PACIFIC ADAPTATION TO CLIMATE CHANGE

NAURU

REPORT OF IN-COUNTRY CONSULTATIONS

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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 Nauru Island (0 32 S, 166 55 E) 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^{o}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^{o}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 Nauru 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. Nauru, 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 Nauru in-country consultations on PACC which were held from October 23 to 27, 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 Nauru 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-Nauru 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.

GENERAL OVERVIEW

2.1 Situation Analysis

12. Nauru is an isolated, uplifted limestone island located 41 km South of the equator at 0^{o} 32' South latitude and 166^{o} 56' East longitude. It is some 2000 km East-Northeast of Papua New Guinea, 4450 km South-Southeast of the Philippines and an equal distance to the Southwest of Hawaii. The nearest island is Banaba (Ocean Island), 300 km due East, which is part of the Republic of Kiribati. The main islands of Kiribati lie a further 400 km to the East.

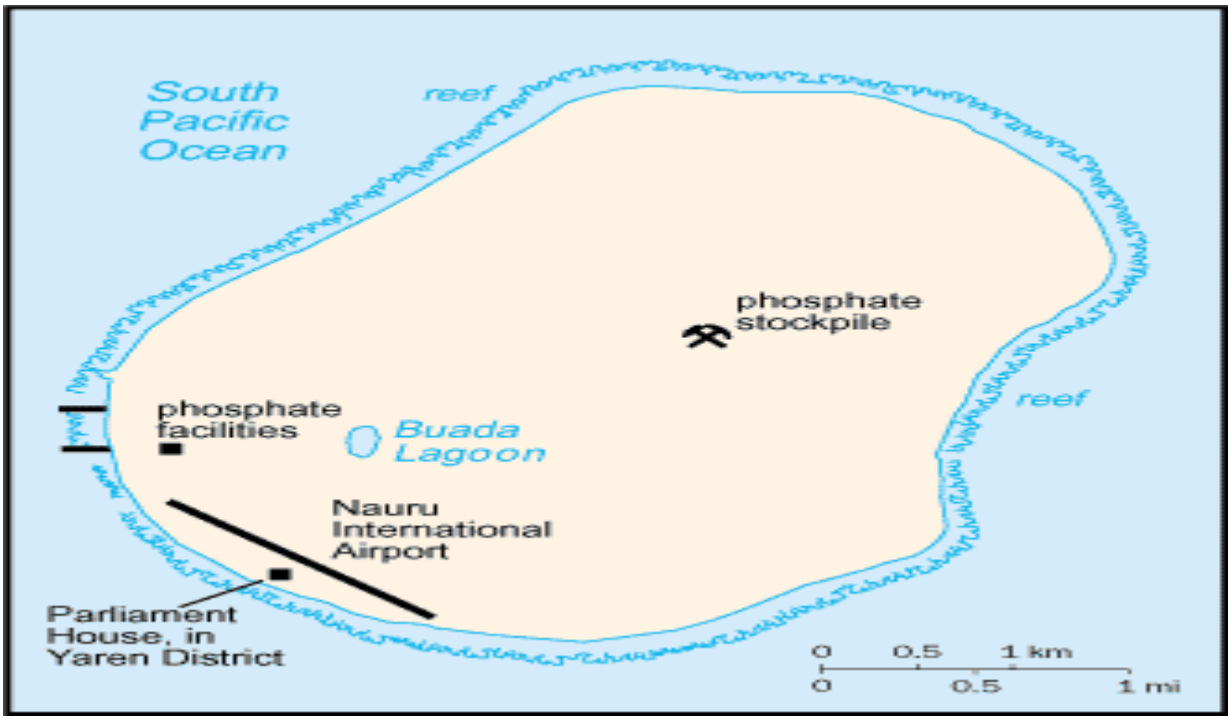

Figure 1. Location of Nauru Island

13. The total land area of Nauru is only 22 km^2 (2200 ha). The island is surrounded by a fringing coral reef between 120 and 300 metres wide which drops away sharply on the seaward edge, to a depth of about 4,000 metres. The land area consists of a narrow coastal plain or "Bottomside", ranging from 100 to 300 metres wide, which encircles a limestone escarpment rising some 30 metres to a central plateau, known locally as "Topside". The population of Nauru is currently estimated at 13,287 (July 2006).

14. The coastal plain is composed of a zone of sandy or rocky beach on the seaward edge, and a beach ridge or fore-dune, behind which is either relatively flat ground or, in some places, low-lying depressions or small lagoons filled by brackish water where the surface level is below the water table (freshwater lens). The most extensive system of these landlocked lagoons is found near the border of Ijuw and Anabar Districts. Scattered limestone outcrops or pinnacles can also be found on both the coastal plain and on the inter-tidal flats of the fringing reef, with particularly good examples in the Anibare Bay area. The escarpment ranges in gradient from vertical cliffs to gradually sloping areas of

colluvial soil (deposits that accumulate on and at the base of slopes as a result of movement by gravity) interspersed with limestone outcrops and pinnacles.

15. The raised central plateau or Topside consists of a matrix of coral-limestone pinnacles and limestone outcrops, between which lie extensive deposits of soil and high-grade tricalcic phosphate rock (Tyrer 1963, Viviani 1970). This area covers approximately 1600 ha (over 70% of the island) and has been the focus of phosphate mining for over 80 years. Relative elevations on Topside vary generally between 20 and 45 metres above sea-level, with occasional pinnacle outcrops reaching elevations of 50 to a maximum of 70 metres above sea-level. The topography remaining after completion of primary phosphate mining is a pinnacle-and-pit relief varying between 2 and 10 metres from the top of the pinnacles to the bottom of the pits. The highest point on the island is Command Ridge in the west at an elevation of 71 metres above sea-level. Buada Lagoon, a landlocked, slightly brackish, freshwater lake, and its associated fertile depression (about 12 ha in area), is located in the low-lying Southwest-central portion of the island at an elevation of about 5 metres above sea-level.

16. Nauru is located in the dry belt of the equatorial oceanic zone, with diurnal temperatures ranging from 26oC to 35oC, and nocturnal temperatures between 22oC and 28oC. Annual rainfall is extremely variable, averaging 2126 mm per year (data from 77 years from 1916 to 1993) with a range of 280 to 4590 mm. Monthly rainfall data available for the period 1977 to 1993 indicate a range of 0 to 746 mm, with 62 months out of 204 months (for which data were available) having less than 100 mm of rain. Rain tends to be more frequent during the months of December to April. Prolonged droughts are common and place severe stress on the natural species and lead to the death of non-coastal exotics and fruit trees (such as breadfruit).

17. Apart from Buada Lagoon there are no surface freshwater resources on Nauru, although there are a few brackish ponds near the base of the escarpment, especially on the northeast of the island in Ijuw and Anabar Districts, and an underground lake in Makwa (Moqua) Cave in the Southeast (Viviani 1970). The only significant permanent freshwater resource is groundwater in the form of a "lens" of often slightly brackish freshwater, hydrostatically "floating" on higher-density saltwater beneath it. The height of the freshwater lens above sealevel and the level of salinity vary in relation to the elevation, geology, texture and shape of the island, and with the amount of water use and rainfall. Currently Nauru's population are reliant on water supplied either from a desalination plant run by the Nauru Phosphate Corporation (1150 tonnes/day) or from local wells. There is little use made of roof rainwater catchments on the island. Existing long term potential threats to the quality of the groundwater resource include contamination by cadmium, rubbish dump leachate, sewage and household waste water e.g. bathroom, kitchen and laundry.

18. Revenues of Nauru have traditionally come from exports of phosphates, now significantly depleted. An Australian company in 2005 entered into an agreement intended to exploit remaining supplies. Few other resources exist with most necessities being imported, mainly from Australia, its former occupier and later major source of support. The rehabilitation of mined land and the replacement of income from phosphates are serious long-term problems. In anticipation of the exhaustion of Nauru's phosphate deposits, substantial amounts of phosphate income were invested in trust funds to help cushion the transition and provide for Nauru's economic future. As a result of heavy spending from the trust funds, the government faces virtual bankruptcy. To cut costs the government has frozen wages and reduced overstaffed public service departments. In 2005, the deterioration in housing, hospitals, and other capital plant continued, and the cost to Australia of keeping the government and economy afloat continued to climb. Few comprehensive statistics on the Nauru economy exist, with estimates of Nauru's GDP varying widely.

Ratification of the UNFCCC

19. Nauru ratified the UN Framework Convention on Climate Change (UNFCCC) on 11 November 1993 and has submitted its Initial National Communication (INC) to the UNFCCC on 30 October 1999. 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, Nauru is one of the countries most vulnerable to climate change and sea-level rise. Nauru also ratified the Kyoto Protocol on 16 August 2001.

20. Ratification of the UNFCCC is one step forward in terms of commitment to addressing climate change and related issues. Nauru 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.

21. At the national level, the proposed project will have strong linkages to a number of on-going UNDP-GEF enabling activities such as Nauru'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).

22. Since the completion and submission of the INC, Nauru 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

23. The Republic of Nauru (RON) launched its National Sustainable Development Strategy (NSDS) in November 2005 which clearly articulates the need for the adequate and reliable supply of power and water. The Government of Nauru has identified that a reliable supply of power and water is critical to sustaining economic growth.

24. The overall impact that the NSDS seeks to make is captured in the people's vision for development and is stated as a future where individual, community, business and government partnerships contribute to a sustainable quality of life for all Nauruans, a vision which emphasizes the desired outcome of sustainable improvements in the quality of life experienced by Nauruans and signals that partnerships at all levels will be a key vehicle to achieving this.

25. The decline in socio-economic conditions that has marked the last decade makes improvements in the quality of life the focus for development effort. On the other hand the long dependence on government makes partnerships between government, business, community, and individuals a necessary means to achieving the vision. The following long term national goals to achieve the vision are listed below in priority order:

a) Stable, trustworthy, fiscally responsible government
b) Provision of enhanced social, infrastructure and utilities services
c) Development of an economy based on multiple sources of revenue
d) Rehabilitation of mined out lands for livelihood sustainability
e) Development of domestic food production

2.2 Stakeholder Analysis

Process and approach used

26. The consultations on Pacific Adaptation to Climate Change (PACC) were conducted by the PDFB team[1] 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.

27. 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.

Institutions and individuals involved/consulted

28. Mr. Brian Star, Director of Projects was the main contact point and assisted the PACC Team (PCT) in all the logistics on the ground. He also accompanied the Team in all their consultations and was very supportive. With his assistance the PCT met a number of key personnel/experts and institutions to inform and ascertain priority areas for adaptation, additional activities for adaptation intervention, institutional mechanism and for delivery of PACC activities and possible or potential for co-financing. Summary of the consultations are outlined below.

Development Planning and Policy Division

29. The PCT met with Mr. Nelson Tamakin, the Secretary and Mr. Samuel Grundler the Director, Development Planning and Policy Division (DPPD). The DPPD was established in 2005 and is largely responsible for coordinating planning efforts at the national level, in particular monitoring the implementation of the NSDS. Under DPPD, a development planning process has been formulated,

[1] Chief Technical Adviser and UNDP Programme Officer

through which all development projects will be analyzed and appraised to ensure they are supportive of the national goals and strategies outlined in the NSDS. They emphasized that water is a major issue for Nauru and more effort is needed to address the water situation now. Thus much of the discussion was centered on what is already happening in the water sector. From the policy and planning perspectives of water sector, they indicated that there are three departments that are dealing with water in Nauru as follows:

a) Rain water harvesting – Planning and Policy Division. Also informed that AusAID and JICA would be providing rainwater-harvesting but did not provide details as to what such support would entail
b) Desalination – Public Utilities
c) Underground water – Nauru Rehabilitation Corporation

Aid Management

30. The Aid Management Unit (AMU) was established in 2003 with support from the Forum Secretariat. The Aid Management Unit will be responsible for coordinating development assistance received from development partners. Previously, coordination of development assistance was fragmented with each department dealing directly with donors without a coherent and coordinated framework. Under AMU, a transparent framework through which development assistance is coordinated will be established. This requires all projects intended for external assistance to be appraised and approved through the development-planning framework, before they are considered for donor assistance. This will ensure that all projects funded under external assistance are supportive of Nauru's national priorities.

31. AMU is very keen on the design and implementation of PACC activities in Nauru. To assist with the PACC process, AMU provided the PCT with a AID Management framework and policy which details the new developments in relation to AID administration in Nauru. This is an important development that would provide donors the framework needed for supporting Nauru.

Nauru Rehabilitation Corporation

32. This Corporation is tasked with rehabilitating the unused and wastelands that have been mined during the phosphate days. Led by its CEO is Mr. Vince Clodumar, the Corporation has two special projects including one on water and the other on waste management. In relation to water, the following activities would be carried out:

a) Drilling and testing of pollution monitoring boreholes;
b) Drilling of trial pumping boreholes;
c) Test pumping of the trial pumping boreholes
d) Water quality testing of groundwater samples
e) Groundwater monitoring programme
f) Trial excavation of trenches to water table under top side
g) Re-estimation of ground water recharge and sustainable yield
h) Groundwater development options

Environment

33. In the meeting with Mr. Tyrone Deiye, he suggested that coastal protection as a major issue for Nauru as there are "hot spots" as he puts it that had been identified. He also alluded to some work Mr. Star (Projects Manager) is currently implementing as part of a coastal protection programme for some communities on the island. The PCT briefed Mr. Deiye on the PACC programme and how it fits into the national development process as well as some of the requirements such as the co-financing aspect.

Agriculture

34. The PCT met with the Director of Agriculture Mr Warrick and the DSAP Officer for Micronesia Ms Mereseini Seniloli who provided information on the programmes currently on-going within the Agriculture sector and department. They further emphasized that all activities within agriculture sector are fully donor-supported including:

a) SPC DSAP – 3 year national scale food production program that provides district level nurseries (successfully feeding district projects) with seedlings. Food crop plantations operating successfully in each district.
b) AusAID – assistance provided to each household to set up kitchen gardens with water storage, seedlings and advice. Complementary assistance is provided in agriculture and aquaculture.
c) Taiwan/ROC support – provides assistance to agriculture and aquaculture initiatives for food production over 5 years. Complementary assistance provided by Taiwan/ROC in agriculture and aquaculture. Set up a Resource Centre for agriculture and aquaculture to provide producers with advice and manuals and also facilities for use of computer for down loading of relevant information.
d) FAO – 2 plus 7 year kitchen gardens program at the district level for households and livelihood. 20% of HH have successful operating kitchen gardens.
e) Commerce & Business Development: Commercially viable alternative livelihood ventures were established by FAO: piggeries, duck and poultry (egg production) and agricultural companies. Approximately 40% of local demand for pork and poultry products met from local production.

Nauru Fisheries and Marine Resources Authority (NFMA)

35. The PCT met with Mr Ross Cain the Secretary, NFMA, who briefed the Team on the coastal programmes currently being run from his department. He indicated that currently they are developing legislation on coastal protection which is currently in draft form and being reviewed by the Minister. He also mentioned that two experts from SPC visited his office last month and would be looking at ways to assist Nauru in their coastal programmes. At present there are no operational budgets for the department as is the case for many government departments in Nauru and outside assistance is very much needed. He also informed the PCT that he is not aware of any financial support from SPC at present and requested SPREP for any assistance with relation to coastal support.

Public Utilities

36. The Head of the Public Utilities Department informed the PCT that currently the department has a desalination plant and two reverse osmosis plants but are not operational as yet. The desalination plant had been out of operation for four years and the cost of repair could be prohibitive.

AusAID

37. The PCT held discussions with Mr. Doug Melvin, First Secretary of AusAID, who mentioned that under the Memorandum of Understanding (MoU) between the governments of Nauru and Australia,

Australia will be providing AUD 600,000 worth of support to Nauru in the area of food production and food security with particular focus on water. Mr. Melvin also mentioned that JICA would provide AUD 100,000 worth of water tanks to assist the Nauru communities increase their water storage capacity. The MOU provides the framework for development assistance in Nauru to be funded by AusAID. The MoU also provides the opportunity for Nauru to negotiate the type of development assistance it needs as opposed to AusAID dictating assistance from Canberra.

38. Given that the PACC objective is to increase resilience of the water sector, there is a need to look at alternative sources of water for Nauru. Currently, Nauru depends on two main sources of water: rainfall and desalination or Reverse Osmosis. In a scenario where there is inadequate rainfall or a prolonged drought in for Nauru, it is envisaged that the water situation would be significantly affected particularly if the desalination plants are not in operation as is the case at present. In the past, when Nauru was able to charter ships to import water from Marshall Islands, Solomon Islands and the State of Kosrae in FSM. This is no longer an option now due to the lack of financial resources. Thus, the best option is to look for alternative water sources such as ground water. Several assessments have been undertaken on ground water resources but further work is needed to ascertain the extent and the potential of the underground water resource.

Summary of discussion

a) There is a need to explore an alternative water source for Nauru. At present they are very vulnerable to changes in precipitation now and into the future. They rely solely on precipitation at present as a source of water as the desalination and reverse osmosis plants are out of action. Repairs for these plants cost millions and the Nauru government is still negotiating with AusAID for repairs. Hopefully these would be addressed sooner rather then later as the machines are rusting copiously.
b) It seems that a potential source of water for Nauru that had not been vigorously pursued is underground water. Studies have shown that this resource is available but further work is needed to make it available to the people.
c) Currently, JICA and AusAID are assisting Nauru to purchase water tanks and distributed to the communities therefore increasing the communities' water retention capacity. However, in the case of a short to long-term drought, the tanks would be redundant as there would be no source of water to refill the tanks.
d) The option of further inspecting the underground water for Nauru and developing it to be available for the people is an adaptation measure worth pursuing. There are already several studies already undertaken on underground water potential for Nauru and the most recent one was carried out by Mr. Tony Falkland in 2003. The report is very detailed in relation to activities that could be carried out plus costing. It should form a good basis of activities that could be supported by the PACC.

Wrap up meeting with Stakeholders

39. 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 Nauru 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 Nauru (PACC-NAURU).
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-NAURU pilot is around USD500,000 and available co-financing is estimated at USD1.6million. On-going development initiatives that targets water storage and water supply include planned annual government expenditures of AUD218, 000 as per budget; AUD 100,000 community water tanks by JICA; AUD 600,000 for water catchment & storage and AUD 900,000 for repairs to the power station; AUD 400,000 for ground water investigations and monitoring; and FAO regional food security programme with a package including water storage at USD 136,000.
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

40. A number of climate change programmes, projects and activities have been carried out in Nauru since the entry into force of the UNFCCC. Nauru implemented an enabling activity project on the preparation of its initial national communication under the UNFCCC and has completed a Phase II enabling activity project (top-up) under the Pacific islands Climate Change Assistance Programme (PICCAP). Nauru Island is also one of the sites where measurement of atmospheric radiation is beig carried out under an US Department of Energy's Atmospheric Radiation Measurement Programme (ARM) and the Nauru 99 campaign. Arm programme is aimed at the study of how the interactions of earth's oceans and its atmosphere cause global weather change. The Nauru Climate Research Station (ARCS II) is part of the Tropical Western Pacific (TWP) field site that is located in the "Warm Pool". The TWP, Cloud and Atmospheric Test bed (CART) area covers roughly 10^{o}N to 10^{o}S.

VULNERABILITY

41. Within the context of Nauru'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. 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 the coral reef and marine environment; coastal erosion; water resources; vegetation; and human health.

42. Currently there is relatively limited detailed information on climate change in Nauru, and like a number of its small Pacific Island neighbors Nauru reacts to situations such as water shortages when they occur. As a small island state (SIS), Nauru has limited resilience to climatic change and therefore the impacts tend to be more severe due to the lack of this natural ability to diversify.

43. Rainfall for Nauru during an El Niño episode will generally result in a wetter than average period. This period of maximum effect is from November to April and usually sees dramatic increases in normally dry areas along the equator and generally decreased rainfalls South West of the merged zone (Fiji). As noted above the pattern of change of El Niño is not fixed throughout the episode, but varies from month to month.

44. Tropical cyclones require specific oceanic and atmospheric conditions for initiation and maintenance and therefore occur only in certain parts of the globe. In the South Pacific, these conditions are associated with the major rainfall zones, and therefore during El Niño years they tend to shift eastward as do the shifts in rainfall zones. Hence in an El Niño year/s the incidence of tropical cyclones is higher. To date Nauru has not been significantly affected by cyclones. However rough to severe weather conditions have been known to occur on occasions (e.g. 1983).

45. Weather in general sees a weakening of the Easterly winds along the equator, sometimes accompanied by strong Westerly outbursts with high waves and hence coastal damage which has been noted in Nauru, Western Kiribati and Northern Tuvalu. Sea temperatures produce a fundamental oceanic signature of ENSO in a fan-shaped area where sea surface temperatures are significantly higher than normal. This extends eastwards from the dateline (180th meridian) along the equator and fans out to the coastline of the Americas. High surface temperatures are known to stress corals and affect fisheries, and this is significant for Nauru.

46. As with other SIDS, Nauru's water supplies are vulnerable to fluctuations in rainfall. The effect may be wide and varied, including the need to introduce desalination as has been the case in the past. Examples of externalities are, the need to truck / import water, increase of health risks, poor crops, etc. In Nauru brackish water is commonly used for sanitary purposes in homes and the two Hotels.

47. The agricultural and fisheries sectors can both be affected when rainfall averages and sea temperatures rise or fall significantly. The effects are often difficult to determine and have specific considerations for either domestic sector or the commercial / industrial sectors, while the risk of fire increases during drought periods, which are associated with the ENSO episodes. For Nauru this risk could be considered to be high considering the limited fresh water resource immediately available and the limited number of suitable points of access to the ocean for pumping seawater.

48. Health is mainly affected through the lack of adequate freshwater supplies which can lead to the higher incidence of water-borne infectious diseases such as typhoid and diarrhea, of which a number of cases have been reported on the island. In Nauru brackish water and seawater is commonly used for sanitary purposes especially in hotels and private housing. The environment in general can be affected during an ENSO episode through stressing a range of areas, lack rainfall, moisture, temperature and stress levels in lagoon, and unusual wave action on coastal zones and on coastal infrastructure.

49. Management of water catchments so as to maintain water quality while providing immediate human benefits in areas that already suffer seasonal shortages and helping to maintain environmental quality is of priority in terms of Nauru's sustainable development strategy. This could be achieved through integrated planning efforts involving community landholders, government departments or by legal or administrative restrictions on activities impacting on water catchments. Catchment management initiatives would have wider environmental benefits, including the maintenance of biodiversity and land productivity.

50. 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 for rainfall harvesting and extraction of groundwater resources would reduce the vulnerability of communities. Thus expansion of rainwater storage capacity, frequently through the installation of water tanks will reduce the vulnerability of communities in times of water shortage.

51. The vulnerability and adaptation assessment undertaken as part of the initial national communication process strongly suggests that the best adaptation strategy in Nauru would be a 'no-regrets' approach, emphasizing that adaptation measures which are consistent with the goals of environmentally, socially and economically sustainable development would help address and prepare Nauru for global climate change and sea-level rise. This can be done through the incorporation programmes on integrated coastal zone management (ICZM) and coastal protection, coastal forest protection and reforestation.

SECTORAL ANALYSIS

52. 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 Nauru were undertaken to determine detailed adaptation activities and baselines.

3.1 Methodology/criteria for selection of priority sector

53. 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 RON'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.

54. Apart from the use of criteria as outlined above in the selection of the priority for adaptation intervention, the weight of evidence regarding the water resources (demand and supply) pointed to a need for urgent action on dealing with water resource problem on Nauru. Information provided by various stakeholders indicated that water resource is considered a critical resource for sustainable development of Nauru. Although some activities are currently being implemented in the water sector with support from bilateral donors climate change issues are not being integrated into water resources management.

55. Findings of the stakeholder consultations were presented to the National Climate change Country Team by the PCT who emphasized the importance of the consultation process, the issues discussed, priorities indicated and the possible focal areas for adaptation intervention. The PCT also drew attention of the NCCCT to the application of the UNDP-GEF criteria for project development (as outlined above in para. 53). Based on the three criteria and the recommendations made on the focus of adaptation intervention by the stakeholders during the various meeting, and on all information the PCT had before it, water resources management was proposed as PACC project for adaptation intervention in Nauru.

56. The PCT then allowed time for further discussion as the pilot site was suggested as a proposal and it was the prerogative of the NCCCT to decide whether or not that site was consistent and aligned with the government's cyclone recovery and rehabilitation efforts. One of the issues raised was that given the requirement of GEF-funded projects for co-financing there was not enough flexibility to carry out adaptation activities in a sector or sectors other than coastal zones which may be more vulnerable and are of higher priority. Co-financing requirements undermine implementation of adaptation in sectors which may be highly vulnerable but which do not have sufficient co-financing.

57. The PCT explained further that while co-financing might be a limitation in proposing adaptation activities for GEF funding in other areas, PACC pilots would provide valuable lessons which can be incorporated into adaptation activities in other areas of priority in the future. PCT further indicated that opportunities exist for developing further proposal for possible funding through various adaptation funds established by the UNFCCC and managed by the GEF.

Thematic Area for Adaptation

58. Based on these three criteria and on the stakeholder consultations (see section 2.2) **Water Resources Management** is the proposed area of intervention for PACC-Nauru. Under this theme, an adaptation project entitled ***"Piloting climate change adaptation in water resources management in Nauru"*** was being planned. This project would focus on enhancing, and where necessary, developing groundwater resources and water infrastructure for 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. Communities/villages are already adversely affected by the changes in rainfall regimes (associated with extreme events) which affect the quality and quantity of potable water.

59. 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

60. Water Resources Management is underpinned by the National Sustainable Development Strategy 2005-2025 and the National Water Plan 2001 as well as the desire to reform the Power and Water Straetgy 2006 within RON's Public Utilities sector.

61. Preliminary estimates of groundwater recharge were made by Jacobson and Hill (1988) who estimated that an average recharge rate was approximately 40% of average rainfall, or about 800 mm per year in Nauru. However, using a water balance model and monthly rainfall data, the average recharge rate is most likely to be higher than this value (approximately 50% of rainfall or about 1,000 mm per year), although annual recharge in some years can be zero owing to very low rainfall conditions and ongoing evapotranspiration. For instance, in the three year period 1998-2000, it was estimated that recharge was zero. Thus accurate estimation of recharge is essential for an assessment of the sustainability of the groundwater resources.

62. A water balance model using daily rainfall and estimates of evapotranspiration has been recommended to be used to generate a sequence of estimated monthly recharge values. The water balance model should be applicable to small islands and should use all available daily rainfall data. Evaporation or climatic data, if available (e.g. from the Atmospheric Radiation and Cloud Station (ARCS-2) site adjacent to the Nauru General Hospital), should also be used to estimate potential evapotranspiration for inclusion in the model. If the data is not available, a climate station should be positioned in the centre of the island.

63. To assist with the recharge study, it is recommended that an automatic (tipping bucket) rain gauge be installed in the middle of the island. Water level and salinity sensors equipped with data loggers should be installed in selected boreholes to assess recharge conditions and salinity at the water table. In addition, soil moisture sensors should be installed at selected depths in dug pits to determine the rate of vertical migration of rainfall through the soil profile.

64. Analysis of rainfall and water level/salinity data will enable the recharge to groundwater to be more accurately assessed. In particular, the response time between rainfall and groundwater level increases can be determined. This will help in calibrating the water balance model to estimate the monthly series of recharge values. In turn, this will assist with the estimation of sustainable yield.

65. Groundwater modelling studies by Ghassemi et al (1990; 1993; 1996), using the data from Jacobson and Hill (1988) concluded that low-yield boreholes would be able to sustainably provide fresh groundwater from the centre of the island. In a summary of this work, Jacobson et al (1997) concluded that 8 low-yield boreholes (at one L/s each), spaced one kilometre apart could supply freshwater. The total is equivalent to approximately 700 kL/day (shown as 400 kL/day in the report).

66. WHO (2001) made a preliminary assessment of groundwater yield on the basis of estimated recharge in average and drought years. The minimum yield was estimated to be 380 kL/day for a drought year (rainfall of 400mm). Further, the yield was estimated at 850 kL/day during a year with 1 in 5 year rainfall and 500 kL/day during a year with 1 in 10 year rainfall. However, these calculations do not take account of inter-annual groundwater storage, which may enable a larger amount than the minimum to be extracted in drought years, provided the groundwater storage is sufficiently large. Sustainable yield estimation should take account of groundwater storage.

3.3 Current institutional and development baseline

67. The key players in the provision of water supply and resource management in Nauru are: the National Phosphate Commission for the establishment and operations of a desalination plant; the Nauru Works and Community Services for distribution of water supply to residents and business; the Department of Health for testing and monitoring water quality, and, the Nauru Rehabilitation Corporation for data collection of wells and aquifers. Additionally the national Department of Economic Development coordinates water sector activities including project proposals and liaison with donors and aid agencies.

68. The freshwater resources of Nauru are contained in Buanda lagoon, a landlocked, slightly brackish freshwater lake located in the southwest of the island on the plateau. Groundwater from the underlying lens is considered extensive, with the result it has been tapped by several hundred household wells to supplement the main source of potable water supply from desalination. A plant commissioned by the government from the National Phosphate Commission (NPC) provides desalinated water using waste heat generated from its power station. Water is delivered by truck to individual households and commercial storage tanks.

69. When the plant is not in operation due to maintenance or breakdown, the island faces severe water shortages and an increased reliance on the groundwater sources for supply. The drought from 1998 to 2001 stretched the water resources on the island and highlighted the urgent need for a sustainable water supply system. The drought resulted in overuse of the lens and a decline in water quality, leading to rising health and environmental issues due to soakage from household sewage pits into the increasingly brackish and contaminated groundwater.

70. Nauru is facing major economic difficulties as it dependency on phosphate-processing winds back in the next decade. With increased diesel costs to maintain the NPC power plant, it is becoming increasingly difficult to meet daily water needs of potable drinking water for the island population. At the request of the Ministry of Health, a draft Water Plan was commenced in 2002 with the support of WHO. The draft plan identified a range of priority actions including feasibility studies on an underground gallery for rainwater storage from airport runway run-off, establishment of a secondary desalination plant, extraction from the fresh surface layer from the groundwater lens (if possible), installation of groundwater monitoring wells and clear delineation of the extent of underground resources so as not to risk over pumping. Most of the water resources information available is some 20 years old and needs urgent updating to indicate data on safe yields, water quality and other important monitoring and assessment data. Finalization of the Water Plan including continued public awareness on the fragility of the islands resources is a major water resource priority.

71. With respect to groundwater resources Jacobson and Hill (1988) provide most of the current knowledge about Nauru's groundwater resource, which occurs in the form of a thin freshwater lens at and slightly below sea level. Further information is provided in Jankowski and Jacobson (1991) and Jacobson et al (1997). As reported in Jacobson and Hill (1988), a groundwater investigation including a drilling program was conducted by the British Phosphate Commission in the mid 1960s (BPC, 1965), but the results were apparently inconclusive according to a report by AGC (1972).

72. Groundwater conditions under Topside were investigated in 1987 using a combination of methods (drilling, geophysics, water testing) and the conclusion was that a thin freshwater lens up to 7m thick is present (Jacobson and Hill, 1988). In all, 12 boreholes were drilled to depths varying between 26m and 83m below ground surface (and between 1m and 55m below water table). Three of these

boreholes were completed as open-hole piezometers with 40mm PVC casing to enable water level measurements. The other holes were not completed owing to cavernous ground preventing the installation of casing. Geologic logs with data showing the salinity (in electrical conductivity or EC units) of water obtained during the drilling process are shown in Jacobson and Hill (1988) and Jacobson et al (1997).

73. Based on the data obtained during drilling, cross-sections of Nauru's groundwater conditions are presented in the above two references. These cross-sections indicate that a discontinuous layer of freshwater up to 7m thick is found under about 3.7km2 of the island. According to the authors, there are two thicker areas of the freshwater lens. The average freshwater lens thickness, as determined by intersections at 11 boreholes, is 4.7m. Below the freshwater layer it was reported that a transition or mixing layer of up to 60m thick exists, below which seawater occurs. This thickness, as the authors note, is unusually thick. This thick transition layer is attributed to intrusion of seawater in major fractures within the limestone. Jacobson and Hill (1988) estimated average recharge as 40% of rainfall. Using this estimate, the average annual recharge is approximately 800mm, or 40% of the average annual rainfall of about 2,000mm.

74. The groundwater head was estimated to be 0.2m above mean sea level at several boreholes. The tidal efficiency is approximately 50% and the tidal lag is approximately 1.5 – 3 hours. The relatively large tidal efficiency (ratio of groundwater to sea level fluctuations) indicates a high hydraulic conductivity of the limestone. Electrical resistivity soundings were also made and the results tend to support the freshwater lens thickness measurements obtained from drilling. This method is, however, only approximate and, as the authors note, the freshwater layer cannot be determined precisely. Groundwater modelling using two (2D) and three dimensional (3D) solute transport models has been applied to the Nauru groundwater system (Ghassemi et al, 1990; 1993; 1996; Jacobson et al, 1997). Adopted hydraulic conductivities were 900 m/day (2D) and 700 m/day (3D). The results of the modelling showed that pumping from vertical boreholes at a rate of about 1 L/s per borehole would be sustainable from a borefield consisting of 8 production boreholes near the centre of the island.

75. Groundwater salinity in selected wells within the coastal margin is reported in Jacobson and Hill (1988) and Jankowski and Jacobson (1991). They measured salinity in terms of total dissolved solids (TDS) at 22 coastal wells in October 1987. The range of TDS for these samples was 290 to 3,245 mg/L, indicating a range from fresh to brackish water. Twelve of the 22 samples (approximately half) showed TDS less than 1,000 mg/L, which is the current WHO drinking water guideline limit (WHO, 1993).

76. Salinity tests were undertaken at four wells on 31st October 2002 during a recent visit (Falkland, 2002) using a portable salinity (EC) meter (refer Table 1). All results indicated freshwater at the water table (EC less than 1,400 µS/cm, which is equivalent to WHO drinking water guideline value of 250 mg/L chloride ion concentration or 1,000 mg/L TDS (WHO, 1993)). Three of the four wells tested had freshwater at the base of the well while one showed mildly brackish conditions. Salinity data in terms of electrical conductivity (EC) and chloride is available for many wells on the island in record books kept at the NPC Laboratory (visited on 31st October). These salinity tests are conducted as part of a set of water chemistry tests when householders bring samples from wells to the laboratory (at no charge to the householder). Other parameters tested are pH, alkalinity, total hardness, sulphate and phosphate. The accuracy of the results is not known.

77. In a report by WHO (2001) a number of possible threats groundwater pollution have been identified. These include the following:

a) Seawater intrusion due to over-pumping.
b) Contamination by leaks from seawater sewerage systems.
c) Contamination by sewage and other wastewater.
d) Leachate from garbage and waste dumps.
e) In addition, there is potential for hydrocarbon contamination from sources (e.g. bulk fuel tanks) in the Aiwo district. This may also be an issue in other parts of the coastal margin (e.g. near fuel tanksat service stations).

78. Over-pumping is considered to be the cause of saline intrusion into private wells in the coastal margin (Jacobson and Hill, 1988). The extent of this problem is not well known as there are no meters on these pumps. The occurrence of saline intrusion can also be due to natural influences. Seawater contamination can also occur in the NPC area due to leaks from the seawater reticulation pipe system and possible overflows from the tanks. Again the extent of the problem is not known.

79. Contamination of groundwater by sewage and other wastes (e.g. greywater and animal wastes) is a concern. Tests of water samples undertaken at the hospital laboratory using the MPN Index method are reported to show evidence of pollution in many wells. Most samples are reported to have MPN greater than 23, indicating evidence of pollution, while some have MPN greater than 1100, indicating gross pollution. This data was not readily available in a database format. It would be most useful if the historical data could be entered into an appropriate database for future use.

80. Leachates from rubbish disposal areas and waste dumps (e.g. cadmium slimes dump on Command Ridge) are possible further sources of groundwater contamination. These sites are not lined and pollutants can easily move through the porous soils and underlying limestone to the groundwater table. There are no groundwater monitoring boreholes to assess potential groundwater impacts at these sites. Based on water samples from 4 sites tested for radioactive elements in 1994, Jacobson et al (1997) reported that the total alpha radiation at one site (Buada lagoon) was slightly above the WHO guideline value for drinking water and hence was a health concern. Total beta radiation was much less than the WHO guideline value.

81. Much effort has already gone into the study of the groundwater resources of Nauru, most notably the drilling program in 1987. A number of comments and issues pertinent to water resources in general and groundwater resources in particular have been outlined in various reports (e.g. Falkland 2002), including:

a) Some uncertainty surrounding the validity of the estimates of fresh groundwater thickness from the drilling program. Jacobson and Hill (1993) noted that “some difficulty was experienced in differentiating groundwater from drilling water which was used in the section of the borehole above the aquifer”. This may have caused the groundwater salinity (electrical conductivity) readings to be in error. As the salinity of the drilling fluid is not stated in Jacobson and Hill (1993), it is not known if this mixing would have caused the samples obtained from various depths to have higher or lower salinity than the actual groundwater. While open holes, such as those drilled in 1987, are suitable for water level measurements, they are not suitable for accurate groundwater salinity profile measurements in freshwater lenses because of the inevitable mixing of freshwater and underlying saline water. This mixing can occur as a result of mechanical dispersion caused by sea level movements forcing the water in the borehole to regularly rise and fall. For accurate salinity monitoring, multi-level piezometers are required.
b) No water level monitoring data available from the three observation holes since the time of drilling. In 2000, NRC was unable to find these boreholes in order to monitor the

groundwater levels (or salinity). It appears they may have been removed or covered during subsequent mining operations.

c) No subsequent monitoring data to suggest how the freshwater lens has responded to wet and dry cycles associated with El Niño and La Niña episodes. Such data from properly constructed monitoring boreholes is essential for long-term management of groundwater resources (freshwater lenses) on small coral and limestone islands.
d) The lack of any subsequent monitoring data (groundwater level or salinity), it is not possible to assess the long-term sustainability of the freshwater lens from the available data and no means at present of assessing water quality impacts from known and potential pollution sources on the groundwater underlying Topside, except for some wells surrounding Buada Lagoon. The wells in the coastal margin provide a means of assessing local groundwater pollution but not necessarily any groundwater pollution that has occurred under Topside.

3.4 Impacts of climate change on the priority sector

82. Previous work on vulnerability and adaptation assessment provides pertinent information on the impacts of climate change and sea-level rise in Nauru. Projected sea-level rise can affect the groundwater by saltwater intrusion and loss of land from coastal erosion or flooding associated with climate extremes.

83. A decrease in rainfall can directly affect water supply as much of its potable water is from rainwater harvesting. Decrease in rainfall can also 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. Increase in sea-level will also affect agricultural production and water resources through salination of freshwater and land loss.

84. Much of the infrastructure and socio-economic activities in Nauru are located near or on the coast which makes them highly vulnerable to effects of climate change and sea-level rise. 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.

85. Nauru 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.

3.4 Methodology for assessing priority baseline

86. The estimated demand for water is 1,500 tonnes per day (1500t/d) which is supplied from rainwater and two reserves osmosis plants (2RVO) which produce 240t/d. The desalination plant with an estimated 950t/d is no longer operational. Thus currently water supply does not meet the demand indicating that water rationing and importation may be necessary measures.

87. Additionally the current water supply is not able to fill the existing and pipeline water storage capacity and therefore will continue to be extremely vulnerable to the impacts of climate change as rainwater and drought fluctuates.

88. Cost-recovery for the supply of water is not much different. Utilities currently charge around AUD $3 for the delivery of 1,000 gallons of water to a customer's premises. However, the consultant estimates that the cost of production and delivery is closer to AUD $27 per 1,000 gallons. Poor cost-recovery, brought about by a lack of adequate financial and operational systems, means that utilities frequently lack necessary funds to provide for their ongoing operational costs, such as spare parts and additional diesel for power generation. This creates an ongoing problem for the regular and reliable supply of services, and with a limited revenue base, means that Nauru is dependent on development partners in times of cash shortages.

89. Deterioration in reliability in the supply of utility services in Nauru is fundamentally due to years of equipment neglect brought about by a lack of regular maintenance. As well, many of the water and fuel storage tanks on the island are well beyond their useful life, and the power and water distribution infrastructure is in urgent need of repair and/or replacement.

90. The focus on water resources management in Nauru is consistent with the RON's policy on improving water infrastructure and facilities with the aim of improving the livelihoods of its communities. Additional adaptation activities increase the resilience of communities and government 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 RON, 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).

91. The pilot will focus on extracting groundwater for Nauruans who rely solely on precipitation as a source of water. (The desalination and reverse osmosis plants that once served the island are out of action and rusting). The current water supply is not able to meet estimated demand of 1,500 tonnes per day (1500t/d) as current supply is only 240t/d from rainwater and desalination. This makes water resource sector extremely vulnerable to the impacts of climate change as rainwater and drought fluctuates. In relation to the national development baseline, the government with Japanese and Australian assistance is distributing water tanks to the communities therefore increasing the communities' water retention capacity. However, in the case of a short to long-term drought, the tanks would be redundant as there would be no source of water for refill. The option of making the groundwater available for the people is an adaptation measure worth pursuing. Several studies have been carried out on underground water potential along with activities that could be carried out plus costing.[2] The studies provide a basis for activities that could be supported by the PACC.

IV. MECHANISM FOR DELIVERY OF FSP

4.1 Institutional arrangements

92. All climate change programmes, projects and activities are being coordinated by the Department of Environment which 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. INC and phase II enabling activity). However based on the policy and institutional context it is proposed that PACC-NAURU will be implemented by the Aid Management Unit in close collaboration with the Projects Office, CIR and

[2] Tony Hughes Report

NRC. The main partners in this project will include Nauru Rehabilitation Corporation, Department of Power and Utilities, Department of Policy and Planning, Department of Environment, Department of Agriculture, and Aid Management Unit.

93. At the national level, PACC-NAURU will be implemented by various stakeholders within their respective mandates while scientific, technical and policy oversight will be provided by the National steering Committee (NSC). The NSC will comprise representatives from various government ministries, agencies and institutions. The project management unit (PMU) will be located within the Projects Office, CIR who will also serve as secretariat to the NSC on matters relating to PACC-NAURU.

4.2 Assessment of existing and potential barriers to implementation

94. PACC-NAURU is underpinned by RON policy and regulatory framework and its National Sustainable Development Strategy 2005-2025 which aims to ensure sustainable use of natural resources as a critical component of its current development strategy.

95. A number of climate change enabling activities (e.g. national communication and Phase II enabling activities) 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-NAURU. Some of these barriers include, competing demands on staff time, inadequate staff resources, equipment, and lack of incentives.

96. 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.

EXPECTED GOAL, OUTCOMES, OUTPUTS AND ACTIVITIES

97. 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 Nauru focusing on sustainable use and management of water resources. This project will also focus on enhancing, and where necessary, investigating and monitoring the use of groundwater resources.

Goal:

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

Specific Objective:

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.”

Specific Outputs:

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

Output 2.10.1a Practical guidance to design and demonstrate a hybrid water supply system to reduce vulnerability to drought events.

Output 2.10.1b Hybrid water supply system (with co-financing support).

Description:

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

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 2.10.1a Practical guidance to design and demonstrate a hybrid water supply system to reduce vulnerability to drought events.
Output 2.10.1b Hybrid water supply system (with co-financing support).

76. This output will assist the Government of Nauru and key stakeholders to develop their capacity to design and demonstrate alternative water and energy sources to reduce vulnerability of current water supply. Nauru depends largely on precipitation and desalinisation. With current high cost of crude oil in the global market and the economic problems plaguing Nauru, desalinisation is very costly to Government thus the need to investigate other sources of water. This will involve exploring underground water sources and alternative energy options to power the two reverse osmosis plants that are currently operating in Nauru. It will also involve adaptive storage design and climate proofing of current water networks. PACC will also explore the option of storage systems (non-tank) with alternative livelihood options (e.g. fishstock cultivation).

77. Desalination and a reverse osmosis plant that once served the island are out of action and rusting. Current supply comes from two reserve osmosis plants (2RVO), which produce 240t/d. The current precipitation and storage capacity is not able to provide the water supply that is needed which is estimated at 1,500 tonnes per day (1500t/d). This makes the water resource sector in Nauru at present already extremely vulnerable to drought due to decline in precipitation. Nauru has a total land area of 22 km^2 (2200 ha) and a population of 13,287. The island is surrounded by a fringing coral reef between 120 and 300 meters wide which drops away sharply on the seaward edge, to a depth of about 4,000 meters. The Government of Nauru has set-aside USD$1.9m to undertake borehole drilling and pumping trials on the topside part of the island as part of its quest for an alternative source of water. The PACC project would assist Nauru to address this vulnerability by developing practical guidance to design and demonstrate a hybrid water supply system for Nauru to reduce vulnerability to drought events. Activities to be undertaken would include:

- Develop a guide to design and demonstrate a hybrid water supply system to reduce vulnerability to drought events.
  - Develop a disaster risk management plan focused specifically on adaptation to droughts;
  - Water efficiency and adaptive storage design designed, evaluated and demonstrated
  - Combine storage systems (non-tank) with alternative livelihood options (e.g. fishstock cultivation);
  - Community-based assessment of vulnerabilities to drought events using climate models and Meteorological data and identification of adaptation options
  - Design and implementation of a program and activities to increase water storage capacity for underground water;
  - Design and develop a GIS database of water networks;
  - Establishing groundwater monitoring programme including conducting recharge and yield analysis.
  - Determine viability of using alternative energy sources to power Reverse Osmosis/Desalinisation plants.

PROJECT LOG FRAMES AND INDICATORS

Project Log Frame and indicators for Nauru 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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ANNEXES

Letter of Co-Financing (to be attached)