights impedes the development of supply or access to the provision of services. Mobilising communities in their wider self-interest is one of the most effective ways of circumventing obstacles to progress because it is both more immediate and responsive to local circumstance.

- **Water Utilities / Business Units / Corporations / Boards:** The delivery end of water supply and wastewater disposal – where it is controlled – comprises a mix of public and private sector arrangements. This is an area where most change has occurred as the efficiency gains of non-political, single-objective structures are tested. In general terms Pacific island countries have shown confidence in moving the water supply sector into quasi-public sector management arrangements. However, in recognition of the public good aspects of this sector, countries have been reluctant to pursue privatisation, preferring, as for example in the case of Vanuatu, to retain the residual assets in public ownership even though with a lengthy contract terms [40 years in the case of Unelco's agreement with the Government of Vanuatu – the Government has recently sold its shareholding in Unelco, seemingly content with the robustness of its contract].

  Within this mix of quasi-public entities can be found a variety of billing regimes, directorship appointment rules, ministerial oversight responsibilities, customer service standards.

  Michael Dworsky's Theme 4: Technology Paper

[2] ADB Annual Report 1999 - Theme Paper No.8 – Water in the 21st Century: p16-17.

[section 2] discusses utilities in some detail, noting three common key traits of effective utilities:

- They are organised as an enterprise with costs recovered through user charges;
- A single manager is responsible for operation, maintenance and management;
- There is a clear and well communicated vision of the utility's purpose and function.

Dworsky then proceeds to elaborate what these things mean operationally and reviews eight utilities within Micronesia. His general conclusion is that none of the utilities meet the model because of constraints created by:

- Insufficient institutional capacity;
- Lack of government support;
- Insufficient public support.

Dworsky lists a further series of national and external constraints [including physical, technological and financial].

In the main Dworsky's lists are not exclusive to the issue of Pacific utilities. They are systemic functional and structural problems within the water sector generally.

4.5 Partnerships and Public Ownership

For relatively small-scale operations, such as characterise the needs of Pacific island countries, the option of full non-public ownership is rarely attractive commercially. Certainly parts of the sector are capable of commercial returns – depending on the terms of sale and conditions of operation – but the more credible future is commercial partnership under public ownership. This is for the simple reason that water is a strategic resource, a natural monopoly, and instituting real pricing across what are comparatively small sectors, with significant numbers of urban poor, would be unlikely to find widespread support . Institutionally, the sort of public-private ventures that have emerged in PNG, Vanuatu, Fiji, Samoa, Tonga, etc [refer **Table 3**] are practical commercial variations on this theme. Once the improbable spectre of non-public ownership is put aside – and considerable public awareness is often necessary – then the real community benefits of a focused commercial approach, aligned with public social and environmental goals, can be appreciated.

There is a steady movement throughout the Pacific in the water sector toward the contracting out of services. In order that these reforms are driven in the light of public policy aspirations, rather than just the commercial notions of efficiency and effectiveness, a number of key policies need to be set in place. In some countries reforms have proceeded in advance of this step – but there is still merit in completing the policy loop and, if possible, renegotiating contracts.

4.6 Regional Institutions

Recognition of the need for co-ordination among common regional initiatives has been a strength in Pacific relationships over the past several decades.

The following are the key regional intergovernmental organisations:

- The Secretariat of the Pacific Community [SPC] was established in 1947 [as the South Pacific Commission]
- The University of the South Pacific [USP] was established in 1968;
- The Pacific Islands Forum Secretariat [PIFS] was established in 1972 [with name changes in 1988 and 2000]
- The South Pacific Applied Geoscience Commission [SOPAC] was established in 1972 [initially under UNDP and then made autonomous in 1984];
- The Forum Fisheries Agency [FFA] was established in 1979;
- The Pacific Islands Development Program [PIDP] was established in 1980;
- The South Pacific Regional Environment Programme [SPREP] was established in 1982 [initially under SPC, it became autonomous in 1995];
- The South Pacific Tourism Organisation [SPTO] was established in 1989.

More recently the eight Heads of the above regional intergovernmental organisations have come together to form an advisory body known as the Council of Regional Organisations in the Pacific [CROP] – a successor body to the 1988 South Pacific Organisations Coordinating Committee [SPOCC]. In addition the Fiji School of Medicine and the South Pacific Board for Educational Assessment have observer status. CROP is chaired by the Secretary-General of the Forum following resolutions made at the 1995 Madang Forum meeting.

All the above agencies, with the exception of the SPTO, have been directly involved with the water sector in various ways.

As the issues of water infrastructure, urbanisation and rural depopulation, poverty and environmental vulnerability [sea-level rise, climate change, contamination and salt water intrusion etc.] become increasingly interwoven, the importance of regional co-operation to manage and support the necessary cross-sectoral poli-

cies and programmes becomes not simply obvious but essential.

In turn the above agencies are financially supported by programme money voted from bilateral and multi-lateral aid donors. Water programmes throughout the Pacific have been funded by the Asian Development Bank, World Bank, UN Development Programme, UN Environment Programme, European Union, AusAID, NZAID, Commonwealth Secretariat, JICA, UK Department for Internal Development, and CIDA, among other agencies.

4.7 Functional Activities

As indicated above, the water sector is extensive and impacts many areas of public and private life. The activities that occur within the sector can be functionally organised in many different ways.

As many Pacific island countries have already moved to establish water utilities [in one form or another] the functional principle of a regulator / retailer separation, which is the norm internationally, is already in place – even if the regulatory powers and responsibilities are not always well and comprehensively defined. It is generally the case that the regulatory role in the Pacific is retained by central government – rather than the emergent model in larger continental countries where quasi-independent industry regulators are being developed [for example, OFWAT in the UK]. While a pacific regional regulator is a conceptual option, jurisdictional problems makes this model unlikely. It is therefore likely that the policy/regulatory role will remain with government agencies into the future – in effect the status quo as can be seen from **Table 3**.

However in many other functional areas there is often no good reason for these activities remaining within central government. Indeed the establishment of regional Pacific organisations and the work undertaken in the water sector by these organisations illustrates the point.

Table 1 following indicates some of the general functions associated with and undertaken in the broader

Table 1. Water Sector Functions.

FUNCTION	GOVERNMENT	NON-GOVERNMENT
Administration	§ Application processing § Hearings and decisions § Prosecution	§ Application reviews under contract § Revenue collection § Customer contract termination
Asset Development	§ Donor-funded programmes	§ Asset development programme § Loan funding
Contract	§ Specifier § Reviewer	§ Govt Contract compliance § Annual accounts and reports § Forward development programme § Customer contracts
Ownership	§ Public assets	§ Build, Own, Operate and Transfer options
Policy and Planning	§ National water policy § Water conservation strategy § Legal policy – integrated codes § Administration policy § Integrated WRM	§ Interpretation § Consumer policies
Price	§ Overview § Contract subsidies § Investment / return on assets	§ Fees and charges § Billing strategy
Public Awareness	§ Water policy and environmental conservation awareness	§ Customer information
Regulation	§ Water quality guidelines and standards § Water quantity controls § Price bands § Competition / Monopoly controls	§ Industry benchmarks § Codes of practice
Research and Investigation	§ National water resources inventory § Watershed sensitivities § Cultural and social associations § Monitoring and review	§ New sources of supply § Implications of use § Assessments § Monitoring reports
Service Delivery	§ Water collection, treatment and supply – including community schemes § Stormwater collection, treatment and disposal	§ Water collection, treatment and supply – including community schemes § Stormwater treatment and disposal
Training	§ Securing funding assistance	§ Training courses § Funded training

Table 2. Water Policy and Plans.

Small Island Countries	National Water Policy	Local Water Policy	Water Legislation	Water Plans
American Samoa			• Constitution 1960[3] • Clean Water Act of 1977 • US Federal Safe Drinking Water Act • US EPA regulations	• Tualauta County Land Use Plan - American Samoa Department of Commerce (ASDOC)
Cook Islands		• Bylaws of Island Councils	• Rarotonga Waterworks Ordinance 1960 • Public Health Act 1996[4] • Public Health Regulation [Sanitation] 1987 • Building Code • Rarotonga Environment Act	
East Timor			• Sector policy and legislation [National Water Resources, Water Services and Sanitation Management]	• National Development Plan
Federated States of Micronesia	• Policy is left to the 4 States through the Utility Corporations.	• Public Health; • Protection of water resources; • Conservation and controlled use.	• State EPAs -drinking water; pollution	• Infrastructure Development Plan
Fiji			• Water Act – halted 1987 • Water Supply Act • Rivers and Streams Act • Native Lands Act	• Master Plans for Water Resource Development • 2001 Cabinet approved establishment of Strategic Water Resource Management Plan Committee[5]
Kiribati			• Building Permit Regulations	
Maldives	• Country Development Plan • National Health Master Plan 1996-2005 • Draft Levels of service • Draft Subsidy ceiling	• Maldive Water and Sanitation Authority [MWSA]		• National Water Supply and Sanitation Master Plan 1980
Marshall Islands				• National Water Supply and Sanitation Master Plan
Nauru	• WHO water supply study 2001			• 2001 draft Nauru Long Term Water Plan • Nauru draft Sanitation Plan
New Caledonia			• Drinking water regulation 1979	
Papua New Guinea	• Water Supply and Sanitation Sector Study 1996 • Allocation of water management functions • Medium Term Development Strategy 1997-2002[6] • National Executive Council decision 17/2000 – Privatisation Commission to prepare water assets for privatisation	• Consultation via Provincial Water Supply and Sanitation Committees • PNG Waterboard Corporate Plan 2000	• PNG Constitution • Organic Law on Provincial Governments and Local Level Governments • Environment Act 2000 • National Water Supply and Sewerage Act • Public Health Act – Drinking Water Quality Regulations • Draft Environment (Water Quality) Regulations	• National Health Plan 2001-2010

Table 2. ... continued

Small Island Countries	National Water Policy	Local Water Policy	Water Legislation	Water Plans
Samoa	• Strategy for the Development of Samoa 2002 • National Water Resource Policy		• Water Authority Act 1993/4 • Draft National Drinking Water Standard • Water Resource Bill	• Master Plan study for Samoa 1996
Solomon Islands			• River Waters Act 1969[3] • Public Health Ordinance 1970 • Water Resources Act 1998 – [halted] • Solomon Islands Water Authority Act 1992 • Environment Act 1998	
Tonga	• Seventh Strategic Development Plan 2001		• Tonga Water Board Act 1966 • Public Health Act 1967 • Tonga Water Board Act 2000 Bill • Water Resources Management Bill	• National Water Resources Development Master Plan • National Water Supply Master Plan
Tuvalu			• Water Resources and Sanitation Management Bill	• Tuvalu Water and Sanitation Plan
Vanuatu			• Public Health Act 1994 • Water Resources Management Bill 2002	• Port Vila Sanitation Master Plan • Rural Water Supply Master Plan

[3] Water supply and sanitation – under this Strategy water related issues are placed under the Ministry of Health.
[4] Territorial Government through the Secretary of the US Department of the Interior
[5] Ministry of Health not mandated to test water quality
[6] Refers to selected urban catchments only.
[7] Committee to investigate authoritative regulatory body on licensing and related matters; currently stalled.

Table 3. Institutional arrangements.

Small Island Countries	National Regulator/Planning/Policy	Urban Provider	Rural Provider
American Samoa	• American Samoa Environmental Protection Agency (ASEPA)[8]	• American Samoa Power Authority[9] [ASPA]	• Village Water Committees
Cook Islands	• Ministry of Health[10] • Dept of Water Works, Ministry of Works[11] • Rarotonga Water Catchment Committee	• Department of Waterworks, MOW	• Office Minister for Island Administration via Island Council Secretary
East Timor	• Serviço das Águas e Saneamento (SAS) • Ministry of Transport, Communications and Public Works	• Serviço das Águas e Saneamento (SAS)	• Serviço das Águas e Saneamento (SAS)[12]

[8] Monitors potable water quality from groundwater wells
[9] Water supply and wastewater disposal
[10] Responsible for septic tank standards and control
[11] Responsible for water supply on Rarotonga
[12] Primarily by means of donor liaison

Table 3. ... continued

Federated States of Micronesia	• National Government through State EPAs	• Metropolitan councils • Utility Corporations [water & power]	
Fiji	• Ministry of Works – Directorate of Water and Sewerage • Ministry of Lands and Mineral Resources[13] • Ministry of Health • Ministry of Agriculture – Land and Water Resources Management Division[14]	• Public Works Department	• Local community
Kiribati	• Water Engineering Section of the Ministry of Works and Energy[15] • Environmental Health Dept of the Ministry of Health and Family Planning[16] • Urban Management Committee	• Public Utilities Board[17]	• Via Ministry of Health and Family Planning
Maldives	• Maldives Water and Sanitation Authority [MWSA]	• Male' Water and Sewerage Company [MWSC][18]	• Ministry of Health and Welfare
Marshall Islands		• Majuro Water and Sewer Company [MWSC] • KAJUR – Ebeye/Jaluit	
Nauru	• Department of Economic Development • Nauru Works & Community Services • Department of Health	• Nauru Works & Community Services	• Nauru Works & Community Services
New Caledonia	• Government of New Caledonia • Provincial government[19] • Communes[20]	• SADET [Tontouta Water Company Ltd][21]	
Papua New Guinea	• Dept of National Planning and Rural Development[22] • Dept of Environment and Conservation[23] • National Water Supply and Sanitation Committee • Dept of Provincial and Local Level Governments[24]	• Eda Ranu – Port Moresby • PNG Waterboard – 11 major centres	• Provincial or Local Level Governments
Samoa	• Department of Lands, Surveys and Environment • Health Department	• Samoa Water Authority	• Samoa Water Authority
Solomon Islands	• Ministry of National Planning • Ministry of Mines and Energy [Water Resources Division] • Ministry of Health and Medical Services[25] • Ministry of Transport, Works and Aviation[26]	• Solomon Island Water Authority [SIWA]	
Tonga	• Ministry of Lands, Survey and Natural Resources • Central Planning Department • Ministry of Health • Water Resources Committee of the Development Co-ordination Committee • Ministry of Environment	• Tonga Water Board	• Tonga Water Board • Ministry of Health • Island Development Committees • Village water committees

[13]Responsible for groundwater assessment and development.
[14]Responsible for river engineering, irrigation and drainage works.
[15]Responsible for water resources management throughout Kiribati
[16]Responsible for water quality monitoring and rural sanitation
[17]A government-owned corporation under the MWE
[18]Operates under a 20 year monopoly concession, licensed by the Ministry of Health and Welfare
[19]River maintenance and management of water use
[20]Drinking water and wastewater management
[21]A subsidiary of SUEZ
[22]Overall sector planning and budgetary allocation
[23]Regulation of water resources and wastewater discharge
[24]National Monitoring Authority
[25]Rural Water Supply Programme
[26]Urban water supply development

Table 3. ... continued

Small Island Countries	National Regulator/Planning/Policy	Urban Provider	Rural Provider
Tuvalu	• Public Works Department		
Vanuatu	• Department of Geology, Mines and Rural Water Supply • Department of Public Health • National Water Committee[27]	• UNELCO • Department of Public Works [Luganville]	• Department of Geology, Mines and Rural Water Supply • Local community

[27]An advisory committee

water sector. For illustrative purposes these have been separated into possible government/non-government activities. To some extent all of these functions are to be found in one way or another throughout the Pacific water sector. In few instances are they systematically instituted.

5. ACTIONS UNDERTAKEN TO DATE

Table 2 and Table 3 on the following pages indicate the current state of affairs with respect to the institutional, policy and planning frameworks for small Pacific island countries. They do not indicate broader international frameworks.

The Tables are not complete in that they do not contain every possible policy or planning instrument that refers to water. They do contain the major elements either tabled by the respective delegates at the Sigatoka meeting or otherwise advised directly. In a number of instances water policy is implicit in country development plans/strategies. These have only been acknowledged where explicitly referred to by country representatives.

As is evident from the Tables, a number of Pacific island countries have legislation necessary to establish their institutional water provider / service delivery agent, and establish basic human health standards, but few have either explicit water resource policy or catchment plans that provide for sustainable water resource management and development.

6. FUTURE NEEDS

Recommendations about options and priorities for meeting each Pacific island country's future institutional water sector needs cannot be made until a specific stocktake of existing arrangements, intentions, and identified water problems is made. While this exercise might be considered a "luxury" that is best put off while more immediate community needs are addressed, the long term financial savings that result from a broader understanding of water resource development impacts, the benefits of water conservation and thorough catchment management - and consequently more equitable access - suggest that any delay should be tempered. Fortunately the Pacific as a whole is already well-attuned to the thinking that lies behind the concept of sustainable water resource management, so the task is less formidable that it might otherwise be.

Nonetheless some broad "Pacific" themes are evident. These are generally discussed in the following section.

6.1 Policy and Legislation

Legal water policy tends to be public health focussed. Drinking water standards and bathing water standards are a vital part of the policy picture. However, while human health-related matters are a vitally important responsibility of the sector, this emphasis can have the unfortunate tendency to downplay source, quantity and natural quality aspects. After all, in an urban context, almost any water can be treated to a potable standard – at a price - but that is hardly a sustainable starting point. Ensuring that critical surface water and groundwater resources are protected from undue contamination is as important long term as the quality of the delivered drinking water – and the clearest way of doing this for surface water is through ensuring a healthy aquatic ecology so that "ecosystem" decontamination processes can be used and the water remains usable. Without strong community policy and appropriate support legislation this is particularly difficult to achieve.

Institutional water policy on governance, service levels, regulator responsibilities, competition, pricing etc. remain either largely informal, or are detached from a water context. For example there is a growing trend in the urban Pacific [as there is internationally] toward utility-structures for water service delivery. However this is not obviously connected to any national water planning policy. Yet in the developed world we know very well that decisions taken on water infrastructure [whether it is for reasons of supply, drainage or disposal] have very significant implications for the form and functioning of our towns. For example, the decision as to where a sewage treatment plant, or a water

supply dam, or a landfill is to be located immediately determines land use, future growth areas and recreational options in the surrounding area. The policy relationship and priority between public town planning policy and infrastructure provision is not, therefore, usually left to utilities to determine. Throughout the Pacific, however, this is often the case in fact.

An area of policy development for which regional assistance has already been identified is in the area of customary practice, land tenure, resource rights, royalties and compensation. This is vitally important as further legislative reform will be necessary in most countries once the policy framework for water has been shaped. Many of the issues discussed during the Sigatoka meeting require harmonised legislation – but the legislative reform must follow rather than lead the policy process, otherwise the effect is likely to be an emphasis on structure and function [the administrative apparatus] rather than the integration of the water resource sector.

6.2 Planning

At the heart of sustainable development planning is the integration of land use [i.e. social / community] and natural resource planning. Once sectoral water policy is adopted, the two key planning requirements of:

- Integrated water resource management; and
- Integrated land use management

can be completed. Most Pacific island countries have commenced planning studies with respect to their major urban settlements – although there are few adopted urban plans. This work needs to be completed in order that future growth planning can be better planned, provided for and directed, and appropriate infrastructure provision made – without inadvertently compromising existing or future sources of water supply, or placing new settlements unnecessarily at risk from flooding events or stormwater disposal routes. At the same time new large commercial users of water can gain confidence that their investments will not be adversely impacted by water shortages.

For many Pacific island countries the usefulness of formal rural planning remains a question of scale and intensity – but is particularly relevant where large-scale changes of use are occurring or are planned to occur. Examples would include mining activities, significant new horticultural enterprises, or changes in agricultural practices such as the application of significance quantities of previously unused agrichemicals, or new forms of introduced stock. Because these kinds of activities tend to be one-off occurrences a standard environmental assessment application process, such as is increasingly found throughout the Pacific, is sufficient *provided* the requirement is formalised and sufficient technical capacity for review can be found and engaged.

6.3 Institutional Strengthening

Strengthening of water resource management capacity is required wherever water resources are being reduced in quantity or quality. This is occurring throughout the Pacific's small islands. None of the delegates attending the Sigatoka meeting suggested that their country had sufficient present capacity across the water sector – while recognising that other technical disciplines were and would continue to compete for the limited available human resource funding.

Priorities need to be determined for institutional and capacity building and strengthening. Across the Pacific this will continue to be necessary at least in the following broad areas:

- technical capacity [policy, planning, regulation, enforcement]
- field research, analysis and monitoring capability
- community relations
- regional capacity
- institutional reform

Whether every Pacific island country needs to replicate the same sets of water sector skills, or whether some of these can reside in regional organisations or be shared between island groupings – such as the Melanesian Spearhead group - remains an ongoing issue.

In the end, each Pacific island country must conduct its own *needs analysis* because the priorities will flow logically from existing institutional arrangements and present water sector problems. For example, while it is easy to identify updated water resources law as a clearly absent institutional framework in a number of Pacific island countries, there is little point in pursuing this as a priority if the water policy and planning framework, tools and experience are not aligned.

One of the questions frequently asked is when to move to legislate. There are two responses to this question:

- that legal policy / law should precede practice and give encouragement to the institutions to develop; or
- that good law usually emerges from the specific problems identified and experienced in practice.

It is not my experience that the Pacific works in step with the first response. As a general observation Pacific island countries are quite conservative in their law

making – and that is an appropriate position to adopt. Where resource law has been enacted in line with the first response I have observed difficulties with implementation arising from a lack of public / community acceptance and understanding. For this reason water law reform should parallel institutional reform and be based on and supported by extensive community consultation. The key is to develop a well-integrated institutional framework, with appropriate roles and sources of funding for the management of water resources and the provision of water services.

Furthermore, reform of water utilities and/or other service delivery entities is desirable where the quality of service is restricted by current operating conditions – whether these are commercial, political or financial. Michael Dworsky in his Theme 4 paper in particular identifies a number of institutional pre-requisites for efficient and effective operation. These include:

- Sufficient authority [statutory and financial] to perform the function;
- Clearly defined and up-to-date objectives and action plans;
- Performance monitoring and good data management;
- Establishment of appropriate industry benchmarks and performance indicators;
- Agreed, realistic strategies for capacity building and technology development and transfer;
- Organisation as a financially stable enterprise;
- Functioning maintenance systems, safety programmes, with written guidelines;
- Clearly defined management and governance structure;
- Appropriate staff skill-sets and training programmes.

Well-governed, financially autonomous utilities – where these are justified by the scale of operation - invariably deliver a higher quality water service to consumers than public sector water departments because, among other reasons, their objectives are relatively straight-forward. This is one of the reasons for their popularity as a governance model – for example in the last 10 years some 500 water utilities have developed in the continental USA alone, and the vast majority of these are public companies under some form of political accountability through their financial reporting mechanisms. One of the principal advantages found with respect to the use of the various forms of water utility throughout the world is the ability to leverage off public policy goals without necessarily having a political bureaucracy attached to the structure. Where utilities or water departments remain closely attached to the political bureaucracy, a degree of conflict can arise that impedes the pursuit of longer-term strategies. Four of the operational policy areas that give rise to most debate in these utility structures are:

- The unit price for water and/or wastewater;
- Arrangements for hardship subsidies/blocks to guarantee a minimum available quantity;
- Whether profits should be taken and, if so, how and to whom the benefits should be distributed;
- The rules for termination of supply/services.

In the establishment of utilities these matters need careful attention and provision for their review should be made contractually.

7. ACTION PLAN

At a Pacific-wide level a number of steps have been identified for institutional reform. The key statements and actions outlined in the next section arising from the Sigatoka meeting are the most recent restatement of these matters.

The following elements [modified from a recent global summary by the ADB[28] – but generally applicable to the Pacific region] should be integral to any future action plan designed to achieve institutional integration:

- Promote a national focus on water sector reform through codifying water laws, sector co-ordination, institutional capacities, policies on poverty and ability-to-pay;
- Foster integrated water resources management, particularly with respect to investment and urban growth development;
- Improve and expand the delivery of safe, reliable water services, particularly by reinforcing private-public partnerships and securing equitable access for poorer parts of the community;
- Foster water conservation and infrastructure efficiency, through educational, regulatory and price-based mechanisms;
- Promote regional co-operation and information exchanges on matters such as legislation, enforcement, tradition, governance, socially inclusive development principles;
- Improve governance structures and arrangements, particularly in the rural areas of Pacific island countries;
- Build technical capacity in the areas of law, policy and planning.

[28]Water For All : The Water Policy of the Asian Development Bank 2001

As can be seen from Table 2 and Table 3 not every Pacific island country needs all of these steps to the same extent. However while these elements underpin existing Pacific water sector institutions, no country has yet developed the fully integrated set.

The 2002 Pacific Regional Consultation Meeting in Sigatoka considered sustainable water resource management under five themes dealing with water resource management, island vulnerability, awareness, technology, institutional arrangements and finance. This resulted in the adoption of a Regional Action Plan.

Five key messages emerged from this with respect to institutional arrangements, supported by 27 specific action elements and 21 supporting statements, as follows:

KEY MESSAGE 1: Work together through a comprehensive consultative process, encompassing good governance, to develop a shared National vision for managing water resources in a sustainable manner.

Proposed Actions	Responsibility
1. Identify a lead agency for initiating the process of developing a National Vision.	Government
2. Prepare a draft consultation strategy for the development of a National Vision.	Governments
3. Establish a process for inclusion and consultation with stakeholders	Governments
4. Seek agreement from stakeholders on the consultation process	Governments Stakeholders
5. Develop a National Vision for Sustainable Water Resource Management.	Government departments Service providers Stakeholders
6. Develop a programme for the community promotion, education and awareness of the National Vision.	Government departments Service providers Stakeholders

Statement 1.1: Governments should develop a National Vision for Sustainable Water Resource Management.

Statement 1.2: Governments should include all parts of the water resource and service delivery sector in the National Vision for Sustainable Water Resource Management – including water, wastewater, sanitation and drainage – and give particular regard to cultural and/or traditional rights and practices.

Statement 1.3: Governments should develop their respective National Vision for Sustainable Water Resource Management through a process of full inclusion and consultation with all stakeholders. That process should be confirmed with stakeholders before the formal development stage commences.

KEY MESSAGE 2: Develop national instruments including national visions, policies, plans and legislation appropriate to each Pacific Island Country taking into account the particular social, economic, environmental and cultural needs of the citizens of each country.

Proposed Actions	Responsibility
1. Establish a process for, and review current laws, policies, plans and other relevant strategies for consistency with the National Vision for Sustainable Water Resource Management.	Governments Stakeholders
2. Identify gaps in existing national instruments for national planning, water resource, land use planning, and development, and align with the National Vision.	Government

Proposed Actions	Responsibility
3. Education and awareness on policies and regulations across all sectors with special focus on decision makers.	Governments Service providers Regional organisations Local government NGOs / CSOs
4. Establish appropriate guidelines and systems for reporting on service delivery, and enforcement of regulations.	Governments

Statement 2.1: Governments should develop sustainable water resource management policies, law, plans and regulations that are consistent with the National Vision for Sustainable Water Resource Management, international and national laws, regulations, technical standards, and obligations.

Statement 2.2: Governments, regional organisations and other stakeholders should cooperate to develop integrated sustainable water resource management plans and other instruments.

Statement 2.3: Governments should develop and implement appropriate water – and associated regulatory frameworks, compliance and enforcement requirements that benefit the specific cultures, customs, economies and environment of the people of the Pacific.

Statement 2.4: Governments and regional organisations, the private sector and NGOs/CSOs should actively co-operate to ensure that sustainable water resource management policies and plans are integrated into the national development policies and plans and other cross-sectoral initiatives.

KEY MESSAGE 3: Promote and establish appropriate institutional arrangements resourced sufficiently to enable effective management of water resources and the provision of appropriate water services.

Proposed Actions	Responsibility
1. Develop such institutional arrangements as are complementary and necessary to effectively manage, water resources sustainably, including through public/private partnerships.	Governments Regional organisations NGOs / SCOs
2. Review existing water agencies and other interested parties involved in sustainable water resource management with a view to facilitating more effective coordination between them.	Governments
3. Carry out a review of systems currently used throughout the region and internationally, for funding the water resource sector. Report findings in a form suitable for use by decision makers.	Governments Regional organisations
4. Develop and implement awareness raising programmes across all levels, on the need for funding mechanisms.	Governments

Statement 3.1: Governments, at all levels, regional organisations and NGOs / SCOs should develop such institutional arrangements as are complementary and necessary to effectively manage, and where the National Vision is in place implement, water resources sustainably.

Statement 3.2: Governments should review existing water agencies and other interested parties involved in sustainable water resource management with a view to facilitating more effective coordination between them.

Statement 3.3: Governments, regional organisations, donors, the private sector and NGOs / SCOs should co-operate to develop innovative approaches to existing funding structures and establish mechanisms to improve cost-recovery.

Statement 3.4: Where appropriate, governments, regional organisations and NGOs / SCOs should cooperate to attract the private sector to invest in sustainable water resource management through private / public partnership and other mechanisms.

Statement 3.5: Governments, donors and regional organisations should co-operate to develop appropriate service delivery and funding mechanisms to equitably address the sustainable water resource management needs of all in both the urban and rural community.

Statement 3.6: Service providers should take into account traditional knowledge and practices complemented by new approaches to sustainable water resource management.

KEY MESSAGE 4: Recognise and share the water resource management knowledge and skills of all stakeholders at a National and regional level in the process of developing and implementing the National Vision.

Proposed Actions	Responsibility
1. Develop and implement national and local public awareness and education campaigns with respect to sustainable water resource management.	Governments Regional organisations Local government Community
2. Regional water resource professionals should be used, wherever practicable, to assist with capacity building.	Governments Regional organisations
3. Local theatre groups and media should be used in raising awareness programmes.	Governments Local government Regional organisations Community
4. Establish processes by which key stakeholders can determine their respective roles and responsibilities for sustainable water resource management within the community.	Governments Service providers NGOs/CSOs Community/Women
5. Create a task force that has representation of all stakeholders that will facilitate the development and implementation of culturally appropriate strategies and activities for sustainable water resource management programmes. The taskforce should have representation that will include women, the disabled and disadvantaged.	All key stakeholders
6. Include public awareness components in the budgeting of all development programmes.	Governments Donors
7. Promote the use of community consultative committees in water sector development programmes.	Governments Community Service providers
8. Perform gender assessment studies in sustainable water resource management, and where appropriate stress the need for gender issues to be included into project planning.	Governments Regional organisations

Statement 4.1: Governments, regional organisations and NGOs/CSOs should co-operate to promote and develop education and awareness of sustainable water resource management issues, including their public health, economic, environmental, social and cultural implications.

Statement 4.2: Governments, service providers and NGOs/CSOs should, in partnership with community agencies, agree their respective knowledge, skills and responsibilities, and use this in the development and implementation of culturally appropriate strategies and activities for the implementation of sustainable water resource management programmes.

Statement 4.3: Governments, service providers and NGOs/CSOs should ensure rural and urban communities have opportunities for active participation in the choice, development and implementation of sustainable water resource management projects, and the on-going operation and maintenance of facilities.

Statement 4.4: Where consistent with health and safety guidelines, planning of water facilities should ensure access for all, with special regard to women, the disadvantaged, the disabled, those in rural and remote communities, and the poor.

Statement 4.5: Governments, service providers, institutions and regional organisations should collaborate throughout, and beyond, the region to improve timely access to and sharing of available data and research on sustainable water resource management and the dissemination and implementation of good practice guidelines.

KEY MESSAGE 5: National and regional leadership in water resource management should be recognised and encouraged.

Proposed Actions	Responsibility
1. Review and identify the need for increased capacity and management training in human resources development and planning in the water resource sector – particularly in the area of leadership [customary, professional, civil and political]	Governments Service providers Regional organisations Co-operating agencies International counterparts NGOs/CSOs
2. Provide training opportunities in the practice of good governance with respect to water resource management.	Governments Service providers Regional organisations
3. Identify funding sources for training programme development.	Governments Service providers Regional organisations Co-operating agencies
4. Develop and provided country-specific and regional training programmes, pilot projects, and guidelines in sustainable water resource management.	Governments Service providers Regional organisations Co-operating agencies NGOs/CSOs
5. Review opportunities for regional partnerships in sustainable resource management leadership training.	Governments Service providers Regional organisations Co-operating agencies International counterparts NGOs/CSOs

Statement 5.1: Governments, regional and international organisations should work together to develop and implement effective leadership development programmes in the area of sustainable water resource management.

Statement 5.2: Governments, local institutions, regional and international organisations should work together in the development of regional and national training courses in support of broader sustainable water resource management development programmes.

Statement 5.3: Governments, regional organisations and NGOs/CSOs should promote and facilitate the development and training of communities and individuals to strengthen and assist their participation in the area of sustainable water resource management.

The above statements and proposed actions point a clear direction with respect to institutional strengthening and reform.

One of the key messages from the conference, which is typically "Pacific", is the emphasis on *working together* to optimise outcomes. The importance of this in terms of achieving integrated water resource management cannot be underestimated. As discussed earlier a fundamental "issue" in achieving integration is the traditional system of land tenure and the system of natural resource ownership/rights. This will only be resolved through recognition of those rights and negotiations over relinquishment.

8. CONCLUSIONS

There is no single, common process for institutional water reform that is applicable to all small island countries in the Pacific. Inevitably solutions will need to be found that fit the circumstance of each country – circumstances that include both natural and human resource issues. In part this will depend upon existing institutional arrangements but, as is very evident from the Sigatoka Regional Action Plan, the need to approach reform in full consultation with the Pacific island communities guarantees that the resulting outcomes will be different.

However, a number of common "building block" ingredients can be identified from the experience of other countries – both developed and developing - that have undertaken water reforms. These building blocks are as follows:

1. **A National Water Sector Assessment:** It is obvious that without a good overall understanding of the knowledge and state of each country's water resource and the way in which the total water sector works, it is very difficult to target reform for the best outcomes. A national water sector assessment should therefore be undertaken - or, if recently undertaken, confirmed. Furthermore, this assessment should be undertaken within the broader policy framework of integrated water resource management.

   Particularly important in this assessment is the identification of a co-ordinating body [an "apex" body] to guide the process, and the establishment of a consultative process to get widespread agreement on the policy and planning "drivers" for the sector. In this regard the adoption of a sustainable triple bottom line reporting framework is recommended. This will enable specific concentration on environmental, social and economic inter-relationships. In that process equity issues relating to the more disadvantaged sectors of the community, and to the unequal gender impact that access and delivery problems generate, can be highlighted, as can specific matters or customary tenure and associated relationships.

2. **A National Vision:** Once the "situational" assessment is complete attention should be directed at the development of a National Vision for the water sector. This should not be a complicated exercise as complex Visions tend to be self-defeating because they often set up competing objectives. However, the Vision must be realistic – in the sense that it takes its lead from the assessment of the status quo including its institutional and instrumental arrangements.

   In particular, attention should be paid to water delivery services [both for potable supply and wastewater disposal] and their integration. It is relatively easy to conduct a policy and regulatory reform without achieving significant operational outcomes – which ought to be the primary purpose of any institutional reform.

   As part of the consultative process, the National Vision should also seek to provide guidance on the relative importance of the different legs of the triple bottom line – the environment, social/cultural and economic – so that a national debate can occur. Visions that state or infer that all of its elements have equivalent priority are easy to write but difficult to implement – unless subsequent direction on this matter is given through the Action Plan.

3. **A National Water Action Agenda/Plan:** Having completed the above assessment and National Vision a more detailed agenda or plan for the water sector can be developed. The key outcome sought from such a Plan is the co-ordination of water-related activities [whether abstraction, use or disposal] for an agreed, integrated set of purposes. The Plan will then also set the agenda for any institutional reform that is necessary – whether at the structural, instrumental or functional level; including agreement on the respective roles of public, quasi-public and private sectors for the various functions outlined in Table 1, section (A)4.7 above.

   The Plan should reflect urban/rural differences and must incorporate pathways for ensuring political commitment to outcomes. Where relevant, the detailed process and content action elements contained under the Sigatoka Regional Action Plan should be incorporated and developed within the Plan. Of particular importance in undertaking this sort of national planning is to set realistic goals, timetables and action sequences. This will only happen if both the policy analysis processes and the public consultative processes are thorough – especially where the plan will rely upon local communities for its implementation and seeks to place restrictions on deemed customary rights.

   The plan should also provide more detailed guid-

ance on the priorities set in the National Vision – and particularly any policies relating to the classification and/or protection of watersheds / catchments; the place of local water management committees; access to water services by disadvantaged persons; the role of traditional village decision authorities such as chiefly councils; processes for resolving claims and disputes to water; critical areas and priorities for further research and investigation; recommendations for sector reform.

4. **Designing Capable Institutions:** Because of the relatively small-scale of government bureaucracies in the Pacific, the tendency is not to create and reform the institutions but to clip additional functions onto existing structures. This also tends to reinforce existing management. While understandable, in that the competent human resource pool is always limited, this is not always desirable. Building capability is not always the same as building capacity. Capable institutions will recognise the areas and instances where they lack capacity and, if given the right incentives, will find creative ways of meeting the need.

   Capable institutions tend to be those with clear purposes, well managed and organised, with motivated personnel who know what is expected of them and when, and directions that are carefully considered and set and not changed without clear reason and explanation.

5. **Designing an integrated investment plan:** In order to exercise some control over piecemeal investment in the water sector, the development of a strategic investment plan is highly desirable.

This will help to:

a) reduce the risk that individual project capital investment in water infrastructure either frustrates or runs contrary to other national water sector goals and priorities; and

b) increase the prospect of optimising infrastructure investment and project management.

   Most Pacific island countries have a development plan of one sort or another – and this is a useful vehicle for this purpose provided the breadth of planning suggested above has been undertaken.

6. **Regional Support:** A number of common regional concerns are emerging. These include general issues such as customary natural resource rights to water and the development of appropriate legal frameworks, as well as specific matters such as compensation and traditional dispute resolution institutions. Bringing information and countries together on these matters is an important regional support role – both in terms of research [e.g. developing a common Pacific legal database on water law] and also facilitative workshops.

   The efficiencies of gathering and distributing region-based information, science and technology should also continue to be pursued. Institutions need reliable data both of a localised and a regional nature. Existing regional organisations and networks appear sufficient for this purpose – and the operators own Pacific Water Association network is a further important avenue.

7. **Dialogue with donors/investors:** At various stages it is important to present the above strategic assessments/agenda/packages to donors/investors to secure agreements to programme sequencing and funding. This is also important to ensure a targeted and integrated approach to the development of the water sector. One of the key risks, in terms of an integrated approach to water resource management, is a haphazard funding programme that fails to support priority tasks at critical points in the overall programme. For example, if long term training and skills development is not supported sufficiently early, then in-country capacity might not be available when any operational institutional reform commences. Similarly if in-country skilled personnel are available but the operational structures for using those skills are not either imminent or in place, then those people are likely to move on to other options.

   One of the success stories of the recent Pacific is the way in which donors and recipient governments are increasingly looking across the board to seek harmonisation of projects and programmes rather than setting up rivalrous or competing objectives [although the matter of donor/consultant preferred technology and ongoing maintenance and replacement compatibility issues will likely remain]. The Sigatoka meeting was a useful example of this, attended by a number of bilateral and multilateral donor agencies.

Throughout the above it is important to remember that for much of the Pacific and its small island countries there are existing, functional, traditional institutions that must be mobilised in achieving any outcome. In rural areas these can often be relied upon to provide the foundation for achievement. In urban areas these are often insufficient and need to be carefully supplemented with appropriate institutional reforms.

At the same time tradition can frustrate progress if it does not fully understand the change that is sought. The need for genuine consultation and awareness of the issues that lie behind any recommendation for water sector reform is the one essential ingredient for success – once the technical thinking has been done. The Pacific Way is a powerful ally when observed.

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THEME 6

FINANCING

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EXECUTIVE SUMMARY

Improved financing of water management in the small island countries of the Pacific presents difficult challenges but offers immense rewards. In all these countries water management is becoming more complex and more urgent. In most of the Pacific, the provision of water supply and sanitation services is lagging behind demand. In some countries growing urbanization is placing unsustainable demands on limited water supplies and the conservation of the water resources has become an urgent necessity. In many countries investment in new schemes will need to be brought forward unless the unfettered demand for water and the losses in the supply and distribution systems can be addressed. In nearly all countries the water authorities are struggling to find the revenue to keep the existing schemes operating and are reliant on central government or external assistance for the capital needed for significant new investment.

The magnitude of the investment needed to improve the efficiency of the existing water supply and sanitation schemes and to provide for future demand is huge, perhaps in the range of US$ 400 - 600 million over the next decade. Obtaining these funds will be difficult. Only a few countries have managed to put in place cost recovery mechanisms and the water authorities are generally reliant on continuing government budget support to maintain their operations. Understandably, the traditional providers of funds have become wary of supporting investments in water schemes which frequently have been financially unsustainable. The most promising source of funding for the future appears to be the consumers themselves. Evidence from those countries that have put their water management onto a commercial basis shows that consumers are willing to pay if they obtain an efficient and reliable service. It also shows that commercial operators can do much to reduce waste in the systems thus bringing down the cost of supply to the benefit of consumers.

Hence the challenge is clear—how to improve the availability of funds for water management. This paper argues that the answer is also clear—provide the consumer with an efficient and reliable service operated on commercial lines while putting in place measures to protect the poor. The paper recognizes that this cannot be achieved either quickly or easily. However, several countries in the Pacific are showing that it can be done and are well on the way to achieving this goal. This paper discusses the challenges and possible responses and offers suggestions on the way forward.

Why is financing such a problem?

This paper argues that the financing problem has two parts. Firstly, there is a huge demand for funds to meet ongoing operating deficits and to finance asset replacements and new works to meet expanded demand. Secondly, there is a problem on the finance supply side with donors and multilateral development agencies reluctant to lend and the private sector unable or unwilling to participate unless the sector is placed on a commercial basis. This supply side problem extends to the revenue side with consumers unwilling to pay for services and governments running short of funds.

The demand for finance is difficult to quantify. There are no comprehensive estimates of the future capital costs and operating costs deficits across the Pacific Island Countries (PIC). However, based on a sample of water sector studies we suggest that the future investment needed for water and sanitation may be of the order of magnitude of US$ 400 – 600 million over the next decade and that the annual operating deficits (if maintained at the present level) might be about US$ 7 million. To put these figures in context, assuming the investment requirement was spread over the next decade, the PICs could expect to have to find about 0.9 percent of their year 2000 GDP each year to meet this need.

The supply side problem — lack of available finance — has many contributing factors. Our analysis suggests that the key contributors are: (i) low cost recovery from users; (ii) excess demand fostered by low or non-existent prices for services; (iii) high cost of provision of

services in part because of inefficiencies and high water losses; (iv) inappropriate policies reflecting, amongst other things, a low 'willingness to charge' on the part of governments and authorities; and (v) both governments and donors faced with growing investment needs in other sectors (education and health) where there are no feasible cost recovery mechanisms.

There are good prospects that some funding could be obtained from the private sector and particularly the provident funds. However, the water utilities are going to have to carefully pursue such funds by putting their 'house in order' and making themselves better investments.

What would an ideal financing scheme look like?

Our vision for a sustainable water management sector is one in which sufficient finance is available (from users and financing institutions) to enable the long term provision of safe, secure and reliable water supplies and sanitation services to all people at a level that they can afford. For the larger utilities, some of the funds will come from the private sector. In the smaller utilities and in rural areas, governments and consumers will still provide the majority of the finance required.

What are the causes of the present financing shortcomings?

In order to achieve this vision, attention needs to be given to the following shortcomings evident in most PICs:

- Water utility governance—need to instill a commercial rather than public works approach
- Internal cost control and efficiency of the present services—costs are high because efficiencies are low.
- Consumer education and awareness—demand is excessive and usage wasteful because consumers are unaware of the longer term consequences of overuse and because water is treated as a free good and its provision a social service.
- Water policies, planning and economic analysis—finance needs are often under-estimated or unknown owing to the lack of appropriate policies, plans and analyses and the capacity to carry out this work.
- Tariff structure, levels and collection—revenue levels are inadequate owing to poorly structured and invariably low tariff levels and ineffective collection processes in many countries.
- Water sector regulation—stronger regulations and enforcement is needed to protect water resources and curb excessive demand and wastage.

How can financing be improved?

There is a need for both a demand side and a supply side response to the problem. On the demand side, the long application lists evident in many urban areas indicate that people desire water and are willing to pay for it. In essence resource managers must rely on some combination of education (moral suasion), regulation and market instruments such as tariffs. On the supply side, a wider range of tools are available and the problems are more easily tackled. The tools include staff training, better operational equipment, loss detection efforts, improved economic and financial analysis, better policy analysis and better designed tariffs. (Water loss reduction and improved metering will in itself require a substantial level of capital investment.)

The general approach suggested in this paper is for water authorities to begin by 'picking the low hanging fruit' and then to progressively move on to the more difficult and slower response activities. We suggest that in most PICs that the 'low hanging fruit' consists of improvements in operational efficiency involving full metering and regular repair and replacement of meters. Once this is accomplished, water loss reduction in other parts of the system will become easier. Costs per cubic meter (cu m) of water supplied to consumers will be reduced because the volume of water sold per volume of water produced will increase. Improving efficiency will help build consumers' confidence which will be a necessary first step to the introduction of tariffs incorporating increased cost recovery. Such improvements in operations will often require parallel institutional (or financial management) reforms. The key requirement is a more commercial approach by the water utility. Experience in the Pacific show that where a commercial approach is followed in the provision of water and sewerage services, reduction in unaccounted for water can be rapidly obtained. This approach could be achieved under a well-structured government department, a water authority or a private water company: the chief determinant of success in this regard is not so much the vehicle used as the way it is built and driven.

Benchmarking should serve as one of the tools used to identify targets for efficiency improvements and to introduce a culture of monitoring into management. Consumer education can start immediately but it will need to be continued over a long period to bring about the changes in attitude needed and it will need to be reinforced by changes in the behavior of water authorities and governments. Work on water sector policies

and analyses of future needs will be required to underpin changes in tariffs and also to provide water authorities with targets for improvement in their levels of efficiency. Work may also be needed to introduce further regulation both to support market instruments such as tariffs and commercialization and to reinforce demand management measures.

How can these changes be implemented in the Pacific?

The Sigatoka Meeting provided a good starting point to introduce the changes needed to move towards a financially, socially and environmentally sustainable water sector for all PICs. Importantly, this meeting created a sense of ownership and responsibility amongst participants along with an indication of each country's commitment to improve the management of the sector. The five key messages arising from the meeting provide points of focus for further implementation including incorporation of the specific measures suggested in this paper.

- **The need for sound policies and regulatory frameworks**. Each country will need to establish overall policies and regulatory frameworks that will foster sustainable development of the sector. This will need to include regulations that permit the creation of a water utility that can operate commercially.
- **The need to develop financially viable enterprises**. Water utilities need to be able to operate commercially to provide the discipline and focus needed to cope with the challenges in managing the water sector.
- **The need for cost control and benchmarking to improve performance**. There are great opportunities to improve the financial performance of most utilities by tackling the range of operational and managerial weaknesses evident in most utilities. The challenge will be to ensure that any improvements made are retained and become institutionalized.
- **The need to develop policies that promote access for the poor**. The major risk associated with moving utilities towards a more commercial approach is that water supply and sanitation services will be placed beyond the reach of the poor. Measures are needed to protect the poor while maintaining the focus on efficiency elsewhere.
- **The need to develop a coherent policy for funding rural water supplies and the management of individual schemes to ensure long term sustainability**. Rural water services present quite different challenges but the key element is likely to lie in mobilizing the communities in some form of self-help scheme.

Action by PICs to implement these Key messages for Theme 6 will be welcomed by external assistance providers since it will indicate that governments are addressing the past failings in this sector. These providers can be expected to provide higher levels of external assistance both for technical assistance and also greater external financing of sector infrastructure. This support is most likely to be obtained where there is a commitment to adopt commercial practices and user pays principles that deliver adequate levels of cost recovery through user charges while at the same time ensuring access for the poor.

It is clear that the challenges associated with improving the financing of water management cannot be addressed through a narrow focus on financial matters. Rather, what is required is a broader focus on building the capacity of water utilities to tackle the range of challenges that have been identified at the Sigatoka meeting. Improvements are needed in consumer confidence that they will receive reliable services before they will express a willingness to pay more than they are now doing. This requires that the utilities improve their overall efficiency through human resource development, prudent use of external assistance and improved water demand management and conservation practices as outlined in the Theme 4 paper.

The path to sustainable water management in the Pacific thus requires capacity building in the utilities, restoration of consumer confidence, demand management, conservation of scarce water resources, establishment of a commercial approach incorporating access to services for the poor and progressive increases in tariffs up to full cost recovery. Countries that commit to this path are likely to obtain support from both bilateral and multilateral agencies over the coming decade. By the end of the decade they will be able to mobilize resources from the private sector and keep pace with the mushrooming demand for their services.

1. INTRODUCTION AND BACKGROUND

1.1 Introduction

Improved water management is critical for the future of small island countries in the Pacific, East Timor and the Maldives. These countries variously have to contend with extremely limited water resources, rapidly growing demands resulting from urbanization, high cost water supply and sanitation schemes, limited access to skilled personnel in water utilities and increasingly limited access to concessional capital for investment. Coupled with these challenges are deep-seated cultural values that have made it difficult for governments to adopt user pays schemes or to regulate access to land and water and the disposal of waste water and human waste. Little wonder then that, despite decades of effort, the management of water still remains as an apparently intractable problem.

The Asian Development Bank (ADB) has been particularly active in efforts to improve water management. In 2001, ADB adopted its policy on water (*"Water for All"*: ADB, 2001) after several years of consultation with stakeholders in the Asia and Pacific region. The principal strategies within this water policy are as follows:

- Promoting a national focus on water sector reform.
- Fostering integrated management of water resources.
- Improving and expanding the delivery of water services.
- Fostering conservation of water and increasing system efficiencies.
- Promoting regional cooperation and increasing the mutually beneficial use of shared water resources within and between countries.
- Facilitating the exchange of water sector information and experience.
- Improving governance and capacity building.

This policy forms a basis for the regional cooperation, improved management, regulation and governance required to manage water services effectively in the Pacific. These strategies will only be successful in helping small island countries move towards sustainable water management if they are implemented as a package. The provision of adequate finance in the form of investment capital for infrastructure development and rehabilitation, and ongoing funds to meet necessary operations and maintenance needs are key requirements for the overall success of this policy.

1.2 The Current State of Water and Sewerage Infrastructure

In most of the Pacific, the provision of water supply and sanitation services is lagging behind demand. In some cities, such as Port Vila and Pago Pago, services are reasonably adequate. Water is available to most of the population, it is drinkable out of the tap, and it is provided 24 hours a day. In many cities, however, piped water supplies are polluted and must be purified by the consumer before drinking. Intermittent supplies are common. In some cities, piped water is not provided for new housing or in low income communities. Piped sewerage is provided in only a few urban areas, and usually has a much lower coverage than water. As a result, pollution of streams and the oceans is increasing and the environment is being adversely affected.

In the past, when the urban areas of the Pacific were less extensive, the harm done by such practices was limited. People could rely on individual supplies from wells, rainwater and streams, and sewage could be absorbed into the natural environment. Now, however, there is often no alternative to piped water supplies and sewerage. All the population are affected by shortages of these services. Young children suffer from diarrhea and skin diseases, and everyone is exposed to diseases such as typhoid and cholera. Tourists complain about the turbidity and smell of the water. The pollution of lagoons and streams threatens traditional fisheries and tourism. The costs to the economy are substantial and will increase as long as water supply management is constrained by inappropriate institutional and financial arrangements.

> **"The traditional view that the public sector should provide urban services for free, financed out of taxation, has not resulted in a satisfactory level of service in many instances."**
> ***The Future of Asian Cities***

In many urban areas in the region the present rates of investment are insufficient to replace existing assets, let alone provide for the future. Most countries seek donor funding for their water supply and sewerage systems while some obtain budget support for their operations. A few countries encourage their utilities to mobilize their own funds through the sale of water and sewerage services. By and large, however, the prices charged for the services are insufficient to cover operating costs and are too low to reduce demand or to encourage the efficient allocation of resources. The funds being mobilized for the sector at present fall far short of what is needed.

All but a few countries in the region take the attitude that water and sewerage should be provided at the

expense of the general public, or better still, at the expense of donors. They are afraid to charge users for their services. But they are missing an opportunity—the countries which charge users the full cost of their water and sewage services and encourage the provision of water supplies and sewerage on a commercial basis, will be able to meet the demand for these services. In addition, they will be able to conserve scarce water resources and thus ensure that the resource remains available into the future.

On the other hand, countries that continue to regard water as a pure social good, to be provided on terms far below cost, will continue to have shortages and will suffer the consequences. The poor will suffer more than the rich because they cannot mitigate the effects of lack of water. Case studies presented in Sigatoka, including those for the Maldives, Port Vila, Papua New Guinea, Ebeye and others confirm these propositions and form the basic points of reference of this paper.

1.3 The Regional Consultation

This paper was prepared for the Pacific Regional Consultation Meeting on Water in Small Island Countries, Sigatoka, Fiji, 29th July – 3rd August 2002. The aim of the meeting, organized by the Asian Development Bank (ADB) and the South Pacific Applied Geoscience Commission (SOPAC), was to discuss key water management issues and to develop a regional policy statement and action plan to be considered by donor organizations, in preparation for the 3rd World Water Forum to be held in Kyoto, Japan in March 2003. A Planning Meeting held in Vanuatu in February 2002 identified six major themes for the Regional Consultation Meeting. These are summarized below. This paper discusses Theme 6 — Financing.

Theme 1 — Water Resources Management: freshwater availability; water quality degradation and pollution; catchment hydrology; aquifer management; appropriate development of water resources.

Theme 2 — Island Vulnerability: Disaster preparedness; climate adaptation; hazard assessment; risk management; dialogue on water and climate.

Theme 3 — Awareness: Advocacy; political will; community participation; environmental awareness; appropriate projects; gender issues; regional organizations.

Theme 4 — Technology: Appropriate technologies; demand management and conservation; human resources; training; resource base; staff retention; regional capacity building.

Theme 5 — Institutional Arrangements: Policy, planning and legislation; compliance monitoring; institutional strengthening.

Theme 6 — Financing: Alternative financing models; cost of water; role of donor organizations.

1.4 The structure of this paper

This paper comprises six sections and it is supported by five appendices. The first section of which this is a part provides an introduction. The second section discusses the nature of the financing problems that are faced by countries seeking to develop their water sectors and outlines the key financing issues. Section 3 provides a simplified view of our vision for an ideal financing scheme and then goes on to provide detailed suggestions about approaches to cost recovery and user charges. Section 4 examines the causes of the shortcomings in water sector finance and also looks briefly at the influence of institutional arrangements. Section 5 discusses how finance can be improved. Section 6 provides suggestions about how these changes could be implemented in the Pacific and concludes with an action plan to complement other action plans developed at the Sigatoka meeting.

Appendix A presents a detailed review of the financial arrangements for water management in Fiji, Kiribati, Maldives, PNG, Samoa and Vanuatu. It seeks to bring out the particular lessons that can be learned by examining the experiences of these countries. Appendix B provides details of the Action Plan along with the specific actions required to implement the key messages that were developed at the Sigatoka consultations. Appendix C deals briefly with the special set of issues associated with rural water supply schemes focussing mainly on the Fiji case study since it has relevance to other small island countries. The financing of rural water supply discussion has been separated from the discussion of urban water management since it presents a fundamentally a different set of issues. Appendix D examines the linkages between institutional structure and financial performance. Appendix E reports on Actions that have already been completed in efforts to improve financial performance of water utilities in the small island countries.

2. WHY IS FINANCING SUCH A PROBLEM?

This paper argues that the financing problem has two main parts. Firstly, there is a huge demand for funds to meet ongoing operating deficits and to finance future asset replacements and new works to meet expanded demand. Secondly, there is a problem on the finance supply side with revenue with consumers apparent unwilling to pay for services and governments unable to continue financing the deficits that water utilities are

incurring. This supply side problem extends to providers of external assistance with donors and multilateral development agencies reluctant to lend and the private sector unable or unwilling to participate unless the sector is placed on a commercial basis.

2.1 The demand for finance

The demand for finance is difficult to quantify. There are no comprehensive estimates of the future capital costs and operating costs deficits across the Pacific Island Countries (PIC). We have examined a sample of water supply and sanitation studies in Fiji, Cook Islands and Kiribati to provide some order of magnitude for the demand for capital. These studies suggest that the capital investment required per household member over the next decade ranges from US $ 280 to over US $ 2000 with a weighted average of around US $ 330. Projecting this requirement onto an estimated combined urban population of the PICs of around 1.4 million we suggest that the future investment needed for water supply and sanitation might be of the order of magnitude of US$ 400 – 600 million over the next decade. Expressed on an annual basis, this requirement of around US $ 40 – 60 million per year represents about 0.75 percent of the combined GDP of the PICs.

There is likely to be an additional requirement needed to fund the annual operating deficits of the water authorities. In the cases of Fiji, Kiribati and Samoa, these deficits represent about 50 percent of the O&M costs whereas in the Maldives, Vanuatu and PNG there is no deficit since the tariffs fully cover the O&M costs and more. In a number of other countries such as the Cook Islands and Palau all the operating costs are met by the government. We estimate that if these deficits were maintained at the present level, the total financing requirement across all PICs might be about US$ 7 million per year[1]. To put these figures in context, assuming the investment requirement was spread over the next decade, the PICs on average could expect to have to find about 0.9 percent of their year 2000 GDP each year to fund both the capital and recurrent costs of water supply and sanitation needs. Clearly - some countries which will have to find much more than this, while others will require no additional funding since their tariffs are already set at a level that enables full cost recovery and capital replacement.

2.2 The supply of finance

The supply side problem — lack of available finance — has many contributing factors. Our analysis suggests that the key contributors are: (i) low (or no) cost recovery from users; (ii) excess demand fostered by low or non-existent prices for services; (iii) high cost of provision of services in part because of inefficiencies and high water losses; (iv) inappropriate policies reflecting, amongst other things, a low 'willingness to charge' on the part of governments and authorities; and (v) both governments and donors faced with growing investment needs in other sectors (education and health) where there are no feasible cost recovery mechanisms.

The main sources of financing in the past have varied according to the country concerned. As indicated in Table 1, the major sources have been bilateral grants, soft loans and government contributions. Vanuatu is unique in that it has obtained private sector funds through its long term contract with a concessionaire (see later). Water consumers have been insignificant contributors of capital and only partial contributors to O&M costs in Fiji, Kiribati and Samoa whereas in the Maldives, Vanuatu and PNG their contributions have fully met O&M costs and also contributed to capital needs (Table 1).

[1] Based on an estimated O&M cost equivalent to 7% of capital, a figure of US$ 400 million for capital invested (i.e. ignoring the existing capital invested) and assuming that the existing tariffs cover 50% of O&M costs in 50% of the countries.

Table 1. Past Sources of Financing & Tariff Coverage.

Country	Fiji	Kiribati	Samoa	Maldives	Vanuatu	Papua New Guinea
Urban Center	*Suva*	*South Tarawa*	*Apia*	*Male*	*Vila*	*Towns*
Institutional Structure/ Arrangement	Government Department	Government Board	Government Authority	J-V Company	Private Sector Concession	Government Board
Main Sources of Past Financing	Government limited grants and soft loans	Bilateral grants	Bilateral grants	Bilateral grants and soft loans	Concessionaire funding	Soft loans and grants
O&M Covered by Collected Tariff	50%	50%	50%	100%	100%	100%
Capital Contribution from Tariff Revenues	Nil	Nil	Nil	Capital and/or dividends to shareholders	Capital plus return to concessionaire	5% return on assets, capital contribution

In the future there are good prospects that the larger water utilities could obtain some funding from the private sector and particularly from provident funds. However, the water utilities are going to have to carefully pursue such funds and governments are going to have to assist them by putting in place a regulatory framework that provides private sector investors with the safeguards they need to invest with confidence. (See later)

2.3 Financing Issues Facing the Pacific Water Sector

The problems with delivering satisfactory water supply and appropriate sanitation services in Pacific Island urban and rural areas are primarily institutional and financial rather than technical. They reflect inappropriate policies, undue government interference, a lack of incentives for consumers to reduce demand and inadequate cost recovery mechanisms. These problems collectively undermine the ability of utilities to operate and maintain water supply and waste water systems properly. Budgetary support for water and sanitation operations – a major contributor to government budgetary deficits in a number of Pacific countries – is unsustainable.

In the Pacific the issue is not one of no water, as is the case in many parts of Africa, but that limited resources need to be managed more effectively.

The financing needs of the water sector are huge, water projects tend to be indivisible and capital intensive, and many countries in the Pacific have backlogs in developing water (and/or wastewater) infrastructure. All governments need a strategy for financing and cost recovery in the water and wastewater sector if adequate funding is to be obtained and long term sustainability assured.

External aid is limited in relation to requirements. Private finance is available but costly and only relevant to larger urban centers where the ability to pay is higher. In some cases joint public – private investment is an alternative option. There is a need for demand management to limit consumption and cost recovery policies with appropriate tariffs to ensure that users meet costs of services in line with accepted levels of affordability.

It is recognized worldwide that for the water sector to be sustainable over the long term, a greater proportion of its costs must be borne by the users. This realization needs to be integrated into the planing and management of the water services sector in the Pacific.

2.3.1 Management of Water Resources

Management of water resources in the Pacific has been generally fragmented and inadequate in part because the economic value of water resources has been understated. There is a need for a more integrated approach to management of water resources, requiring improved policy formulation, laws, regulation, and sector structures if long term sustainability is to be achieved.

Water is a critical natural resource and essential for development. The issues connected with managing it are inherently diverse and complex. They involve questions of allocation and distribution, equity, conservation, pricing, regulation, education, participation and sustainable use. Accordingly it is essential that Government policies recognize the need for overall management of water resources and the need for policies that ensure the economic value of water resources are recognized and reflected in government policies, laws and regulations. Stakeholders are increasingly recognizing the need for integrated water resource management to deal with issues such as the protection of water reserve areas against inappropriate economic activities by landowners. The Theme 1 - Water Resource Management and the Theme 3 – Awareness papers deal in detail with many of these issues.

Many international initiatives have been taken to promote the conservation and efficient management of water. The Dublin and Rio conferences in 1992 were useful in helping participants perceive water as part of the ecosystem, a natural resource, and a social and economic good. Once water is perceived in this way, the need for integrated water resource management becomes self evident.

2.3.2 Efficiency in the Allocation of Resources

Where prices do not reflect economic costs, misallocation of resources will occur. The use of the price mechanisms in the water sector is evident in only a few Pacific Island countries. The low cost of water has lead to excessive use and wastage in many countries. A key reason for the declining urban water supply services and the lack of funding to maintain or rehabilitate systems in the Pacific is that there are no cost recovery mechanisms such as tariffs in place to meet these costs.

In Rarotonga in the Cook Islands for example no tariffs are charged resulting in excessive consumption and the need for government to seek external funds for operations and maintenance. As indicated in Table 1, in Fiji and Samoa the tariffs collected cover only 50 percent of the full operating costs necessitating government support. This has led to a deterioration in services in many parts of Fiji. This maybe compared with the situation in Port Vila, Vanuatu, and Male, Maldives where tariffs cover full operating and maintenance costs as well as capital costs. In these urban areas, customers are provided with 24 hour service with good pressure and water quality.

Conservation of water and its sustainable use are increasingly critical factors in managing the resource. Government and civil society need to see water as an economic good. Financial incentives for optimizing water use need to be strengthened through a mix of water charges, market based instruments and penalties. Public awareness programs are needed to reinforce the incentives and penalties.

The demand for water can be managed through a combination of efficient pricing, effective regulation, and appropriate education and awareness. Tariffs need to be structured to achieve adequate cost recovery to ensure sustainable long term management of the resource and associated infrastructure, and at the same time encourage conservation and penalize waste. While proper pricing of water services is necessary, there is also a need for effective regulation to protect both the sources of water and their management and to encourage greater participation by the private sector in the provision and management of urban water services. This then needs to be coupled with greater community awareness and public relations to educate all users on the importance of proper water management and the need for cost recovery to ensure financial sustainability of the sector. Community awareness and public relations and education are subjects of the Theme 3 – Awareness paper.

2.3.3 Sources of Sector Funding

As a result of existing poor management and poor cost recovery practices in many countries, present funding levels are inadequate to meet proper O&M costs, plus capital available for infrastructure development for the sector is also inadequate, and will be more so in the future as systems continue to deteriorate and urban populations rise. Donor funding for the urban water sector is declining for two reasons :

- Donors place higher priority on other areas such as health and education, where cost recovery is more difficult.
- Poor management, lack of effective cost recovery and an unwillingness to change these practices means that donors are not investing in the urban water sector as they cannot see any long term sustainability resulting from this lack of willingness to adopt more commercial practices.

To overcome the above problems the urban water sector must improve management practices, adopt more commercial policies which makes the sector more attractive to donors and makes investment in water supply more attractive to the private sector.

In the future, the expansion of access to water and the improved provision of water services will require that capital investment be funded more from within the sector by users, with not only the full operation and maintenance costs met by users but also capital costs in the form of debt repayment and possibly contributions to initial capital costs through tariffs or contributions by way of connection costs and provision of labor, especially in rural projects. Consumers will be expected to meet a greater proportion of the total costs of service provision, subject to any short term subsidy considerations. (In addition, wherever possible tariffs should include the cost of environmental externalities and the recovery of resource management costs and regulation.) PNG, Port Vila, and Male demonstrate that this is a realistic objective for other Pacific island countries.

2.3.4 Adequacy of Tariff Structures and Revenue Collection Rates

Where they exist in the Pacific, tariff structures are often poorly designed. They have limited impact on demand and are often too low to generate adequate revenues. Poor tariff design, coupled with poor collection arrangements, results in levels of revenues inadequate to maintain systems. This then results in a deterioration of services and a decline in willingness to pay and a consequent further decline in revenues. What is required is a well designed tariff structure that generates adequate revenue and provide a demand management effect, but at the same time allows the poor to meet their basic needs at a price they can afford.

In Theme 4 a review of 8 utilities indicated that only two were financially stable, with five struggling to meet costs on a monthly basis. Political influence and personal biases prevent adequate collection of tariffs with collection rates less than 50% of billed revenues commonplace.

The Male water tariff in the Maldives provides a good example of an "ideal" tariff structure. The domestic tariff has three progressive bands. The initial domestic block provides water at low cost to meet basic needs (of the poor), the next block is charged at the levels of average costs, while the third or top band charges consumption at the full or economic cost of supply. Institutional customers are charged a single tariff equivalent to the average tariff while all industrial and commercial customers pay the full economic cost.

2.3.5 Need for Consultation to Build Awareness

Policies for the sustainable use of water need to be developed in consultation with all stakeholders. Water users are often unaware of the technical and economic issues facing water service providers or of the possible risks to the use of water resources. Wider consultation is required to build greater awareness of these issues and hence acceptance of the need for improved cost recovery through user charges such as tariffs.

Communities, both rural and urban, are rarely involved in resource planning and management. Although women are often more concerned with managing water than men they are often not consulted. Holistic and integrated water resource management, and commu-

nity involvement and understanding of the issues are prerequisites to improved resource use. These matters are discussed in detail under Themes 1 and 3.

2.3.6 Cost Control and Benchmarking

The strategy for improving operating and financial performances should aim to improve the productivity of the cost base and on implementing an improved maintenance regime. Cost control and improved efficiency of operations are key requirements for water supply and sanitation operations. They can be achieved in part through monitoring and benchmarking the delivery of water and sanitation services against recognized standards of good practice (and good value) in other similar small town urban environments.

The Pacific Water Association (PWA) benchmarking program commenced in 2001 and although the initial data requires refinement and the development of an ongoing program before this tool can be used effectively, it does offer the basis to improve operational performance. The initial benchmarking results showed that the level of unaccounted for water was much too high, and needs to be addressed. For example, the American Samoa Power Authority (ASPA) has unaccounted for water of 20% while a number of utilities in the region have unaccounted for water of 40% to 50% of water production. (See Table 6 and Appendix A.)

A regional program is needed to reduce unaccounted for water. This is discussed in Theme 4 on Technology where Guiding Principle 2 recommends regional collaboration and partnership to reduce unaccounted for water. This will improve the sustainability and financial performance of utilities and maximize the use of existing scarce resources and/or reduce the need to develop new water resources. However, reducing water losses requires capital investment, which again raises the question of how to obtain the necessary funds to undertake this work.

3. WHAT WOULD AN IDEAL FINANCING SCHEME LOOK LIKE?

3.1 A vision

Our vision for a sustainable water management sector is one in which sufficient finance is available to enable the long term provision of safe, secure and reliable water supplies and sanitation services to all people at a level that they can afford. (Ideally financial self sustainability of the sector should be the aim, which means that users meet full O&M costs plus debt service on funds used for investment in the sector.)

For the larger utilities, some of the funds will come from the private sector . The private sector will be much more likely to invest when they can be assured that their investment is secure and particularly when they feel confident that the revenue from users is secure. The cost recovery policies and practices of the water utilities are thus key determinants of the willingness of the private sector to invest in larger schemes.

"Market-oriented public agencies can deliver services effectively where user charges can be introduced, as in water supply"
The Future of Asian Cities

In the smaller utilities and in rural areas, governments and consumers will still provide the majority of the finance required or they will directly provide the inputs needed to operate and maintain their own systems. Hence even with the smaller schemes and rural areas, improved cost recovery lies at the heart of the improvements that need to be made to move towards an ideal financing scheme.

The remainder of this section discusses cost recovery and user charges. It sets out the issues that should be taken into account when developing financial and cost recovery policies for the urban water and sanitation sector, in particular the need to consider economic, financial, social and administrative objectives when developing tariff policies and tariff structures. Lack of adherence to such objectives, political influence and weak institutional structures present the major threats to the long term financial sustainability of the sector. While external capital inflows are necessary for development, expansion and rehabilitation of water and sanitation systems, cost recovery through user contributions is necessary to meet ongoing operating costs and in many cases repayment of loans.

3.2 Cost Recovery and User Charges

3.2.1 Tariff Setting Objectives

Cost recovery mechanisms, especially tariffs, are the means by which costs of water supply and wastewater costs, as well as the associated financial, environmental and social costs are recovered from users. The cost recovery mechanisms which are most likely to be successful are those that have been designed on the basis of their ability to meet the four specific objectives that determine long term sustainability. These objectives are outlined below.

(i) **Economic Efficiency**. Tariffs should ideally ensure that charges for water and wastewater are sufficient to cover full economic costs, thus achieving economic and environmental efficiency of resource allocation in the water and wastewater sector. They should also include demand management features to achieve conservation and should incorporate the polluter pays principle when charging for wastewater services.

(ii) **Financial Sustainability**. Tariffs should provide the water and/or wastewater entity with sufficient revenue to cover all its operating costs (including depreciation), any debt servicing requirements, taxa-

tion, and ideally provide a proportion of future capital expenditure;

(iii) **Social Acceptability**. Tariffs should be affordable and in line with consumers willingness to pay. For domestic customers, this means that the cost of providing the basic needs (both water and wastewater) of a low income (or poor) household (Say 40 –60 lpcd) should represent no more than 4-6% of the household income of a 'poor' family. Similarly, the cost of providing the average consumption (say 120-150 lpcd) beyond basic needs should not exceed 3-5% of the 'average' household income. A figure of 5-6% is often used where the cost covers both water and wastewater collection services. (Where solid waste services are included a figure of 6% is often adopted.)

(iv) **Administratively Understandable**. Tariff structures should be capable of implementation in terms of metering, billing and revenue collection and also readily comprehensible and understandable to customers.

It is not unusual for the above objectives to conflict and final tariff design is typically a compromise between them. The salient points related to the above objectives are discussed below.

3.3 The Economic Efficiency Objective

3.3.1 Economic Efficiency and Economic Pricing Principles

Although tariffs based on the full economic cost of supply may prove unaffordable, it is still considered good practice to calculate what level of tariff would be needed to fully meet the economic objectives. This involves determination of the economic cost of providing water and wastewater services. Generally this is the economic cost of the next major investment in water supply and distribution, and/or wastewater collection and treatment facilities.

"Economic pricing of services (full cost recovery) is a long term and important objective for cities in the region; but first there should be improvements in efficiency, competition, cost reductions and rates of collection."
The Future of Asian Cities

In theory, tariffs should reflect the Long Run Marginal Cost (LRMC) of water and wastewater services. However in practice, it is difficult to estimate the LRMC for water and sewerage projects because of the large and long-life additions to capacity which are typical in the sector. Therefore the Average Incremental Cost (AIC) concept is used as an approximation of the LRMC for the purposes of project evaluation and tariff formulation. When the AIC is calculated in economic prices incorporating all costs incurred by the economy as a whole (including environment and regulatory costs), it is referred to as the Average Incremental Economic Cost (AIEC). When the AIC is calculated in financial prices (the costs that must be met by the utility) it is referred to as the Average Incremental Financial Cost (AIFC).

3.3.2 Importance of Economic Pricing Signals

The importance of economic analysis is that it identifies the overall costs of present consumption and, for new projects, it identifies the cost of the next best (future) water supply project. This is the price that should be charged for all water sales to recover costs over the period of the project where new investments are being undertaken. Thus, current water consumption in upper tariff bands (after average levels of domestic consumption are met) should be charged at this level in an ideal tariff structure. This means that consumers pay this cost for consumption in excess of average levels. In this way they would pay the future cost which their consumption brings forward as existing capacity is used up or which alternatively leads to the discouragement of such consumption so that the need for additional investment is deferred. Pricing at a level below the economic cost will result in wastage or excessive consumption and this will brings forward the requirement for further investment before it would otherwise be necessary were the correct pricing signals provided to consumers through the tariff.

3.4 The Financial Sustainability Objective

Financial objectives relate to the satisfactory financial performance and long term sustainability of the water and wastewater entities. Accordingly, water and wastewater tariffs should be set at an overall level to meet:

- Direct Operating Costs (Cash operating and maintenance costs);
- Other Indirect Operating Costs comprising: (i) Depreciation; (ii) Interest: (iii) Government taxes and duties
- Cash Flow Requirements comprising: (i) government dividend payments and retained profit policies such as approved rate of return criteria; (ii) principal repayments on loans; (iii) a proportion of future capital expenditure (e.g. 20%); and (iv) an acceptable cash balance to meet working capital requirements (e.g. two months).
- Balance Sheet Structure comprising: (i) an acceptable balance sheet structure (debt to equity ratio) (e.g.70:30); (ii) an adequate rate of return (net profit) on capital (expressed as revalued net fixed assets in operation (e.g.5%); and (iii) an acceptable level

Table 2. Cost Recovery Objectives.

Objective	Specification	Common target
Cost Recovery Ratio (CRR)	The CCR requires that the operating entity generate total revenues, equal or greater than the sum of: (i) its total operating expenses, including depreciation; and (ii)the amount by which debt service requirements exceed the provision for depreciation.	1.0
Debt Service Ratio (DSR)	The DSR requires that tariffs be set (that is, the average financial tariff) so that cash flows after meeting operating expenses are at least 1.3 times estimated debt service costs.	1.3
Self Financing Ratio (SFR)	The SFR requires that tariffs be set (that is, the average financial tariff) so that cash flows after meeting operating expenses and debt service, are also sufficient to meet say 20% of projected capital expenditure. (The SFR is often calculated with capital costs averaged over three years.)	20%

and age structure of accounts receivable.[2]

3.4.1 Public Sector Financial Objectives

3.4.1.1 Multilateral Agencies

Multilateral agencies such as ADB and the World Bank (WB) specify cost recovery objectives in their loan agreements to ensure that tariffs can meet debt service payments and, more importantly, to ensure long term sustainability. In the case of the water and wastewater companies the objectives include those shown in Table 2.

These financial objectives may be encapsulated in some return on capital objective (RoR), preferably on a revalued asset basis. This is normally set at 5% to 8%. The RoR provides a measure of overall efficiency and is intended to ensure that funding/assets earn a minimum rate of return. Thus the SFR and DSR set minimum requirements to meet specific financial objectives such as to meet debt service and /or to generate revenues to meet a proportion of future capital expenditure, while the CRR and RoR are more general financial objectives and provide overall cost recovery and efficiency targets necessary to ensure long term sustainability.

3.4.1.2 Bilateral Agencies.

Bilateral agencies seldom set strict financial targets but often make well meaning statements on cost recovery and the long term financial sustainability of the urban water sector. However, lack of clear financial objectives for the sector and specific cost recovery targets results in poor financial performance since recipient countries set less than adequate tariffs necessitating further grants for rehabilitation projects and government budget support to meet O&M costs. Countries rarely use the grant funding as an opportunity to establish the infrastructure and then operate it on a commercial basis, thus ensuring long term financial sustainability. PNG and Male, however, have been recipients of grant monies, but their utilities have financial objectives that require tariffs to be set at levels that assure strong cash flows from operations, rather than minimizing tariffs in line with their low (grant) financing costs.

3.4.2 Private Sector Financial Objectives.

The private sector generally seek a higher rate of return on its investment than the public sector or multilateral and bilateral providers. They need to take account of country risk as they are seldom provided with a government guarantee. Of more importance is their need for certainty that revenue streams through tariffs will meet investment repayments, operating costs and provide an overall profit. Accordingly, financial objectives and tariffs which ensure cost recovery need to be in place and operating in advance of any private sector investment. Typically the private sector seeks an after tax return on equity funds of 20% per annum, and 10% to 15% on the overall investment.

"Most countries in the (Asian) region are moving towards market-based reforms … and the use of private sector resources in service delivery" ***The Future of Asian Cities***

In the case of Build-Operate-Transfer (BOT) type arrangements the private sector promoter may be seeking a 'take or pay' contract as a guarantee of the revenue stream to meet operating costs and repayment of debt.

3.4.3 Importance of Financial Objectives for Both Public and Private Sector

It is normal to ensure that the overall average tariff in any year is adequate to meet all the financial objectives. The main implication for tariff structuring is therefore to ensure that the tariff structure will generate average revenue per cu m sufficient to meet financial objectives while also ensuring that tariffs are affordable to average income and low income households.

It is necessary for the government/utility to define clear financial objectives and cost recovery policies for the

[2]Accounts receivable should not exceed 40-60 days of sales, and older debts should be aggressively pursued with strict enforcement of disconnection policies as a threat for non-payment.

urban water sector and then to allow the utility to set tariffs that will meet these objectives. Loan covenants can assist by reinforcing the need to adhere to agreed financial objectives. A financial plan and preparation of financial projections over at least a five year period are a necessary requirement in assessing the ability of tariffs to meet cost recovery objectives (meet O&M costs, any debt service, SFR or profit requirements) of the sector or that of the water and/or wastewater entity. In the case of the private sector investor, these issues will need to be resolved prior to investment while public sector agencies may be more willing to deal with the issues as part of continuing sector reform.

3.5 The Social Objective - Affordability and Willingness to Pay

The primary social objective for tariff formulation is to ensure that all members of the community are able to afford access to clean water supply and to waste water disposal services without placing an undue burden on their expenditure. In particular, poor households need access to a level of services that meets their basic needs. By providing all members of society with access to these services, governments can ensure that the public health benefits are realised for society as a whole.

3.5.1 Ability to Pay

The affordability or ability to pay is generally focussed on two benchmarks. The first benchmark is the 'lifeline' or minimum demand requirements of poor urban households. Depending on location this is commonly set at 40-60 lpcd. A guideline figure of affordability is that the water supply and wastewater charges for these services should cost no more than 4-6 percent of the 'poor' household's income. The second benchmark is the likely minimum demand requirements of average consumers. Again, depending on location, this is commonly set at around 120-180 lpcd.[3] A guideline figure of affordability is that the water supply and wastewater charges for these services should cost no more than 3-5 percent of the 'average' household's income. Socio-economic surveys are used to determine the level of both 'average' and 'poor' household's income.

In practice, ability to pay is constrained by willingness to pay. In the Pacific, while there is a growing acceptance for the need to pay for water, there is limited experience of being required to pay the full cost of water supply and very little experience in paying for wastewater collection and treatment services. Consequently there is a need to raise consumers willingness to pay by providing a better understanding of the cost of these services and the need for consumers to pay for these services. This commonly requires community consultations, public relations efforts and ongoing consumer education campaigns.

"Regulation of prices for example is an inefficient way to achieve equity objectives. It is preferable to make direct transfer payments to disadvantaged groups because they allow markets to perform efficiently, without the political imposition of distortions or subsidies in investment allocation and in pricing which lower efficiency".
The Future of Asian Cities

For very poor households, mechanisms outside the tariff structure need to be developed to make water and wastewater services affordable. (It should not be the role of the utility or the tariff structure to finance this group). In some cases this may take the form of public taps as in Male. However, in many countries the provision of public taps has fallen out of favour as a means to provide minimum services to the poor.

An alternative is to provide rebates on water and wastewater bills. Ideally, the payment of such rebates or discounts on the water tariff would be the responsibility of the government and should be provided as some form of payment system. This allows the water supply and/or wastewater utility to operate in a commercial manner with the tariffs for very poor households paid by government. These costs should be viewed as a community service obligation that is agreed between the water utility and government agency with the cost reimbursed by the government agency.

3.5.2 Importance Of Social Objectives and Developing Affordable Tariffs

Access to water and waste water services for all households should be a priority objective of governments since it is a major means of addressing poverty alleviation goals. However, in meeting these objectives it is important that governments keep in mind the economic and financial objectives necessary for long term sustainability of the water management sector. It is generally possible to meet these objectives by developing tariff structures that allow basic needs to be met through provision of a lifeline block in the tariff structure supplemented if necessary by direct welfare payments as suggested above.

3.6 The Administrative Objective - Billing and Income Collection

Any recommendations on tariff structure must be capable of implementation in terms of metering, billing and revenue collection. Also it is important that the tariffs are readily comprehensible and understandable to customers. It has been shown that increasing the com-

[3] In the case of Maldives and Kiribati this level is likely to be of the order of 20 lpcd with 40 lpcd (or less) for an average and low income household. The guidelines should be based on country norms of consumption relative to water resource availability. In Maldives the lifeline block provides for 10 lpcd at a concessional rate.

plexity of tariff structures reduces the customer's understanding and also that there is a close correlation between the customer's understanding and willingness to pay.

Where the collection efficiency of a billing system falls below 90%, the integrity of the billing and collection system falls into question. Users realize that there is no penalty for non-payment so that they do not pay. Other users observe this and in turn decide not to pay. In this way collection levels continue to decline unless some form of intervention takes place. Those that pay generally feel that they have an obligation to pay while those that do not pay simply do not because they know that they can get away without paying. Many more will pay if they are simply asked.

It is important that water entities have efficient meter reading, billing and money collection operations. To be successful, the entity must have clearly understood and enforced disconnection policies so that water and wastewater bills are paid in a timely fashion. Penalties for non payment should be well publicized so that customers know they will be disconnected. Where wastewater charges are levied these should be collected as part of the water bill. Where wastewater is not paid then there needs to be a cross default provision to disconnect water supply.

Unless revenues from tariffs can be collected from users then there is not much possibility of the financial and cost recovery objectives of the sector being met. Improvement in tariff collection efficiency offers one of the more promising opportunities to quickly improve the financial performance of many water utilities. The additional revenues raised in this way can then be immediately applied to improved operating performance thus increasing the general willingness to pay and paving the way for tariff increases where required. (See 'low hanging fruit' later)

3.7 "Ideal" Tariff Structures

3.7.1 Water Tariffs

This section discusses both the structure of tariffs and some of the key features that should be contained in any tariff structure.

3.7.1.1 Tariff structures

In theory, the key decision concerning the structure of the tariff is whether it should comprise a flat rate for all consumption of water or whether it should incorporate a progressive rate. Many economists argue that a flat rate tariff structure is most desirable, but this also has limitations and does not encourage conservation of scarce water resources and is limited in providing water at a price that low income consumers can afford to meet basic needs. The main criticism of progressive tariff structures generally results from poorly designed structures rather than in any inherent conceptual issue.

Generally some form of progressive tariff structure is desirable for domestic households. This allows provision of a lifeline block of consumption to meet the basic water requirements of low income households at a price they can afford and a second block to meet average levels of consumption. If these blocks are priced at affordable levels, this meets the social objective. The next (third) block should be priced at the full economic costs to provide a demand management effect and provide for conservation of resources.

The main deficiency of progressive tariff structures is that there are often too many bands and the bands are too wide. This occurs in the Pacific and is true of tariffs in Samoa and Fiji. This results in all or most domestic consumption occurring within the lowest band(s), leading to poor revenue generation and low cost recovery. It also means that there is almost no impact on demand leading to excessive consumption and tolerance of waste.

2.4.1.2 Desired features in tariffs

A water tariff structure suited to small island countries would ideally include the following features:

- A minimum charge to ensure a minimum level of revenue from all customers,
- Some form of fixed monthly charge to reflect meter reading, billing and collection costs as well as meter replacement costs. (There needs to be some mechanism to ensure that these costs do not mean that poor households pay significantly higher rates per cu m of water used compared with more affluent households).
- No more than three or four tariff bands all of which other than the last (highest) should be no larger than 10 cu m.
- Provision of a lifeline block for low income consumers. As a general guide the lifeline block should provide 40 lpcd and be set at a price that covers O&M costs. (If this is not affordable for poor households it would be preferable if government met the shortfall in the form of a welfare payment).
- Progressive sales charges to act as a demand management/conservation incentive with higher levels of consumption set at the economic cost or higher levels. The domestic tariff may have three or four progressive bands.
- A single tariff for all customer categories.[4]

[4] Although there are theoretical benefits in having separate tariff categories for domestic and other classes of consumers to limit the initial concessional lifeline block to domestic customers, our view is that these benefits are offset by the economic costs associated with differential pricing of water according to its use. Where the lifeline block is limited to basic needs then the cost to the utility will not be that great, especially where any subsidy element is recovered in charges at the average and higher levels of consumption.

3.7.2 Wastewater Tariffs

Wastewater tariffs are generally flat rates for all customer classes with the prime objective of encouraging full use of the system and recovering costs of collection and wastewater treatment. It may, however, be necessary to have a lower "lifeline block rate" to coincide with the water tariff structure lifeline block to ensure that overall tariffs are affordable to low income households.

Treatment and disposal costs are related to wastewater strength as well as to flow (volume) and thus the level of pollution loading is a factor that should also be reflected in the tariff. All dischargers, including households, should pay pollution charges based on the estimated or measured levels of polluting substances contained in their effluent, in accordance with the "polluter pays principle". This is based on the premise that all households, businesses and industries contribute to the pollution of surface waters and should share in meeting the costs of management, control and abatement. This is likely to be only of relevance in larger urban centers where there is a wastewater collection and treatment system in place. In these circumstances the discharge from any industry or commercial enterprise should be assessed and charged accordingly.

AN "IDEAL" TARIFF STRUCTURE – MALE, MALDIVES

In Male water is provided by reverse osmosis from sea water. A Joint Venture agreement provides for tariffs to be set to achieve a 15% FIRR. All customers are metered and are provided with wastewater services. The Domestic tariff structure includes a lifeline block that provides a concessional block of consumption for 10 lpcd. This is balanced by higher charges for higher consumption in excess of 8.1 cu m per household per month. Non-domestic customers pay a flat rate charge. The tariff includes a fixed monthly charge of about US $ 2.55 per cu m per month, in line with the costs of maintaining a connection and meter replacement, plus monthly meter reading and billing functions. The tariff structure satisfies economic and financial objectives and at the same time is affordable as evidenced by consumers willingness to pay. The tariff is understandable and customers pay their bills promptly with well publicized disconnection policies clearly understood by consumers. Accounts receivable are some 30 days of sales or one billing cycle.

Table 3. MWSC Tariff (Water and Sewerage Charges).

Customer Class	Tariff Band	Lpcd per HH	Cu m per month	US$ per cu m
Domestic	1	0 – 90 (2)	0 – 2.70	2.16
	2	91 – 270	2.71 – 8.10	6.48
	3	> 270	>8.10	8.64
Standposts (3)		Flat rate		6.48
Institutional		Flat rate		6.48
Commercial		Flat rate		8.64

Notes:
(1) Current tariff includes a fixed monthly charge of US$2.55 per month.
(2) Assumes 10 lpcd and a household size of nine
(3) Standpost charges met by Government of Maldives.

The tariff bands and consumption levels in Male reflect the shortage of water and the need to provide the bulk of water through the expensive process of reverse osmosis of salt water. Extending this structure into the Pacific we would suggest that the three bands for domestic consumption could be set at 10 cu m, 11-20 cu m and then above 20 cu m.

3.7.3 Sector Regulation, Management and Monitoring Costs.

All the costs of sector regulation and monitoring should be covered by the water and wastewater tariffs or permits and licensing fees as far as possible. Often, in a developing country context, these are borne by government agencies but ideally they should be recovered from users out of tariffs or other charges. These costs should be included in any economic analysis (for example calculation of AIEC).

3.7.4 Connection Costs and Connection Fees/ Charges

Connection charges allow the utility to obtain contributions from new water service customers. In some circumstances where large water supply or wastewater customers wish to connect to the system they maybe asked to meet a share of the additional water treatment or wastewater treatment capacity needed to meet their demand. This is often referred to as a headworks charge. Generally speaking, individual domestic customers and small industrial customers are only required to meet the costs of connection from the distribution pipeline and associated metering charges.

Additional connections or new customers are usually in the undertaking's financial interests (if it has unused capacity) and in the community's interest (to promote public health). The general trend is to levy connection charges reflecting the actual costs of the connection, but often customers maybe charged an average cost to connect. It is important to ensure that these costs are affordable to poor households and do not represent a barrier to connection and hence a barrier to access to a clean and safe water supply. As a minimum, the utility should offer payment by installments over 24 or 36 months to ensure connection costs are affordable to poorer households.

4. WHAT ARE THE CAUSES OF THE PRESENT FINANCING SHORTCOMINGS?

4.1 Introduction

In this section we discuss the causes of the shortcomings evident in the water management sector of many small island countries. Although the major focus of this paper is on financial matters, we briefly touch on other

important areas since clearly remedial action is needed across all of these areas.

In analyzing the financial aspects, we draw on a review of the current tariffs, cost recovery policies, financing and financial planning of five Pacific Island countries and the Maldives with the purpose of drawing lessons on what works best. This review is also used to identify issues and constraints and to review the remedial actions already completed and those proposed to achieve long term sustainability.

The countries reviewed are Fiji, Kiribati, Samoa, Vanuatu, Papua New Guinea (PNG) and the Maldives.[5] Information is available on the economic costs of supply for Fiji, Kiribati, Samoa and Maldives.[6] The five countries represent a range of institutional and financing options as indicated in Table 4 and summarized below.

- Vanuatu represents a private sector concession arrangement;
- Maldives a joint venture company between the private sector and government;
- Samoa represents a government authority;
- Kiribati and PNG represent government boards; and
- Fiji represents a government department.

4.2 Non-financial causes

4.1.1 Non-commercial utility governance

Most water utilities across the Pacific are either government entities or they are operated as if they were government entities. They are managed and operated more along the lines of a Public Works Department than a commercial undertaking. This is evident in many of their attributes as indicated in Table 5 and summarized below.

- They often have a mandate that extends beyond water management with the result that water management is not their sole focus.
- They are often poorly equipped and chronically short of funds. Often they do not receive all the tariff revenues since these are re-directed into consolidated revenue and only returned in part through budget appropriations.

[5] These countries are all subject to detailed analysis and the results are presented in Appendix A of this paper.
[6] Economic Costs have been extracted from past feasibility studies. They have not been updated to 2002 prices, but nevertheless are representative of future costs and provide a comparison with existing financial tariffs in each country.

Table 4. Characteristics of Case Study Water Sectors.

Country	Fiji	Kiribati	Samoa	Maldives	Vanuatu	Papua New Guinea
Urban Center	Suva (1)	Sth Tarawa (2)	Apia (3)	Male (4)	Vila (5)	Towns (6)
Institutional Structure/ Arrangement	Government Department	Government Board	Government Authority	J-V Company	Private Sector Concession	Government Board
Main Sources of Past Financing	Government budget plus limited grants and soft loans	Bilateral grants	Bilateral grants	Bilateral grants, soft loans & foreign private sector	Private sector (Concessionaire) funding	Bilateral grants and multilateral soft loan

Table 5. Governance Arrangements and Performance Attributes.

	Government Dept	Authority	Corporation
Focus on exclusively on the water sector	*	**	***
Access to funds	*	*	***
Staffing	*	**	***
Authority to make all relevant decisions including pricing	*	**	***
Flexibility	*	**	***
Independence of Governing Boards	*	*	***
Formal performance standards and monitoring	*	**	***
Operational focus on commercial result	*	**	***

- They are often short of qualified staff.
- They are often lacking in authority and are accustomed to decisions being made beyond their control or influence for political or other reasons.
- They often lack the flexibility to respond to issues in different ways and are restricted to public service norms regarding pay, working conditions and responsibilities.
- Their governing boards are often subject to considerable political influence.
- They tend not to have or to apply performance standards.
- Their operational focus tends to be on technical excellence rather than commercial results.

4.2.2 Inefficiency of the present services

Many of the water utilities experience difficulties in controlling costs in part because of the cycle indicated in Figure 1 below. As indicated in Theme Paper 4, there is an urgent need to:

- Improve technology in support of more effective management;
- Collaborate across the region to reduce unaccounted for water; and
- Ensure that there are appropriately trained and experienced professionals available to operate the utilities.

Figure 1. Operational Difficulties of Water Utilities.

4.2.3 Unsupportive consumer attitudes

One of the most important improvements needed in water sector management will require consumers to become more conscious of the need for economy in their use of water and more careful in their disposal of wastewater. Before there is any change in behavior in these areas there will need to be changes in attitude and the water utilities will have to play a leading role in bringing about this change. In order to convince consumers of the need for a more prudent approach to water management, all levels of society including public servants and politicians will need to be recruited to the cause and all will need to lead by example.

4.2.4 Inadequate water policies, planning and economic analysis

Improvements in water resource policies, planning and analytical capacity are essential parallel developments needed to enable improvement in financing of the sector. Policies are needed to provide the mandate to put in place the regulatory framework needed to ensure that water utilities can function effectively. These policies range from support for regulations that allow utilities to disconnect non-paying users to safeguards that might be needed to mobilize private sector investment in water utilities. Sector planning includes thorough assessments of future needs, options for alternative sources of supply, assessments of ability to pay, reviews of effectiveness of education campaigns and many other activities needed to support sound management of the water sector. It also includes the development of financial plans for the water authorities not only to allow them to make their operations more efficient but also so that they can be better prepared to seek financial support from other sources when required.

4.2.5 Weak water sector regulation

Regulations are needed to back up various operations of the water utilities and particularly to convince consumers that they need to comply with the rules. In addition to having the regulations in place, there needs to be a willingness on the part of government and the utility to enforce these regulations. This is particularly difficult in many situations such as in the protection of water reserves and it is understandable that governments are reluctant to impose on what may have been viewed as existing traditional rights. Nonetheless, the consequences of failure to impose the regulations are so dire that governments do need to act quickly. In many cases failure to enforce regulations will jeopardize the entire sustainability of the water management sector.

4.3 Financial Causes – Tariffs and Cost Recovery

This section presents a review of current tariff policies, economic costs and financial objectives across the small island countries. It focuses on tariffs and assesses the performance of each country against the four objectives that tariffs ought to reflect (see Section 3). Tariffs are examined in terms of their ability to: (i) provide the correct pricing (economic) signals to customers; (ii) achieve sector financial objectives (whether specified or implied); (iii) meet social or acceptable affordability criteria that should include delivering acceptable levels of service to ensure public health benefits are realized; and (iv) whether they are administratively understandable and whether adequate billing and collection procedures are in place so that revenue (from tariffs billed) is actually collected.

The key elements of the above discussion are summarized in Table 6. A detailed analysis of each country is presented in Appendix A.

4.3.1 Performance in relation to economic efficiency

In the cases of Samoa, Fiji and Kiribati, existing tariffs do not provide the appropriate pricing signals to consumers as shown by the high economic and financial subsidies evident when economic costs are compared with existing financial tariffs. In the case of Fiji it would be possible to establish affordable tariffs that would achieve full cost recovery but it would be necessary to provide a lifeline block to ensure affordability to low income households. Improved tariff structures, billing and collection procedures would also likely result in lower water consumption.

"The efficiency argument for cost recovery is persuasive. As long as consumption is subsidized, users are likely to demand more quantity and quality than if they have to pay fully for the service. This causes over-investment in the sector and also reduces incentives to conserve resources."

"Unless governments are willing to give up significant increments of economic efficiency, there is no alternative to the use of pricing to ration supply."

The Future of Asian Cities

In the case of Kiribati, because of high investment costs, it is evident that it would be difficult to set tariffs at full cost recovery but it would be possible to set tariffs to recover the full O&M costs and a proportion of capital costs. This would help ensure long term sustainability.

Samoa still has one of the highest levels of per capita consumption in the world at 350 to 400 lpcd in the case of non-metered customers. For metered customers the present tariff structure does not exert any demand management effect on typical levels of domestic consumption of up to 60 cu m per month. Consumption at this level exceeds the design capacity of the system and should be reduced. Proposed tariffs in 2003, although an improvement, will still be much less than economic costs, thus encouraging the continuation of high consumption patterns. (Samoa has had the luxury of almost all its water infrastructure having been financed through grant aid.)

In the Maldives, despite higher economic costs than Kiribati, the higher household incomes means that households pay charges that are close to full economic costs. Maldives has a true lifeline block to meet basic needs of low income households. Domestic consumers operating at higher levels of consumption, and all institutional and commercial consumers pay the economic price or in excess of this, resulting in a weighted average close to the economic costs.

The situation is similar in Vanuatu, however, like Fiji it could be argued that tariff bands are too wide thus limiting the demand management effect. In Vanuatu it would be fairer to introduce a lifeline block equivalent to 10 cu m per month to ensure affordability for low income households and then to reduce the number of additional blocks. (Vanuatu has relatively high tariffs in the lower bands and an excessive number of tariff bands).

In PNG, Male and Port Vila, the tariff structures provide customers with the appropriate signals that additional consumption is more expensive, as increasing consumption levels fall into higher tariff blocks. This strong demand management measure will result in a reduction in wastage and increased conservation of resources. Tariffs in both Male and Vila are set in line with economic costs. Both also have fixed monthly charges that ensure a greater level of revenue from customers helping to offset the high level of fixed costs that the utilities face.

4.3.2 Performance in relation to financial sustainability

The present tariffs for Samoa, Fiji and Kiribati result in financial losses to the utility and thus they do not satisfy the financial objective (see 3.2.2). In contrast, both Vanuatu and Maldives achieve full cost recovery targets through tariffs. When this is coupled with better operational performance as evidenced by lower water losses, it means that full cost recovery and sector financial self sufficiency can be achieved at a lower overall cost. In the case of PNG, tariffs are set to achieve a 5% rate of return on net fixed assets in service.

Where water supply and wastewater projects are financed commercially there is a requirement for tariffs that ensure financial sustainability. Problems arises where grant aid results in no requirements to set such financial tariffs. As a result revenues are generally inadequate to even meet O&M as preventative maintenance is ignored in the desire to set tariffs as low as

possible to satisfy political rather than commercial objectives.

In pursuing political agendas in the form of low tariffs, it is the urban poor that end up being disadvantaged as their service is likely to deteriorate first in the peri-urban areas. Alternatively, lack of funds means that the distribution system cannot be extended to bring water to peri-urban areas where the poor are more likely to reside. Without access to capital to develop new schemes, water sources are also likely to be inadequate to supply services to such areas.

Countries receiving grant aid (including Compact Payments) to finance urban water supply should use the opportunity to establish clear financial objectives and cost recovery policies for the sector. PNG has taken this opportunity and has set its tariffs to meet a 5% rate of return on net fixed assets in service irrespective of the sources of funding. This is one of the main benefits of such a financial objective that requires a minimum level of overall financial performance. Elsewhere, tariffs have been kept at low levels and utilities have sought assistance from government. Invariably, that assistance has been inadequate resulting in insufficient maintenance, deteriorating assets and decline in service levels. Systems have deteriorated and there have been no funds for capital replacement necessitating external capital funds for rehabilitation of inadequately maintained systems. This cycle needs to be broken, and appropriate financial objectives and cost recovery targets set to ensure long term system sustainability (or at least a greater level as in some cases such as Kiribati where tariff levels may be limited by affordability).

4.3.3 Performance in relation to the Social Objective – Affordability and Willingness to Pay

Only PNG and Male could be said to provide a genuine lifeline block for low income consumers in their tariff structures. Kiribati has a flat rate charge of A$5 or A$10.00 per month, while Fiji and Vila both allow an initial block of 50 cu m for three months or 17 cu m per month at the lowest tariff rate. This is excessive for a lifeline block and in both countries much of the consumption is in this band. In Vanuatu, however, the 'stepping' of the tariff is much less therefore cost recovery is higher.

In Samoa and Fiji existing tariffs result in a monthly water and sewerage bill equivalent to 1.6% and 1.4% of monthly household income respectively, which is well within accepted levels of affordability at 5%. In Male existing tariffs result in a monthly bill of US$5.1 or approximately 3.0% of household income while in Vanuatu an average "domestic customer" would pay US$ 8.3 equivalent to around 2 to 3% of household income.

As Table 6 shows, there is an opportunity to double tariffs in Fiji, Kiribati, and Samoa and still have affordability levels around 3%, or of the order of Vanuatu and Male. This would provide additional revenue that could meet O&M costs with a surplus available to contribute to capital investment requirements.

4.3.4 Performance in relation to Administrative effectiveness

In the case of Fiji the system of three monthly meter reading and monthly billing on estimates has lead to considerable confusion and dissatisfaction. In Kiribati there was almost a complete breakdown in the billing system in 1996 with the computerized and manual systems often showing conflicting data. In Samoa customers presumably have got used to the logarithmic basis of the tariff, with many customers paying on a flat rate basis anyway. In Male and Vila there does not appear to be any customer confusion over existing billing practices.

Where the collection efficiency of a billing system falls below 90%, (as in Fiji, Kiribati and Samoa) then the integrity of the billing and collection system falls into question. This has become a factor both in Fiji and in Kiribati but Samoa is making efforts to improve collection efficiency and recover arrears. Institutional strengthening in Kiribati and Fiji should also see an improvement in this area in the near future.

4.4 Financing and Institutional Arrangements

4.4.1 Sources of Funding in the Urban Water Sector.

The external funding available to urban water sectors has apparently declined over the last ten years, probably for a combination of two reasons. Firstly donor have become dissatisfied with both the financial and operational performance of urban services in many countries and have lost interest in funding further projects. Secondly donors see a more pressing need to provide support to social sectors such as health and education, with the belief that there is greater opportunity to self finance urban water supplies when proper cost recovery policies have been put in place.

The sources of financing that have traditionally been accessed and would likely represent main sources in the near future in the Pacific are shown in Table 7.

4.4.2 Funding Sources Utilized by Each Country

Fiji has met most of the cost of financing the development of the sector out of the government budget and has only recently sought external financing. JIBEC have

Table 6. Estimates of Economic Costs of Water Supply and Average Tariffs (US cents per cu m).

Country	Fiji	Kiribati	Samoa	Maldives	Vanuatu	Papua New Guinea
Urban Center	Suva (1)	Sth Tarawa (2)	Apia (3)	Male (4)	Vila (5)	Towns (6)
Water Source	Surface water	Groundwater/ desalination	Surface/ groundwater	Desalination	Surface/ groundwater	Surface/ground water
Full Cost Recovery – Economic Cost	US cents/cu m 51.9	US cents/cu m 357.6	US cents/cu m 60 (7)	US cents/cu m 644.0	US cents/cu m 50.0	US cents/cu m N.A.
Water/Wastewater	Water and ww	Water and ww	Water only	Water and ww	Water only	Water only
Ave Domestic Tariff	22.7	75.0 (water only)	9.0 / 6.0 (8)	506.0	40.0	21.0
Ave. Lpcd	190	20	250/400 (9)	24	138	125
Ave HH cu m/month	31.3	7.5	60.0 / 138 (9)	6.5	20.7	26.3
Collection Efficiency %	56% (9)	47%	80% (10)	99%	99%	95%
Effective Average Domestic Tariff	12.7	39.5	7.2 / 4.8 (9)	506.0	40.0	21.0
O&M Covered by Collected Tariff	50%	50%	50%	100%	100%	100%
Capital Contribution from Tariff Revenues	Nil	Nil	Nil	Capital and/or dividends to shareholders	Capital plus return to concessionaire	5% return on assets, capital contribution
Debtors (days of sales)	288	400	192	30	30	192 (11)
Operational Efficiency (Water losses %)	50%	50%	45%	8%	23%	28%
Affordability Present Tariff (% Ave.HH Income)	1.4%	2.0%	1.6%	3.3%	2 to 3%	N.A.

SOURCES:
1) Suva Nausori Masterplan, 1999 and ADB Fact Finding Missions, 2000 to 2002.
2) Kiribati Sanitation and Public Health Project, ADB, 1996 and recent comment.
3) Apia Urban Development Project, ADB Fact Finding Mission, 1997 and recent SWA comment.
4) MWSC Tariff Review, Danida 1999, and recent MWSC comment.
5) UNELCO 2002 and consultants estimates.
6) PNG Waterboard. Operations cover 11 towns, excluding Port Moresby which has been privatized.
7) US cents 60 is for water supply only, a US cents170 per cu m includes sewerage project down town and central Apia area.
8) US cents 9.0/cu m for metered consumption, and US cents 6.0/cu m for unmetered assuming charge of WS$ 12 per month.
9) Consumption : metered is estimated at 60 cu m per month and unmetered 138 cu m per month.
10) Includes collection of past arrears that increases level of collection for the current period.
11) There is an inconsistency between present high collection efficiency and excessive level of debtors which is explained by the fact that a high level of arrears is being collected in conjunction with present tariff. 44% of debtors relate to government organizations, which are expected to pay in due course.

Table 7. Sources of Funding.

Domestic	International
Government funds (Include Trust Fund Sources.)	Multilateral Bank Loans (World Bank, ADB, EIB etc)
Local loans (Include Provident Funds.)	Bilateral Loans/Export Credits (JIBEC, KfW, IFU)
Customer contributions such as connection costs	Bilateral Grants (Include Compact Payments)
Private Sector Sources – both loans and equity contributions	BOT, Private Sector Management Contracts, Private Sector Concession Agreements
Customer revenues - from tariffs to meet O&M and finance share of future capital expenditure.	Mixed Capital Public-Private Partnerships.

provided a loan for Nadi – Lautoka expansion with GoF meeting any rehabilitation costs. Government is seeking finance from ADB for the rehabilitation and expansion of the Suva – Nausori system.

Samoa has been the recipient of grants to fund water supply, most recently from the EU for rural water supply schemes on Upolo and Savaii. Previous grant funding established the water sources and treatment facilities for the Apia water supply system. ADB has proposed financing of the Apia Central Sanitation Project.

The original water supply and sanitation systems on South Tarawa were developed with the assistance of Australian Aid. The current rehabilitation and expansion is being financed by an ADF Loan from ADB at concessional interest rates (1%). Given affordability issues, these funds maybe passed on as a grant to the operating entity, the Public Utilities Board or its successor. The Government of Kiribati will need to provide counterpart funding.

The Male water and sewerage system was financed by a J-V between the Government and a foreign joint venture partner. The JV was awarded to a Danish firm with Male Water Supply & Sewerage Company (MWSC) provided with an IFU (Danish Export Development) loan of about US$4.0 million at a 4.5% interest rate to be repaid by 2001. Danida also provided GoM with a grant to assist with the rehabilitation of the system. The Foreign J-V partner purchased a 30% equity share in MWSC.

In Port Vila, the Concessionaire (UNELCO) which also operates the electricity supply facility, agreed from 1994 to invest VUV800 million (US$6 million) over the 40-year concession period.[7] UNELCO finances all improvements, upgrading and extensions to the distribution network in accordance with a work program agreed by both parties.

The PNG Waterboard has received soft loans from ADB (and World Bank in the past) and grants from AusAID and JICA. Because of its good financial and operational track record, the Waterboard has no difficulty obtaining funding from these agencies. In addition, the presence of agreed corporate and investment plans allows funding agencies to identify projects for financing that fit into a coherent development program that is aimed at developing a long term sustainable water sector.

5. HOW CAN FINANCING BE IMPROVED?

There is a need for both a demand side and a supply side response to the problem. On the demand side, the challenge lies in demand management. In almost all situations the demand is outpacing supply. If demand can be moderated the finance required will be less. The long application lists evident in many urban areas indicate that people desire water and are willing to pay for it. This suggests that market forces can be used to simultaneously moderate demand and to raise additional funding through tariffs. In addition to the use of market instruments such as tariffs, resource managers must rely on some combination of education (moral suasion) and regulation to moderate demand. The way forward is no doubt to use all three approaches in parallel—tariffs, consumer education and regulation.

On the supply side, the challenge lies in obtaining greater productivity from the assets of the water utility and in reducing the costs of supply. The water utilities have a wider range of tools available and the problems are more easily tackled than those on the demand side. Water utilities (or governments) are in the fortunate situation to be able to control much of the supply side whereas the best they can do on the demand side is to try to influence demand. The tools available to improve supply side performance include staff training, better operational equipment, loss detection efforts, improved economic and financial analysis, better policy analysis and better designed tariffs.

5.1 A possible way forward

Given the long list of shortcomings of the water management sector, the challenge is to decide where to start the improvement process. The general approach suggested in this paper is for water authorities to begin by 'picking the low hanging fruit' and then to progressively move on to the more difficult and slower response activities.

Although each country will need to make its own assessment, as a starting point we suggest that in most PICs the 'low hanging fruit' consists of improvements in the billing and collection of revenues and in operational efficiency in the water utility. Some suggested areas for improvement are discussed below. Improving efficiency will help build consumers' confidence which will be a necessary first step to the introduction of tariffs incorporating increased cost recovery. Such improvements in operations will often require parallel institutional (or financial management) reforms. The key requirement here will be a more commercial approach by the water utility. Experience in the Pacific show that where a commercial approach is followed in the provision of water and sewerage services, reduction in unaccounted for water can be rapidly obtained. This approach could be achieved under a well-structured government department, a water authority or a private water company: the chief determinant of success in this regard is not so much the vehicle used as the way it is built and driven.

Benchmarking should serve as one of the tools used

[7]There is a fixed investment rate of VUV40 million per year for the first 5 years of the contract and VUV20 million for the 35 years thereafter.

to identify targets for efficiency improvements and to introduce a culture of monitoring into management. Consumer education can start immediately but it will need to be continued over a long period to bring about the changes in attitude needed and it will need to be reinforced by changes in the behavior of water authorities and governments. Work on water sector policies and analyses of future needs will be required to underpin changes in tariffs and also to provide water authorities with targets for improvement in their levels of efficiency. Work may also be needed to introduce further regulation both to support market instruments such as tariffs and commercialization and to reinforce demand management measures.

5.2 Improving bill collection

As indicated in Table 6, two of the countries reviewed have collection efficiencies of around 50% and one has efficiency of about 80%. This represents a very good opportunity to boost revenues without significant additional costs. A campaign to collect arrears coupled with firm and highly publicized action to disconnect non-payers would send very strong signals to consumers and to the employees of water utilities. (Vanuatu, Port Vila demonstrates that with aggressive collections and proper billing systems that revenue collections can be increased from levels around 50% to over 90% and be maintained at that level.)

If a high proportion of non-payers are poor households then this approach would not be appropriate. Rather, what is needed might be an approach to government to put in place some form of direct subsidy to poor households whereby government would pay the bills as a welfare measure. Many developed countries provide rebates for the utility bills of lower income families and such a scheme could be progressively introduced to the PICs. (However, in the case of poor households there is also ample evidence such as in Port Vila that poor households in squatter areas (in the peri-urban area) are required to pay well in excess of water tariff for their non-piped sources.)

5.3 Reducing water losses

The three countries with low debt collection efficiencies also have water losses of around 50%. Reduction in these losses offers multiple benefits—increased revenue from sales; increased availability of water; delayed need for system expansion; and strong public relations signal about the need to conserve water. It is acknowledged that detection of leaks and reductions in unaccounted for water are not easily achieved in many situations for a variety of reasons. However, the Theme 4 paper on Technology also advocates action in this area suggesting the need for a ‘standard leak detection program for the Pacific Island Countries which can be shared and is continuous’. The actual process of attempting to detect leaks and discover losses can be used as a strong motivating and unifying activity for a water utility that may previously have been suffering from low morale because of the apparent reluctance of its management to deal with this highly evident problem. The starting point is to meter all consumers and ensure that meter are accurate through continuing testing and replacement.

The reduction in water losses will also help give credibility to subsequent efforts to increase water tariffs since consumers will not be able to point to water losses and suggest that the water utility needs to put its own house in order before it seeks to charge more for water.

The process also is likely to provide the utility with substantial ‘ammunition’ in the form of detailed rehabilitation requirements to seek financial support from government or bilateral donors as part of a comprehensive reform program for the water sector.

While reducing water losses is seen as an essential first step, it is recognized that considerable capital investment is required to achieve this step. Accordingly, careful planning is necessary and funds obtained from the government or donors if this is to be achieved.

5.4 Achieving other efficiencies

There is likely to be a large range of improvements that can be made in the operations of almost all utilities. The Theme 4 paper suggested ways to deal with such capacity building, infrastructure development and efficient operation and maintenance indicating that these will remain a priority for the utilities. A key feature of those recommendations was the need to recognize that capacity building is a long term exercise with no finish line—it needs to become part of the way the utilities operate. In addition to within utility efficiencies, in some countries there may be a need for external efficiency measures such as water saving devices, meters, flow restriction devices etc.

5.5 Development of Financial Plans for Urban Water Sector

Good progress has been made in financial planning for the sector but more needs to be carried out prior to efforts to raise tariffs. Financial plans and financial projections have been prepared for the urban water sectors in Samoa, Kiribati, Fiji and Maldives. These plans provide a basis to identify sector funding requirements, sources of financing and to help set the tariffs. These analyses were then used to define broad financial objectives for the sector and the cost recovery targets to be achieved through tariffs. This lead to recommendations on financial covenants to be adopted to ensure that tariffs are maintained at the appropriate levels to

achieve the proposed objectives. These financial plans have shown the need for improved cost recovery in the case of Fiji, Kiribati and Samoa.

In PNG, the Waterboard has prepared a Corporate Plan of 2000 which provides strategic directions for its business activities in the provision of urban water supply and sewerage services. The Divisions annually produce Business Plans based on the Corporate Objectives. The corporate plan includes a list of projects to be implemented once financing and resources are available. In this way the corporate and financial plans help the PNG Waterboard and its funders to identify project opportunities and allow them to assess the financial implications. Details of PNG Waterboard's Corporate Plan are set out in Appendix A.

This is an excellent example of a public utility taking the initiative to set its operations on a sound footing with a clear focus on compatible objectives of consumer service and operational and financial viability. This in turn provides donors with confidence and a desire to be involved in financing future projects in a successful organization and well managed sector.

5.6 Increasing tariffs

In most small island countries there is a need to increase tariffs in line with the suggestions in this paper. These tariff increases should be announced well before the time of their introduction and at the same time the utilities should announce and publicize some form of guarantee of customer service standards. The actual introduction of the tariff increase should ideally be delayed until such time as the service level matched the guarantee.

5.7 The importance of institutional arrangements

The institutional arrangement used to accommodate a water utility is clearly an important consideration. However, we suggest that the actual structure used is much less important than the way in which it is managed and operated. For this reason institutional improvements alone are unlikely to be sufficient to improve water services. Rather, clear goals, policies and actions need to be agreed upon that serve the interests of the community at large. Effective oversight arrangements should be established with meaningful representation by consumers and other stakeholders, such as landowners.

Nonetheless, institutional arrangements are important and can facilitate the change towards the more commercial culture and behavior that we have been advocating in this paper. The efficiency of water utilities can be improved through the processes of commercialization and corporatization which may be appropriate first steps to establishing the independence of operations required for consumer-oriented water services. It is worth noting, however, that corporatization has not always been accompanied by commercialization in water enterprises in the Pacific.

The PNG Waterboard demonstrates that a public sector operation can operate commercially. At the same time, private sector management in Port Vila and a public/private Joint-Venture in Male have also proved successful. We conclude, therefore, that there are numerous institutional arrangements that can work—the key is to ensuring the institution functions commercially.

Appendix D further examines the links between financial performance and institutional structure.

5.8 Regulation of the Urban Water Sector

There is relatively minimal regulation of the water sector in the Pacific. There is only a limited regulatory framework and no functioning regulatory agency separate from the utility and from the Ministry or municipal government responsible for economic regulation for public or private water services in most countries in the Pacific. Apart from PNG, the PICs do not have water laws and regulations that clearly set out rules for private participation or assign responsibilities for setting tariffs and service quality standards for the urban water supply sector. The lack of this regulatory framework has not been seen as an impediment to private sector participation to date.

The PNG Government believes that the water sector can be managed more efficiently through privatization. In February 2000 the National Executive Council directed the Privatization Commission to start preparing the water assets (Eda Ranu for Port Moresby and the Waterboard for provincial and district areas) for privatization.

In the Maldives the Maldives Water and Sewerage Authority (MWSA) is charged with the regulation of the sector but it is not really independent of GoM. At the same time GoM is the majority shareholder in the Male Water Supply and Sewerage Company (MWSC), so that there is limited independence of MWSC and it would be difficult for MWSA to regulate the sector. Nevertheless, to date, GoM has done nothing that would jeopardize the financial position of the minority J-V shareholder and has adhered to the spirit of the J-V agreement to set tariffs at levels to meet a 15% IRR on equity invested.

In the case of Vanuatu, the Concession Agreement sets out the obligations of the concessionaire in terms of water quality, levels of service and tariff adjustment procedures.

While the PUB in Kiribati and the SWA in Samoa may be said to be independent boards/authorities they have no real financial independence from their governments

when it comes to setting tariffs. In Fiji, the water sector operations are part of a government ministry

Despite the fact that the lack of regulation does not seem to have impeded private sector participation to date, it would be useful to reexamine the need for greater regulation in future. This might be particularly important for those PICs seeking to obtain greater private sector investment into the water sector. These issues are discussed in detail in the Theme 5 paper. Governance arrangements for the water sector are particularly important and these are discussed in Section 3.4 of the Theme 5 paper. One of the lessons that has emerged from the water sector internationally, is that the water sector requires much more comprehensive and integrated management if the three elements of social welfare, environmental/ecosystem integrity and economic/financial productivity are to be achieved in a sustainable, triple bottom line way. In order to make this happen a number of fundamental actions are necessary. ADB[8] has characterized these as follows:

- stakeholder participation in all stages of the project cycle;
- attention to the complementary roles of the public and private sectors, recognition of the special contribution of women, and incorporation of economic instruments to improve allocative efficiency;
- integration of pro-poor strategies into project formulation to ensure that services are extended to poor areas and that rights of access are assured for the poor and other disadvantaged groups;
- strengthening of regulatory and control functions to maximize opportunities for private sector participation in service delivery;
- environmental protection and enhancement as an integral part of every new project, with each project being evaluated in the whole river basin context; and
- acquiescence of directly affected communities prior to committing investment funds.

If the above matters are to be properly incorporated into the sector, then attention to issues of governance are crucial. An appropriate regulatory framework must be put in place to encompass the requirements of all stakeholders and to set out the rules and regulations that will encourage private sector involvement and at the same time provide the regulatory and governance frameworks necessary for the benefit of all stakeholders.

5.9 The Need for Donor Support

Although there has been a decline in donor support for the water sector in the Pacific, the needs are increasing, especially if the vulnerable and declining water resources of many PICs are to be managed properly. Financial support is needed in the form of technical assistance and to finance for water and wastewater infrastructure. These are discussed below.

5.9.1 Technical Assistance Requirements

Technical assistance is needed to address pressing planning, management and training needs. At the Sigatoka meeting, each Theme listed a number of key requirements that need addressing. These include :

- Themes 1 and 2 identified significant deficiencies in national capacities to conduct water resource assessments and monitoring programs, which prevent countries from conducting proper planning, development and sustainable management of water resources. These tasks would require external support and technical assistance.
- Theme 3 identified the need for donor support for a regional information service.
- Theme 4 sought donor support for a Regional water loss reduction program.
- Theme 5 sought donor support for developing appropriate laws and regulations in each Pacific Island country.
- Theme 6 requires donor support for the development of sector plans, investment master plans, corporate plans, financial objectives, cost recovery policies and tariff structures in many countries, and the need for rural water supply and sanitation strategies.
- All Themes indicated a need for capacity building and training.

There needs to be coordination between donors and government agencies in each country to ensure that water resource management plans, legal and regulatory requirements, sector investment plans, and corporate plans together with financial objectives are developed with the overall objective of ensuring long term sustainability of the sector.

5.9.2 Funding of Infrastructure Requirements

In many small island countries there is a pressing need for external donor support for expansion and rehabilitation of water and sanitation facilities. This includes source development and protection, water treatment and distribution, as well sewerage collection and treatment facilities or basic sanitation facilities. However, one of the overriding themes of this paper is the lack of adequate cost recovery and user charges, in the form

[8]ADB Annual Report 1999 - Theme Paper No.8 – Water in the 21st Century: p16-17.

of tariffs, in these countries to provide funds to at least meet the operation and maintenance needs of the sector. There is widespread reluctance in much of the Pacific to adopt commercial policies in the sector that would see users pay for the services they receive.

This is in direct contrast to philosophies now in vogue in developed countries and in much of Asia where most countries are adopting a commercial approach to providing such services with the requirement to charge users through tariffs for the services that are provided. To the extent possible and where affordability allows, users are expected also to meet the capital costs of the sector by meeting the debt service costs of loans and the capital costs of expansion and replacement out of tariffs.

Accordingly there is a need to develop corporate plans for utility (or other acceptable entities) operations in each country that emphasize the need to establish commercial operating principles, financial objectives and cost recovery and proper tariff structures. These matters can be embodied into corporate plans that set out future investment requirements and financial projections showing how such financing can be repaid through tariffs (if required) in conjunction with adequate revenues to meet operations and maintenance requirements.

Multilateral donor support is unlikely to be forthcoming without a commitment to a more commercial approach to the operations of the sector with emphasis on user charges to avoid the repayment of loans becoming another burden on government finances. This will free governments to meet other objectives such as poverty alleviation, where water supply is provided to urban and rural poor, while greater commercialization will encourage the opportunity for private sector participation in the sector.

For those countries contemplating greater involvement of the private sector, Figure 2 may be of some interest. This so-called transitional financing system envisages that the water corporation will assume more responsibility and directly access the private capital market by borrowing and seeking direct investment in urban services. The water company may issue a debt instrument for sale directly to investors. In the US, direct access is the primary source of infrastructure finance for local implementing authorities.[9] This may only be appropriate in some of the larger PICs, however, many have National Provident Funds that are seeking good long term investment opportunities which is a source that could be tapped.

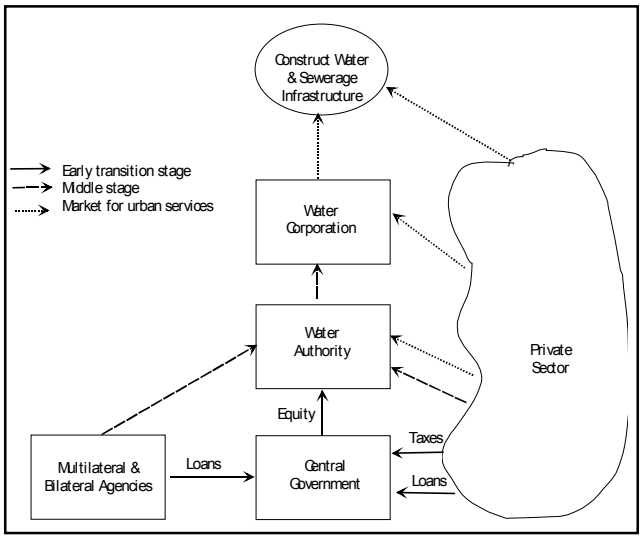

Figure 2. Transitional system of urban infrastructure financing – Demand driven.

6. HOW CAN THESE CHANGES BE IMPLEMENTED IN THE PACIFIC?

6.1 Sigatoka Action Plan : Theme 6 Financing Actions, August 2002

Following presentation and discussions in Fiji in August 2002 the following key messages were proposed for sector financing to form part of the Regional Action Plan.

The first key message related to establishing overall policies and regulatory frameworks in each country to encourage the economic development of the sector. The second stressed the need to develop financially viable enterprises and the third emphasized the need for cost control and benchmarking to improve performance. The fourth key message related to developing policies that promoted access for the poor and the fifth key message proposed the need to develop a coherent policy for funding rural water supplies and the management of individual schemes to ensure long term sustainability.

The Key messages for Theme 6 reinforce those areas that will encourage greater participation of the donor community both in the provision of technical assistance and also greater external financing of sector infrastructure. This donor support is more likely to be gained where there is a commitment to adopt commercial practices and user pays principles, resulting in adequate levels of cost recovery through tariffs.

The five key messages are summarized below, while the proposed actions are set out in Appendix B.

Key Message 1: Create Overall Policies and Regulatory Environment

"Create a better and sustainable environment for investment by both the public and private sector, by de-

[9] See the paper 'Financing urban development: Urban competitiveness in the global economy' by Ronald W. Johnson. This is part of the report ADB 1996 The Future of Urban Cities

veloping and implementing National, sector and strategic plans that identify the economic, environmental and social costs of different services and develop pricing policies, which ensure the proper allocation of resources for the water sector."

This is a common goal that runs through each of the Themes namely to develop an overall sector plan and policy framework. In Theme 6, the emphasis is on getting the pricing (and regulatory) regimes correct.

Key Message 2: Establish Financially Viable Utilities for Long Term Sustainability

"Establish financially viable enterprises for water and sanitation that result in improved performance by developing appropriate financial and cost recovery policies, tariffs, billing and collection systems, financial and operating systems."

This is a message that runs through Theme 4 about developing strong utilities with financial viability being a cornerstone requirement.

Key Message 3: Reduce Costs for Long Term Sustainability

"Reduce costs through improved operational efficiency, using benchmarking, development of water loss reduction programmes and improved work practices".

Again, this is a message that runs through Theme 4 about developing strong utilities as a result of regional cooperation, especially in the area of reducing water losses which are a major cost in many Pacific country operations.

Key Message 4: Ensure Access for the Poor

"Ensure access for the poor to water and sanitation services by developing pro poor policies that include tariffs with lifeline blocks and transparent and targeted subsidies".

The overarching goal of ADB, WB, bilateral agencies and governments is to assist the poor gain better access to services at prices they can afford as a prime platform to achieve poverty alleviation. This can be achieved through extension of services to peri urban areas and good tariff structuring.

Key Message 5: Develop Sustainable Rural Water Supply Funding and Management Arrangements

"Achieve sustainable rural water and sanitation services at a community level through developing strategies that incorporate mechanisms for appropriate financing and capacity building".

A large proportion of Pacific island population lives in peri-urban and rural areas that are not serviced by typical urban utility water and sanitation service organizations. This area assumes the same importance as message 1 as it needs inputs at all levels from central government through to provincial to local village institutions to achieve long term sustainability. Appendix C of this paper deals with the rural water sector.

6.2 Focal points for further implementation

The Sigatoka Meeting provided a good starting point to introduce the changes needed to move towards a financially, socially and environmentally sustainable water sector for all PICs. Importantly, this meeting created a sense of ownership and responsibility amongst participants along with an indication of each country's commitment to improve the management of the sector. The five key messages arising from the meeting provide points of focus for further implementation including incorporation of the specific measures suggested in this paper.

- **The need for sound policies and regulatory frameworks**. Each country will need to establish overall policies and regulatory frameworks that will foster sustainable development of the sector. This will need to include regulations that permit the creation of a water utility that can operate commercially.
- **The need to develop financially viable enterprises**. Water utilities need to be able to operate commercially to provide the discipline and focus needed to cope with the challenges in managing the water sector.
- **The need for cost control and benchmarking to improve performance**. There are great opportunities to improve the financial performance of most utilities by tackling the range of operational and managerial weaknesses evident in most utilities. The challenge will be to ensure that any improvements made are retained and become institutionalized.
- **The need to develop policies that promote access for the poor**. The major risk associated with moving utilities towards a more commercial approach is that water supply and sanitation services will be placed beyond the reach of the poor. Measures are needed to protect the poor while maintaining the focus on efficiency elsewhere. This responsibility should be shouldered by government as part of its welfare concerns.
- **The need to develop a coherent policy for funding rural water supplies and the management of individual schemes to ensure long term sustainability**. Rural water services present quite different challenges but the key element is likely to lie in mobilizing the communities in some form of self-help scheme.

Action by PICs to implement these Key messages for Theme 6 will be welcomed by external assistance providers since it will indicate that governments are addressing the past failings in this sector. These agen-

cies can be expected to provide higher levels of external assistance both for technical assistance and also greater external financing of sector infrastructure. This support is most likely to be obtained where there is a commitment to adopt commercial practices and user pays principles that deliver adequate levels of cost recovery through user charges while at the same time ensuring access for the poor.

It is clear that the challenges associated with improving the financing of water management cannot be addressed through a narrow focus on financial matters. Rather, what is required is a broader focus on building the capacity of water utilities to tackle the range of challenges that have been identified at the Sigatoka meeting. Improvements are needed in consumer confidence that they will receive reliable services before they will express a willingness to pay more than they are now doing. This requires that the utilities improve their overall efficiency through human resource development, prudent use of external assistance and improved water demand management and conservation practices as outlined in the Theme 4 paper.

The path to sustainable water management in the Pacific thus requires capacity building in the utilities, restoration of consumer confidence, demand management, conservation of scarce water resources, establishment of a commercial approach incorporating access to services for the poor, improvements in bill collection and other efficiencies along with progressive increases in tariffs up to full cost recovery. Countries that commit to this path are likely to obtain support from both bilateral and multilateral agencies over the coming decade.

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APPENDIX A

FINANCIAL REVIEW OF SELECTED COUNTRIES

1. INTRODUCTION

The current tariffs and cost recovery policies of five Pacific Island countries and the Maldives are reviewed with the purpose of trying to draw some lessons on what appears to achieve the desired objectives, and to identify issues and constraints and discuss actions completed to date and proposed where improvements are required to achieve long term sustainability. This section concentrates on an examination of current tariff policies, economic costs and financial objectives in the countries/urban centers under review.

Tariffs are examined in terms of their ability to provide the correct pricing (economic) signals to customers, their ability to achieve sector financial objectives (whether specified or implied), their ability to meet social or acceptable affordability criteria that should include delivering acceptable levels of service to ensure public health benefits are realized, and finally whether they are administratively understandable and that proper billing and collection procedures are in place so that revenue from tariffs are actually collected.

The countries in question are Fiji, Kiribati, Samoa, Vanuatu, Papua New Guinea (PNG) and the Maldives. These countries are all subject to case studies and it is not proposed to present detailed information on their operations in this paper. However, they represent a range of institutional and financing options. Information is available on the economic costs of supply for Fiji, Kiribati, Samoa and Maldives.[10] Vanuatu represents a private sector concession arrangement, Maldives a joint venture company between the private sector and government, while Samoa represents government authority and Kiribati and PNG government boards, and Fiji a government department.

Samoa and Kiribati's water and sanitation facilities have been financed largely by grant aid, while the Fiji government has financed the bulk of the past sector's investment from its own budget. PNG has been financed by bilateral grants and multilateral bank loans. In the case of Maldives the funding of the water and sanitation facilities in Male was provided from grant aid, a low interest loan and foreign private sector investment. In Vanuatu for the past eight years sector expansion and rehabilitation has been met by the private sector concessionaire.

[10]Economic Costs have been extracted from past feasibility studies. They have not been updated to 2002 prices, but nevertheless are representative of future costs and provide a comparison with existing financial tariffs in each country.

2. FIJI AND SUVA – NAUSORI WATER AND SANITATION PROJECT

2.1 Fiji : Suva – Nausori Economic Costs

The Suva Nausori ADB TA project estimated the economic costs in both financial prices and economic prices for the Overall masterplan 2003 to 2022 for both water supply and sewerage and for the proposed project over 2003 to 2007. This provides an opportunity to assess the costs over different time periods and increasing investment requirements.

Firstly it is important to note that the estimate in economic prices (AIEC) are higher because of the higher discount rate (SOCC of 12%) and also because it incorporates all costs met by various parties while the AIFC (financial prices) represents those costs that must be met by the Water and Sewerage Department (WSD) and uses the weighted average cost of capital (WACC of 2.1%) as the discount rate. In addition the longer term masterplan costs are higher for water supply as projects are developed in a least cost framework so that the cheapest sources etc are developed first. In the case of the sewerage component the long term cost is lower as excess capacity constructed in the initial project is fully utilized.

For pricing and tariff purposes for the short term project, the Feasibility Report (and Case Study) argue that the short term water project costs and the overall masterplan sewerage costs, should be used for evaluating tariffs.

Where existing tariffs are less than the AIFC and AIEC, then the difference represents the financial and economic subsidy to water users respectively. That is the amount by which water users are subsidised by other sectors of the economy. (This is summarised in Table 1).

The AIFC is used for tariff development purposes as these are the costs (and the financing charges) that need to be met by WSD. In line with economic principles the objective should be to set tariffs at a level that average tariffs approximate the AIFC and all tariffs for upper band levels of consumption should be at or above the AIFC.

2.2 Derivation of Affordable Tariffs.

The analysis of the AIFC (capital and operating costs) can be used to identify and develop affordable tariff structures to achieve first, full cost recovery and sec-

Table 1. Suva-Nausori Project, Summary Economic Costs for Water Supply and Sewerage.

Total Master Plan, 2003 - 2022	Water		Sewerage		Water and Sewerage	
F cents/cum	AIFC	AIEC	AIFC	AIEC	AIFC	AIEC
Capital	44.6	94.4	43.5	120.4	88.1	214.8
O&M	23.4	19.8	22.7	24.8	43.2	47.5
Total	68.0	114.2	66.2	145.2	134.2	259.4
Proposed Project, 2003 - 2007	**Water**		**Sewerage**		**Water and Sewerage**	
F cents/cum	AIFC	AIEC	AIFC	AIEC	AIFC	AIEC
Capital	29.9	87.2	59.2	161.9	89.1	249.1
O&M	14.3	14.9	37.1	36.2	51.4	51.1
Total	44.2	101.2	96.4	198.0	140.6	299.2

ond, to meet operating and maintenance costs of the water and sewerage schemes in the project area. The assessment is carried out for the low and median income households to assess the level of monthly income required. The results are summarised in Table 2 for the proposed project 2003 to 2007.

In the case of a median income household, 3.2% of household income is required to achieve full cost recovery of both water and sewerage services. This suggests that it is possible to structure tariffs to achieve full cost recovery for both water supply and sewerage for an average household within acceptable affordability limits. The recovery of O&M costs would amount to only 1.1% of average household income. This may be compared with combined water and sewerage bill at the current tariff of F$15.17, which equates to 1.4% of household income. This leads to the conclusion that for an average household the water and wastewater bills would simply meet future system O&M costs with no effective contribution to capital cost recovery.

It is evident that a low income household would be able to meet a full cost recovery tariff for water and sewerage amounting to 4.2% of household income, which would be within the acceptable levels of household affordability. However, this would probably exceed willingness to pay where most households have access to the existing water supply system, which many consider adequate, while many households use septic tanks and therefore do not have to meet a monthly sewerage charge. Water only full cost recovery tariff would represent 1.7% of household income.

The average bill for a low income household at the current tariff for water and wastewater would be F$5.24

Table 2.Summary Alternative Cost Recovery Levels and Affordability for Households in Suva-Nausori Area, based on Short Term Plan (2003-2007).

		Average Income		Low Income	
Income	**F$$/month** **cum/mth.** **Lpcpd**	1083 31.35 190		388 14.85 90	
Sub project	**F cents/cum**	**F$/HH/mth.**	**Affordability**	**F$/HH/mth.**	**Affordability**
Water Supply Full Cost Recovery O&M only	 44.21 14.32	 13.86 4.49	 1.3% 0.4%	 6.57 2.13	 1.7% 0.5%
Sewerage (1) Full Cost Recovery O&M only	 66.19 22.66	 20.75 7.10	 1.9% 0.7%	 9.83 3.37	 2.5% 0.9%
Water & Sewerage Full Cost Recovery O&M only Water Full Cost, Sewerage O&M only	 110.41 36.98 66.87	 34.61 11.59 20.96	 3.2% 1.1% 1.9%	 16.40 5.49 9.93	 4.2% 1.4% 2.6%
Current WSD Tariffs (2) Water Sewerage Total		 8.90 6.27 15.17	 0.8% 0.6% 1.4%	 2.27 2.97 5.24	 0.6% 0.8% 1.3%

Note : (1) : As noted in text the AIFC used in the Overall Masterplan cost
(2) : See current WSD tariff below.
(3) :Tariffs based on water sales, therefore include an allowance for water losses.

or 1.3% of household income. This would not cover combined O&M costs of the proposed project. Where a low income household only had a water connection then the estimated bill of F$2.27, would represent 0.6% of household income. This would meet the O&M cost of the water component. However, if present levels of collection efficiency of 60% is factored in, then present revenues would not meet O&M costs.

On the other hand, the recovery of O & M component (F$ 5.24 per month) of the AIFC by low income households would amount to only 1.4% of monthly household income. For a low income household, this may be compared with a combined sewerage and water bill of $5.24 per month, equivalent to 1.3% of household income. However, as noted above, most low income households are likely to be only connected to the water supply, and therefore paying a monthly bill of F$2.97, which is equivalent to 0.6% of household income. However, if present levels of collection efficiency of 60% is factored in, then present revenues are not able to meet O&M costs.

2.3 Implications for Tariff Design

A progressive tariff structure, with a life line block, lower than the full AIFC cost, would allow low income households to meet their basic water and wastewater requirements at a price they could afford, while tariffs in higher bands could allow full cost recovery to be achieved at affordable tariffs for an average income household.

The above discussion leads to the conclusion that the project is affordable with tariffs able to be set to achieve full cost recovery within acceptable limits of household expenditure both for average income households and for low income households.

Accordingly as supply improves WSD should be able to increase charges to the levels proposed above. This would remove the burden from the Government of having to subsidise water and sewerage services in the Suva–Nausori area. It is generally accepted that households are prepared to pay such tariffs where they receive a good 24 hour supply of good pressure potable water and associated wastewater services. Households in the socioeconomic surveys indicated that they were prepared to pay higher tariffs for a better water supply. The increasing level of disruption over the last two years has reinforced this willingness to pay. However, the actual levels that households would be willing to pay is not known. This is supported by other research referred to in footnote 2 where poor households are found to be willing to pay for a reliable water supply service.

A progressive tariff structure, with a life line block, would allow low income households to meet their basic water requirements at a price they could afford, while tariffs in higher bands to average income households could allow full cost recovery to be achieved at affordable tariffs for average income household. The ability of the existing tariff to satisfy cost recovery objectives is discussed below.

2.4 Present WSD Water and Sewerage Tariffs

The tariff is uniform for the whole country. This means that the less expensive systems such as Nadi – Lautoka are being used to cross subsidise Suva Nausori which has a high electrical pumping requirement for both water and wastewater services. In addition small systems with untreated water are paying the same price for a much lower level of service thus effectively cross subsidising the larger urban systems. (Alternatively it may be argued that these smaller systems were meeting their full costs leaving the government to subsidise the larger urban systems).

Although water meters are only read every three months, WSD has begun to charge customers monthly. This has led to much confusion. The socioeconomic surveys for the Suva Nausori project of both domestic and commercial customers have indicated a clear preference for meters to be read monthly and for monthly billing. In fact customers are now demanding that if they are billed monthly that their meters be read monthly. All customers are metered, but where meters are not working, customer's consumption is estimated on the lowest of the last three readings.

Table 3 sets out the current WSD charges effective from January 2000. While the WSD tariff is for the country as a whole, the comments below relate to how this tariff would achieve cost recovery objectives in terms of the Suva-Nausori water supply and sewerage system and the proposed project.

2.5 Subsidy Implications Present Tariffs compared with Economic Costs (AIFC)

Subsidy implications of AIFC tariffs compared with present water and sewerage tariffs are set out in Table 4. Firstly within the existing WSD tariff structure as shown above, there is a cross subsidy between the average financial domestic tariff and the commercial financial tariff for water of F$ 0. 25 per cum and for combined water and sewerage of F$ 0.27 per cum.

Further when the average domestic tariff is compared with the average economic costs (AIFC) then there is a financial subsidy of F$ 0.14 per cum. The Commercial tariff on the other hand exceeds the economic cost, but there is an overall average financial subsidy of F$ 0.07 per cum. In the case of sewerage tariffs the overall financial subsidy is F$ 0.45 when compared with the economic costs. When water and sewerage is combined then the financial subsidy when compared with the economic cost is F$0.54 per cum.

Table 3. WSD Current Water Tariff Structure.

Category	Consumption Bands Cum/3 months	Consumption Bands Cum/month	Tariff F$/cum	Tariff US$/cum (2)
Water				
(i) Domestic	1 – 50	1 – 17	0.153	0.072
	51 – 100	18 – 33	0.439	0.207
	Over 100	Over 33	0.838	0.396
(ii) Commercial	All units	All units	0.529	0.250
Sewerage				
(i) Domestic	All units	All units	0.200	0.095
(ii) Commercial	All units	All units	0.200 (1)	0.095
Average Tariffs	**Water (F$/cum)**	**Sewerage (F$/cum)**	**Average (F$/um)**	**Average (US$/cum)**
Domestic	0.284	0.200	0.484	0.229
Commercial	0.529	0.226	0.755	0.357
Average	0.353	0.210	0.563	0.266

Note (1) : Sewerage tariff assessed for all major industries and is based on tariff of F$ 0.200 per cum and an average F$ 0.226 per cum
(2) : 1US$ = 2.116 F$ or 1F$ = 0.4726 US$

Table 4. Analysis of WSD Tariff and Subsidy Implications with AIFC Estimates.

	Water F$/cum	Sewerage F$/cum	Overall F$/cum
Average Tariffs			
Domestic	0.284	0.200	0.484
Commercial	0.529	0.226	0.755
Average	0.353	0.210	0.563
Economic Costs (AIFC)	0.421	0.662	1.104
(i) Subsidy element (AIFC compared with Average Tariff)			
Domestic	0.137	0.462	0.620
Commercial	(0.108)	0.436	0.349
Average	0.068	0.451	0.541
(ii) Subsidy element with 65% Collection Efficiency			
Domestic	0.272	0.562	0.834
Commercial	(0.003)	0.459	0.425
Average	0.186	0.501	0.687

If the collection efficiency is taken into account then the financial subsidy would increase. The above analysis assumes that the revenue received from the tariff is 100% of that billed. Assuming a collection efficiency of 65% for Suva Nausori for water supply and wastewater collections then the effective subsidy increases as shown in the table below as the revenue from the existing tariff base declines. Thus the financial subsidy comparing the current tariff with the economic cost will average F$0.69 per cum.

2.6 Comment on Existing Tariff Structure.

The existing tariff structure does not provide households with the correct economic signals and thus has a limited demand management effect. Sewerage tariffs do not cover cash O&M costs.

The existing tariff structure does not meet the financial sustainability test as it does not generate sufficient revenues to meet O&M costs let alone any contribution to capital expenditure. The sector is reliant on the GoF to meet the balance of O&M costs and all capital expenditure for rehabilitation and expansion. This problem however, is made worse by the current billing and collection arrangements which result in an overall 60% of bills being collected.

The existing tariff is able to meet standard affordability criteria for low income and average income households. However, because of the declining performance of the sector the water supply and sanitation services are failing to meet the populations social requirements for adequate safe supplies of drinking water and wastewater disposal services.

The tariff structure with three monthly meter reading and monthly billing based on estimates is confusing for

customers and requires frequent adjustments and rebates. Consequently the meter reading and billing arrangements fail the test of being readily understandable to customers.

Further the current institutional structure with billing undertaken by the Water Rates Office and funds then transferred to the consolidated fund means that WSD is not directly responsible for collecting revenues to meet its own budget requirements which are met by the GoF out of the consolidated fund. In fact the integrity of the whole billing system is declining with the collection efficiency steadily falling and now averaging 56% for the whole of Fiji. The Water Rates Office simply lacks the manpower and vehicles to rectify this problem.

2.6.1 Declining Collection Efficiency

In 1998 Water Sales for WSD were estimated at F$19.4 million and collections at F$12.1 million. This represents a collection efficiency of 64%. Over the next three years while billings increased to F$23.1 million for 2001, collections were only F$13.2 million which includes arrears from previous years. Consequently at best the collection efficiency is now some 56% and accumulated arrears of outstanding bills is F$18.2 million. Collection Efficiency is higher in the Suva Nausori area but probably would not exceed 65%.

3. KIRIBATI : SAPHE PROJECT AND PUB

3.1 Current Water Supply Situation (2001)

Most of the residents in South Tarawa (70%) are connected to the Public Utilities Board (PUB) water supply system either through a piped system (with own or shared tap) or receive delivered water via PUB tankers. It is mandatory in S. Tarawa for houses with iron roofs to have a rainwater collection tank installed. However, only 11% of households have rainwater tanks that are currently operating. Shallow Wells are also a significant source of water in some areas where the supply from the PUB system is insufficient. The use of water from shallow wells is mainly for bathing and washing and in some rare instances for drinking and cooking. The delivery of water by PUB is a combination of a piped system and tanker system. As of December 2001, PUB continues to deliver to a significant number of domestic and commercial users through tankers. At least 42% or 1,657 out of the total of the total 3,869 domestic users and 18 out of 50 commercial users are delivered water through tankers.

Water production has not increased significantly over the last 5 years. In 2001, total annual production was estimated at 0.5 m. cum or within the range of the estimated 1300 cum per day capacity. With the completion of the SAPHE project, this is estimated to increase to some 1,600 cum per day initially and as much as 1,900 cum per day. Currently, groundwater accounts for 92% of water production and desalination water 8%. Of the available production of 0.5 m. cum in 2001, it is estimated that NRW is of the order of 45%-50%, which even for an old system is already considered on the high side.

The current number of consumers served by the PUB has grown considerably in 2001. As of year end, there are 3,937 users were connected to the PUB of which 92% (3689) were domestic and 8% (68) commercial/ Industrial. Domestic water tanker users receive on average 200 l/day or a maximum of 5 cum. per month for a flat rate $ 5.00 per month. In excess of 200 liters per day, the consumer has to pay extra on a per cum. basis plus delivery charges. It is estimated that domestic piped system water users consume roughly 5 cum per month. Basing on these available data, it is estimated that 90% was consumed by the domestic users and 10% by non-domestic users. On the average, the domestic users consume about 4.79 cum. per month or about 20 lpcd. That is, consumption is similar whether by tanker or using piped network due to the limited hours of operation of the piped supply.

3.2 Economic Costs of Combined Water and Sewerage Projects

The Kiribati Sanitation Public Health and Environmental Project (SAPHE) feasibility study of 1996 estimated the economic costs of alternative development options. The results of the analysis, ignoring the timing of these investments, suggests that there is not much to differentiate between each on a cost per cum when comparing the 200 cum per annum airport storage capacity with the proposed Abatao and Tabiteuea galleries. (However on a cost per cum basis the 50 cum per annum storage capacity option (not shown above) at the airport was almost 3 times as expensive as the other three options).

The least cost analysis of the alternative water projects shows the attractiveness of the water rehabilitation and rainwater tank projects (see Table 5). The preferred development project consists of the rehabilitation of the existing system and the development of an airport runoff storage tank capable of providing up to 200 cum per day which would then be followed by the development of galleries at Abatao and Tabiteuea in the expansion up to 2010. The analysis shows that rainwater tanks are another cost effective means of providing water.

The above four water supply options were tested in various development sequences. The airport 200 cu m option was preferred as the initial investment as it deferred payment of the reservoir land rental until 2003, a saving of $A568,000 when discounted to 1996.

Table 5. Summary of Alternative Development Options, A$ per cum of water sales.

	Project Alternatives (1998–2010)	Capital Cost A$ '000	CMD	Capital	AIEC (A$ per cum)			
					Fixed O&M	Annual Resevoir	Variable O&M	Total
1. Rehabilitation		3559.8	750	107.5	19.2	0.0	33.9	160.7
2. Expansion Projects	Water Sources							
Standalone Projects								
Airport Tank	200 Cum	1321.1	200	187.9	36.1	0.0	29.9	254.1
New Galleries	Abatao	973.5	250	106.3	21.3	73.0	36.4	237.1
	Tabiteuea	919.6	300	83.9	16.8	98.6	38.0	237.4
3. Preferred Project Combination								
Expansion plus Rehab. (Airport 200 cum followed by Abatao and Tabiteuea galleries)	200 Cum	9424.6	2250	172.3	24.8	27.0	41.0	265.3
4. Other Projects								
Rain Water Tanks		990.0	300	151.6	12.8	0.0	0.0	164.4
Desalination								
i. Includes network rehabilitation		4676.3	2250	100.5	25.2	0.0	497.9	623.7
ii. Standalone requires tankers and storage not included in costs		699.3	1000	49.6	15.0	0.0	468.9	533.6

Notes : Economic costs, AIEC, Assuming a 10% discount rate and NRW of 25%

Consequently the least cost option to meet South Tarawa's needs to 2010 with some modest expansion of coverage from 70% to 80% of the population is to firstly develop a storage facility at the airport to collect airport runoff, and then to meet demand by extending the transmission pipeline to Abatao (2007) and then to Tabiteuea (2009), and to develop infiltration galleries at these locations.

In contrast the analysis demonstrates that desalination plants are an expensive alternative and are almost three times the cost of the preferred development option. It is also a highly technical option which may not be suitable to the atoll environment.

3.2.1 Combined Water Supply and Sewerage Costs

Adding the economic estimates for water supply and sewerage services results in a cost of A$ 6.38 per cum (including reservoir payments) for incremental water production and rehabilitation and expansion of the salt-water sewerage system. O&M costs represent A$1.64 per cum, which includes an allowance for reservoir payments of A$ 0.64 per cum. (The reservoir payments represent 38% of the operating cost element and are regarded as a fixed element.) In practice therefore the existing tariff at A$1.33 per cum (or A$10 per month) would not even cover fixed and variable O&M costs of water supply where these included the reservoir payments.

Also in 1995 collection levels were 47%, meaning that for every A$1.00 billed in 1995 only A$0.47 is collected which means that funds collected only cover around half of the estimated future cost of proper O&M. It is probably true to say that the existing system deteriorated because of lack of funds to meet proper O&M and provide for replacement of items such as pumps, etc., on a timely basis. Hence the need for the present rehabilitation project.

Table 6. Summary of AIEC for Water and Sewerage, A cents per cum of water sales.

	Capital	Operating	Total
Water Supply	348.3	139.8	488.1
Sewerage	119.1	24.2	143.3
Total	467.4	164.0	631.4

Note: (1) Assumes NRW of 25%, real discount rate of 10% and project life of 40 years.

3.2.2 Other Water Supply Options

Rainwater Tanks

Rainwater tanks could provide a further 500-1000 cum per day, depending upon the size of tank and the extent of the programme and the level of investment. A 10 cum tank with a 100 square meter catchment area could provide 0.38 cum per day, with the investment of A$99 per 100 m of catchment area, providing the equivalent of 750 ten cubic meter storage tanks and associated catchment areas providing 300 cum per day. The feasibility studies showed that this is the next least cost project on a cost per cum basis at A$1.64 per cum after the "Rehabilitation project" at A$ 1.61 per cum which was part of the preferred project option.

Desalination Water Production Option

A detailed review of desalination plants as an alternative water source was undertaken, with reverse osmosis technology thought the most appropriate for com-

parison. Given the state of the existing transmission line and distribution network, it is still necessary to embark on the rehabilitation project to upgrade the network to a suitable level to allow proper functioning of the system.

The Rehabilitation Project with North Tarawa Expansion or the Desalination Plant option would meet South Tarawa's needs to 2010. However the analysis demonstrates that the options would cost an average of A$2.62 per cum and A$6.23 per cum respectively. Thus the Desalination plant option was over twice as expensive as the development option proposed.

The estimated costs associated with a standalone desalination plant result in an economic cost of A$5.34 per cum or at least two times the cost of the preferred rehabilitation and expansion option. However the distribution of water from the desalination plant would still require the rehabilitation of the pipeline and network. Alternatively water would need to be delivered by truck and stored in water tanks. This involves further costs not included in the A$ 5.34.

A desalination plant has been installed in South Tarawa as an emergency stop gap measure to cover water supply while the existing system is rehabilitated and expanded. However, as noted above it would not have been part of the preferred least cost development option.

3.2.3 Summary of Economic Analysis

In summary the economic analysis and calculation of the AIEC and AIFC allowed the costing and identification of the least cost development option. This involved rehabilitation of the existing network and sources (the rehabilitation project) and then expansion to airport to utilise airport run off and then exploitation freshwater lenses in North Tarawa.

The analysis also identified that rainwater tanks were the next best option after the rehabilitation project, while the desalination project was ruled out as it was more expensive than the proposed expansion project. The analysis therefore suggests that there should be effort made to encourage households to build rainwater tank systems.

The analysis also identified the fixed and variable components of the operating costs, which were then used as the basis of tariff formulation, and derivation of affordable tariffs.

3.3 Proposed Tariffs in SAPHE Feasibility Study

With metering, it was considered possible to design a water tariff to ensure that low income households pay a user charge in line with what they can afford – a life line tariff which reflects the provision of their minimum requirements (20 lcd for an average household), and a charge for an equivalent amount of sewerage. However, because there will be more water users than sewerage users it is not possible to relate sewerage charges directly to water use. Also households will have other water sources, other than PUB such as water tanks and wells. Therefore we have needed to consider a flat rate monthly charge for sewerage that is affordable to low income households. In the case of water, consumption in excess of an average of 20 lpcd would be charged at a higher rate and would also have built in a sewerage surcharge to reflect the fact that those households using a greater amount of PUB water may also generate a greater amount of sewerage/waste water.

The tariff structure in Table 7 has been developed related to the levels of affordability, and is thought to be equitable to all users. The proposed water tariff is A$1.00 for the first 5 cu m per month, A$2.50 for the next 10 cu m per month and above 15 cu m A$5.00 per month. A flat uniform sewerage charge of A$5.00 is proposed.

For a low income household, A$10.00 per month rep-

Table 7. Proposed Tariff Structure and Affordability, SAPHE Feasibility Study 1996.

Water and Sewerage							
Tariff Bands	0 – 5	6 – 15	>15				
A$/cu m	1.00	2.50	5.00				
Sewerage							
A$/month	Flat	5.00	HH connected to sewerage				
Affordability (% of Household Income)			**Water**		**Total**		**%**
	Cu m/month	A$ / cu m	A$/mth.	A$ / month	A$ / month		
Lifeline/Low Income	5.00	1.00	5.00	5.00	10.00	**Low**	3.6%
Balance	5.00	2.50	12.50				
Total (Average)	**10.00**		**17.50**	**5.00**	**22.50**	**Average**	**4.1%**

resents 3.6% of household income whereas for a medium income household, A$22.50 per month represents 4.1% of household income. At the average income level, paying A$22.50 per month means that if O & M costs and reservoir payments require an average of A$16.4 per household per month, then the balance of A$6.1 per household per month could contribute to capital replacement, PUB overheads, or debt servicing. In fact this should be applied to the timely replacement of electro mechanical equipment as well as meters that need replacing on average every ten years.

The proposed tariff structure for water has three bands. The first band 0-5 cu m is designed as a life line block so that all customers, especially low income households have access to water at a price they can afford. The revenue from this of A$10.0 meets the fixed and variable operating costs of water and sewerage of A$10.0.

The next block of 6-15 cum has been set at $2.50 per cum which is in line with the average cost of water produced under the project ($2.63 per cum) and in real terms is about 22% higher than the inflation adjusted tariff at $2.09, if the current tariff had kept pace with inflation (and government salary levels) since it was first set at $1.00 in January 1981. The second band also introduces the concept of a higher cost to incorporate a sewerage surcharge as these customers will use more water and hence will produce more wastewater.

The second band is also designed to allow large households, say 12 members rather than the average of 8 members, to have access to 40 lpcd at the rate of $2.50. Thus the average cost per cu m for this customer would be $2.00 which means, that in real terms, that there has been no increase over 1981 levels, or conversely it represents the same percentage of household income as in 1981.

The third block has been set at $5.00 per cu m to avoid wastage and introduce an element of demand management into the tariff structure. Also as can be shown from the table above the AIEC is A$4.88 and accordingly larger consumers should be paying at or above the AIEC as this signals the true cost of their future consumption. Also future projects are likely to cost more than this, for example desalination so that excessive consumption brings forward the need for more expensive marginal projects. This is being signaled in the tariff structure.

It is proposed to have a uniform tariff for all customers categories. Essentially domestic customers tariffs are well below the economic price to be within levels of affordability. While all customers receive this concession any commercial customers - hotels, restaurants, government buildings will very quickly after their first 15cu m per month pay A$5.00 per cu m thereafter.

In addition to the water charge it is proposed that all those connected to the sewerage system will pay a charge of $5.00 per month as noted in Table 7.8.2 most of those areas currently connected to the sewerage system have higher than average incomes, so that overall affordability for water and sewerage is for an average household around 2% in Bikenibeu, Bairiki, and Betio, and for low income households the lifeline block is some 4% of household income.

Larger commercial customers connected to the sewerage system should pay on the basis of the number of toilets/cisterns at a rate of $5.00 per cistern/month. This should also apply to government departments and commercial/industrial customers.

The proposed tariff structure would meet full O&M costs and future capital replacement costs.

3.4 PUB Billing Procedures and Collection Efficiency

The system of billing in 1995 was based on meter readings that were used by PUB to update the manual and computerised systems. During the month staff would refer to the manual system to inform customers of their outstanding accounts. The computer system software is batch based and debtors accounts only updated once a month, at month end.

There were frequent differences on the balance of customer accounts between the manual and computerised systems. Customers did not believe the account balances when they have to pay and the meters are not readily visible for the customer to check his usage. It is reported that customers, disenchanted with the whole water situation of rationing and lack of supply, started disconnecting their meters. It is also reported that even the police started disconnecting their police houses and then the Public Utilities Board reduced their meter reading activities. This does not appear to have been a policy decision of the Board or the Ministry but rather a consensus agreement between the staff. For 1995 this situation led to only 47% of the money billed been collected.

The billing of water tariffs was discontinued in 1996 and did not recommence until financial year 2001.

3.5 Comment on Existing Tariff Structures 2001

In September 2000, PUB reintroduced user charges for domestic water users. Below is the current water charges for various types of service delivery and consumers:

Based on the estimated consumption data, and the above tariffs, domestic consumers accounted for 58% of revenues and non-domestic 42%, a total of A$368,175 compared with operating cash costs of A$ 890,536 for the same financial year ended 2001.

Table 8. Current PUB Water Tariff , 2002.

User Type	Charges
Domestic/Institutional: Piped System Tanker	Flat Rate of: $10 per month $5 per month (at 200 litres/day) or 5 cum per month
Commercial/Industrial Piped System Tanker System	Metered Rate of: $5 per cum $5 per tanker plus delivery charge

The existing tariff structure for piped households does not provide households with the correct economic signals and thus has a limited demand management effect. (Sewerage tariffs were discontinued in 1995 and water tariffs in 1996. Water tariffs were reintroduced for the financial year ending 2001.)

The existing tariff structure fails the financial sustainability test as it does not generate sufficient revenues to meet O&M costs let alone provide any contribution to capital expenditure. The sector is reliant on the government funding to meet the balance of O&M costs and all capital expenditure for rehabilitation and expansion. The government failed to meet these costs resulting in the deterioration of the water and sewerage systems thus requiring the present rehabilitation project.

While the existing tariff is able to meet standard affordability criteria for low income and average income households, because of the declining performance of the sector the water supply and sanitation services fail to meet the populations social requirements for adequate safe supplies of drinking water and sanitation services. The Feasibility Study concluded that an average income household could pay A$ 25 per month at a 5% level of household income. This is well in excess of the present A$5 and A$10 per month paid by households.

Billing and collection systems required attention as integrity of the whole billing system had declined in 1995 to a point where the collection efficiency was only 47%. It is expected that on completion of the SAPHE in November 2002 and with improved management practices that the collection efficiency will increase from 1995 levels.

3.6 Tariff Study 2002, and Water Demand Management Proposals

Tariff proposals for the implementation of the current project are currently been evaluated so that the above comments will need revision in light of these findings. The proposals do not include metering of domestic water supply customers but rather the provision of a fixed amount of water per day. Therefore the progressive tariff structures recommended in the feasibility study would need modification.

A primary objective of the SAPHE Project and PUB water supply operations is to provide an equitable supply of water to all customers preferably through individual house connections. The very limited water resources in Kiribati make this objective very difficult. A promising option to help overcome this problem is to have a constant flow system with flow restricting devices on each connection. This system supplies each household with a constant flow of water that is fed slowly into a small tank located on a concrete block stand adjacent to the house. The system is designed to provide about 250 litres per day to each household.

Three pilot areas were established to test the effectiveness and customer acceptance of constant flow arrangements to individual houses. Based on the results of the pilot works, it is likely that the constant flow system will be extended to serve all other areas in South Tarawa incorporating the modifications that have evolved from the pilot study.

All non-domestic customers would still be metered. Satisfactory cost recovery levels and tariffs are also necessary for the operation of the sewerage system.

4. SAMOA : APIA AND SAMOA WATER AUTHORITY

4.1 Economic Costs of Supply

4.1.1 Apia Sewerage Project

The Apia Integrated Urban Development Project provided an estimate of the economic costs of a reticulated sewerage project for the main Apia central business district and associated residential areas. These sewerage options were reviewed in 1999 costs are summarized below and show that the economic costs in financial prices would be equivalent to S$3.90 per cum of waste water disposal. This further review of options led to a reduced cost which favored an ocean outfall rather than aerated lagoons. The revised cost was estimated at S$ 3.36 per cum.

However, this project was for the Apia central area and is not representative of the costs of wastewater services for Apia as a whole. The balance of Apia relies on septic tanks for wastewater disposal. However, much of the central area is low lying and prone to flooding so that septic tanks are not an effective means of disposal.

4.1.2 Estimate of Economic Cost of Apia Water Supply

The EC, “Water Authority, Organisation and Tariff Study” February 1994 calculated a weighted average system cost per cum for Apia. This was adjusted to 1997 prices to provide an estimate of the future economic costs of water supply for Apia. This resulted in an estimate of

S$1.99 per cum with estimated O&M costs for Apia of S$0.37 per cum and outside Apia for NW Upolu and Savaii of S$ 0.50 reflecting the very high pumping costs associated with the deep tubewell pumps of the Upolo and Savaii water supply project.

4.1.3 Combined Economic Costs of Water and Sewerage.

While the water supply and sewerage costs could be combined to give an overall economic cost of S$ 5.35 per cum, the proposed Apia sewerage project only covers a limited area outside the downtown business area, so is not really representative of economic costs of water and sanitation services for Apia as a whole, where septic tanks will continue to be the main means of managing domestic wastewater disposal.

4.2 Present SWA Tariff Structure

The progressive tariff structure is based on a logarithmetic formula. The tariff follows what is commonly referred to as a "slab" tariff where all consumption is charged at the same highest tariff in which any consumption falls. The tariff essentially has 25 steps representing consumption bands increasing from 1 cu m to 25 cu m per day or 30 cu m to 750 cu m per month as set out in Table 9. Where customers are not metered they are required to pay a charge equivalent to WS$12.0 per month. This is payable quarterly.

Tariff structures of this nature existed, for example in Thailand (Provincial Water Authority), prior to 1993. However, they have generally gone out of favour because of the very high marginal cost of consuming one cum in the next highest bracket that results in all consumption charged at the highest rate. For example, the first 30 cu m cost S$0.12 per cum, or S$3.60 for the month. However 31 cu m would cost S$9.30, so that the marginal cost of the additional cum is S$5.70. The "average" marginal cost of 30 cum in the second bracket is S$0.48 compared with WS$0.12 for the first 30 cum.

This could be argued is a strong incentive from a demand management perspective to not waste water as the penalty is severe where customers consumption is all charged at the highest rate. Nevertheless, the bands are quite wide, with most households unlikely to consume in excess of 60 cu m, or certainly 90 cu m per month. However, as noted above the penalty is very severe for consuming one cum in the next bracket above the band in which the bulk of consumption is incurred.

In the case of low income households provided they keep consumption below 30 cu m per month – for a household of 8.3 persons consuming 120 lpcd, then affordability would not exceed 0.5% of household income. Similarly for an average income household consuming some 250 lpcd or 60 cum per month the cost would be S$ 18 per month or 1.6% of Household income. Affordability analysis suggests that where households paid 5% for water services would amount to S$28 per month for a low income household and S$ 56 per month for a median income household.

Unmetered consumption levels are of the order of 350 – 400 lpcd or 130 to 140 cum per month putting Samoa near the top in the world when it comes to water consumption levels. While metering is expected to reduce this level of consumption, consumption will still be excessive by international standards, unless tariffs are increased to exert a greater demand management effect on consumption.

4.3 Accounts Receivable and Collection Efficiency

In 1995 WSWA accounts receivable were in excess of 120 days, with many accounts uncollectable. Accounts receivable transferred from PWD in 1995 amounted to WS$1.383 million and included water bills outstanding from as far back as 1988. Such accounts are uncollectible and it was recommended that these should be written off. Accounts receivable in 2002 for SWA are now 192 days suggesting that collection efficiency and/or arrears are still a problem with SWA but nevertheless progress is being made in collecting arrears with average collections now about 80% of billings. Collections include current months billings and collection of arrears.

Table 9. SWA Existing Tariff Structure.

Consumption	Consumption	Average Charge All Units		Marginal Rate next cum	
Cum Per day	Cum Per month	S$ per cum	US$ per cum	S$ per cum	US$ per cum
1	1 - 30	0.12	0.04	0.12	0.04
2	31 - 60	0.30	0.09	0.48	0.15
3	61 - 90	0.48	0.15	0.84	0.25
4	91 - 120	0.60	0.18	0.96	0.29
5	121 - 150	0.70	0.21	1.10	0.33
..	..	..	..	..	..
25	721 - 750	1.40	0.33	1.88	0.57

Table 10. Proposed SWA Tariff in 2003.

		Daily cum	Monthly cum	Tariff $S	Tariff US$
Domestic Tariff Bands	i	0 - 0.5	0 - 15	zero	zero
	ii	0.5 - 2.2	16 - 66	0.5	0.17
	iii	> 2.2	>66	0.67	0.22
NON Domestic		All	All	0.67	0.22

4.4 SWA Proposed Tariff in 2003

The SWA will continue with a metering program in Apia and plans to introduce a more simplified tariff in 2003 shown below. SWA have estimated that the lifeline block of 15 cum per month would cost S$1.9 million and this will be provided to SWA by the Samoan Treasury as the cost of supplying a lifeline block to all domestic consumers.

The above tariff (Table 10) is much easier to understand than the present tariff. While it also introduces a demand management effect the levels of consumption are still high by international standards and the tariff in the third consumption band for domestic and for all non-domestic consumption is only 37% of the estimated economic costs. The lifeline block is excessive at 15 cum per month and there is no justification for providing this level of water (or any level of water) at a zero cost. This means that water supplies will continue to be provided at rates less than economic costs, thus encouraging consumption at excessive levels which would be reduced were upper tariffs set at/near the economic cost of supply.

5. MALDIVES, PRIVATE SECTOR JOINT VENTURE (MWSC)

5.1 Background

The Male Water Action Plan prepared in 1994 with the assistance of Danida recommended that an international operator be invited to form a Joint Venture (J-V) with the Government of the Maldives (GoM) to rehabilitate, expand and operate the Male Water Supply and Sewerage Company (MWSC) over a period of 20 years. The J-V Agreement for the establishment and operations of MWSC dated 30 March 1995 sets out the ongoing basis on which tariffs should be set. In particular that tariffs should be set so "that an Internal rate of return of at least 15% over the Concession period is maintained".

The JV was awarded to a Danish firm with MWSC provided with an IFU loan of about US$4.0 million at a 4.5% interest rate to be repaid by 2001. Danida also provided GoM with a grant to assist with the rehabilitation of the system. The Foreign J-V partner purchased a 30% equity share. The foreign J-V partner provided a general manager and advisors for the first four years of development and operation. These advisors were charged as costs to operations. MWSC is now managed by Maldivian personnel who were trained over the initial period of operations.

The definition of the calculation of the IRR was not set out in the JV, but during a Danida Tariff and J-V Review carried out in 1998 and 1999 the definition was clarified at a Board meeting in October 1998. It was agreed that the 15% IRR should be calculated on shareholders equity. For the purposes of the tariff review and calculation of the 15% IRR, this was defined as annual investment and operating cost flows less debt funding and the resultant debt servicing costs and repayment. The J-V also provided for dividends to be paid out to GoM and the J -V operator (and partner). The J-V agreement implied that once the company is profitable they could pay out a dividend of 90% until a reserve fund of 10% of share capital was built up, after which a dividend equivalent to 100% of the profit could be paid out.

5.2 MWSC Tariff (Table 11)

The J-V agreement set out a "Base Tariff" and tariff structure which resulted in an average tariff of MRf 76.8 per cum. At the time of the Review the Base Tariff was re-estimated based on the proposed 15% IRR definition at MRf 75.8 per cum or US$6.47 per cum. The Male Water Action Plan and J-V agreement recommended the following tariff structure. This included a lifeline block of 10 lpcd per person for an average household of 9 persons. Other tariffs were calculated to arrive at the average tariff estimated to achieve the 15% FIRR.

5.3 Male – Economic Costs and Comparison with the MWSC Tariff (Table 12)

At the time of the Danida review the economic costs of the system was estimated as shown below. The overall cost is US$6.52 per cum. There is a high variable cost related to the high energy cost of generating fresh water from salt water in the desalination process. MWSC have their own generators and generate their own electricity. However, pump stations use electricity purchased from STELCO.

Table 11. MWSC Tariff (Water and Sewerage Charges) MRf per cum.

Customer Class		Lpcpd per HH	Cum per month	MRf per Cum	US$ per cum
Domestic Tariff bands	i ii iii	0 – 90 (2) 91 – 270 > 270	0 – 2.70 2.71 – 8.10 >8.10	25.32 75.95 101.26	2.16 6.48 8.64
Standposts (3) **Institutional** **Commercial**		Flat rate Flat rate Flat rate		75.95 75.95 101.26	6.48 6.48 8.64

Note: (1) Current tariff includes a fixed monthly charge of MRF30 (US$2.55) per month
(2) Assumes 10 lpcd and a household size of nine
(3) Standpost charges met by Government of Maldives
(4) 1 US$ = 11.7 MRf

Table 12. Calculation AIFC for Male.

Breakdown of Cost	AIFC		
(Discount rate – 15%)	US$/cum	MRf/cum	%
Capital	4.18	49.16	64.1%
Fixed O&M/Overhead	0.62	7.34	9.6%
Variable O&M	1.72	20.24	26.4%
Total	6.52	76.75	100.0%

Table 13. Identification of Financial Subsidies in MWSC Tariff.

	Average Tariffs	Subsidy to AIFC	
	MRf/cum	MRf/cum	%
AIFC	76.8	1.0	1.3%
Overall Average	75.8	17.2	22.3%
Domestic Average	59.6		

The calculation of the AIFC in Table 12 when compared with the average tariff shows the level of financial subsidy as shown in Table 13.

There is a very modest subsidy when the average tariff is compared with the AIFC of MRf 1.0 per cum. There is a cross subsidy between domestic customers and the overall average tariff of MRf 16.2 per cum and MRf 17.2 per cum when compared with the AIFC. However, higher domestic customers pay the same tariff as commercial customers for consumption exceeding the average. (Also, it should be borne in mind that the 15% FIRR discount rate exceeds that normally applied to financial analysis and calculation of AIFC).

5.4 Comment on Existing Tariff Structure.

The existing tariff structure provides households with the correct economic signals and thus has a demand management effect. The tariff structure includes a true lifeline block that provides households with a concessional block of consumption. This is balanced by higher charges for higher consumption above the AIFC average for consumption in excess of 8.1 cum per month. Other classes of customers pay a flat rate charge. The tariff now (since 2000) includes a fixed monthly charge of MRf 30 cum per month, that is in line with the costs of maintaining a connection, plus monthly meter reading and billing functions.

Thus the structure satisfies economic and financial objectives and at the same time is affordable as evidenced by consumers willingness to pay. The tariff is understandable and customers pay their bills promptly with well publicised disconnection policies clearly understood by consumers. Accounts receivable are some 30 days of sales or one billing cycle.

5.5 Summary of MWSC Performance

Despite the high tariffs there has been a steady increase in consumption since 1996 with consumption increasing on average at around 20% per annum for the past five years. Sale of water through stand posts has steadily declined. (The GoM meet the cost of standposts and pay MWSC at the average tariff of MRf 75.95 per cum.). The following notable events have been achieved over the past seven years.

(a) The IFU loan ($4.0 million) has been repaid ahead of schedule.

(b) The MWSC has been paying dividends to the shareholders since 1999, with estimated level in 2002 projected at around US$ 0.4 million.

(c) MWSC has been handed over to Maldivian management who continue to operate the system at the same level of service with steadily increasing financial performance despite increases in diesel fuel costs over last few years.

(d) Adequate funds (capital and/or dividends) are available for expansion and replacement of Reverse Osmosis plants and network expansion. Wastewater treatment could also be financed from these sources.

(e) The level of collection efficiency is about 99%. Clear disconnection policies are enforced.

(f) Consumption of piped water has increased from 0.5 cum per household per month in 1996, to 3.8 cum in 1998 to 6.5 cum in 2002. This results from increased consumption and a switch from public taps

owing to greater acceptance of the convenience of private taps.

(g) MWSC tariffs are affordable to low income and average income households. Monthly water bills represent about 1.2% of household income for a low income household consuming 1.8 cum per month and about 3.0% of household income for an average income household consuming 6.5 cum per month.

6. VANUATU : VILA AND CONCESSIONAIRE, UNELCO

6.1 Background

UNELCO Vanuatu Ltd. (a subsidiary of the French Group Lyonnaise Des Eaux-Dumez) manages and operates Port Vila's water supply under a concession contract (for 40 years) to the Government (previously operated by the PWD) from February 1994. UNELCO has pledged that; "water supplied shall at all times have the qualities required by the standards of force in Vanuatu and, as far as possible, to the standards set by WHO". UNELCO within the limits of its contract; will manage and operate the water supply services in Port Vila (water production and distribution); finance and construct the works including renewals, upgrading and extensions of the network in conformity with this contract.

Sectors outside the area of the contract can eventually be included into the area of contract after the installation of individual meters for each water connection, and subject to the network conforming to standards set by UNELCO. The limits of the concession can be extended by agreement between the Government and UNELCO, to rural sectors outside the Port Vila municipal boundary, but must be supplied from the Port Vila network. To date two addendums have been signed in order to access the villages of Erakor and Ifira and the second to Blacksands.

The amount of investment to be made over the 40-year concession period is around VUV800 million (US$6 million). The Government allows UNELCO, to use free of charge, the land occupied or to be occupied by the facilities and equipment, in particular the pumping station, reservoirs and right-of-ways for pipe installation. UNELCO finances all improvements, upgrading and extensions to the distribution network in accordance with work program agreed by both parties. There is a fixed investment rate at VUV40 million for the first 5 years of the contract and VUV20 million thereafter.

The contract with the government is to supply the water service at a fixed contract price. House connections are equipped with Kent water meters and the most recent figures show 4,606 connected meters in the greater Port Vila area. Those that are not connected to UNELCO in the greater Port Vila area obtain water from surface and groundwater sources and are either serviced by individual water systems (for example wells and/or pumps that service 1-2 households) or by private individuals.

6.2 UNELCO Tariff (Tables 14 & 15)

The tariff was agreed in 1994 plus an adjustment clause to maintain its value as part of the Concession Agreement. The adjustment clause has lead to only modest increases in tariffs over the past 8 years. There is only one tariff for all customers with four tariff bands. The median customers level of consumption is 62 cum per quarter. The true level of average domestic consumption is likely to be less. For example eliminating all consumers over 300 cum per quarter results in the median falling to 58 cum per quarter.

Table14. UNELCO Tariff – Volumetric Charge all customers.

Consumption Bands		Tariff	Tariff
Cum per 3 months	Cum per month	US$ per cum (1)	Vatu per cum
1 - 50	1 - 17	0.32	43.28
51 - 100	18 - 33	0.42	56.26
101 - 200	34 - 66	0.45	60.59
Over 201	Over 67	0.49	64.92

Note (1) : 1 US$ = 133.4 Vatu

Table 15. UNELCO Tariff – Quarterly Fixed Charge all customers.

Meter Size	Vatu per Quarter	US$ per Quarter
15 mm	530	4.0
20 mm	860	6.4
25 mm	2150	61.1
30 mm	5400	40.5
40 mm	7560	56.7
Above	10810	81.0

Note : Subscribers whose quarterly water consumption is less than 25cum are charged Vatu 265 (US$2.0).

Some interesting observations can be drawn from the consumption data provided. The bottom 25% of consumers consume an average of 17.0 cum per quarter. Those that qualify for the 265 Vatu fixed charge represent 19% of customers and have an average consumption of 13.4 cum per quarter. This information suggests that there are quite a large percentage of the customers that are limiting their consumption of piped water to less than 10 cum per month and would equate to lifeline block in "the supposedly ideal" tarff structure

6.3 Comment on Tariff Structure

No information is available to assess the economic costs of supply but it is assumed that this would be equivalent to the average monthly revenue (volume and

fixed charges) as out of this amount the utility has to meet operating costs, capital expenditure and concessionaire's profit. With fixed charges this would be of the order of US$ 0.50 cents per cum. The tariff structure provides the appropriate signals for demand management to ensure economic use and at the same time generates income to meet UNELCO's financial objectives.

There is some financial subsidy between average consumption and the estimated economic costs but like Maldives this would not be great.

The tariff has a progressive tariff structure, but like Fiji the bands are too wide, especially at the low end. Consumption at lower levels is probably limited by price and that it would be better to have a lifeline block covering 10 cum per month for domestic customers. Non-Domestic customers should have a separate tariff category so that they would not benefit from this concession or that currently provided under the current tariff for the first 50 cum per quarter.

Tariffs appear affordable to average income households at around 2 to 3% of household incomes but are likely to be in the range of 4% of household income for low income households.

Billing and collections are enforced, so that like MWSC Male, revenue is around 99% to 100% of billings.

6.4 Improvement in Service Standards

Prior to the signing of a concession with UNELCO Vanuatu Ltd. in 1994 the Public Works Department (PWD) was responsible for the provision of urban water supply. A water section within the department was responsible for the operation and maintenance of the water supply in Port Vila. Generally the water system in Port Vila was in good condition but required better maintenance. In densely populated settlements, the water supply was often interrupted and there were no guarantees of a 24 hour supply.

The urban water supply system was a financial drain to the national government in terms of the financial losses generated, especially 1989 and 1994. There was some improvement in the financial condition in 1992 to 1993 attributable to the increase in rates from 1992 from the previous flat rate of VUV40 per cubic metre of water consumption to VUV52 per cubic metre. The Vanuatu National Audit Office estimated outstanding water bills for Port Vila alone prior to its transfer to UNELCO at VUV160 million or two years of sales.

The concession has enabled the government to avoid the high capital costs required in rehabilitating and expanding the system had it continued on with its poor operating and maintenance practices.

Since the signing of the concession, UNELCO has improved the operating conditions of the water supply network with water losses reduced from around 50% to 23% plus raised collection efficiency to around 95 to 99% by making sure bills are paid. UNELCO provides an uninterrupted 24-hour service to all of its customers and any leaks or other problems are repaired within a short period (1-2 days).

7. PAPUA NEW GUINEA AND PNG WATERBOARD

7.1 Background

In general, water is abundant in Papua New Guinea. However, some islands in the New Guinea Islands Region, the Papuan islands in the Milne Bay Province and the Papuan Coast, have experienced water shortage problems during the prolonged dry periods which are more pronounced during El Nino induced dry spells.

For the urban sector, the extraction, treatment and distribution of water and the collection, treatment and discharge of wastewater are the functions of two State-owned water utilities. PNG Waterboard established under the National Water Supply and Sewerage Act, manages water supplies and sewerage services in eleven major centres throughout the country. On the other hand, Eda Ranu registered under Companies Act and solely owned by the Government, operates the Port Moresby City Water Supply and Sewerage systems. The water supply and sanitation services not operated by the two utilities are operated and managed by Provincial Governments or Local Level Governments.

The regulation of Water Resources and Wastewater Discharge into the environment (groundwater, rivers, springs, lakes and oceans) is the function of the Department of Environment and Conservation. The Environment Act 2000 provides comprehensive standards for protection of environment and water. The DEC issues Water Use Permits with conditions to be complied with by the Permit Holders. The Permits can be for groundwater exploration, extraction of groundwater and surface water or discharge of wastewater into a water body.

The Government believes that the water sector can be managed efficiently through privatisation. In February 2000 NEC policy decision (17/2000) directed the Privatisation Commission to start preparing the water assets (Eda Ranu and the Waterboard) for privatisation. The Privatisation Commission has engaged project managers and strategic advisers to undertake detailed studies and to identify and evaluate the options for privatisation of the entities. The Privatisation Act 1999 requires the privatisation policy for each enterprise to be approved by the Minister and submitted to the National Executive Council (NEC) for consideration and approval. The process is on-going.

PNG Waterboard

The PNG Waterboard is a Government trading enterprise established under the National Water Supply and Sewerage Act. It is financially autonomous. Its Corporate Plan and the annual Business Plans dictate its business activities. The membership of the Board of Directors as provided in the National Water Supply and Sewerage Act consists of a representative each from PNG Institution of Engineers, PNG Institute of Accountants, PNG Chamber of Commerce and Industry, PNG Institute of Management and the three Departmental Heads of Works, Health & Finance. The Board by its membership bring into the water industry a diverse range of expertise at its meetings, which in itself is an ongoing consultative process.

The very highly professional and ethical conduct of the Board in the discharge of its duties through consultation has earned the respect of the Government, private sector, the community at large and aid donors. The PNG Waterboard covers 11 provincial towns and 3 district centers and has about 25,000 customers. Approximately 10% are connected to a piped sewerage system. The Waterboard proposes to take over another provincial town this year and is projecting a growth in overall connections of 3% per annum.

Table 16. PNG Waterboard Tariff Structure.

Tariff Bands	Kina	US$
Domestic Water		
'0 -12	3.50/month (Flat charge)	0.89/month (Flat charge)
	0.290/cum (equivalent)	0.074 / cum (equivalent)
'13 - 30	0.640/cum	0.164 / cum
>30	1.050/cum	0.269 / cum
Sewerage		
'0 -12	4.86/month (Flat charge)	1.24/month (Flat charge)
	0.405/cum (equivalent)	0.104 / cum (equivalent)
>13	0.143/cum	0.037 / cum
Non-Domestic Water		
'0 -12	3.50/month (Flat charge)	0.89/month (Flat charge)
	0.29/cum (equivalent)	0.074/cum (equivalent)
'13 - 30	0.64/cum	0.164/cum
>30	1.05/cum	0.269/cum
Sewerage		
'0 -12	4.86/month (Flat charge)	1.24/month (Flat charge)
	0.405/cum (equivalent)	0.104/cum equivalent)
>13	0.420/cum	0.107/cum

Note : 1 US$ = 3.92 PNG Kina

7.2 PNG Waterboard Tariff Structures (Table 16)

The tariff structure meets the following basic principles as determined by the PNG Waterboard:

- Adequacy to generate cash requirements for sustainability,
- Affordable by all consumers, and
- A tool for water conservation.

The major challenge, however is to maintain revenue adequacy with annual price adjustments to accommodate price increases as determined in the Consumer Price Index.

7.3 Comment on Tariff Structure.

The tariff has a progressive structure which provides customers which has a demand mangement effect. The tariff structure includes three blocks with a flat rate charge covering the first block of 12 cum at a low rate per cum. This block represents a lifeline block and provides households with an initial block concessional block of consumption. The tariff for next band is double the first band , with the third band about 65% higher than the second band. The initial flat rate charge ensures a minimum level of revenue for the Waterboard and provides an initial 12 cum per month to households at a concessional rate. While the overall tariff meets full cost recovery in a financial sense the higher tariff bands are less than the economic cost of future supply.

The sewerage tariff follows that for water with an initial flat rate fixed charge covering the first 12 cum per month, and then a charge per cum for all consumption in excess of 12 cum of K 0.143 per cum. The main demand management effect is the water charge.

The Non-Domestic water tariff is the same as the domestic water tariff. In the case of the sewerage tariff the initial block is covered by the same flat charge as domestic consumption with all units after the first 12 cum charged at K 0.420 per cum, or three times the domestic rate.

Thus the structure generally satisfies economic and financial objectives and at the same time is affordable as evidenced by consumers willingness to pay.

8. OTHER FINANCING OPTIONS – EBEYE WATER AND SANITATION IMPROVEMENTS

Ebeye, is a very small island (0.36 km^2) in the Republic of the Marshall Islands (RMI) with a population of approximately 10,000 in 1999. The island faces a variety of serious challenges. Underlying all of these is the extreme population density and the lack of land for ex-

pansion. Because of Ebeye's high population density, environmental concerns are crucial to the well being of the populace. Proper sanitation, adequate drinking water, and a dependable power supply are all interconnected and are crucial aspects of Ebeye's environment and hence the well being of its people.

By 1999 the power system, water supply and sewearge services had all but ceased to function leaving the population without access to basic services and exposed to outbreaks of disease such as cholera. In an effort to improve the situtaion the ADB provided a $10 million loan to the RMI for infrastructure improvements on Ebeye. Approximately US$ 5 million was devoted to improving utility services. Funds (US$ 1.8 million) were also obtained from the USA Deparment of Interior from the Operations & Maintenance Improvement Program (OMIP) and from RMI on a matching grant basis.

A contract for management of the Kwajalein Atoll Joint Utility Resources (KAJUR) utility on Ebeye was awarded to the American Samoa Power Authority (ASPA), which was tasked with managing the KAJUR and improving power and water production and distribution as well as the sewer system. The RMI provided funds to meet ASPAs services and to meet some the local costs of the ADB funded components. Overall about US$ 10 million was spent on infrastructure services and their management from both external sources (ADB and USA DOI) and from local sources (RMI).

ASPA were responsible for the managing the construction of improvements (engineering design, tender, bidding, contract award and contract management) as well as the operation of the utility. With respect to the utility management contract ASPA provided management, professional engineers and technicians to work alongside and train local staff to enable them to manage and maintain the utilities operations themselves in the future.

The project has been heralded a success with the power and water services now been operated satisfactorily. Ebeye personnel are being trained to eventually assume responsibility for the full management and operation of the island's utility infrastructure. THE RMI has extended the ASPA contract to manage Ebeye Island's power plant and related infrastructure operations for two more years. In addition to managing the power plant, ASPA and Ebeye power plant staff are working on an urgently needed sewage system upgrade.

The whole infrastructure improvement program utilising external financial sources and the management and operating skills of ASPA are set out in the Ebeye Case Study Report.

Sufficeth to say here is that the combination of utility management and operating skills provided by ASPA and external funding (multilateral and bilateral sources) and RMI funding have been utilized to not only rehabilitate the existing systems, improve their management and operations, but also to train local Ebeye personnel so that they can eventually take over the operation and management of the facilities. This demonstrates a good example of utilising several sources of funding and regional expertise that have resulted in a stronger utility base in Ebeye as a result of training in proper management and operational practices. In conjunction with adequate cost recovery, this should lead to long term sustainable operation of the utility services.

9. FINANCIAL PROJECTIONS AND FUTURE INVESTMENT REQUIREMENTS.

9.1 Development of Financial Plans for Urban Water Sector

Financial plans and financial projections have been prepared for the urban water sector in Samoa, Kiribati, Fiji and Maldives in order to identify sector funding requirements, sources of financing and the necessary levels of tariffs needed to meet sector operating and maintenance costs, any loan repayments, and to provide funds for some future capital investment.

These analyses were then used to define broad financial objectives for the sector, and cost recovery targets to be achieved through tariffs. This in turn lead to recommendations of financial objectives in the form of covenants that should be adopted to ensure that tariffs are maintained at the appropriate levels to achieve the proposed objectives. The analyses also took into consideration that tariffs had to be affordable to both average and low income households.

9.2 MWSC Financial Projections and Tariff Review, 1999

In the case of Maldives the financial objectives were defined by the J-V Agreement and required a 15% rate of return on equity invested. This objective requires tariffs that would meet all operating and maintenance costs, plus recover past capital expenditure and meet future replacement capital expenditure and earn a 15% rate of return on equity investment. While tariffs have never been set to achieve the 15% IRR the return at around 14% has been regarded as acceptable by all shareholders.

9.3 Kiribati Tariff Review, 2002

As noted above the financial projections and tariff review that was undertaken in 1996 as part of the Loan PPTA are currently been updated to provide recommendations to the Government on future cost recovery ob-

jectives, tariff policies, tariff structures and tariff levels and PUB operational performance. In the case of tariffs for domestic customers where there will be no metering these will need to be simply a flat rate monthly tariff. In place of metering it is proposed to have restrictor valves that will limit each household to 250 litres per day. This is seen as an equitable solution to providing all households with sufficient water to meet their basic needs.

9.4 Samoa IUDP, 1997 and Present Institutional Strengthening Project.

Financial projections for SWA were prepared in 1996 as part of the Integrated Urban Development Project. These were subsequently updated in 1997 as part of a ADB Fact Finding Mission. The objective of the projections at that time was to identify the capacity of SWA to service debt for the proposed Apia Central sewerage project, and to examine tariff levels necessary to achieve progress in meeting SWA self sufficiency at least in terms of operating costs. Water tariffs prevailing at that time have not been increased and SWA still requires Treasury support to meet O&M costs. However, ongoing institutional strengthening with the assistance of AusAid is improving accounting systems and moving SWA towards greater financial self sufficiency.

9.5 Fiji Suva Nausori Project, February 2002.

Financial projections for the Public Works Department, WSD were prepared to identify the ongoing Government of Fiji (GoF) funding for the sector under alternative cost recovery policies and tariff levels. In recent years the Government has met all capital costs through either direct grants or through external loans repaid by Ministry of Finance.

The basis of the investment program was the Masterplans developed for various systems throughout Fiji. These also provide the basis for WSD's annual applications for funding within the Fiji Budget.

The financial model developed was used to identify the implications of alternative cost recovery options.

9.5.1 Existing WSD Tariffs with no improvements in Billing Procedures

Assuming no change in billing and collections and no tariff increases the analysis forecasted that the GoF would need to provide F$471 million over the next ten years or and amount equivalent to F$47 million per annum to meet the balance of O&M costs, debt servicing, and proposed capital expenditure.

9.5.2 Existing Tariffs but improvements in Billing Procedures

Improvement in billing and collection of revenues means that all consumers would be paying for the water they use under the present tariff. Ensuring customers pay the present tariff for the services they receive saves the GoF F$101 million over ten years or F$10 million per year. Nevertheless support to the sector at F$370 million is required and is still likely to place strains on government finances.

9.5.3 Tariffs Increased in Line with System Improvements

Domestic water and sewerage tariff increases are proposed in 2006 and 2008 to coincide with completion of the Nadi – Lautoka and Suva – Nausori projects. Tariff increases maybe of the order of 30 to 40% in each year. It is expected that households will be willing to pay higher tariffs for the improved services that are likely to arise. An average income household in Suva – Nausori would spend up to 3% of household income on water and sewerage charges in 2006 compared with 1.4% in 2002 while a low-income household would spend up to 3.5% of household income on water and sewerage charges in 2006. Such increases should be limited to the main systems with lower increases recommended for the smaller systems.

Under this option GoF support to water and sanitation sector falls to F$177 million as a result of tariff increases in 2006 and 2008 coupled with improvements in billing and collection systems. This maybe compared with a cost of F$471 million to GoF where there is no change to existing billing and collection procedures.

Thus the preparation of financial projections and the model can be used as a tool to assist the GoF to identify the impact of various cost recovery options and tariffs for various investment options.

9.6 PNG Waterboard Corporate Plan

The ***PNG Waterboard Corporate Plan*** was produced in 2000 giving strategic directions for its business activities in the provision of urban water supply and sewerage services. The Divisions annually produce ***Business Plans*** based on the Corporate Objectives. The following are key Corporate Objectives on which Divisional Business Plans are prepared:

- *Meeting Corporate Responsibility* by increasing coverage in the urban towns, licensing private water operators and minimising audit discrepancies.
- *Financial Viability* by achieving a 5% return on investment, to reduce debts outstanding and to in-

vest in short tern money markets such Treasury Bills.

- *Marketing and Public Relations* to increase sales, increase the profile of PNG Waterboard and the services it provides.
- *Focus on Customers* by achieving above 80% satisfaction on services it provide, good relation with all the stakeholders at District and Operational level.
- *Systems Optimisation* by improving operational efficiency, reducing water losses and ensuring proper asset management.
- *Human Resources Managemen*t by recruiting and maintaining well trained and motivated workforce.

The Waterboard corporate plan includes a list of projects to be implemented once financing and resources are available. In this way a corporate and financial plan aids PNG Waterboard and its funders to identify project opportunities and allow them to assess the financial implications both in terms of capital costs and funding requirements, and ongoing operating costs and revenues and debt service implications for the Waterboard.

This represents an excellent example of a public utility taking the initiative to set its operations on a sound footing with a clear focus on compatible objectives of consumer service and operational and financial viability.

APPENDIX B

SIGATOKA ACTION PLAN: THEME 6 FINANCING ACTIONS

1. INTRODUCTION

Following presentation and discussions in Fiji in August 2002 the following key messages were proposed for sector financing to form part of the Regional Action Plan. The five key messages and proposed actions are set out below.

The first key message related to establishing overall policies and regulatory frameworks in each country to encourage the economic development of the sector. The second stressed the need to develop financially viable enterprises and the third emphasised the need for cost control and benchmarking to improve performance. The fourth key message related to developing policies that promoted access for the poor and the fifth key message proposed the need to develop a coherent policy for funding rural water supplies and the management of individual schemes to ensure long term sustainability.

Key Message 1: Create Overall Policies and Regulatory Environment

Create a better and sustainable environment for investment by both the public and private sector, by developing and implementing National, sector and strategic plans that identify the economic, environmental and social costs of different services and develop pricing policies, which ensure the proper allocation of resources for the water sector.

Supporting statements:

- Governments, regional organisations, donors, the private sector and NGOs/SCOs should co-operate to develop innovative approaches to existing funding structures and establish mechanisms to improve cost-recovery.
- Where appropriate, governments, regional organisations and NGOs/SCOs should cooperate to attract the private sector to invest in sustainable water resource management through private/public partnership and other mechanisms.
- Governments, donors and regional organisations should co-operate to develop appropriate service delivery and funding mechanisms to equitably address the sustainable water resource management needs of all in both the urban and rural community.

Actions Required

Actions	Responsibility
Improve regulatory oversight and sector governance	Government
Develop sector master plans to identify funding and cost recovery requirements and benefits in terms of improved health and poverty alleviation objectives	Government
Investigate possible conjunctive use of water from other infrastructure projects (such as hydro dams etc)	Utility/Govt
Consider separate potable water and salt/grey water systems for different treatment uses	Utility/Client
Adopt polluter pays principles	Government
Identify potential benefits of partnerships in service provision such as joint ventures	Government
Assess potential for contracting out particular functions to local groups such as leak detection, billing, aspects of equipment maintenance, etc	Utility/Govt
Improve bankability of enterprise to investors & donors	Utility/Govt
Improve demand management	Utility/Govt
Develop tariff policies and structures to generate revenues to meet financial and cost recovery policies	Utility/Govt
Policy for transparent, sustainable, targeted subsidies	Government

Key Message 2: Financially Viable Utilities for Long Term Sustainability

Establish financially viable enterprises for water and sanitation that result in improved performance by developing appropriate financial and cost recovery policies, tariffs, billing and collection systems, financial and operating systems.

Actions Required

Actions	Responsibility
Develop business plans, financial plans, and financially sustainable cost recovery strategies	Utility/Govt
Improve billing and collection procedures and legislate disconnection policies	Utility/Govt
Develop tariff structures to achieve adequate cost recovery (but protect affordability)	Utility/Govt
Establish sound asset management procedures and funding, including proper operation and management practices	Utility
Information sharing and capacity building for sustainable sector finance	Utility
Consider potential cost-savings through multifunction authorities	Government
Align tariff increases to service improvements	Utility
Allow water utility to keep tariff revenues	Government
Increase consultation and public awareness to support need for cost recovery and hence tariffs or tariff increases	Utility
Report in transparent manner including costs and tariffs to all stakeholders including consumers	Utility

Key Message 3: Cost Reduction for Long Term Sustainability

Reduce costs through improved operational efficiency, using benchmarking, development of water loss reduction programmes and improved work practices.

Actions Required

Actions	Responsibility
Reduce water losses through water loss reduction programmes	Utility/Client
Use of water-saving devices to reduce wastage (by customers)	Utility/Client
Benchmarking to reduce costs, electricity, staff numbers and salaries	Utility/Regional
Report in transparent manner including costs and tariffs to all stakeholders	Utility/Govt
Information sharing and capacity building	Utility/Regional

Key Message 4: Ensure Access for the Poor

Ensure access for the poor to water and sanitation services by developing pro poor policies that include tariffs with lifeline blocks and transparent and targeted subsidies.

Actions Required

Actions	Responsibility
Clear framework for participation by poor	Local Govt/Govt
Use trust funds for community water supply and sanitation	Local Govt/Govt
Affordable cost recovery policies, tariffs with life line blocks to ensure services supplied at affordable prices.	Utility/Government
Policy for transparent, sustainable, targeted subsidies	Govt

Key Message 5: Rural Water Supply Funding and Management

Achieve sustainable rural water and sanitation services at a community level through developing strategies that incorporate mechanisms for appropriate financing and capacity building.

Actions Required

Actions	Responsibility
Formulate policy for financing rural water supply and sanitation	Government
Formulate strategy to increase funding for rural water supply and sanitation	Local Govt/Govt
Strengthen capacity of water committees/community groups for self-sufficient operation and maintenance of community managed water supply and sanitation facilities	Local Govt/Govt
Consider Trust funds and community savings schemes as sources for community and rural water supply	Local Govt/Govt

APPENDIX C

RURAL WATER SUPPLY SECTOR AND FUNDING ISSUES

1.1 Introduction

The above sections discuss issues mainly related to the urban water supply sector, although there is a blurring, where for example all water supply in Kiribati (South Tarawa) could be regarded as rural in nature while in Samoa the urban corridor from Apia to the airport is regarded as rural, while many "urban towns" may have similar large periurban areas that have only informal water supplies. Nevertheless, many PICs have large rural populations that live in villages away from the main urban centres or immediate environs and require water supply and sanitation systems to meet their basic needs that are affordable and sustainable over the long term.

The key issues that need addressing in most countries include

- the provision of funding for the sector,
- institutional organisation at both the national and the local village/project level, and
- the management and operation of facilities at the local/village/project level.

These key factors are important when considering the long term sustainability of rural water supply systems.

1.2 Characteristics Impacting on Water Issues

Some of the key characteristics of rural water schemes that need to be appreciated in designing improvements are summarized below:

- The schemes usually provide direct access to water sources (i.e. gravity fed systems, direct river access or rainwater harvesting) based on traditional arrangements. This means that once a supply structure is in place the water is 'free' to those 'connected' to the system.
- In some situations such as the construction of new schemes or expansion of existing schemes, land tenure and resource ownership issues can lead to complex legal or property rights issues.
- In most communities there is a veiw that water is, and should remain, free to all within a group.
- Many rural communities within the Pacific can be classified as 'partially monetised' economies. The cost or value of water supply for these communities may not be recognised in a strictly monetary manner, which in turn will have implications for any attempt at recovering costs through a tariff or levy system.
- The isolation or remoteness of the schemes means that they often are located beyond the established (centralised or national) supply development, operation and maintenance network.
- There is often great variety in the nature and scale of supply in rural areas. Boreholes, gravity fed systems, rainwater harvesting or a combination are all commonplace, but present different investment, maintenance and operation implications.
- Technical and human capacity limitations may lead to inappropriate technology choices, or inefficient operation and maintenance practices. Improvement in the capacity through either national or local programs may prove key in managing rural supply in a sustainable manner.

The assumption should not be drawn from the above points that financial (or equivalent) sustainability is unachievable in rural areas, however they do clearly emphasise some of the challenges to be overcome in reaching this goal, and suggest that rural water supply will continue to be an issue necessarily treated separately from that of urban areas.

There is generally a lack of awareness of the actual value of the water supply and/cost of supply, and hence implied value of improvement (or cost of deterioration) in water quantity, quality or reliability. At the same time this lack of structured mechanisms for financing supply, operation and maintenance, or accounting for water's (economic) value may lead to inappropriate choices and consumption patterns.

1.3 Areas to be Addressed in Pacific Rural Water Sector

All developing countries tend to struggle with rural water supply provision. However, while there will be no universal model that can be adopted to work in all countries, there is a need to provide PICs with a framework that sets out the practices that have been effective elsewhere, so they can build on it for their own rural water supply programs. A first attempt at such a framework is provided below based on the Fiji rural water supply review and comments from other PICs.

- Institutional arrangements—ensure that responsi-

bility for rural water supply and sanitation schemes is clearly assigned.

- Financing arrangements—put in place equitable cost sharing and readily understood arrangements for financing rural water supply schemes. Just as in the case of urban water supplies, governments lacks the funds to meet the full cost of water supply on behalf of users. Beneficiary contributions will be needed and will help build ownership by the households or villages involved.
- Planning arrangements—there needs to be clear channels from village level through to national level to apply for funding for rural schemes. The qualifying requirements and levels of government and community contribution must also be known and clearly understood at each level about what is required for a scheme to qualify.
- Consultation arrangements—there needs to be high level of community participation so that the households or users get the scheme they want and are willing to pay for (within the boundaries of assistance framework proposed).
- Operational arrangements—At a village or project level there must be a clear understanding of operation and maintenance requirements for the project to ensure sustainability. This may involve training of personnel. It may require recruitment of staff to run and manage the system as well as the provision of charges (or supply of labour) to sustain the scheme.
- User charges—there needs to be clear agreement on what users need to pay to support the O&M of the system and if necessary meet any share of initial capital investment and any future debt service costs (where loans are provided), and any major breakdown or future rehabilitation.
- Water allocations—in the absence of metering there needs to be equitable agreement on water use.

1.4 Proposed Action – Key Message

Because of the importance of rural water supply, one of the Theme 6 Finance Actions covers the financing of rural water supply and sanitation and the development of a framework for carrying out projects and ensuring their operational and financial sustainability.

APPENDIX D

FINANCIAL PERFORMANCE AND INSTITUTIONAL STRUCTURE

1. Introduction

Table 1 in section 2.2 of the Theme 5 paper shows that there appears to be a relationship between institutional structure and financial performance—those utilities operating identifies lower financial and operational performance with utilities that continue operations as government departments (Fiji) and government boards and authorities (Kiribati and Samoa) tend to perform less well in terms of cost recovery that those operating in a more commercial structure such as a J-V company and a concessionaire respectively in Maldives and Vanuatu. The more commercial structures have better results in terms of collection efficiency and operational efficiency as measured by the level of non revenue water (including both technical and non-technical losses). In both Vanuatu and the Maldives the need to adopt these structures arose following the failure of government operated structures. It became necessary to introduce private sector operators to gain the necessary financial autonomy and operational improvements needed to ensure sector sustainability.

However, the PNG Waterboard demonstrates that a public sector trading company with clear autonomy, appropriate financial objectives and an agreed corporate plan can be successful. The ability to operate commercially within an agreed set of financial and operational parameters being the key requirement.

The Ebeye Case Study shows that the combination of: (i) utility management and operating skills provided by ASPA; (ii) external funding from multilateral and bilateral sources; and (iii) domestic funding from RMI funding have proved successful. This combination has not only rehabilitated the existing systems and improved the management and operations, but it has also trained local Ebeye personnel so In conjunction with adequate cost recovery, this should lead to long term sustainable operation of the utility services that they can eventually take over the operation and management of the facilities.

In Fiji, despite the reorganization initiatives of recent years, the water and sewerage sector remains fragmented. Water and wastewater charges are collected through the Water Rates Office, and all revenues are paid into the Government consolidated fund. Water services funding requirements, both capital and operating, are then funded as part of the annual government allocation.

1.1.1 Need for Clear Financial Objectives

Our analysis suggests that the clarity of financial objectives is the main factor that distinguishes the commercially-oriented group of water utilities from the less commercially-oriented group.

In Fiji, the Water and Sewerage Section (WSS) within the Public Works Department has had no clear financial objectives. The situation is similar to the situation that existed in Vanuatu prior to the concession arrangement in 1993. However, improvements in collection procedures and modest tariff increases (to about 3% levels of household incomes) would provide around 65% of the sector's immediate financing requirements and thus ease the burden on government. Some sector reorganisation would also be necessary to achieve these goals.

In Kiribati although the PUB as a statutory board has had clear financial objectives, these were not consistently applied and the PUB did not have the management independence of other organisations such as the Kiribati Oil Company. In Samoa, the SWA is dependent on Treasury to meet the balance of operating costs and presently lacks financial autonomy.[1]

On the other hand in Maldives the J-V company had a clear financial objective to set tariffs to achieve a 15% rate of return on equity investment, while in Vanuatu the concession agreement provides for an acceptable rate of return to the concessionaire which in turn established a base tariff by agreement with the government and an automatic tariff adjustment procedure based on an agreed formula. In the Maldives the government has an 70% shareholding in the J-V company so it becomes the major beneficiary of the dividend distribution.

In the case of the commercially-oriented PNG Waterboard, it is required to set tariffs to meet a 5% rate of return on all assets. This has allowed it to operate on a sound financial basis and with donor support and funding progressively expand its services.

[1]There are plans for it to become financially independent with regard to financing operating and maintenance costs.

1.1.2 The need for Financial Objectives with Grant Funding

There is a pressing need for Pacific Island countries using bilateral grants for urban water supply and sanitation to ensure that they require their utilities to put in place clear financial objectives. Without such measures, it is likely that their governments will continue with a policy of low tariffs, resulting in excessive water use and wastage and poor cost recovery. This will mean a continued reliance on government funding (or bilateral grants where they are available) to meet both operating costs and capital costs of future expansion and rehabilitation works.

1.1.3 Other Options – Public Funding and Private Expertise Combined

Ebeye is a small island (0.36 km^2) in the Republic of the Marshall Islands (RMI) with a population of approximately 10,000 in 1999. By 1999 the power system, water supply and sewerage services had all but ceased to function leaving the population without access to basic services and exposed to outbreaks of disease such as cholera. In an effort to improve the situation, ADB provided a $10 million loan to the RMI for infrastructure improvements on Ebeye. A contract for management of the Kwajalein Atoll Joint Utility Resources (KAJUR) utility on Ebeye was awarded to the American Samoa Power Authority (ASPA), which was tasked with managing KAJUR and improving power and water production and distribution as well as the sewer system. The RMI provided funds to meet ASPAs services and to meet some the local costs of ADB funded components. Overall about US$ 10 million was spent on infrastructure services and their management from both external sources (ADB and USA DOI) and from local sources (RMI).

The project has been heralded a success with the power and water services now being operated satisfactorily. Ebeye personnel are being trained to eventually assume responsibility for the full management and operation of the island's utility infrastructure. RMI has extended the ASPA contract to manage Ebeye Island's power plant and related infrastructure operations for two more years. In addition to managing the power plant, ASPA and Ebeye power plant staff are working on an urgently needed sewage system upgrade.

This is a good example of a country utilising several sources of funding and regional expertise to create a stronger utility with increased capacity as a result of training in management and operational practices. In conjunction with adequate cost recovery, this should lead to long term sustainable operation of the utility services.

APPENDIX E

ACTIONS COMPLETED

1.1 Current Institutional and Policy Reform Initiatives.

1.1.1 Introduction

A number of PICs have recently embarked on initiatives aimed at institutional strengthening and policy reform as indicated below. These initiatives are likely to lead to improved performance provided that they are also supported by the introduction of appropriate application of financial and economic reforms. This means that in the longer term the PICs should move towards full economic pricing but in the medium term future, the objective should be to achieve financial viability of water and wastewater enterprises. This means setting tariffs to meet operating and maintenance costs and where possible repaying loans and providing for future capital expenditure, especially rehabilitation and replacement out of the tariff. These matters are presently being addressed.

1.1.2 Samoa and Kiribati Institutional Strengthening Initiatives

In Samoa, AusAid is assisting with the institutional strengthening of SWA, increasing metering and improving billing and collection procedures. (This is the subject of a separate Case Study). ADB loan project in South Tarawa, Kiribati is rehabilitating and expanding the present water and sanitation systems and providing for institutional strengthening in the expectation of improved sector management and performance.

1.1.3 Fiji Institutional and Sector Reform

Similarly in Fiji the government is committed to improved sector performance and to sector reorganisation. The Government's current policy on public enterprise reform is contained in the Economic and Fiscal Update Supplement to the 2002 Budget Address, published in November 2001. In the case of water and sewerage services, the policy is for these services to remain in Government ownership but to be re-organized according to the following underlying key principles:

- clarity of objectives;
- management autonomy and authority;
- strict accountability for performance; and
- an increasingly competitive environment.[1]

The initial reform will simply take the form of establishing a separate Water and Sewerage Department. This maybe followed in the future with the development of a Fiji Water Board. This structure is close to that of a commercial entity and would lead to more coordinated management and performance of the sector.

1.2 Benchmarking of Pacific Water Utilities

Benchmarking provides a useful tool as part of any process of continuous improvement. The purpose of benchmarking is to search for and identify best practice (which may be within or outside the sector) with the objective of implementing appropriate best practice and improving performance. ADB Regional Technical Assistance (RETA 5883-REG) assisted water supply and electric power utilities in developing countries of the Pacific to develop appropriate operational, institutional and financial performance evaluation criteria and benchmarks. While the initial data collection and comparison of performance in 2001 yielded some strange results that made the data difficult to use, the development of this tool in coming years will be of immense value to water utilities both to monitor their own annual performance over time but also to compare their performance with other utilities in the region.

The strategy for improving both operating and financial performance should include measures to improve productivity rather than simply increasing tariffs and implementing an improved maintenance regime. Cost control and improved efficiency of operations are key components. This requires the performance and delivery of water and sanitation services be monitored and benchmarked against recognized standards of good practice (and good value) in other similar small town urban environments.

1.3 International Networking Sources for Financing Issues

The Global Water Partnership Tool Box has been developed as a resource to help water agencies develop clear financial policies and cost recovery mechanisms. The lessons learned that are discussed in the Tool Box

[1] It is not clear how Ministry of Finance officials see the limited reorganisation of the sector can achieve this except perhaps through performance targets and benchmarking.

with respect to cost recovery mechanisms are very relevant to the Pacific. These lessons are outlined below.

- Public acceptance of the need for cost recovery. A public information campaign maybe needed if consumers are used to regarding water as a gift of nature.
- Strong political backing and the avoidance of extravagant and unaffordable promises before elections.
- Provision for poor (by targeted subsidies or free quotas). Direct support maybe more effective, since subsidies often benefit the rich more.
- Financial transparency and regular and automatic price adjustments based on agreed criteria.
- Firm and clear public regulation of tariffs set by private sector and public utilities.
- Private companies find it easier to levy and raise charges than their public counterparts.
- Increases and higher tariffs are easier to implement when there is an associated improvement in services.
- Charges are only one instrument of demand management and work best in conjunction with other measures, such as cost control, leakage control, more efficient implements, recycling, reuse etc.

In addition to this should be added :

- Tariffs must be understandable and tariff billing and collection procedures must be enforced.