



PACIFIC ADAPTATION TO CLIMATE CHANGE

KINGDOM OF TONGA

REPORT OF IN-COUNTRY CONSULTATIONS

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I. INTRODUCTION

1.1 The need for adaptation to climate change

1. Small island developing States (SIDS) are highly vulnerable to climate change and sea level rise owing partly to their small land masses surrounded by ocean, and their location in regions prone to natural disasters. SIDS are often characterized by having relatively large populations for the area they occupy with high growth rates and densities; poorly developed infrastructure and limited natural, human and economic resources, and their high dependence on marine resources for their livelihood needs. Most of their economies are reliant on a limited resource base and are vulnerable to external forces, such as changing terms of trade, trade liberalization, and migration flows. Adaptive capacity to climate change is generally low.

2. In the Pacific region where the Kingdom of Tonga (20 00 S and 175 00 W) is situated, the climates are influenced by a number of factors such as trade wind regimes, the paired Hadley cells and Walker circulation, seasonally varying convergence zones such as the South Pacific Convergence Zone (SPCZ), semi-permanent subtropical high-pressure belts, and zonal westerlies to the south, with the El Niño Southern Oscillation (ENSO) as the dominant mode of year to year variability (Fitzharris, 2001; Folland *et al.*, 2002; Griffiths *et al.*, 2003). The Madden-Julian Oscillation (MJO) also is a major mode of variability of the tropical atmosphere-ocean system of the Pacific on times scales of 30 to 70 days (Revell, 2004), while the leading mode with decadal time-scale is the Interdecadal Pacific Oscillation (IPO) (Salinger *et al.*, 2001). A number of studies suggest the influence of global warming could be a major factor in accentuating the current climate regimes and the changes from normal that come with ENSO events (Hay *et al.*, 2003; Folland *et al.*, 2003).

3. Recent studies in the southern Pacific region show that the annual and seasonal ocean surface and island air temperatures have increased by 0.6 to 1.0°C since 1910 throughout a large part of the South Pacific, southwest of the South Pacific Convergence Zone (SPCZ) where as decadal increases of 0.3 to 0.5°C in annual temperatures are only widely seen since the 1970, preceded by some cooling after the 1940, which is the beginning of the record, to the northeast of the SPCZ (Salinger, 2001; Folland *et al.*, 2003).

4. Analyses of trends in extreme daily rainfall and temperature across the South Pacific for the period 1961 to 2003 show significant increases in the annual number of hot days and warm nights, with significant decreases in the annual number of cool days and cold nights, particularly in years after the onset of El Nino, with extreme rainfall trends generally less spatially coherent than were those of extreme temperature (Manton *et al.*, 2001; Griffiths *et al.*, 2003). Variations in tropical cyclones, hurricanes, typhoons in all small islands' regions are dominated by ENSO and decadal variability which result in a redistribution of tropical storms and their tracks, so that increases in one basin are often compensated by decreases in other basins. For instance, during an El Niño event, the incidence of tropical storms typically decreases in the far western Pacific and the Australian regions, but increases in the central and eastern Pacific while during La Nina the trend reverses. The numbers and proportion of hurricanes reaching category 4 and 5 globally have increased since 1970, while total number of cyclones and cyclone days decreased slightly in most basins which is consistent with the trends observed in the Pacific islands region. Additionally, in the tropical South Pacific, the distribution of tropical storms and their tracks are dominated by ENSO and decadal variability, with small islands to the east of the dateline

highly likely to receive a higher number of tropical storms during an El Nino event compared to a La Niña event and vice versa (Brazdil *et al.*, 2002).

5. Past studies of adaptation options for small islands have been largely focused on adjustments to sea-level rise and storm surges associated with tropical cyclones. There was an early emphasis on protecting land through ‘hard’ shore-protection measures rather than on other measures such as accommodating sea-level rise or retreating from it, although the latter has become increasingly important on continental coasts. Vulnerability studies conducted for selected small islands (IPCC, 2001) show that the costs of overall infrastructure and settlement protection is a significant proportion of GDP, and well beyond the financial means of most small island states. More recent studies since the TAR have identified major areas of adaptation, including water resources and watershed management, reef conservation, agricultural and forest management, conservation of biodiversity, energy security, increased share of renewable energy in the energy supply, and optimized energy consumption. Proposed adaptation strategies have focused on reducing vulnerability and increasing resilience of systems and sectors to climate variability and extremes through mainstreaming adaptation.

6. While small islands must adapt to the consequences of climate change, their adaptive capacity is limited and is being further eroded by external factors such as the internationalisation of economic activity and internal population pressures. People in small islands have historically adapted to variability in climate and sea conditions. It is not clear how valuable this experience will be in dealing with the longer-term mean changes in climate and sea level, especially since traditional mechanisms for coping with environmental hazards are being lost in many islands.

7. The need to implement adaptation measures in small islands with some urgency has been recently reinforced by Nurse and Moore (2005), and was also highlighted in the TAR where it was suggested that risk-reduction strategies together with other sectoral policy initiatives in areas such as sustainable development planning, disaster prevention and management, integrated coastal zone management and health care planning should be employed. Since then a number of projects on adaptation in several small island states and regions have adopted this suggestion. Projects aim to build capacities of individuals, communities and governments so that they are more able to make informed decisions about adaptation to climate change and to enhance their adaptive capacity in the long run.

8. Given the urgency for adaptation in small island states there has been an increase in *ad-hoc* stand alone projects, rather than a programmed or strategic approach to the funding of adaptation options and measures. It can be argued that successful adaptation in small islands will depend on supportive institutions, finance, information and technological support. Thus an adaptation strategy for the Pacific islands and indeed for Tonga should include a strategy for precautionary adaptation since it is difficult to predict far in advance how climate change will affect a particular site, sector or community. Thus adopting a “no regrets” adaptation measures would be justified even in the absence of climate change, as this would more than likely lead to better management of natural resources and sustainable development.

1.2 Objective of Pacific Adaptation to Climate Change (PACC)

9. Given the foregoing urgency for the need for adaptation to climate change in the Pacific island countries, a Pacific Adaptation to Climate Change (PACC) has been developed to assist with the implementation of adaptation measures in 11 countries of the region. The Kingdom of Tonga (Tonga), as one of the countries will participate in the PACC to implement adaptation measures to enhance its resilience to the adverse impacts of climate change in the longer term.

10. The principal objective of the PACC is to facilitate the implementation of long-term adaptation measures to increase the resilience of a number of key development sectors in the Pacific island countries to the adverse impacts of climate change. A framework for PACC (PACC framework) will be developed through a consultative process involving all relevant stakeholders (including national governments and their respective agencies, institutions, departments and ministries, and non-government organizations, where appropriate, CROP agencies, donor partners, private sector, where appropriate, and others deemed necessary). The PACC framework will guide the implementation of the PACC at the national (including community and/or village) and regional levels.

1.3 Scope of the Report

11. As one the of the key outcomes of the in-country consultations is to determine detailed adaptation activities and baselines in each country, this report provides the outcomes of Tonga in-country consultations on PACC which were held from September 25 to 29, 2006. The report is divided into five sections: section I outlined the urgency for adaptation to climate change in SIDS, building on the IPCC third assessment report; section 2 provides a general overview of the climate change and development situation (situation analysis) in Tonga covering issues relating to assessment of impacts of climate change on the biophysical and human systems and stakeholder analysis; section 3 covers sectoral analysis with regard to a methodology and/or a criteria used to select a priority sector for adaptation intervention, institutional and development baselines within the priority sector as well as the analysis of the impacts of climate change within the priority sector; section 4 provides information of the delivery mechanism for full-sized project implementation of the PACC-Tonga component and section 5 covers the project goals, outcomes, outputs and activities. The letter of endorsement for co-financing and list of individuals/experts and their respective institutions consulted during the in-country consultation are appended as annexes in section 6.

II. GENERAL OVERVIEW

2.1 Situation Analysis

12. Kingdom of Tonga (dubbed "The Friendly Islands") were united into a Polynesian kingdom in 1845 and became a constitutional monarchy in 1875 and a British protectorate in 1900. It withdrew from the protectorate and joined the Commonwealth of Nations in 1970 and remains the only monarchy in the Pacific. It comprises a total area of 748 km² with total land area of 718 km² and 419 km of coastline (Figure 1). The country has a total of 172 islands, 36 of which are inhabited. The estimated population of Tonga in 2006 (July) is 114,689 which represents an increase of 46,905 people from the population of 97,784 on the census night in 1996.

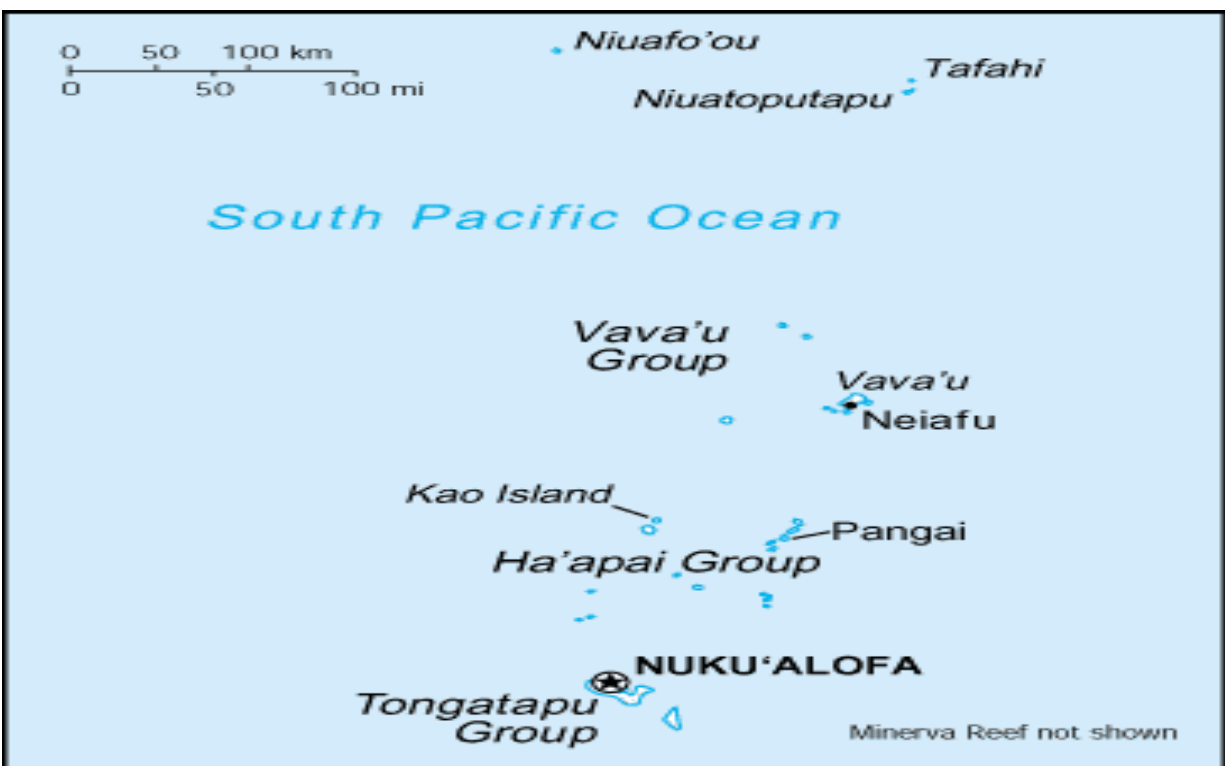


Figure 1. Location of Kingdom of Tonga

13. Tonga consists of four island groupings spread over north-south axis: Tongatapu and 'Eua (South), Ha'apai (central); (Vava'u (north); Niufo'ou and Niua Toputapu (far north). The population of Tonga was 97,784 in 1996, with Tongatapu being the most populous island with the highest density accounting for 69% of the total population.

14. The climate is characterized by high rainfall and humidity and high temperatures which remain generally uniform throughout the year. Interannual variation of rainfall is high, usually influenced by El Nino-Southern Oscillation (ENSO) phenomenon. However, the country experiences severe tropical cyclones during the summer months of November -April and is also vulnerable to anomalously long dry spells associated with the El Nino (warm) phase of the El Nino-Southern Oscillation (ENSO)

phenomenon. Tonga is also highly vulnerable to other extreme climate events including, for example, coral bleaching associated with high ocean surface temperatures and/or extremely low tides. The impacts of climate-related events are felt right across the nation's economic, social and environmental systems, thus making future changes in climate, including extreme events, an issue of great concern nationally.

15. Tonga, a small, open, South Pacific island economy, has a narrow export base in agricultural goods. Squash, coconuts, bananas, and vanilla beans are the main crops, and agricultural exports make up two-thirds of total exports. The country must import a high proportion of its food, mainly from New Zealand. The country remains dependent on external aid and remittances from Tongan communities overseas to offset its trade deficit. Tourism is the second-largest source of hard currency earnings following remittances. The government is emphasizing the development of the private sector, especially the encouragement of investment, and is committing increased funds for health and education. Tonga has a reasonably sound basic infrastructure and well-developed social services. High unemployment among the young, a continuing upturn in inflation, pressures for democratic reform, and rising civil service expenditures are major issues facing the government.

Ratification of the UNFCCC

16. Tonga ratified the UN Framework Convention on Climate Change (UNFCCC) on 20 July 1998 and has submitted its Initial National Communication (INC) to the UNFCCC on 21 July 2005. Following the preparation of its INC and Phase II enabling activities, the country has initiated efforts to create an institutional set-up that seeks to mainstream climate change issues into the national legal frameworks. Moreover, its INC provides compelling evidence that, by global standards, Tonga is one of the countries most vulnerable to climate change and sea-level rise.

17. Ratification of the UNFCCC is one step forward in terms of commitment to addressing climate change and related issues. Tonga is also a Party to many other UN conventions, such as those, among others: Convention on Biological Diversity, the Cartagena Protocol for Biosafety, the Stockholm Convention for Persistent Organic Pollutants, and Convention to Combating Desertification.

18. At the national level, the proposed project will have strong linkages to a number of on-going UNDP-GEF enabling activities such as Tonga's National Capacity Self-Assessment (NCSA) activities, National Biodiversity and Action Plan (NBSAP), National Sustainable Land Management Project (SLM) as well as with other UNDP-funded activities in the area of sustainable energy including the UNDP-GEF funded Pacific Islands Renewable Energy Project (PIREP), and the proposed Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP).

19. Since the completion and submission of the INC, Tonga has embarked on the implementation of sustainable development programmes which have strong linkages to its reporting commitments under other multilateral environmental agreements. These reports include its contribution to World Summit on Sustainable Development (WSSD) and Johannesburg Plan of Implementation (JPOI), Barbados Programme of Action for Small Island Developing States (BPoA) and the International Meeting on the Review of the Barbados Programme of Action (IM), National Strategy and Action Plan (NBSAP) under the Convention on Biological Diversity (CBD).

SUSTAINABLE DEVELOPMENT STRATEGY

20. The *Strategic Development Plan Eight 2006-2009: Looking to the Future Building on the Past* (SDP8) provides the vision and strategies for Tonga's development in the medium-term. The review of

development performance prior to the adoption of SDP8 revealed that Tonga has made substantial long-term economic and social progress, and that in recent years the Government has sought to ensure this continues through improving public sector management, creating an environment conducive to increased investment and employment by the private sector, and investing in education and health. Thus Government of Tonga (GOT) desires sustained, sustainable and equitable economic growth and to provide its people with basic education, health and other basic services in an effective and efficient manner, thus ensuring an enhanced quality of life for all.

21. The vision of SDP8 is “To create a society in which all Tongans enjoy higher living standards and a better quality of life through good governance, equitable and environmentally sustainable private sector-led economic growth, improved education and health standards, and cultural development.” In order to realize this vision, SDP8 also established eight development goals which it plans to achieve by:

- a) Creating a better governance environment
- b) Ensuring macroeconomic stability
- c) Promoting sustained private sector-led economic growth
- d) Ensuring equitable distribution of the benefits of growth
- e) Improving education standards
- f) Improving health standards
- g) Ensuring environmental sustainability and disaster risk reduction
- h) Maintaining social cohesion and cultural identity

2.2 Stakeholder Analysis

Process and approach used

22. The consultations on Pacific Adaptation to Climate Change (PACC) were conducted by the PDFB team¹ and involved eight stakeholder consultations and workshops and several focus group meetings. Three approaches were used to solicit and collect information from various ministries, agencies, institutions of government and non-government organizations:

- a) Gathering of information (including policy documents) relating to the activities, programmes and projects from various government ministries, departments and agencies,
- b) Meetings/consultations and workshop held with representatives of relevant ministries, agencies institutions of government and non-government organizations,
- c) A national consultation workshop on PACC priorities.

23. The consultations were focused on the activities relating to adaptation and other related issues such as institutional arrangements, and opportunities for promoting synergy between the various activities and organizations, priorities for PACC activities, consistent with the UNDP and GEF guidelines/criteria for adaptation activities. Specific issues covered in the meetings and consultations included all elements of project implementation including policy/regulatory framework to integrate adaptation within the design and implementation of development activities; institutional framework; information and knowledge; stakeholder involvement and co-financing possibilities.

¹ Chief Technical Adviser, UNDP Programme Officer and GEF Expert Consultant

Institutions and individuals involved/consulted

24. A total of seven ministries, agencies and institutions of government and non-government organizations involving 21 experts were consulted during the in-country consultations and workshop. These consultation workshops provided the opportunity for all individuals and organizations to be informed about PACC objectives, priorities and activities and also to consider some of the common elements or priority activities for adaptation implementation. The consultation meetings were usually carried out over 1-2 hour sessions. Thus, in total 12 hours of consultations were held spread over five days.

Department of Environment

25. The PACC Consultation Team paid courtesy visits to the Director of Environment and staff of the Climate Change section. Briefing from the PACC Consultation Team (PCT) emphasized the need for Tonga to firm up very early in the week on the priority thematic area for PACC it would like to focus on. The PACC project focuses on three thematic areas: water resource management, coastal management and infrastructure and food production and food security, and Tonga was encouraged to choose a thematic area it would like to work on under the PACC so that consultations would be much more focused.

26. Following some discussion on the thematic areas it was suggested that given the information and other sustainable development projects that are currently being implemented in Tonga PACC should focus on water resources management. This recommendation was based on the following considerations:

- a) In the area of coastal zone management , several donors have already provided support in that area. However, it was found that not many activities are being carried out in the coastal zone management sector except for some monitoring and coastal protection work being funded by AusAID in several communities on the island of Tongatapu.
- b) In the case of the food production and food security programme of government, the Technical Corporation Programme (TCP) of FAO and SPC's DSAP project, are currently being implemented to address, among others, food security issues
- c) Water resources is a serious concern for communities/villages in the Hihifo District, Tongatapu, where it often experiences water shortages caused by drought and by lowering of the freshwater lens under ground.
- d) The Tonga Water Board has conducted assessments of water issues including infrastructure and the vulnerabilities that the people are facing; and
- e) Co-financing of PACC activities for water resources management can easily be solicited from the government and other donors working on water resources management

Department of Lands and Surveys

27. A meeting was held with the department of Lands and Surveys on PACC project. At the outset the PCT informed the department that the meeting with Department of Environment already identified water resources management (WRM) as a thematic area for adaptation intervention in Tonga under PACC. In response the representative of Department of Lands and Surveys endorsed the proposal to focus on WRM and indicated that a draft legislation for WRM is already available. He further noted that WRM issues are critical for the Hihifo District of Tongatapu. He also informed the PCT about other water-related activities that are either being implemented in or planned for Tonga such as the EU-funded

programme on Island vulnerabilities, the rainwater harvesting project by the Tonga Trust. He emphasized that while water supply remains a big concern for many island communities the biggest problem faced by many is the lack of access to water and the lack of adequate water storage facilities.

Ministry of Health

28. The next meeting was held with a Public Health Inspector, Ministry of Health, which is responsible for rural water supply in Tonga. The Health inspector outlined the activities with regard to water and sanitation in rural areas. He informed the PCT that the Ministry regularly carries out inspections of the communities and households and information is kept in a database. House-to-house inspections are carried on sanitation conditions, rainwater tanks, and other water use issues. He also informed the PCT that recent inspections had been carried out in eight villages of Hihifo District where there is a problem of water supply/availability due to the overdraw of the borehole. Overdrawing of the boreholes meant that new borehole had to be developed further away from the villages/communities.

Tonga Trust

29. A consultation meeting was also held with the Tonga Trust because of their involvement in water issues in the communities. The Tonga Trust, established in 1979, is an indigenous, non-governmental development organization involved in social, human, community and environmental development and training. Additional programmes have focused on eco-forestry, pesticide awareness, environmental education, community theatre, and sanitation. It has been continuously involved in women's development and health issues, including water supply and poverty alleviation. The Tonga Trust has been implementing pilot programmes on rainwater harvesting in the outer islands of Tonga. It has also conducted testing of rainwater at schools, training workshops on rainwater harvesting and developed a training manual for rainwater harvesting. Rainwater harvesting pilot programmes involve monitoring, capacity building and training, use of guidelines/manual, exchange of information and know-how and dissemination of lessons learned. Ensuing discussions were centred on the possible engagement of the Tonga Trust given its experience in rainwater harvesting in communities to be involved with the PACC project. Details of engagement of the services of Tonga Trust will be finalized as the PACC project is developed.

Meteorological Services

30. A courtesy meeting was held with the Head of the Tonga Meteorological Services mainly to introduce the PACC project and also to ascertain the availability of the data and information on the climatology of the Hihifo District. The PCT provided a brief on the focus of earlier consultations which focused on water resources management as a thematic area for adaptation intervention in Tonga. He advised that rainfall data and other climate data can be made available but there is no specific data for the Hihifo District alluding to the fact that rainfall distribution in Tongatapu is sparse. However, he also mentioned that despite this rainfall records for are fairly representative of many of the areas in Tongatapu.

Tonga Water Board

31. The meeting with the Chief Engineer of the Tonga water Board was held to ascertain if there were water development projects overseen by Tonga Water Board which the PACC project could build and also to seek data and information on the water resources sector of Tongatapu. The PCT informed the Tonga water Board that water resources management has been proposed as the priority thematic area for

adaptation intervention and the pilot site would be the Hihifo District of Tongatapu. The Chief Engineer, while agreeing to the proposed adaptation theme and the pilot site, stressed that Tonga Water Board is responsible for the planning, installation, operation and maintenance of public water supply systems in selected urban areas of Tongatapu, 'Eua, Ha'apai and Vava'u and the Ministry of Health is responsible for rural water supply, often working through the Village Water committees. He further stated that the biggest problem with urban water supply is the loss through leakage. This problem is compounded by the fact that there is no legislation or a coherent policy on water resources management which would define roles and responsibilities/mandates for water resources in Tonga.

Kolovai Village Water Committee (Hihifo District)

32. A community Site visit was organized by the Department of Environment to meet with the Kolovai Village Water Committee to find out more about water management issues in a rural area. After formal introductions, the PCT introduced the PACC project emphasizing that it is a climate change adaptation implementation project focusing on any one of the three thematic areas of water resources management, food production and food security, and coastal zone management and its associated infrastructure. The PCT also indicated that earlier consultations with government departments pointed to water resources management as a priority area for adaptation in Tonga.

33. The District Officer, speaking on behalf of the Water Committee, outlined the water resources management situation in the Hihifo District. The information can be summarized as follows:

- a) Since 1963 when the water reticulation system was installed with support from the World Health Organization funding of water pumping and distribution has been done by the people themselves. A borehole was established at the first village of the district supplying water to six villages where water is being pumped for 15 hours only (6:00am -9:00pm) although this is not sufficient to meet demand. A 24-hour pump would meet the water needs of the six villages. There is no pumping of water from the borehole 9:00pm to 6:00am every day.
- b) The main problem is the cost of fuel used to operate the pump. Currently four (200ltr) drums of petrol per month cost over \$2,000.00 are used to operate the pump and this is proving to be costly as the fuel prices continue to rise. A fee of \$10 per household per month is collected to pay for the caretaker of the water pump/reticulation system, a town clerk and a treasurer. There are 500 households with about 3,000 people in the district.
- c) There are four boreholes in the district but pumping of water is only done from two boreholes. However, optimally six pumps are needed to meet the demand for water.
- d) Demand for water is likely to increase over the long term due to other developments. Currently there are five tourist motels/hotels, one health clinic and four primary schools who also need water. Any further development of tourism industry would put additional pressure on the water supply system.
- e) The other problem that is becoming evident is the narrowness of the land in this part of Tongatapu Island so saltwater intrusion into the freshwater aquifer is common especially during storms and El Nino- Southern Oscillation (ENSO) phenomenon. Hihifo District also receives less rainfall than other parts of Tongatapu. Due to the narrowness of the land and saltwater intrusion of the freshwater lens a new borehole had to be built further away (towards the central part of the island) from the villages making distribution problematic.
- f) With respect to water quality there is no perceived problem or there has been no reported diseases relating to the use of groundwater.

- g) The institutional framework for water management is often centred on the Village or District Water Committees who manage water supply (pumping and distribution) and maintenance. Each village also has a Town Officer and a District Officer.
- h) The implementation of PACC project would be carried out in an integrated manner involving villages/communities (Water Committees), Department of Environment, Central Planning, Department of Lands and Surveys, Tonga Water Board, Ministry of Health, and Tonga Trust.

STAKEHOLDERS AND INSTITUTIONS CONSULTED

Institution	Stakeholders interests/responsibilities	Relevance to climate change/reasons for inclusion	Role in the Consultation process
GOVERNMENTAL INSTITUTIONS			
DEPARTMENT OF ENVIRONMENT	<p>Operational focal point of the UNFCCC.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> - management of the state of the environment; -national coordination of actives and programmes related to MEAs including implementation, monitoring and evaluations -issuance and vetting of projects including permits and environmental impact assessments -Liaising with relevant national agencies for assistance to ensure the effective representation at meetings of the Parties to the Convention and other relevant meetings; - Liaising with relevant regional and international bodies to ensure that the representation of the Cook Islands at any meeting concerning a Convention is informed and effective; - Managing or participating in any project, or part of a project, aimed at implementing any aspect of environmental concerns - Disseminating information to local stakeholders and creating public awareness on environmental concerns 	<p>Climate Change Section established within DoE.</p> <p>Secretariat to National Environment Coordinating Committee.</p> <p>Responsible for preparation of the INC and SNC and its submission to the CoP</p> <p>Responsible for NAPA preparation in collaboration with other relevant agencies</p>	<p>Consultations with the UNFCCC focal point for discussion of PACC priorities for in terms of technical issues, opportunities for synergy among various projects and institutional arrangements.</p> <p>Consultation on the provision of climate data and information as well as on the needs for capacity-building, training and research (collection, analysis and archiving) and dissemination of information</p> <p>Consultations on issues relating to technologies data and information for research and systematic observations (contribution and participation in global research and observing.</p> <p>Consultations on arrangements for stakeholder consultations on PACC priorities.</p> <p>Consultations on the proposed thematic area of water resources management for adaptation intervention.</p>
DEPARTMENT OF LANDS, AND SURVEYS	<p>Responsible for land management and all matter relating to land, natural resources and environment</p> <p>Responsible for monitoring of environmental issues in Tonga</p>	<p>Member of the National Committee on Climate Change</p>	<p>Consultations on national priorities, mainstreaming of climate change in national environmental strategies, programmes and other documents, as well as on current and planned projects.</p> <p>Consultations on the proposed water resources management</p>

Institution	Stakeholders interests/responsibilities	Relevance to climate change/reasons for inclusion	Role in the Consultation process
MINISTRY OF HEALTH	<p>Responsible for surveillance and early warning for vector-borne and water-borne diseases</p> <p>The relationship between climate change (rainfall and temperature) and the incidence of vector-borne and water-borne diseases</p> <p>Responsible for rural water supply and sanitation</p>	<p>Member of the National Committee on Climate Change</p> <p>Has regularly conducted health inspections of the rural water supply systems.</p>	<p>Consultations on information and data on the health effects of changes in rainfall and temperature</p> <p>Provision of health statistics relating to climate-related stresses (diseases) from the pilot site.</p>
METEOROLOGICAL SERVICES	Responsible for climate forecasts, information and data	Member of the Climate Change Committee	<p>Consultations on data and information on the climatology of Tongatapu Island.</p> <p>Possible project priority identification – suggesting PACC to focus on water resources management.</p>
TONGA WATER BOARD	Responsible for the planning, installation, operation and maintenance of public water supply systems in selected urban area of Tongatapu	Member of NCCC	<p>Consultations on information and data on water sector assessments and issues</p> <p>Discussions on possible co-financing opportunities</p>
TONGA TRUST	<p>Focuses its activities on social, human, community and environmental development and training - eco-forestry, pesticide awareness, environmental education, community theatre, and sanitation</p> <p>- Womens' development and health issues, including water supply and poverty alleviation</p>	Provides training and support to rural communities on rainwater harvesting programmes	Consultations on the possible role for Tonga Trust to facilitate training and awareness on rainwater harvesting techniques
HIHIFO DISTRICT WATER COMMITTEE	Responsible for Hihifo District water supply and maintenance	Proposed pilot site for adaptation in water resources management	Consultation meeting to ascertain water resources management issues in the district and to provide details on the purpose and objectives of the PACC

Wrap up meeting with Stakeholders

34. The PCT presented their findings at a luncheon meeting with the stakeholders and the National Climate Change Committee. The agenda focused mainly on the proposed focus for Tonga as well as the proposed institutional arrangements. Issues that have been raised and agreed upon included:

- a) The endorsement by NCCC to focus on Water Resources Management thematic area for PACC in Tonga (PACC-TONGA) as well as the proposed pilot location in Hihifo District, Tongatapu.
- b) The appreciation of NCCC that this pilot project will focus on actual implementation of adaptation activities rather than further assessment work as with many enabling activities in currently being conducted in the country;
- c) The expected size for PACC-TONGA pilot is around USD750,000.
- d) The expected ratio for co-financing to be applied in this pilot project is 1:4 (i.e. for every dollar of the GEF resources there should be four dollars from other sources).
- e) On institutional arrangements, the NCCC has endorsed that the project management unit be set up directly under the Department of Environment, with the NCCC as the advisory body on technical and management issues. The terms of reference (TOR) for the PMU and management arrangements will be developed and will include a provision for the PMU to be accountable to the NCCC, UNDP and SPREP for the project.

2.3 Climate change programmes, projects and activities

35. A number of climate change programmes, projects and activities have been carried out in Tonga since the entry into force of the UNFCCC. Tonga implemented an enabling activity project on the preparation of its initial national communication under the UNFCCC and is currently completing a Phase II enabling activity project (top-up). Tonga submitted its initial national communication to the UNFCCC on July 21 2005. The country is currently carrying out its national capacity self-assessment to identify capacity needs for the implementation of the UNFCCC. Tonga has also initiated a process for the preparation of its second national communication under the UNFCCC.

36. Given that the threat of climate change in Tonga is no longer an issue for the future as extreme climate related events are being faced today in climate sensitive sectors, several community adaptation projects were implemented with funding support from Australia through its Australian Agency for International Development (AusAID) and Tonga Department of Environment. Community-based adaptation focused on mangrove replanting and building of seawalls in two villages in the Hihifo District, Tongatapu. The projects not only helped communities to build their resilience but also sensitize the communities about the effects of climate change and sea-level rise.

VULNERABILITY AND ADAPTATION

37. Within the context of Tonga's initial national communication a vulnerability and adaptation assessment was conducted to determine what is known about the possible effects of climate and sea-level change, possible adaptation to these effects and the resultant vulnerabilities; identify gaps in

knowledge in determining climate and sea-level change effects, adaptation options and vulnerability; and identify national needs and priorities to prepare for climate and sea-level change.

38. The results of the vulnerability and adaptation assessment indicate that key development sectors will likely be affected by climate change and sea-level rise. These sectors include water resources, forestry and agriculture, coastal areas and resources, fisheries and human health.

39. SRESB2 climate scenario projected a decrease of average rainfall by approximately 10.9% by 2050, which would lead to a reduction in average annual recharge 457mm to 317mm (i.e. 30 % reduction). Prolonged dry periods will decrease water supply for uses in rural areas and outer islands while reduction in recharge to groundwater would mean a reduction in potable water supply for uses in rural areas and outer islands.

ADAPTATION

40. Management of water catchments so as to maintain water quality and maximize groundwater recharge will minimize climate change impacts on water resources while providing immediate human benefits in areas that already suffer seasonal shortages and helping to maintain environmental quality. This could be achieved through integrated planning efforts involving rural landholders, provincial authorities, and departments of lands, agriculture, forestry, mines, water supply and environment or by legal or administrative restrictions on activities impacting on water catchments. Catchment management initiatives would have wider environmental benefits, including reduced erosion and soil loss, maintenance of biodiversity and land productivity.

41. Improved management and maintenance of water supply networks to reduce wastage will also reduce vulnerability in both urban and rural areas. This will require training in maintenance of taps, tanks and pipes and access to appropriate hand tools.

42. Extension initiatives that promote water conservation and moderate usage, while raising awareness of the importance of water resource management, will also help to maintain long-term water supplies. Introduction of policies to extract freshwater from coastal aquifers only where there are no feasible alternatives would reduce the vulnerability of coastal communities and reduce the need to replace infrastructure should salt water intrusion occur. Expansion of rainwater storage capacity, frequently through the installation of water tanks will reduce the vulnerability of communities in times of water shortage.

III. SECTORAL ANALYSIS

43. The principal objective of Pacific Adaptation to Climate Change (PACC) is to facilitate the implementation of long-term adaptation measures to increase the resilience of a number of key development sectors in the Pacific island countries to the adverse impacts of climate change. The development sectors are food production and food security, water resources management and coastal zone management and its associated infrastructure. Given limited financial resources the countries have been encouraged to focus only one of the three development sectors where adaptation intervention would be essential. The in-country consultations in Tonga would also determine detailed adaptation activities and baselines in each country.

3.1 Methodology/criteria for selection of priority sector

44. Given that PACC would only support adaptation activities in one of the three main development sectors of food production and food security, water resources management and coastal zone management and associated infrastructure it was necessary to select one of these priority areas for adaptation intervention. In order to facilitate the selection of the priority area the following criteria was used for PACC priority sector. That the selected adaptation project or activities should have:

- a) A strong fit/alignment with the government's existing programmes
- b) All necessary baseline assessments have been carried out, and additional activities are ready for implementation, and,
- c) Ability to co-finance and ability to deliver.

Consultations

45. The selection of the thematic area for adaptation intervention was based on a number of factors which resulted from in-country consultations and the documents made available to the PCT. The selection was initially suggested by the Director of the Environment who was first consulted

Thematic Area for Adaptation

46. Based on these three criteria and on the stakeholder consultations (see section 2.2) coastal zone management and its associated infrastructure was selected as a priority sector for adaptation intervention in Tonga under the PACC project. Under this theme, an adaptation project entitled "*Piloting climate change adaptation in water resources management in Hihifo District, Tongatapu*" was proposed. This project would focus on enhancing, and where necessary, developing water infrastructure for six communities. The basic tenet is that the current water infrastructure design is not able to cope with changes in rainfall regimes and sea-level changes leading to saltwater intrusion of the groundwater thereby affecting potable water for consumption, agricultural production and industry as well as having adverse effects on livelihood of villages. Six communities/villages (>3,000 popn) are already adversely affected by the changes in rainfall regimes and sea-level change (associated with extreme events) which affect the quality and quantity of potable water.

47. At present there is limited integration of climate change adaptation into sectoral development planning and budgeting processes relating coastal zone management and its associated infrastructure and it is hoped that a project such as this will sensitize decision-making that will integrate climate change concerns into planning and budgetary processes over the long term.

3.2 Assessment of priority sector for adaptation activities

48. A number of adaptation options have been identified by a vulnerability and adaptation assessment conducted during the preparation of the initial national communication. These options deal with water issues in the country and linked to economic efficiency and environmental benefits, cultural and social suitability and practicability considerations. Because the water reticulation system suffers chronically from leakage it would be necessary to include leakage control as part of ongoing activity of the water management system. In order to be able to effectively manage water loss from leakage community education and awareness about water resource issues would also become a critical component.

49. Community education and awareness would not only prevent further water loss from leakage but also enhance and promote water conservation in communities. It has been widely recognized that only

with the support and participation of the community at large, especially women and children, will the small islands be able to reduce wastage and move towards sustainable development of their freshwater resources. Thus, an appropriate community information and education in this regard are most important and can be provided through public meetings, school presentations, TV program and radio broadcasts. It is essential that governments and water agencies recognise the need for community participation in water resources conservation, planning and management in order to preserve freshwater resources for future generations on small islands.

50. Demand management of water resources are generally more cost effective than alternative source development. Thus by reducing the demand for water or by ensuring more effective use of existing sources, there will be less pressure on limited water resources. In areas where water is supplied to the consumer, a pricing policy and water metering should be developed as an effective way managing demand to include low-income earners and others. This would lead to water conservation because people will only use water when they need it. An alternative would be to encourage communities/villages that use flush toilets to use sea water for flushing.

51. In the short, medium and long term, there are a number of adaptation options aimed at developing additional or supplementary freshwater resources, or maximising the use of currently available resources. These options include:

- a) Expansion of rainwater collection schemes - These measures obviously add additional construction costs but as a long-term strategy they provide a means of 'climate proofing' to cater for future droughts especially on islands relying on rainwater as a major source of water supply.
- b) Groundwater protection measures - Several measures are available to protect groundwater from contamination whether from seawater intrusion or biological and/or chemical pollution.
- c) Land use planning and water reserves - Effective land use planning and management is most important for the protection of water resources from contamination. This is particularly important on coral islands with highly permeable soils and shallow water tables where groundwater is very susceptible to pollution. Water reserves or 'groundwater protection zones' should be established and land use regulated where potential freshwater resources exist for future use. This will require negotiation between government and private landowners and agreement on appropriate administrative, legal and financial conditions.
- d) Non-polluting sanitation systems -Composting toilets can act to protect fresh groundwater, and have been the subject of trials in recent years on a number of Pacific islands. These trials were conducted to assess the physical, biological and cultural acceptability of this relatively simple technology. The advantages of appropriately designed composting toilets are: simple construction; protection of groundwater (under the village areas); water conservation (as no flushing water is required); and production of a useful agricultural fertilizer.
- e) Dry sanitation systems - Dry sanitation systems can be used which does not use water for flushing, transport or treatment, which saves considerable quantities of water. Dry sanitation also avoids the considerable water loss through leaking toilet cisterns
- f) Coastal management and protection - Measures to protect coastal areas on small islands are an important component in the long-term sustainable management of islands, including the water resources. If island margins are eroded the area available for freshwater lens occurrence may be diminished.

- g) Desalination - Desalination is a relatively expensive and complex method of obtaining freshwater for small islands. The cost of producing desalinated water is almost invariably higher than 'conventional' options (e.g. pumping of groundwater) due to the high-energy costs and other operating costs. In extreme cases where other water resources are exhausted it may be a necessary source of freshwater. For operational reasons, desalination technology has not been successful in some small islands and the desalination plants have been removed or lie idle. Common problems have been insufficient filtering of feed water, intermittent power supplies and insufficiently trained operator.
- h) Importation of water - Importation of water from other country is one of the last options mainly due to very high cost involving therefore it is not recommended to the outer islands.

3.3 Current institutional and development baseline

52. The water resources of Tonga are primarily in the form of groundwater. Surface water resources are not present on most islands, except 'Eua and some of the volcanic islands including Niuafu'ou and Niuatoputapu. Rainwater is the supplementary source of portable water. Groundwater is normally pumped from drilled wells and some old dug wells, some of which are over 50 meters deep. The water supplies for the main urban centers: Nuku'alofa (Tongatapu), Pangai (Ha'apai) and Neiafu (Vava'u), and some villages' water supplies are also source from groundwater. Rainwater is mainly collected on rooftop and stored in reinforce concrete, fibre glass and galvanized iron tanks, and most households own one or two of these.

53. The following organizations are involved in water resources assessment, development and management:

- a) *Ministry of Lands, Survey and Natural Resources (MLSNR)* is responsible for assessment and monitoring (quantity and physical and chemical) of water resources throughout Tonga and for advice of future development and management of water resources,
- b) *Tonga Water Board (TWB)* is responsible for the planning, installation, operation and maintenance of public water supply systems in selected urban area of Tongatapu, 'Eua, Ha'apai and Vava'u.
- c) *Village Water Committees* are responsible for the operating and maintaining the physical components of village water supply systems.
- d) *Ministry of Health (MOH)* is responsible for implementing and maintaining village water supply schemes and for monitoring and surveillance of the biological quality of public water supply schemes.
- e) *Central Planning Department (CPD)* is responsible for the overall co-ordination and monitoring of aid projects, and for co-ordination of development plans including the affecting the water sector.
- f) *Tonga Meteorological Services (TMS)* is responsible for operation and maintenance of the key climatic stations, climate data and information.
- g) *Water Resources Committee* is a subcommittee of Development Co-ordination Committee (to be designated as the National Water Authority), is responsible for initiating and reviewing development and other proposal related to water resources, and making recommendations to the Development Co-ordination Committee for forwarding to Cabinet.
- h) Ministry of Works (MOW) owns the only drilling rig used for production of bore holes.

- i) *Ministry of Agriculture & Forestry (MOW)* is responsible for promoting agricultural production and possible use of irrigation.
- j) *Ministry of Finance (MOF)* is responsible for the nation budget and thus has an impact on capital and recurrent funding of water resources and water supply projects, and
- k) Private Consumers and NGOs.

54. The ownership of groundwater is vested in the Crown. Sanitation facilities are mainly in the form of flush toilets with concrete septic tanks and shallow leach fields. Once the tanks are full, sludge is then transported to an open sewage site for drainage and treatment. The MOH is the responsible agent.

55. It appears that water resources management is carried out by many institutions and agencies of government and their roles and responsibilities are driven by their own mandates. Under the SDP8 one of the government's development strategies is to achieve a better standard of living, sustainable economic growth, and better quality of life throughout the outer islands and rural areas in Tonga by 'improving infrastructures and utility services'. In this regard and with assistance from the Governments of Australia, New Zealand, European Union, and Japan the total financial contribution to regional and rural communities for 2005/2006 FY is estimated at TOP \$10.3 million. Some of these funds was spent on water projects in rural communities.

Hihifo District: Pilot Site

56. The Upper Hihifo District consists of 6 Villages, Foui, Ha'avakatolo, Kolovai, 'Ahau, Kanokupolu, and Ha'atafu. These Villages are situated 15 kilometres south east of Nuku'alofa, the capital of Kingdom of Tonga, on the main Island of Tongatapu. The Upper Hihifo District lies on north south direction and is the home to Prime Minister and 4 Tourist Beach Resorts including the only surfing resort in the Kingdom.

57. The Water supply system of Upper Hihifo District was launched around the mid sixties. A Village Water Committee elected by the Village Community governs the Upper Hihifo District Water supply. At present, about 95% of the Village population are served by the water supply. However the shortage of water supply is a major problem for these villages especially the far northern villages of Haatafu, Ahau and Kanokupolu. The water pressure is so low that water only runs in the morning and sometimes at night. These people store water during the night time in buckets and containers for use during the daytime. To supplement water they also get water from their neighbours. To supply water for the Resorts, the village supply is suspended to enable the Resorts to fill their reservoir tanks. Insufficient water poses a major problem for the Resorts and the village resident's daily life.

58. To supplement the water shortage, most residents have built their own rainwater tanks. Rainwater is used not only for supplement to the shortage of water but for drinking purpose, since people prefer it "softer" taste. However, two major problems are evident. The possibility of the rainwater being contaminated by dust and saprophyte, and during the drought seasons, rainwater becomes scarce. Therefore, rainwater is not recommended in terms of sanitation and stability of water volume.

59. Since there is no river or surface water present in the main Island of Tongatapu, ground water is the main source for water supply. The Liahona Fresh Water lens cease at Foui Village where the Upper Hihifo District begins. This has proven to be disadvantage to the Upper Hihifo District area; because the bore well are located at the edged of the fresh water lens and the increase in the ground water intake has possibility to cause salination of the ground water. This becomes a great concern to conserve the ground water source in order to continue ground water utilization as the main water source.

60. The current system runs from a couple of bores at Foui which pumps directly into the distribution network which supply the entire 6 villages all the way to Ha'atafu. This means that water is only available if the pumps are on which is not the case if it is pumped to a collection reservoir at high spot for gravity distribution to the network. The distribution network consists of asbestos cement pipe which are undersized and plagued with leakage. Since the engine and pump is running non-stop to meet the demand plus the leakage, it is therefore liable to playing up.

61. With the Villagers only paying a flat rate of \$8.00 dollars a month regardless of the amount of usage, the VWC are struggling to meet the cost of the pumps let alone the maintenance and repair costs. This proposal looks at supply water from existing bores at Foui Village plus 3 new bores via a rising main to a proposed ground level reservoir at Kolovai (about 23 meters ASL) which will gravity feed the distribution network of Upper Hihifo District. The entire water consumers of the Hihifo District will now be metered as of this Project to encourage wise use and conservation of water resources.

3.4 Impacts of climate change on the priority sector

62. Previous work on vulnerability and adaptation assessment provides pertinent information on the impacts of climate change and sea-level rise in Tonga. The GCM outputs for Tonga indicate that climate change and sea-level rise will have serious effects on the biophysical systems and development sectors of the economy. For instance, in the water resources sector, using SRESB2 scenarios, it is probable that by 2050 rainfall will have decreased by 10% with a concomitant reduction of recharge of the groundwater by up to 30%. By 2100 the rainfall is likely to decrease by 17.5% with a 32% reduction in recharge of the groundwater. Projected sea-level rise can affect the groundwater by saltwater intrusion and loss of land from coastal erosion or flooding associated with climate extremes.

63. A decrease in rainfall can affect agricultural production and perhaps the most significant impact on agriculture will most likely come from the effects of sea-level rise associated with storm surge and other extremes. It was projected that by 2100 a 1m sea-level rise in Tongatapu would effect the loss of 10.3km² of land or 37.3km² of land with storm surge. This would mean a total loss of 14% of land area of Tongatapu . Increase in sea-level will also affect agricultural production and water resources through salination of freshwater and land loss.

64. The effect of climate change and sea-level rise on coastal zones and resources would be significant. Thus land loss, shoreline retreat, coastal erosion and wave-overtopping would affect beach vegetation and mangrove forest which act as buffers against such extremes. Much of the infrastructure and socio-economic activities in Tonga are located near or on the coast which makes them highly vulnerable to effects of climate change and sea-level rise.

65. Changes in temperature and rainfall are likely to affect human health through incidences of vector-borne and water-borne diseases. Additionally frequent and high intensity tropical cyclones could affect the economy and the livelihood of the people.

66. Tonga is affected by tropical cyclones and is susceptible to extreme climate events such as prolonged droughts associated with the ENSO events, coral bleaching and cause severe damage to socio-economic activities and infrastructure, agriculture and biodiversity.

3.5 Methodology for assessing priority baseline

67. During the Tonga country consultations by the PACC team, it has been agreed to focus adaptation intervention on increasing the resilience of water resources management in Hihifo District of Tongatapu. This pilot project will provide lessons learned and recommendations and design of follow-up projects will complement the pilot and will produce recommendations and the follow-up schemes for potential replication on a wider scale in Tonga and elsewhere.

68. The methodology used for assessing the priority sector was based on the consultations held with various government departments and ministries. Further information on the water resources sector was sought from the pilot community, Tonga Water Board, Department of Environment, Central Planning Department, Department Lands and Surveys, Ministry of Health, and Tonga Trust. Additional information was gleaned from the documents obtained from the same organizations during the consultations. The principle documents used in assessing the water sector is the Government's Strategic Development Plan Eight and the initial national communication which was completed as part of its obligation under the UNFCCC..

3.6 Determination of adaptation activities

69. The focus on water resources management in Hihifo District is consistent with the GOT's policy infrastructure development on outer island and rural areas with the aim of improving the livelihoods of rural and outer island communities.

70. Additional adaptation activities increase the resilience of 500 households (>3,000 people) to climate change and its adverse impacts, improve the management of water resources over the long term for use in households, agricultural production, tourism, and other infrastructure development. Adaptation activities were determined on the basis of the policies and programme priorities of GOT, climate change impacts, need for adaptation, and ability to co-finance and ability to deliver the implementation of such activities (see section 5 for further information).

71. Water resources of Tongatapu is mainly from groundwater sources and supplemented by rainwater. The Hihifo District at the northwestern end of the island also relies heavily on groundwater sources for consumption and other use needs. Climate change and sea-level rise will have a significant impact on the livelihoods of the communities in Hihifo District which suffer from drought and impacts of saltwater intrusion affecting ground water. The mean annual rainfall for the island of Tongatapu is 1,753mm with an mean annual recharge of 524mm to the groundwater or 30% of the total rainfall. During El Nino-Southern Oscillation (ENSO) event there is less rainfall as indicated by a monthly mean rainfall of less than 100mm as opposed to monthly mean of 200mm (Fielea 2005). With less rainfall, there is less recharge and with continued pumping of groundwater and a rise in sea-level leads to saltwater intrusion into the groundwater aquifer. Salinity profiles and measurements of electrical conductivity of groundwater carried out in Hihifo District between 1997 and 1999 indicated that during ENSO-forced drought the groundwater was affected by saltwater intrusion thus placing additional pressure on limited water supplies from rainwater tanks and for consumption and industrial use. Additionally, two atmosphere-ocean global circulation model outputs indicate that by 2050 groundwater recharge will have decreased by 20-24% and with a high likelihood of high frequency and more intense ENSO events and sea-level rise, water resources for

the whole of Tongatapu will be negatively impacted which in turn will affect the livelihood of communities/villages that depend almost entirely on groundwater resources.

72. Given the above scenario additional adaptation activities will focus on enhancing the resilience and adaptive capacity of the communities/villages in Hihifo District by integrating climate change and sea-level rise risks into their water resources management. The activities will contribute towards increasing the storage capacity of water supply for the district including its quality and maintain its sustainable yield to account for periods of extreme events (such as ENSO and tropical cyclones), and to improve sustainable management of water resources.

IV. MECCHANISM FOR DELIVERY OF FSP

4.1 Institutional Arrangements

73. All climate change programmes, projects and activities are being coordinated by the Climate Change Section of the Department of Environment. Climate Change Section currently has two full-time staff that carry out tasks/activities relating to climate change in the country such as the preparation of climate change enabling activities (e.g. phase II enabling activity, and second national communication) and other bilaterally funded adaptation projects (e.g. Kanokupolu Foreshore Restoration programme). The Climate Change section also serves as a secretariat for the National Environment Coordinating Committee (NECC).

74. Under the PACC-TONGA project, the Climate Change Section will continue to coordinate climate change activities relating to PACC. Given that PACC is focused on implementation of adaptation activities, the implementing agency for PACC-TONGA will be the Department of Environment (DoE), DoE will also serve as secretariat to the NECC on issues relating to the implementation of PACC-TONGA.

75. In addition to the implementation of PACC-TONGA, DoE will host at least two full-time staff that will provide the day-to-day operation of the PACC-TONGA. These two full-time staff will be part of the PACC Project Management Unit (PMU). The PMU will be directly responsible to the Director of Environment.

76. At the national level, PACC-TONGA will be implemented by various stakeholders within their respective mandates while scientific, technical and policy oversight will be provided by the NECC. The NECC comprises representatives from various government ministries, agencies and institutions. Other partners in the project will include Department of Lands and Surveys, Tonga Meteorological Services, Tonga Water Board, Ministry of Works, Ministry of Health, Ministry of Agriculture, Ministry of Finance/Treasury, Central Planning Department, Tonga Trust, District Water Committee, and six/eight village water committees.

4.2 Assessment of existing and potential barriers to adaptation implementation

77. PACC-TONGA is underpinned by GOT policy and regulatory framework and its Strategic Development Plan Eight wherein it identifies “Improving the lives of the people in rural areas and outer

islands by improving service delivery, expanding market access to rural produce, lowering of credit and transportation, and ensuring sustainable use of natural resources” as a critical component of its current development strategy.

78. A number of climate change enabling activities (e.g. national communication and community adaptation projects) have also involved numerous organizations, institutions and individuals in carrying out various tasks and activities. These activities have been supported by the National technical committee through the provision of scientific, technical and policy oversight and guidance. Thus many of the roles and responsibilities have been clarified. However some barriers still remain and will have to be overcome in order to improve delivery of the PACC-TONGA. Some of these barriers include, competing demands on staff time, inadequate staff resources, equipment, and lack of incentives.

79. Lack of capacity (human, systemic, institutional, financial and technical) constrains the sharing of information and knowledge particularly of climate change and adaptation issues which makes the integration of climate change adaptation into sustainable development prohibitive. A project of this kind will more than likely make the integration of climate change into sectoral planning possible.

V. EXPECTED GOAL, OUTCOMES, OUTPUTS AND ACTIVITIES

Goal:

80. The main goal of this project is to enhance the capacity of the Cook Islands to adapt to climate change, including variability, in selected key development sectors.

Specific Objective:

81. The main goal of this project is to “increase the resilience of the water resources management sector and to enhance adaptive capacity of villages/communities and socio-economic activities to climate change and sea-level rise.” This goal will be achieved through a project “Piloting climate change adaptation in water resources management in Hihifo District, Tongatapu Island focusing on sustainable use and management of water resources. This project will also focus on enhancing, and where necessary, constructing the reticulation system of approximately 4 kilometers in length.

82. The implementation of adaptation activities in water resources management will entail the implementation of water conservation, water use efficiency, protection of groundwater, rainwater harvesting and storage. Adaptation interventions will include (soft) non-structural and structural (hard) options that compliment each other. The main goal of this project is to “increase the resilience of water resources management sector to impacts of climate change and sea-level rise.” The objective is to enhance adaptive capacity of villages/communities to cope with adverse effects of climate change and sea-level rise on the water resources.

Specific Outputs

Output 1.1: Relevant plans and programmes incorporate climate risks in the water sector in Tonga.

Output 2.1: Practical guidance on water resource use and management response to 3-4 year ENSO occurrence and associated drought.

Output 2.2: Water resource use and management response to 3-4 year ENSO occurrence and associated drought demonstrated.

Description:

Output 1.1: Relevant plans and programmes incorporate climate risks in the water sector in Tonga.

83. This will include integrating climate change into key development sectors that are highly vulnerable to climate change which include; agriculture, water, and coastal management. At the national level, work in climate variability and change is still the 'domain' of Meteorology Services, Environment Departments and National Disaster Agencies but the impacts are being felt by other agencies e.g. Fisheries, Agriculture, Forestry, Physical Planning, and Public Works. To mainstream key climate change issues into development plans of government sectors, a number of critical steps would be followed, which requires collaborative analytical and policy inputs from a number of different technical experts and domestic partners. Critical components of mainstreaming include: review of the NSDS and its role in national development; the identification of the strengths, weaknesses, gaps, responses to strengthen specific sectoral management (problem tree analysis and objective/ solution identification); the review of the link between sectoral plans and NSDS and the relationship between sectoral medium term budget and the medium term national fiscal expenditure and revenue budget; and strengthening of sector level budgeting that reflects outcome focused priorities and national development goals.

Specific activities to be undertaken would include:

- Promote and support dialogue, exchange of information and coordination amongst early warning, disaster risk reduction, disaster response, development and other relevant agencies and institutions at all levels, with the aim of fostering a holistic and multi-hazard approach towards disaster risk reduction.
- Development or customizing of a mainstreaming methodology that takes into consideration climate change technical and policy frameworks and issues;
- Forming of a Mainstreaming Team to work with key government sectors to mainstream climate change issues into key sectoral plans and policies;
- Countries to form V&A Teams comprising people in various agencies and institutions who can collaborate, integrate their work and be the main contact points in the various agencies to champion adaptation approaches and initiatives. Once the teams are formed a range of capacity building initiatives to be developed in the next component can be implemented.
- Mainstream climate change risk considerations into planning procedures, especially for major infrastructure projects, including the criteria for design, approval and implementation of such projects and considerations based on social, economic and environmental impact assessments.

Output 2.1: Practical guidance on water resource use and management response to 3-4 year ENSO occurrence and associated drought.

Output 2.2: Water resource use and management response to 3-4 year ENSO occurrence and associated drought demonstrated.

84. This output will assist the Tonga Water Board and the Department of Health and key stakeholders to develop the Hihifo District communities' capacity to protect and manage their underground water resources from salinity and unsustainable human activities. It would involve capacity training and application of vulnerability and adaptation assessments using climate information on current water demand and supply, use of climate change models and local experience (traditional knowledge) to identify, evaluate, design and demonstrate appropriate water retention capacity/technologies, Design and develop an integrated multi-stakeholder catchment, conservation and protection model as an adaptation management tool.

85. Hihifo district consists of 6 villages situated 15 kilometers south east of Nuku'alofa, the capital on the main Island of Tongatapu. The water resources of Tongatapu are mainly from groundwater sources and supplemented by rainwater. Climate change and sea-level rise has had a significant impact on the livelihoods of the communities in Hihifo District which suffer from drought and impacts of saltwater intrusion affecting ground water resources. The mean annual rainfall for the island of Tongatapu is 1,753mm with a mean annual recharge of 524mm to the groundwater or 30% of the total rainfall. During El Nino-Southern Oscillation (ENSO) event there is less rainfall as indicated by a monthly mean rainfall of less than 100mm as opposed to monthly mean of 200mm² With less rainfall, there is less recharge and with continued pumping of groundwater and a rise in sea-level leads to saltwater intrusion into the groundwater aquifer. Recent short-term sea level trend in Tonga for February 08 according to the SEAFRAME data was around +8.6mm/yr³. This is well above the IPCC Fourth Assessment Report's observed sea level rise of 3.1 +/- 0.7 mm/yr. Measurement of sea level data in Tonga started in 1993. It is clear that if action is not undertaken now to seriously address the preservation of underground water in the Hihifo district, water supply into the future would be seriously compromised. The government of Tonga has committed US\$1,500,000 as co-financing for water resources management in the larger Hihifo area and the PACC project would significantly contribute to this endeavor. Specific activities to be undertaken would include:

- Community based vulnerability assessment incorporating climate models, traditional knowledge and meteorological data for evaluating and forecasting current and future water demand for Hihifo district
- Use of climate change models and local experience (traditional knowledge) to identify, evaluate, design and demonstrate appropriate water retention capacity/technologies to reduce vulnerability to prolonged droughts
- Use climate models and data to guide the development of bore hole management plans to minimize salt water intrusion into underground water sources and develop and implement local strategy for alternative sources of water supply
- Design and develop an integrated multi-stakeholder catchment, conservation and protection model as an adaptation management tool to minimize climate change impacts that are compounded by unsustainable human activities.

² Fielea, 2004

³ South Pacific Sea Level and Climate Monitoring Project Monthly Data Report February 2008.

PROJECT LOG FRAMES AND INDICATORS

Project Log Frame and indicators for Tonga would be finalized during the inception meeting of the PACC project.

BUDGET

Responsible	ERP/Atlas	Budget Description							
	Budget Code								Total
				Year 1/08	Year 2/09	Year 3/10	Year 4/11	Year 5/12	Budget
Outcome 1	71200	International Consultants (including national regional staffing)	10,000	10,000	0	0	0	0	10,000
	71300	Local Consultants (including national staffing)	30,000	5,000	5000	10,000	5,000	5,000	30,000
	71400	Contractual Services - Ind	20,000	5,000	5,000	5,000	5,000	0	20,000
	71600	Travel	20,000	0	5,000	5,000	5,000	5,000	20,000
	72100	Contractual Services - Co	40,000	10,000	10,000	10,000	10,000	0	40,000
	72200	Equipment & Furniture	10,000	5,000	1,000	3,000	1,000	0	10,000
	72400	Communication & Audio Visual equipment	4,000	2,000	500	500	500	500	4,000
	72500	Supplies	1,000	500	100	100	200	100	1,000
	72800	Information technology and Outreach	3,000	500	1,000	500	1,000	0	3,000
	74200	Printing, Publishing & Production	2,000	0	500	500	500	500	2,000
Subtotal			140,000	38,000	28,100	34,600	28,200	11,100	140,000
Outcome 2									
	71200	International Consultation	10,000	10,000	0	0	0	0	10,000
	71300	Local Consultants	40,000	5,000	15,000	15,000	5,000	0	40,000
	71400	Service Contracts - Ind	50,000	5,000	20,000	15,000	5,000	5,000	50,000
	71600	Travel	20,000	2,000	5,000	5,000	5,000	3,000	20,000
	72100	Contractual services - Co	297,400	60,480	60,480	60,480	60,480	55,480	297,400
	72200	Equipment & Furniture	10,000	0	5,000	5,000	0	0	10,000
	72500	Supplies	40,000	5,000	10,000	10,000	10,000	5,000	40,000
	72400	Audio Visual Equipment and Communication	10,000	2,500	2,500	2,500	2,500		10,000
	72800	Information Technology Equipment and Outreach	10,000	3,000	3,000	2,000	1,000	1,000	10,000
	74200	Printing and Publications	10000	1,000	3,000	3,000	2,000	1,000	10,000
Subtotal			497,400	93,980	123,980	117,980	90,980	70,480	497,400
Outcome 3									
	71200	International Consultants							
	71300	Local Consultants							0
	71600	Travel	20,000	4000	4000	4000	4000	4000	20,000
	72100	Contractual Services - Co							0
Subtotal			20,000	4000	4000	4000	4000	4000	20,000
Outcome 4			88,758	17752	17752	17752	17752	17750	88,758
Subtotal			88,758	17752	17752	17752	17752	17750	88,758

Total			746,158	153,732	173,832	174,332	140,932	103,330	746,158
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SELECTED REFERENCES

- Adger, N., Mace, M.J., Paavola, J., and Razzaque, J., 2003: Justice and equity in adaptation. *Tiempo* 52, 19-22.
- Adger, W. N., S. Huq, K. Brown, D. Conway, M. Hulme, 2003: Adaptation to climate change in the developing world. *Progress in Development Studies*, 3 (3), 179-195.
- ADB (Asian Development Bank) 2004: *Environmental Pacific Regional Strategy, 2005-2009*, ADB Manila, Philippines, 105 pp
- Barnett, J., 2001: Adapting to climate change in Pacific Island Countries: The problem of uncertainty. *World Development*, 29, 977-993
- Brazdil, R., T. Carter, B. Garaganga, A. Henderson-Sellers, P. Jones, T. Carl, T. Knustson, R.K. Kolli, M. Manton, L.J. Mata, L. Mearns, G. Meehl, N. Nicholls, L. Pericchi, T. Peterson, C. Price, C. Senior, Q.C. Zeng, and F. Zwiers, 2002: *IPCC Workshop on changes in extreme weather and climate events*, Workshop Report, Beijing, China, 11-13 July, 2002, 41- 42. Accessed 15.11.2004 at <http://www.ipcc.ch/pub/extremes.pdf>
- Folland, C.K., J.A. Renwick, M.J. Salinger, N. Jiang, and N.A. Rayner, 2003: Trends and variations in South Pacific Islands and ocean surface temperatures. *Journal of Climate.*, 16, 2859-2874
- Folland, C.K., J.A. Renwick, M.J. Salinger, and A.B. Mullan, 2002: Relative influences of the Interdecadal Pacific Oscillation and ENSO on the South Pacific Convergence Zone. *Geophysical Research Letters*, 29, 21-1-21-4
- Griffiths, G.M., M.J. Salinger, and I. Leleu, 2003: Trends in extreme daily rainfall across the south pacific and relationship to the South Pacific convergence zone. *J. Climatol.*, 23, 847-869.
- Government of Tonga, 2005. Initial National Communication under the UNFCCC, Nuku'alofa, Tonga.
- Government of Tonga, Impacts of climate change and sea-level rise on water resources in Tonga: Findings, Gaps and Recommendations, Department of Environment, Nuku'alofa, Tonga.
- Government of Tonga, 2005. Upper hihifo District Water Supply Improvement Project, Engineering and Planning Division, Tonga Water Board, Nuku'alofa, Tonga.
- Government of Tonga, 2006. National Sustainable Development Strategy, Nuku'alof, Tonga.
- IPCC, 2001: *Climate Change 2001: The Scientific Basis*. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881 pp.
- Lal, M., H. Harasaw and K. Takahashi, 2002: Future climate change and its impacts over small island states, *Climate Research*, 19, 179-192.
- Manton, M.J., P.M. Dellaa-Marta, M.R. Haylock, K.J. Hennessy, N. Nicholls, L.E. Chambers, D.A. Collins, G. Daw, A. Finet, D. Gunawan, K. Inape, H. Isobe, T.S. Kestin, P. Lefale, C.H. Leyu, T. Lwin, L. Maitrepierre, N. Oprasitwong, C.M. Page, J. Pahalad, N. Plummer, M.J. Salinger, R. Suppiah, V.L. Tran, B. Trewin, I. Tibig, and D. Yee, 2001: Trends in extreme daily rainfall and temperature in southeast Asia and the south Pacific: 1961-1998. *J. Climatol.*, 21, 269-284.
- Nurse, L., G. Sem, J.E. Hay, A.G. Suarez, P.P. Wong, L. Briguglio and S. Ragoonaden, 2001: Small island states. . In: *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken, and K.S. White (eds.). Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 842-975.
- Nurse, L., and R. Moore, 2005: Adaptation to global climate change: an urgent requirement for

Small Island Developing States. *Review of European Community and International Law (RECIEL)*, 14 (2), 100-107.

World Bank, 2000: *Cities, Seas and Storms: Managing Change in Pacific Island Economies. Vol. IV, Adapting to Climate Change*. World Bank, Washington, D.C. 72 pp.

World Bank, 2002: *Cities, Seas and Storms: Managing Change in Pacific Island Economies*. World Bank, Washington, D.C.

World Bank, 2006: *Not If, But When: Adapting to Natural Hazards in the Pacific islands Region: A Policy Note*. World Bank, Washington, D.C., USA, 60 pp.

ANNEXES

Letter of Co-financing

LIST OF EXPERTS AND INSTITUTIONS CONSULTED

**Kutusi Fielea
Masima Sefesi
Papiloa Foliaki
Viliami Soakai
Feleti Vaka
Tevita Hiva
Katainia Manupuna
'Ofa Fa'anunu
Taniela Kula
Asipeli Palaki
Loal Liava'a
Azania Newton
Talo Fulivai
Taniela Faletau
Mafile'o Mas
Luisa Tui'afitu
Lilieta Takau
Tupe Samani
Uilou Samani
Mosese Fifita**

**Tonga Water Board
Hihifo District Officer
NGO
Tonga Trust
Tonga Trust
Hihifo District Water Comité
Hihifo District water Comité
Meteorological Services
Lands and Survey
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Department of Environment
Ministry of Health**