

NORTH TARAWA CONSERVATION AREA

South Pacific Biodiversity Conservation Programme

Project Preparation Document

Environment Unit

Ministry of Environment and Social Development

Bikenibeu, Tarawa

Republic of Kiribati

December 1995

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FOREWORD

It is with considerable pleasure that I forward this Project Preparation Document for the North Tarawa Conservation Area to the South Pacific Regional Environment Programme. This represents an important step in the Republic of Kiribati's desire to promote the sustainable utilisation of the marine and terrestrial resources of North Tarawa, one of the most important fishing areas in the Republic of Kiribati.

I feel that the approach we have taken towards biodiversity conservation is an appropriate one for Kiribati. By including a cultural component in the definition of biodiversity, the suggested activities of the North Tarawa Conservation Area Project (NTCAP) can reinforce our traditional use and appreciation of plants and animals of our atoll and ocean environment.

In the following pages we attempt to present information on the growing international interest in biodiversity, relate this to the South Pacific Biodiversity Conservation Programme, and discuss the rationale for selecting North Tarawa as a Conservation Area. We then attempt to summarize information on biodiversity in North Tarawa and on demographic, economic and institutional factors related to environmental management and sustainable development in Kiribati. Finally, the details of activities to conserve biodiversity identified by pilot communities in North Tarawa are provided.

Although the NTCAP is ambitious, the Ministry of Environment and Social Development and the communities of North Tarawa believe it is workable. We feel this way because of its community driven nature, the commitment of North Tarawa's leaders to the project, and the compatibility of the project methodology to the Kiribati way of life.

Finally, I wish to take this opportunity to express the sincere thanks of the Government of the Republic of Kiribati to SPREP and the South Pacific Biodiversity Conservation Programme for their support of the objective of biodiversity conservation as a basis for sustainable development in both Kiribati and the Pacific Islands. I would also like to thank those people who have contributed their time and ideas to help in the completion of this Project Preparation Document. Finally, particular thanks are due to the people of North Tarawa, whose enthusiasm and commitment remains the most important ingredient for establishment of their islets, lagoon and ocean as a conservation area and a model for sustainable development for the benefit of future generations of I-Kiribati.

Te Maori, Te Roi e Te Tabemoa

The Honourable Timbo Keariki
Minister of Environment and Social Development

ACRONYMS AND ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau (now AusAID)
AMAKAia	Maea Ainen Kiribati
CA	Conservation Area
CACC	Conservation Area Coordinating Committee
CASO	Conservation Area Support Officer
EEC	European Community
EEZ	Exclusive (Extended) (200-mile) Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Nino (Ninyo) Southern Oscillation
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	Environment Unit
FFA	Forum Fisheries Agency
FSP	Foundation for the Peoples of the South Pacific
GDP	Gross Domestic Product
KTFE	Kiribati Task Force on the Environment
MENRD	Ministry of Environment and Natural Resources Development
MHARD	Ministry of Home Affairs and Rural Development
MHFPSW	Ministry of Health, Family Planning and Social Welfare
MCTC	Ministry of Transport, Communication and Tourism
MWE	Ministry of Works and Energy
KTFE	Kiribati Task Force on the Environment
NEMS	National Environmental Management Strategy
NGO	Non-Governmental Organisation
NOAA	US National Oceanic and Atmospheric Administration
NTCA	North Tarawa Conservation Area
NTCAP	North Tarawa Conservation Area Project
PEDP	UNDP Pacific Energy Development Programme
PIDC	Pacific Island Developing Countries
PPD	Project Preparation Document
PUB	Public Utilities Board
RERF	Revenue Equalisation Reserve Fund
SOPAC	South Pacific Applied Geoscience Commission
SPRMTCP	South Pacific Regional Marine Turtle Conservation Programme
SPBCPS	South Pacific Biodiversity Conservation Programme
SPC	South Pacific Commission
SPREP	South Pacific Regional Environment Programme
TLMP	Tarawa Lagoon Management Plan
TOGA	Tropical Oceanic Global Atmosphere Programme
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNICEF	United Nations Childrens Fund
USAID	United States Aid in Development
USP	University of the South Pacific

EXECUTIVE SUMMARY

The North Tarawa Conservation Area Concept

The Government of the Republic of Kiribati has formally proposed to the South Pacific Regional Environment Programme (SPREP) that the islets, lagoon and reefs of North Tarawa Atoll be designated a Conservation Area under the South Pacific Biodiversity Conservation Programme (SPBCP). The proposal for a "North Tarawa Conservation Area Project" has been approved, subject to the completion of a detailed Project Preparation Document (PPD). This document constitutes the PPD.

The main emphasis of the North Tarawa Conservation Area (NTCA) will be the encouragement of sustainable development while simultaneously protecting important marine and terrestrial ecosystems and species. Associated activities include the provision of information, development of regional policy and educational programmes. The NTCA will therefore differ substantially from a conventional protected area or reserve in which human activities are discouraged.

In the initiation and planning of the NTCAP, local communities must play an integral role, agreeing to participate in its development and implementation. Once the NTCA is established, it should be community driven and owned and reflect the on-going wishes and desires of the local people, with local communities ultimately taking over the administration and management of the CA.

North Tarawa was selected for designation as a CA by the Government of Kiribati for several reasons: 1) the area's wide range of terrestrial and coastal habitats; 2) the unusually high biodiversity and resource richness of the adjacent lagoon waters and coral reefs; and, 3) the area's proximity to South Tarawa, which is Kiribati's only urbanised region and which exerts strong non-local pressures on the exploitation of resources, particularly the marine resources, compared with the pressures on other Outer Islands of the country.

Biodiversity and Biodiversity Conservation

The way in which the concept of **biodiversity** is defined is central to the success of the project. The "biodiversity" of North Tarawa includes all terrestrial and marine ecosystems, all plant and animal species and varieties found in these ecosystems, and the knowledge, uses, beliefs and language that the people of North Tarawa have in relation to their ecosystems and species. According to this definition, which includes a cultural dimension, the "biodiversity" of even the smallest North Tarawa community is considerable. "Biodiversity" in the context of this project is therefore not just a matter of scientific, economic, recreational or ecological value. It is the "capital" on which development and maintenance of the local communities is based.

In the context of the SPBCP, **biodiversity conservation** is seen as synonymous with sustainable use. It is argued – based on the experiences of other areas of the world – that if the biodiversity of North Tarawa is not conserved or used on a sustainable basis, and if traditional sustainable management practices, and the knowledge and relevant language are not maintained

or strengthened, then forms of modern development by themselves may prove inadequate to sustain the people in the long term. It is the resource owners and users at the community level who hold the long-lasting key to biodiversity conservation.

The Kiribati and North Tarawa Environment

The Republic of Kiribati has a total land area of only 822.8 km². It consists of 33 islands in three main groups - the Gilbert Islands (formerly part of the British Gilbert and Ellice Islands Colony and known locally as Tungaru) in the west, the Phoenix Islands in the centre, the Northern and Southern Line Islands to the east, plus the single island of Banaba, 400 km to the west of the Gilbert Islands. The islands are extremely isolated and fragmented, covering an ocean area of some 13 million km² between 4 deg 43 min N and 11 deg 25 min S latitude and 169 deg 32 min and 150 deg 14 min W longitude. There is, thus, very limited land area, spread over millions of square kilometres of deep ocean.

The main Gilbert (Tungaru) group, consists of 16 small atolls or limestone islets extending 640 km from north to south. Some 93.3 per cent of the population of 72,298 live in the Gilbert Group, which makes up only 278.4 km² (33.8 per cent) of the total area. The islands, of the group, from north to south, include, Makin, Butaritari, Marakei, Abaiang, Tarawa, Maiana, Kuria, Aranuka, Abemama, Nonouti, Tabiteuea, Onotoa, Beru, Nikunau, Tamana and Arorae. All are true atolls with central lagoons, with encircling islets of varying size and shape, except Makin, Kuria, Nikunau, Tamana and Arorae, which are slightly raised limestone islets or "table reefs" with no lagoons. Tarawa, the most populous island, where the capital is located, has islets with an estimated area of 19.9 km², extending over 64 km from north to south. North Tarawa accounts for about two-thirds (12.7 km²) of this area.

In general, on the ocean side of atolls like North Tarawa, there is an uplifted fringing limestone reef in the wave zone, which may be covered by a sandy beach. This runs up to a raised rampart or shingle ridge of wave-washed boulders and coral fragments deposited during storms. This ridge is commonly the highest portion of the island, or of the individual islets that comprise the atoll, and no more than 3 m above mean sea level. Inland of the rampart and extending towards the lagoon is an area of windblown sand and debris. Near the lagoon shore, the increasingly finer deposits are of lagoonal origin. Limestone outcrops with little or no soil and low-lying swampy areas are commonly found on islets.

In the case of North Tarawa, on the lagoon side, there is a narrow to very wide intertidal or foreshore area of fine sand which is exposed at low tide. This area constitutes one of the most important fishing grounds for "reef gleaning", mainly for a wide range of shellfish. Farther from shore, the bottom drops off to the deeper parts of Tarawa Lagoon. On the ocean side of the fringing limestone reef is an intertidal fringing reef that gradually drops off into the ocean. This is also an important fishing and gleaning area, with many fisherman diving or taking their boats and canoes over the reef edge into the open ocean or to dive on the outer edge of the reef or on the reef slope.

Between the individual atoll islets are passes or reef channels through which small boats and fish and marine larvae are flushed with the changing tides. Although important to the

ecology of the lagoon, the channels are obstacles to transportation between islets. As a result, a major development priority over the past thirty years has been to link individual islets with a system of causeways. Unfortunately, there is strong evidence that causeways inhibit the spawning cycles of bonefish and a number of other important shellfish and finfish species.

Water Resources

The only permanent freshwater resource on atolls is groundwater in the form of a "lens" of often slightly brackish freshwater, hydrostatically "floating" on the higher-density saltwater beneath the island. The height of the lens above sea level and the level of salinity vary in relation to the elevation, shape and width of islets and the amount of water use and rainfall. In the case of Naa Islet, a small islet at the northern end of North Tarawa, the lens is very poorly developed. Replenishment or recharge of the lens is solely by rainfall. In areas where the lens is close to the surface, pools are often found during excessively wet periods, especially during high tides.

The location and degree of development of the groundwater resource influences the nature of the vegetation as well as the location of village wells and cultivation pits. The quantity and quality of groundwater and the habitability of islands is severely affected during times of extended drought. This is particularly true on Naa.

Soils

The atoll soils of Kiribati are very infertile, being young, shallow, alkaline, coarse-textured and of carbonatic mineralogy. Because of their immaturity, they vary little from the original coral-limestone parent material overlaying the limestone platform. They range from 25 cm to 1 m or deeper, with some accumulation of clays and H²S near the centre of islets near the water table. Potassium levels are often extremely low, and pH values of up to 8.2 to 8.9 and high CaCO³ levels make scarce trace elements, particularly iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn), unavailable to plants. Activity of soil micro-organisms is limited, soil water-holding capacity is very low because of coarse texture, and ground water is often saline. Fertility is highly dependent on organic matter to lower soil pH, to capture and recycle plant nutrients, and to retain soil water. These characteristics make conventional agriculture, as practiced on other larger Pacific islands, almost impossible in Kiribati.

Although the level of organic matter can be relatively high in undisturbed soils under natural vegetation, it can decrease dramatically as a result of clearance by fire or replacement by coconut plantations or other introduced plants.

Climate

Kiribati is located in the dry belt of the equatorial oceanic climate zone, with mean daily

temperatures ranging from 26 to 32°C, with the recorded highs and lows being 22 and 37°C. Annual rainfall is extremely variable, both annually and between islands, with annual averages in the Gilbert group ranging from about 1000 mm for the drier islands such as Arorae and Tamana near the equator to 3000 mm for the wetter islands such as Butaritari in the far north, and 1,550 mm on Tarawa. The natural vegetation and crops are, consequently, much more luxuriant on islands like Butaritari and Makin in northern Kiribati than on the islands farther south.

Vegetation and Flora

The indigenous vegetation and flora of the atolls of Kiribati are among the poorest on earth. The coastal strand, mangrove, and inland forest vegetation of Kiribati has been severely modified due to: 1) thousands of years of habitation and selective removal of indigenous species for construction, boatbuilding, firewood, and other purposes; 2) the expansion of monocultural coconut groves for export production of coconut oil and copra; 3) the expansion of coastal settlements, which in urban South Tarawa, occupy much of the coastline; and, 4) the foraging pigs in inland sites and along beach flats. It is crucial to sustainable development and the cultural survival of the people of Kiribati that the uniquely adapted and culturally useful vegetation and flora be protected and enhanced.

The terrestrial vegetation associations of atoll Kiribati are limited to: 1) coastal strand vegetation; 2) limited areas of mangroves and coastal marsh vegetation; and, 3) relict stands of inland forest. Secondary and cultural vegetation associations include: 4) coconut-palm-dominated agricultural lands, including giant swamp taro or babai pits, under various stages of cultivation and fallow; 5) houseyard and village gardens; and 6) extensive and variable areas of ruderal vegetation. There is virtually no remaining primary inland forest in North Tarawa, with all of it, except for the rare relict stand or individual tree, having been replaced by coconut-dominated vegetation associations.

The flora of the Gilberts group consists of approximately 306 species, of which only 83 are possibly indigenous. None are endemic. The balance is made up of ornamentals, weedy exotics, food plants, and a limited number of other useful cultivated plants. Although greatly outnumbered by exotics, indigenous species still dominate some of the most disturbed habitats, as well as constituting most of the culturally and ecologically important species. A large proportion of these indigenous species (40 of 83 for the Gilberts) are severely restricted in distribution, endangered or possibly extinct, due to removal and severe habitat modification or limitation.

Environmental (ecological) functions that plants provide include shade, animal and plant habitats, soil improvement, material for mulching, land stabilization, and protection from wind, erosion, flood and saltwater incursion, and the desiccating effects of salt spray. Of particular value are mangroves, which contribute either directly or indirectly, through primary and secondary productivity, to the nutritional requirements of a high proportion of marine food species.

Atoll plants possess great cultural utility, having uses that range from medicine and

general construction through body ornamentation to mulching, fish poisons and musical instruments. Preliminary analyses of available data on Kiribati indicate 170 uses for 29 indigenous species and 104 uses for 39 exotic species. This gives a total 274 uses for 68 species, a clear indication of the cultural utility of plants in Kiribati.

Particularly important are the traditional food and beverage crops, the replacement of which by imported foods such as sugar, white rice and flour, softdrinks, alcohol and tea has led to dangerous levels of food dependency and some of the highest incidences in the world of vitamin and mineral deficiency and nutrition-related diseases. Diseases such as iron-deficiency anaemia, night blindness induced by vitamin-A deficiency, diabetes, cardiovascular disease, hypertension and stroke, gout and hyperuricemia, some forms of cancer and dental disease, which were rarely encountered in the past are now serious causes of morbidity and mortality in Kiribati, and among other atoll populations.

Terrestrial and Marine Fauna

There are probably no indigenous land mammals in Kiribati, with the Polynesian rat (*Rattus exulans*) plausibly being an aboriginal introduction. The main indigenous land animals consist of birds, insects and some land crabs. With the exception of a few bird species introduced by humans, most birds are either sea birds or migratory species. The lagoonal and pelagic environments in Kiribati support an abundance of marine avifauna, which nest primarily on uninhabited atoll islets, and in vast numbers on the uninhabited atolls of the Phoenix and Line groups. Species include migratory species that use the north-south oriented island chains to stop and feed as well as those species that find the isolated atolls habitats ideal for breeding and nesting.

The rich avifauna constitutes an important resource both to the people of Kiribati and to the world and should be protected because of its important role in the oceanic ecosystem. Although no reserves exist in the Gilbert Islands, numerous reserves and wildlife sanctuaries have been established in the Line and Phoenix Islands. Naa Islet could be considered as a possible bird sanctuary within the NTCA.

The insect fauna constitutes the majority of the terrestrial animals found on atolls. Many are important to the functioning of atoll ecosystems, whereas others such as mosquitos and flies, which spread disease, and cockroaches, are noxious pests. The *Papuana* taro beetle, which seriously affects the production of *Cyrtosperma* and *Colocasia* taros and bananas (*Musa* cultivars) is considered a major constraint to sustainable agricultural production. It is currently restricted to South Tarawa. A major concern within the proposed NTCA is the maintenance of effective quarantine measures to keep North Tarawa free of this serious pest.

Kiribati's relatively rich marine fauna includes between 300 and 400 finfish species alone. Industrial fisheries make an important contribution to the national economy and small-scale fisheries are an important source of cash income and have important nutritional and social roles to play in sustainable development.

In terms of subsistence, the sea provides virtually all the animal protein in the diet.

Almost all non-toxic finfish species over a few centimetres in length and many shellfish and other non-fish marine organisms are eaten, and various shells, teeth and other hard parts are used for handicrafts or other purposes. Because of the limited terrestrial protein and carbohydrate resources, fish consumption is among the highest in the world, with an estimated average consumption of 565 g/capita/day on rural atolls, thus satisfying both the minimum daily protein requirements and much of the daily energy requirements. Consumption in urban South Tarawa was estimated to be 320 g/capita/day.

The fisheries resources in Kiribati and North Tarawa can be divided into: 1) the lagoonal and reef, or "inshore" fishery; 2) the "offshore" fishery, which includes both the pelagic and near-shore deep water fisheries; and 3) mariculture or aquaculture of finfish and seaweed.

The lagoonal and reef resources include a wide range of finfish and a great variety of other living resources from turtles and crustaceans to seaweed and other plants. Kiribati's EEZ of over 3.55 million km² has considerable potential for pelagic fisheries of tuna and flyingfish, and, to a lesser extent, for the increased exploitation of deepwater bottomfish and sharks and harvesting of deepwater corals.

Traditional fishers used a great variety of methods from reef gleaning at low tide in the intertidal zone to deepwater handlining, primarily for oilfish, to depths of 150 m. Each method contained many specialised techniques involving different types of nets, hooks and lines, baits, lures, spears, nooses, traps and fences, poisons and gleaning strategies, with as many as 33 distinct techniques having been recorded for some atolls.

On most islands, fishing is carried out from traditional sailing or, more rarely, paddling canoes. In some areas, particularly in South Tarawa, these have been replaced by outboard-powered craft. In North Tarawa, non-motorised fishing craft are still important.

More modern methods include improved tackle, boats, nets and ice boxes used by local artisanal fishermen; and the increasing use of improved deepwater hand-reels for commercial deepwater snapper and shark fishing. A number of fish aggregation devices (FADs) have been deployed to increase both subsistence and commercial catches. Of environmental concern is the use of **orooro** fishing where crow bars are used to beat the water to scare fish, particularly bonefish into gillnets, the use of up to 2 to 5 km long-lines for shark and tuna fishing within Tarawa Lagoon, and the limited use of scuba or hookah gear to collect beche-de-mer.

One of the main economic developments in Kiribati over the past decade has been maricultural production of echeuma seaweed (*Echeuma cottonii*, properly *Kappaphycus alvarezii*). The dried seaweed is baled and exported to Europe, where it is refined to extract carrageenan, a commercial name for a class of indigestible polymers containing carbohydrate and sulphate, which are used to thicken or stabilize food and pharmaceutical products. There is also a small system of milkfish ponds in North Tarawa at Abaokoro.

These diverse marine resources, which have helped sustain the people of Kiribati since their first arrival on their islands over three thousand years ago, constitute a renewable subsistence and commercial resource if managed wisely. The potential sustainability of the

resource is evidenced by the fact that, despite thousands of years of almost daily "reef gleaning" at low tide for almost anything edible, and of almost any size, it is still possible, even in South Tarawa and other densely populated areas, for poor families to glean their daily protein needs from the intertidal zone and fringing reef areas.

However, the scarcity of certain marine organisms, such as turtles, bonefish (*Albula vulpes*), large reef cods (Serranidae), snappers (Lutjanidae), goat fish (Mullidae) emperors (Lethrinidae) and giant clams (*Tridacna* spp.), and smaller catches and decreasing average size of some species, indicate that atolls have been overfished in the past. There is also evidence in North Tarawa of declining yields of flying fish, possibly due to local overfishing, and yellowfin tuna, attributed to overfishing by long-liners and purse-seiners.

Of perhaps greater concern is that increasing commercialisation of many of these species, such as tuna, baitfish, giant clams, beche-de-mer and a wide range of other finfish and crustaceans, has put increasing pressure on these resources, thus underlining the need for protective legislation and sustainable production strategies.

Fortunately, the conservation ethic remains strong among most of North Tarawa's communities, where the wide range of conservation practices still in use indicates that I-Kiribati traditionally attempted to manage their marine resources on a sustainable basis. Their management was based on an extensive knowledge of fish, fishing technology, and the sea. Some of the main mechanisms included secrecy about fishing grounds and techniques, temporary or seasonal taboos or bans on species or fishing grounds, restrictions on the consumption of certain species (e.g., some species such as turtles or giant clams were reserved for chiefs or priests), fines or penalties for resource abuses, and clan tenure or limited access to reef and lagoon areas.

Unfortunately, the principle of limited access and some of the other marine resource management mechanisms are breaking down. The main causes seem to be the amalgamation and relocation of settlements during the colonial period, an imposed belief in open access for marine resources, increased use of motorised boats capable of fishing in the open ocean, and increased emphasis on commercial fishing, modern education and development along Western lines.

Population Distribution and Growth

Ethnically, the indigenous peoples of Kiribati are Micronesians who have probably inhabited the islands for 3000 years or more. Of the current estimated 1995 population of about 80,000, about 96 per cent are I-Kiribati, sharing a common culture, a common language, and a common resource-use tradition. The people of North Tarawa are almost exclusively I-Kiribati. Some of the main commercial fishermen and marine products exporters are, however, South Tarawa-based foreigners, or local Chinese who are married to I-Kiribati.

The average annual rate of natural population increase is 2.4 per cent. However, emigration is estimated at 0.3 per cent, which results in a net annual population growth rate of 2.1 per cent, (i.e., with a doubling of the population in 35 years). The growth rate for South

Tarawa is 3.1 per cent. Reliable figures on internal migration do not exist, but considerable migration can be observed from the outer islands to urban South Tarawa.

Because of the very limited land area, Kiribati has some of the highest crude population densities in the world, especially in the Gilbert group, where 96 per cent of the population of Kiribati live, and particularly in highly urbanised South Tarawa, with densities of 4,167 persons per square kilometre. Such population densities are a particularly serious obstacle to sustainable development, given the extreme infertility of the soils and scarcity of fresh water on most atolls. The "nutritional population densities" (the average number of persons per unit of arable land) are significantly higher than the crude population density figures indicate. High nutritional population densities and increasing commercial fishing by South Tarawa-based boats also put increasing pressure on the marine resources of both South Tarawa and North Tarawa and other nearby "outer islands". The population densities on North Tarawa itself, however, are lower, but still high, at just under 300 per km².

The National Economy

Over 80 per cent of the Kiribati workforce is engaged in subsistence agriculture and fishing, which provide most of the basic needs of the people in the outer islands and in North Tarawa. Attempts to encourage increased market orientation of the economy have had limited success.

Kiribati has limited natural resources of commercial economic importance except for fish, primarily tuna (currently the major non-aid source of foreign exchange by value) and some possibility of mining sea-bed minerals in the distant future. Coconut products, mainly copra, have traditionally been an important export by value and the sole agricultural export, although the export of *Echeuma* seaweed, which is used in food processing as a food stabiliser, has recently surpassed copra exports in value. Beche-de-mer or sea cucumber (**kereboki**), sharkfin and limited export of lobster and other specialty seafoods and some handicraft constitute other minor exports.

Tourism development is minimal, although there is some promise of expanding a specialised tourist industry on Kiritimati, based on avifauna and game-fishing, and limited ecotourism on some of Kiribati's outer islands, including North Tarawa.

With little in the way of private sector activity, the public sector and public enterprises dominate economic activity, and there is very little infrastructural or other economic development outside of South Tarawa and Kiritimati. Most paid employment is in the public sector. Limited skills and the limited capital base outside government mean that the government remains responsible for providing essential basic services such as electricity generation, fuel supply, communications, shipping, printing, and even hotel operation, generally through direct investment and the establishment of statutory bodies. The efficiency of these public-sector enterprises has been often low and the government has established policy guidelines for the transfer of such service enterprises to the private sector. The government is actively encouraging the establishment of small-industry production of consumer goods to broaden the production

base and foster import substitution.

Unfortunately, a legacy of British colonialism is that the one asset which could have provided the means to sustain higher levels of material well-being, the phosphate on Banaba, was exhausted just before independence in 1979, immediately cutting foreign earnings and government revenues in half. The end of mining quickly turned a positive domestic savings rate into a highly negative one. The gap over the years has been covered by withdrawals from the interest income of the Revenue Equalisation Reserve Fund (RERF), which since 1956 had accumulated royalties on past phosphate exports from Banaba. Kiribati, until recently, has avoided drawing down that capital, except for its purchase of Teraina (Washington Island) and Tabuaeran (Fanning Island) in the Line Group. In 1985 Kiribati managed to do away with budgetary support from Great Britain. The trade deficit is met primarily through the fishing licence fees paid by foreign vessels fishing in the Kiribati EEZ, through grant aid and through significant levels of remittances from I-Kiribati working overseas.

Because the government has tried to live within its means and has followed a very tight fiscal policy, external debt and debt service remain at less than 1 per cent of exports of goods and services, while substantial external reserves are held in the RERF and in gross official foreign exchange reserves (each account held approximately A\$260 million in 1991, which represents a substantial increase in RERF's value from A\$70 million in 1979).

However, the Kiribati economy remains very open and vulnerable. Imports account for about 75 per cent of GDP. Customs revenue from imports, fish royalties and licensing fees and withdrawals from interest income on accumulated external assets abroad, contribute over 75 per cent of Government revenue. Imports (at around A\$30 million a year) continue to outstrip exports (at around A\$5-6 million a year), resulting in a trade deficit in the order of A\$24-25 million a year.

Kiribati's high dependence on external assistance was estimated at nearly US\$300 per capita in the early 1990s. Since 1982, external assistance has been equivalent to about 40 per cent of GDP, and accounted for 95 per cent of gross investment.

Thus far, the government has managed to balance its books without having to destroy its limited resource base. But as the commercial imperative becomes more pronounced and as more and more I-Kiribati want modern technologies and social services, the government may find it increasingly difficult to balance the need for more and immediate cash income against long-term sustainable development.

With scant comparative advantage economically, the development process in Kiribati, and particularly in rural areas such as North Tarawa, has been slow. This is the development dilemma that the government and people of Kiribati are facing. Although the I-Kiribati have lived a relatively sustainable way of life for thousands of years in the atoll environment, it was at a relatively low level of material well-being, a level which is no longer considered adequate by many I-Kiribati. This is particularly so for people living in urbanised South Tarawa who desire some of the more appropriate modern technologies and social services that will make their life easier, safer, healthier and more enjoyable. A higher level of material well-being of course

would require increased cash incomes, foreign exchange, and changes in lifestyles which, if not pursued in the right manner, could undermine the cultural and traditional resource-use systems which have promoted sustainability in the past.

The North Tarawa Economy

Despite limitations of soil and water, a sophisticated subsistence agricultural system is still the basis of the North Tarawa economy. The crops grown are coconut, breadfruit, pandanus, native fig and the cultivation of **te babai**, the giant swamp taro, and to a limited extent true taro and bananas. The roots crops and the bananas are planted in pits dug through to the freshwater lens and mulched and fertilised with the leaves of salt-tolerant coastal plants. Other important staple food crops, such as breadfruit, pandanus and coconut palms are also given similar care to ensure their survival in the atoll environment. Because of the increasing salinity of the groundwater, infestation by the *Papuana* taro beetle (on South Tarawa only) and the declining importance of **te babai** relative to copra production, cash employment and imported food, a large proportion of the pits have been abandoned on some islands. *Babai*, however, still remains of great cultural importance as a ceremonial food in North Tarawa and outer-island Kiribati.

There are currently a number of projects encouraging the cultivation of short-term vegetables and appropriate food trees and an increased production of pigs and poultry to widen the local nutritional base, although they have been relatively unsuccessful on North Tarawa.

Commercial export cropping is restricted to the coconut palm for the production of copra, the world price of which continues to fall relative to the cost of imported goods. Despite decades of coconut replanting and rehabilitation programmes to replace senile palms and to expand plantations, copra production continues to fall.

There is virtually no modern forestry activity, although casuarina, eucalyptus, *leucaena* (*Leucaena leucocephala*) and a number of other species have been introduced for windbreaks, fuelwood production and soil improvement. Traditional Kiribati forestry or agroforestry, which is still practiced, is based on the planting and protection of pandanus and other large coastal trees that are the main local sources of timber for house building, general construction, canoe-making, toolmaking and woodcarving. Many of these trees are in short supply due to increasing use, felling to expand coconut plantations, mainly during the colonial period, and the failure of the current generation to either replant or protect trees. There is considerable interest in mounting appropriate coastal reforestation, agroforestry and forest protection programmes, both for their ecological and cultural value and their role in ameliorating the potential impact of global warming and sea-level rise.

A particularly important role of the agricultural system, in addition to food and export production, is the production of a wide range of useful products such as medicines, beverages, animal feed, fuelwood, fertiliser, tools, fishing equipment, handicrafts, construction materials, canoes, fencing, fibre and cordage, dyes, oils, perfumes, body ornamentation and toys, the value of which, when added to the value of subsistence fishing, is estimated to constitute between 20 to 80 per cent of the real incomes of the people of North Tarawa.

The main agricultural products produced in North Tarawa for sale in South Tarawa include firewood, pandanus thatching for houses, fresh and cooked pandanus and breadfruit, mature and green coconuts, concentrated toddy syrup (**kamaimai**), coconut coir rope, mats, fishermen's hats, fans and other handicrafts made from treated pandanus and coconut leaves. The protection and strengthening of these time-tested and productive systems will constitute one of the main components on the NTCAP.

Fishing continues to be an important commercial and subsistence activity throughout Kiribati and in North Tarawa, although some resources are under increasing pressure from outside commercial fishermen, especially from South Tarawa. Subsistence fishing, including fishing by men for finfish in the lagoon and, less commonly, in the open ocean, and reef gleaning, mainly by women and children on the expansive intertidal reef flats and fringing reef, mainly for shellfish, is an almost daily activity in North Tarawa.

Skipjack and yellowfin tuna, and a range of other finfish and the common shellfish, **te bun** and **te nuou**, are occasionally either taken to South Tarawa for sale or, in the case of lobster and mantis shrimp (**te waro**), sold to directly to commercial exporters who buy directly from villages in North Tarawa.

Among the main recent commercial developments have been the maricultural production of echeuma seaweed (*Echeuma cottonii*, properly *Kappaphycus alvarezii*) and the harvesting of beche-de-mer for export.

Although the Philippines provides the bulk of the world's production of echeuma seaweed, it has been estimated that Kiribati could eventually produce about 4 per cent of the world's production, which would contribute about \$US 2 million in foreign exchange to the economy. Studies indicate that a family farming a 1 ha farm with about 600 lines and 13,230 plants, could realise a yearly income of about \$US1917 (Casa Tec 1993:59). Of the estimated 40,000 MT maximum productive potential, North Tarawa, alone, with its extensive areas of tidal flats, has the greatest potential of about 2,700 MT, and perhaps the greatest potential for approaching this level of production due to its relatively high population.

Environmental Issues or Constraints to Sustainable Development

At the national level the major long-term threat to sustainable development is that posed by climatic change or global warming and associated sea level rise which could make the atolls almost uninhabitable. This possibility, which threatens the very existence of atoll societies, has caused serious concern at all levels in the community. Although there is uncertainty as to the amount and rate of potential sea-level rise, it remains a major consideration in planning for sustainable development.

Of almost equal concern is the constraint to sustainable development posed by increasing population, including rural to urban migration, which puts excessive stress on natural and cultural resources and undermines any hope of sustainability, particularly in urbanised South

Tarawa. None of the problems associated with acute land shortage, land fragmentation, the poverty of terrestrial resources, the fragility of marine resources to overexploitation and the threat posed by pollution and waste disposal can be addressed unless something is done to control high rates of population growth and rural to urban migration.

Because of the susceptibility of biodiversity and natural resources to degradation and their significance to subsistence and to potential commercial development, high priority is placed on the conservation, protection and enhancement of freshwater resources, soils, terrestrial plants and animals, and reef, lagoon and ocean marine resources. In the same context, the conservation of biological diversity, of **both** wild and domesticated species, as a basis to support continuing human habitation of the atolls is a priority. Also of particular importance, as a basis for the maintenance of both biodiversity and the health of the human population, is the enhancement of rainwater catchment capacity and the protection of existing groundwater resources and coastal waters from pollution.

Because of the critical importance of good nutrition to a healthy society, and because of the critical role that subsistence production plays in the real incomes of people, the breakdown of subsistence production systems, perhaps most importantly the deterioration of the traditional food system, is seen as a major constraint to sustainable development. With the declining consumption of local foods and medicines, which have provided the basis for the health of Kiribati society for thousands of years, there have been serious increases in the incidence of vitamin and mineral deficiency, obesity, diabetes and cardiovascular disease and an increasing dependence on costly imported products. Subsistence production systems, as integral and dominant components of the atolls ecosystem, **must** be protected along with the natural environment to ensure sustainability. This is an issue that will be addressed directly in the NTCA Workplan.

To address these sustainability issues will require: 1) environmental education, including both traditional and modern environmental education, to eliminate "environmental blindness" and to stress, in both the formal and non-formal education systems, the constraints to and opportunities for sustainable development in Kiribati; 2) more adequate data and further research on resources and the sustainability of strategic ecosystems as a basis for informed national and local planning and development; and 3) environmental- protection infrastructure in the form of legislation, agencies, research, training and conservation area development.

Institutional Arrangements: Environmental and Conservation Legislation, Land Use Policies and Programmes

Kiribati does not have a comprehensive national environmental policy, but there are already in place legislation and sectoral policies addressing specific environmental concerns. These need updating and integration into a national multisectoral umbrella arrangement encompassing resource and environmental protection and management. In this vein, one of the stated objectives of the 6th and 7th National Development Plan 1987-91 is "sustainable use of resources".

In recognition of the need to address environmental issues cross-sectorally, the government established an Environment Unit (EU) within the Ministry of Environment and Natural Resources Development (MENRD); appointed an Environmental Coordinator for the EU; and set up a Kiribati Task Force on the Environment (KTFE).

The EU, now within the new Ministry of Environment and Social Development is the prime body responsible for the co-ordination and integration of environmental concerns into development policies and programmes, although many environmental responsibilities are still vested in various government departments, Island and Town Councils. The Unit has been strengthened by the hiring of an Environment Officer, an Environmental Education Officer and a number of other project-related staff. It now also has a SPBCP-funded Conservation Area Support Officer (CASO) who will be responsible for the implementation of the NTCAP (see Terms of Reference in Appendix II). As stressed in the Kiribati NEMS, the operation of the EU is, however, still hampered by inadequate staffing for the size of the task, by a lack of specific scientific and environmental training, and by limited financial support.

The Kiribati Task Force on the Environment (KTFE), initially set up informally solely to prepare the National Report to the United Nations Conference on Environment and Development (UNCED), has now been established formally to advise on environmental policies. Its composition, with members from all the relevant government agencies, the private sector and NGOs is intended to reflect the cross-sectoral nature of environmental concerns.

The Constitution of the Republic of Kiribati does not include set clauses relating directly to environment policy, but its preambular declaration that "the natural resources of Kiribati are vested in the people and their Government" can be taken to imply the notion of sustainable resource use. There is also existing legislation relevant to specific environmental concerns, such as 1) land or resource use and management and access to terrestrial and marine resources, 2) coastal management and protection, 3) conservation of strategic or endangered marine and terrestrial resources, 4) water, sanitation and environmental health, and 5) control of specific potentially polluting, dangerous or environmentally disruptive substances and materials.

In addition, the Local Government Act of 1984, which provides for the establishment of local government through a system of Island Councils, includes, among the Councils' wide-ranging functions, several of which relate to environmental management and protection.

The *Country Report for UNCED: Kiribati* prepared in consultation with the Kiribati Task Force on the Environment (KTFE) and a wide range of other government and non-government agencies for the United Nations Conference on Environment and Development (UNCED) held in June 1992, is a detailed document providing information on the status of the Kiribati national and cultural environments, major constraints to environmentally sustainable development and suggests priority areas for action to address these problems. As a follow-on to UNCED, with the assistance of SPREP, and funded by UNDP, Kiribati completed the *Kiribati National Environmental Management Strategy* (NEMS) in 1993 and the *Kiribati State of the Environment Report* in 1994. A *Kiribati Review of Environmental Legislation* and a *Kiribati Review of Environmental Education* were also completed as part of the NEMS process.

The NEMS provides a long-term perspective that could be used to promote sustainable development. The NEMS stresses that the broad objective of the Kiribati government in the environment sector is "to achieve an environmentally sustainable development and a better quality of life" by "utilising the natural resources without compromising the ability of the future generations to live out of the same resources".

Particularly relevant to the establishment of the NTCA is the Applied Atoll Ecological Study, a study of Tarawa Lagoon, conducted jointly by the Government of Kiribati and US Agency for International Development (USAID). The product is a Draft *Tarawa Lagoon Management Plan* (TLMP). The project conducted for MNRD by BioSystems Analysis Inc. of Tiberon, California, in conjunction with the University of the South Pacific Marine Studies Programme, and funded by USAID, included shellfish and benthic ecology assessments, a finfish assessment, with special emphasis on bonefish, a study of primary and secondary production and food chains (food webs), and lagoon circulation, with particular emphasis on the impact of causeway development.

The study pointed out that a TLMP is urgently needed to address serious pollution problems and deterioration of the lagoon's natural resources. The suggested TLMP included the establishment of a "Lagoon Management Council", which would be seen as part of the private sector and independent from government, but which would interact with relevant government ministries and NGOs, fishermen, fisherwomen and business people (the user public), and with Island Councils and Unamwane (Councils of Elders). A key aspect of the TLMP would be "comanagement" (co-operative management) of lagoon resources between the central government and local communities adjacent to the resources. Under the plan, local management would be in control of "who fishes, where they fish, when they fish, how much they are allowed to take, what equipment they are allowed to use, and enforcement". Such local control is essential because government does not have the financial or human resources to impose and enforce regulations.

The report also stresses that the current view of the use of the lagoon based on English Common law, i.e., that the lagoon is open to all to do anything they want, will lead to a "Tragedy of the Commons" where everyone gets what they can while they can with no regard for future generations.

The major objective of the TLMP is to increase the productivity of the lagoon to approach its maximum sustainable yield. To do so, some resources will need to be protected for many years so that they can build up sufficient populations for sustainable harvesting. Major recommendations include banning or dramatic restriction on the use of gill nets in the lagoon, banning the use of scuba and hookah equipment and swim fins for collecting and harvesting to maintain deep water stocks, a five-year moratorium on the harvest of giant clams, restrictions on the harvest of sea turtles, the protection of mangroves, the establishment of a system of protected areas, the encouragement of increased open ocean fishing to reduce pressure on lagoon resources, and the opening of a significant number of passageways in all existing causeways between the islets of Tarawa Atoll to increase circulation and allow more fish and invertebrate larvae and juvenile fish to enter the lagoon.

Project Objectives

The primary objective of the NTCAP and its Work Plan during Phase I (year 1) is to PROMOTE THE CONSERVATION AND SUSTAINABLE USE OF "BIODIVERSITY" WITHIN THE NORTH TARAWA CONSERVATION AREA (NTCA). In pursuing this objective, emphasis is placed on: 1) participatory planning and community-based strategies of resource use; and, 2) the maintenance of biodiversity within the NTCA by means of the multi-purpose use of a large variety of species and ecosystems.

In the context of the NTCAP, "biodiversity" includes:

1. All terrestrial and marine ecosystems (e.g., coastal and mangrove forests, scrublands, coconut plantations, excavated taro pits, villages, beaches, tidal flats, reefs, lagoon, and open ocean);
2. All plant and animal species and varieties found in these ecosystems (e.g., all species of trees, shrubs, vines, herbs, grasses, seaweeds, shellfish, finfish, beche-de-mer, and crustaceans, as well as all varieties (cultivars) of food crops such as pandanus, coconut, breadfruit, native fig, and bananas).
3. The knowledge, uses, beliefs and language by which the people of North Tarawa, and the people of Kiribati in general, relate to their biodiversity. This would include the "biodiversity-use systems" that have served as a basis for the relatively sustainable habitation of the atolls for over three thousand years, beginning long before European contact with the islands.

Because most resource-use decisions in Kiribati are made and enforced at the community and individual landowner or resource-user levels, emphasis in the NTCAP is placed on increasing the capabilities and involvement of local communities in the conservation of biodiversity.

Because there is no single sustainable development activity or single ecosystem or species that can satisfy all of the commercial and subsistence needs of the people of North Tarawa, emphasis will be placed on multi-ecosystem, multi-species and multi-purpose use of the biodiversity within the NTCA in order satisfy the short- and long-term needs for BOTH cash and subsistence.

In pursuing this approach, other specific objectives of the NTCAP include:

1. The identification of endangered or culturally and economically important terrestrial and marine ecosystems and plant and animals species within the NTCA that could become the focus of community-level protection and sustainable-use programs.
3. The identification of constraints to, and practices which do not favour, sustainable use and conservation of biodiversity in North Tarawa.

4. The identification of opportunities or programmes for sustainable use and management of biodiversity that might increase cash and non-cash incomes and the quality of life of the people of North Tarawa (the emphasis here is on increasing cash incomes without undermining non-cash incomes, both of which largely depend upon the sustainable use of biodiversity).
5. The promotion of activities that foster the sustainable use, protection and enhancement of the biodiversity of North Tarawa.
6. The discouragement of practices that contribute to the loss of biodiversity or that undermine sustainable development in North Tarawa.
7. The active involvement, in all of the above, of the local people of the NTCA, because the success or failure of the project will depend very much on the landowners and residents of the CA as the direct beneficiaries.

Constraints to Conservation and Sustainable Use of Biodiversity in North Tarawa

Based on discussions with five local communities in their **maneaba** (traditional meeting houses), the Eutan (North) Tarawa Island Council and resource-development agencies in South Tarawa, major constraints to the conservation and sustainable use of biodiversity in North Tarawa include:

1. Inadequate resource-management mechanisms, including lack of local community control over inshore marine resources, and the absence of lack of enforcement of environmental legislation.
2. Loss of ethnobiological and environmental knowledge among the young.
3. Coastal soil erosion and saltwater incursion.
4. Interruption of lagoon circulation by causeway construction between atoll islets which seems to have affected the spawning cycles and behaviour of a wide range of marine organisms .
5. Overexploitation of inshore fisheries resources, including turtles, giant clams, beche-de-mer, ark shell (bun), bonefish (ikarii), goat fish (maebo), baitfish (tarabuti), large demersal species, some sharks and other commercially-important target species, especially by commercial fishermen from South Tarawa who employ unsustainable fishing methods..
6. Deforestation and loss of culturally, economically and ecologically valuable trees, plants and associated wildlife.

7. Declining indigenous bird and terrestrial animal populations due to habitat destruction, overexploitation or predation.
8. Absence of a system of marine and terrestrial reserves and sanctuaries.
9. Water shortage and poor water quality.
10. Poor soils and limited agricultural potential.
11. Poor marketing structure for primary products.
12. Inadequate small-scale tourism development.

Project Management

At the national level, in terms of the NTCAP, the "Lead Agency" is the Environment Unit (EU) of the Ministry of Environment and Social Development (MESD). The EU will be responsible for the overall management of the NTCAP, with appropriate staff members contributing to and/or coordinating relevant components of the NTCAP. Activities which fall within particular sectors (e.g., agriculture, fisheries, education, home affairs, health, tourism, or women's affairs) will be implemented in consultation and cooperation with the relevant agencies in North Tarawa and nationally. Efforts will be made to avoid duplicating ongoing activities of government and non-government agencies, and to complement such activities in the context of the promotion of sustainable use of biodiversity with NTCA.

As the Lead Agency, the EU will be the main link with SPBCP and other agencies that may fund activities under the project. It will be responsible for administering project funds and for the submission of quarterly reports and work plans to SPBCP. The EU will report on all planned activities and the progress of the NTCAP to the National Environment Coordinating Committee.

A Conservation Area Support Officer (CASO), funded under SPBCP, but working for the EU, will be responsible for the day-to-day management of the NTCAP, and will be the link between EU and the North Tarawa-level management of the NTCAP. The CASO will act in consultation with a Conservation Area Coordinating Committee (CACC) and representatives of participating communities.

The composition of the CACC includes high-ranking North Tarawa-based representatives of relevant North Tarawa-based government agencies, representatives from the traditional Unamwane (Council of Elders) and government representatives from participating communities. Provisions are made for the co-option of additional appropriate members as the need arises and/or the inclusion of appropriate persons who are not resident in North Tarawa.

Specific Activities

Specific activities or projects proposed for implementation during Phase I include:

1. Participatory planning meetings/workshops;
2. Biodiversity use and baseline studies;
3. Key ecosystem and species protection;
4. Marine ecosystem management enhancement;
5. Terrestrial biodiversity enhancement;
6. Education and public awareness campaigns;
7. Small-scale tourism development; and
8. Handicraft marketing and training.

These activities have been identified by, or in consultation with, local communities of North Tarawa, the North Tarawa Island Council, relevant North Tarawa-based government and non-government representatives. With administrative and logistic support from the CASO, the activities will be implemented, monitored and modified by the same groups. Selected government agencies, NGOs and private businesses from South Tarawa have also indicated their interest in facilitating and actively supporting the implementation of such activities. The activities are not listed in order of importance, and to achieve best results several of the activities will have to run simultaneously. Experience elsewhere shows that conservation efforts which focus on only one environmental issue or on only one environmentally-sound economic enterprise have failed or met with only limited success.

To implement most of the activities, there will need to be training or workshops to learn, share or develop skills. Most of these workshops and attachments can be done locally in North Tarawa, using either local expertise, both within and between communities and within North Tarawa-based government and non-government institutions. In some cases, however, persons with specific skills could be brought to North Tarawa from South Tarawa or overseas to run community or North Tarawa-based workshops, depending on the focus of a given activity.

Budget

The total estimated cost of Phase 1 of the North Tarawa Conservation Area Project (NTCAP) is \$US 59,750. The proposed budget is divided into: 1) salaries and cost of the management and implementation of the project; 2) costs of the individual activities suggested for inclusion in Phase 1 of the project; and, 3) Kiribati Government contribution. The costs of transport, fees, per diems, materials production, equipment and contingencies are included within each of the suggested individual activities. The main costs in terms of salaries and project management include the salary and support for the CASO, and limited funds to allow relevant

representatives from Environmental Unit and other relevant South Tarawa agencies to make field visits to North Tarawa to support the CASO and to visit participating local government agencies and communities. The estimated costs per year for years 2-5 would drop from \$59,750 during Year 1 to \$36,700, \$31,950, \$26,200 and \$25,200 respectively. The total estimated cost of the NTCAP over its five-year duration would be US\$179,800, an amount that gives flexibility for necessary modification of the project or the change of emphasis to other activities identified by the participating communities within the NTCA.

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1 INTRODUCTION

The Government of the Republic of Kiribati has selected two localities as Conservation Area Projects (CAPs) under the South Pacific Biodiversity Conservation Programme (SPBCP) of the South Pacific Regional Environment Programme (SPREP). These CAP localities were initially designated as Naa CAP, the northernmost islet of North Tarawa in the Gilbert Group, and Cook Islet CAP, which is part of Kiritimati (Christmas Island) in the Line Islands. In the preparation of this document, which refers only to the first of these localities, the designation Naa CAP will be replaced by the more appropriate name of North Tarawa CAP. In accordance with SPBCP guidelines, this document – the Project Preparation Document (PPD) for the North Tarawa Conservation Area Project (NTCAP) – constitutes Stage II of the SPBCP's CAP process.

The PPD has been developed in conjunction with appropriate authorities in Kiribati and after formal meetings with the local communities of the proposed North Tarawa Conservation Area (NTCA). The document's main objectives are:

1. To provide relevant background information on the proposed NTCA;
2. To draw attention to issues of concern relevant to biodiversity conservation within the NTCA;
3. To identify suitable objectives, activities, strategies, and an organisational or management structure for the NTCA; and,
4. To provide a detailed Work Plan of activities for the implementation of the CA under Phase 1 (the first year) of the NTCAP.

For the preparation of this PPD a mission was undertaken to South Tarawa and North Tarawa in June 1995 by SPREP/SPBCP consultants Prof. Randy Thaman, Dr. William Clarke, and Mr. Temakei Tebano, of the University of the South Pacific, together with Ms. Temawa Taniera (Atoll Research Programme, University of the South Pacific, Tarawa) and Mr. Bwere Eritaia (Environment Section, Ministry of Environment and Social Development, Republic of Kiribati), who has been designated as Conservation Area Support Officer (CASO) for the CAPs in Kiribati. The objectives of the PPD mission were:

1. To determine the degree of community interest in and willingness to become active participants in the NTCAP;
2. To identify the constraints against, the activities that might promote, and the people's major concerns relating to biodiversity conservation and sustainable development;
3. To collect relevant background information on the nature of the proposed NTCA and the communities within it, the character of the biodiversity, the nature of current development, and the political, community, and developmental

infrastructure of the area; and,

4. To consider, and discuss with local communities, community leaders, North Tarawa Island Council, and government authorities, potential strategies, activities, and project- management alternatives.

The information collected on the mission has subsequently been incorporated into this PPD, which, thus, reflects to a great extent the views of the local residents and government officials. Persons consulted are listed in Appendix 1.

2 PROJECT BACKGROUND

This section provides background on the Republic of Kiribati's initiative to develop a North Tarawa Conservation Area (NTCA) under the SPBCP. It includes information on: 1) increasing international interest in biodiversity conservation and management; 2) SPBCP and Conservation Area Project development; and 3) the rationale for the proposed North Tarawa Conservation Area Project (NTCAP) under SPBCP.

2.1 Increasing International Interest in Biodiversity

The formalisation of the Convention on Biological Diversity (CBD) at the United Nations Conference on Environment and Development (UNCED), the "Earth Summit", held in Rio de Janeiro in June 1992, underlined the importance of biodiversity conservation as a basis for sustainable development everywhere. The CBD, which provides a framework for the protection of both terrestrial and marine biodiversity, was signed by nine Pacific island countries, including Kiribati. The Convention is particularly important to countries of the Pacific Islands, which have "globally significant areas of biological diversity", and whose people, cultures, and economies depend on the protection and sustainable use of their terrestrial and marine life. The importance of the protection of small island ecosystems is also included in *Agenda 21*, the UNCED action plan for the attainment of sustainable development.

The CBD and the protection of biodiversity were also key issues for concern at the Global Conference on Sustainable Development for Small Island States held in 1994 Barbados, and attended by a delegation from Kiribati.

The implementation of the CBD in the Pacific Islands is being facilitated by the SPREP-based South Pacific Biodiversity Conservation Program (SPBCP), a five-year, \$US10 million programme funded through the Global Environment Facility (GEF) and the Government of Australia. The GEF is designed to help developing countries deal with critical regional and global environmental issues, which include ozone depletion and climate change, the use and protection of international waters and biodiversity conservation. It is administered by the World Bank, the United Nations Environment Programme (UNEP), and the United Nations Development Programme (UNDP).

Kiribati has also completed a National Environmental Management Strategy (NEMS) which has among its major programmes, initiatives that will be protective of biodiversity and that would be significantly furthered by the establishment of the NTCA. These include: 1) the identification and protection of special habitats and species; 2) the conservation and management of mangroves; 3) the establishment of an arboretum of traditional cultural and medicinal plants; and 4) the conduct of training workshops on the conservation and management of reefs and marine living resources.

2.2 Rationale for SPBCP and Conservation Area Project Development

The main aim of the SPBCP is to develop strategies and to provide technical and financial assistance to eligible independent Pacific Forum countries for the conservation and sustainable use of biodiversity. These countries are the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Niue, Palau, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Western Samoa. Other member countries of SPREP (which has a wider membership than the Forum) may participate in SPBCP-supported activities although they are not eligible to receive support from the GEF.

The SPBCP seeks to establish, in eligible countries, a system of diverse Conservation Areas (CAs) in which human activities will be guided to protect important ecological features and to enable sustainable use of natural resources within the CA. Ancillary activities include the provision of information, species protection, regional policy, and educational programmes.

The rationale for the establishment of a system of CAs is that in areas such as the North Tarawa CA, and elsewhere in the Pacific Islands, where people depend heavily on their terrestrial and marine resources for their subsistence and cash production, there is a need to promote the conservation and sustainable utilisation of these resources. It follows that, under the SPBCP, CAs are not areas to be preserved wherein development is prohibited. Rather, CAs are to be areas where resources are sustainably utilised in a way that also conserves terrestrial and marine biodiversity for the benefit of future generations. This approach differs from national parks and conservation areas in industrialised countries where people are not so dependent on their natural environment for their day-to-day survival, and where conservation efforts are focused mainly on protection and recreation, rather than on sustainable utilisation.

The more specific objectives of SPBCP, in terms of the establishment of CAs, are:

1. Identification of priority areas – potential CAs – for the conservation of biological diversity ;
2. Assistance in the creation of CAs that protect biodiversity and wherein natural resources are managed for ecologically sustainable development;
3. Protection of threatened or endangered terrestrial and marine species in the Pacific region;

4. Improvement of regional awareness of the importance of conserving biological diversity, and of the means to achieving that conservation; and,
5. Improvement of capabilities and working relationships between different sectors and agencies contributing to the conservation of biological diversity.

Major emphasis is placed on the convictions, first, that local communities must play an integral role in the initiation and planning of the project, agreeing to participate in its development and implementation; and, second, that once Conservation Area Projects (CAPs) are established, they should be community driven and owned and reflect the on-going wishes and desires of the local people, with local communities ultimately taking over the administration and management of the CA.

The SPBCP also recognises that:

1. There will probably be a lack of awareness and management skills amongst the local communities who have the most immediate need to conserve the environment;
2. There will be a need to be a gain in tangible benefits, including financial returns, from sustainable-development activities if local communities are to be willing to conserve the biodiversity of the areas selected as CAPs; and,
3. There will need to be an understanding that sustainable development is an ongoing and lengthy process, extending beyond the initial funding period of SPBCP, and that, in the long term, the communities in a CAP will have to become self-reliant and substantially dependent on their own community resources to carry out the conservation measures needed to ensure the protection and enhancement of the environment for future generations.

In terms of eligibility, CAPs may be conceived and promoted for funding by a government, by an NGO, or by a private-sector institution. In all cases, projects should have the formal endorsement of the government.

2.3 Rationale for the Proposed North Tarawa Conservation Area

After taking into consideration the above criteria and the economic and environmental conditions prevailing in Kiribati, the Ministry of Environment and Natural Resources Development (now the Ministry of Environment and Social Development), as the proposing ministry, and the Ministry of Home Affairs and Rural Development, as the implementing ministry, in consultation with SCBCP professionals and the Biodiversity Sub-Committee of the Kiribati Task Force on the Environment proposed that the North Tarawa locality be targeted as a CA because of:

1. the area's wide range of terrestrial and coastal habitats, including mangroves and an unusual stand of an important tree of Polynesia and Micronesia, *Pisonia grandis* (**te buka** in the Kiribati language);
2. the unusually high biodiversity and resource richness (including beche-de-mer and bonefish) of the adjacent lagoon waters and coral reefs; and,
3. the area's proximity to South Tarawa, which is Kiribati's only urbanised region and which exerts particularly strong non-local pressures on the exploitation of North Tarawa's resources, particularly the marine resources, compared with the pressures on other Outer Islands of the country – North Tarawa being classed as an Outer Island although it is a part of Tarawa atoll.

3 BIODIVERSITY AND BIODIVERSITY CONSERVATION

3.1 Biodiversity in the Context of North Tarawa CAP

In the context of the NTCAP, the concepts of biodiversity and biodiversity conservation would include:

1. All terrestrial and marine ecosystems (*e.g.*, coastal strand vegetation, mangroves, gardens, agroforests, and *babai* pits (excavated plots of giant swamp taro *Cyrtosperma chamissonis*), relict stands of forest, reefs, lagoons, and the open ocean. (See sections ?? on terrestrial and marine resources below for a more detailed account of the ecosystems in North Tarawa.)
2. All plant and animal species and varieties found in these ecosystems (*e.g.*, all species of trees, shrubs, vines, herbs, grasses, seaweeds, shellfish, finfish, beche-de-mer, crustaceans, and other marine life, and all varieties of domesticated plants and animals, such as *babai*, coconuts, breadfruit, pigs and chickens).
3. The knowledge, uses, beliefs, and language that the people of North Tarawa have in relation to their biodiversity. This would include the time-tested "biodiversity-management systems" which have served as a basis for the relatively sustainable habitation of the atoll islets for over three thousand years, beginning long before the introduction of the cash economy into Kiribati.

3.2 Biodiversity Conservation

In the context of the SPBCP, biodiversity conservation is seen as synonymous with sustainable use. It is argued – based on the experiences of other areas of the world – that if the

biodiversity of North Tarawa is not conserved or used on a sustainable basis, and if traditional sustainable management practices, and the knowledge and language (*e.g.*, plant and animal names and the language associated with farming and fishing techniques, seasons, tides, etc.) are not maintained or strengthened, then forms of modern development by themselves may prove inadequate to sustain the people in the long term. Moreover, as stressed in the SPBCP programme document, it is the resource owners and users at the community level – the people who catch the local fish, collect the shellfish on the reefs, dig the *babai* pits, plant breadfruit and coconut palms, and raise pigs on land – who hold the long-lasting key to biodiversity conservation.

4 THE ENVIRONMENT OF KIRIBATI AND NORTH TARAWA

This section provides a brief overview of the environment and the potential for sustainable development in the Republic of Kiribati and, more particularly, within the North Tarawa CA.

4.1 Natural Resource Endowment

The natural resources of the Republic of Kiribati are either extremely limited, as in the case of terrestrial, lagoonal and near-shore resources, or extremely vast and difficult to utilise and manage, as in the case of the country's oceanic marine and seafloor resources within its extended exclusive economic zone (EEZ) of 3.55 million km². In either case, it will be a demanding matter to develop and manage these resources effectively, on a long-term basis, to serve the commercial and subsistence needs of current and future generations of I-Kiribati (the people of Kiribati).

With regard to the terrestrial, lagoonal, and near-shore resources, effective management will require practical developmental research on the living and non-living natural resources of atolls. Such research might include: 1) generation of data on the extent, nature, and current use or development and conservation status of the available natural resources; 2) evaluation of current and potential development strategies (both traditional/local and modern/imported); and 3) assessment of the impact that different development or management alternatives might have on resources or on the potential for sustainable management of these resources by the people of Kiribati. Without such data, resource development, management, and conservation will be problematic.

4.2 Land and Ocean Area

The Republic of Kiribati has a total land area of only 822.8 km². It consists of 33 islands in three main groups - the Gilbert Islands (formerly part of the British Gilbert and Ellice Islands Colony and known locally as Tungaru) in the west, the Phoenix Islands in the centre, the Northern and Southern Line Islands to the east, plus the single island of Banaba, 400km to the west of the Gilbert Islands. The islands are extremely isolated and fragmented, covering an

ocean area of some 13 million km² between 4 deg 43 min N and 11 deg 25 min S latitude and 169 deg 32 min and 150 deg 14 min W longitude. They extend some 3,870 km from Banaba on the west to Kiritimati (Christmas Is.) in the east and 2,050 km from Teraina (Washington Is.) in the Northern Line Islands to Flint Island in the Southern Line Islands. There is, thus, very limited land area, spread over millions of square kilometres of deep ocean.

The main Gilbert (Tungaru) group, consists of 16 small atolls or limestone islets extending 640 km from north to south and located 700 km to east of Nauru, 400 km east of Banaba, and about 250 km from the atoll nations of Tuvalu on the south and the Marshall Islands on the north. Although the total claimed land area of Kiribati is 822.8 km², some 93.3 per cent of the population of 72,298 live in the Gilbert Group, which makes up only 278.4 km² (33.8 per cent) of the total area. The islands, of the group, from north to south, include, Makin, Butaritari, Marakei, Abaiang, Tarawa, Maiana, Kuria, Aranuka, Abemama, Nonouti, Tabiteuea, Onotoa, Beru, Nikunau, Tamana and Arorae. All are true atolls with central lagoons, with encircling islets of varying size and shape, except Makin, Kuria, Nikunau, Tamana and Arorae, which are slightly raised limestone islets or "table reefs" with no lagoons. The size of individual islands ranges from Tamana and Makin, with areas of 5.2 and 7.2 km², to Maiana, Abaiang and Tabiteuea, with areas of 28.1, 28.5 and 49 km². Tarawa, the most populous island, where the capital is located, has islets with an estimated area of 19.9 km², extending over 64 km from north to south. North Tarawa accounts for about two-thirds (12.7 km²) of this area.

The sparsely inhabited Phoenix group to the east of the Gilberts Group consists of eight scattered islands which have a total land area of only 28.7 km². All are low atolls with enclosed lagoons.

The Line Islands are made up of three northern islands, Teraina (Washington), Tabuaeran (Fanning) and Kiritimati (Christmas) and five southern islands, Malden, Starbuck, Vostok, Caroline and Flint. They have a total land area of 515.7 km² and constitute 62.7 per cent of the land area of Kiribati. The largest island in the group is Kiritimati with an area of 363.7 km².

Banaba, an uplifted coral-limestone island is located 400km west of the Gilbert group at 0 deg. 53 min. S. lat. and 169 deg. 35 min. E. long.

4.3 Atoll Landforms

In terms of the nature of land or geomorphology, Kiribati consists of true atolls, with reefs and islets that encircle or partly encircle central lagoons; limestone or reef islands, with no lagoons; and the uplifted phosphatic limestone island of Banaba. As this document's concern is with North Tarawa, which is a part of Tarawa atoll, only the characteristics of atolls will be described.

In general, on the ocean side of atolls like North Tarawa, there is an uplifted fringing limestone reef in the wave zone, which may be covered by a sandy beach. This runs up to a raised rampart or shingle ridge of wave-washed boulders and coral fragments deposited during

storms. This is commonly the highest portion of the island, or of the individual islets that comprise the atoll, and no more than 3m above mean sea level. Inland of the rampart and extending towards the lagoon is an area of windblown sand and debris. Near the lagoon shore, the increasingly finer deposits are of lagoonal origin. Limestone outcrops with little or no soil and lowlying swampy areas are commonly found on islets.

In the case of North Tarawa, on the lagoon side, there is a narrow to very wide intertidal or foreshore area of fine sand which is exposed at low tide. This area constitutes one of the most important fishing grounds for 'reef gleaning' mainly for a wide range of shellfish. This drops off to the deeper parts of Tarawa Lagoon. On the ocean side of the fringing limestone reef is an intertidal fringing reef that gradually drops off into the ocean. This is also an important fishing and gleaning area, with many fisherman diving or taking their boats and canoes out over the reef edge into the open ocean or to dive on the outer edge of the reef or on the reef slope.

Between the individual atoll islets are passes or reef channels through which small boats and fish and marine larvae are flushed with the changing tides. Although important to the ecology of the lagoon, the channels are obstacles to transportation between islets. As a result, a major development priority over the past thirty years has been to link individual islets with a system of causeways. Unfortunately, there is strong evidence that causeways seem have a negative effect on the spawning cycles of bonefish and a number of other important shellfish and finfish species.

4.4 Climate

Kiribati is located in the dry belt of the equatorial oceanic climate zone, with mean daily temperatures ranging from 26 to 32°C, with the recorded highs and lows being 22 and 37°C. Annual rainfall is extremely variable, both annually and between islands, with annual averages in the Gilbert group ranging from about 1000 mm for the drier islands such as Arorae and Tamana near the equator to 3000 mm for the wetter islands such a Butaritari in the far north, and 1,550 mm on Tarawa. The natural vegetation and crops are, consequently, much more luxuriant on islands like Butaritari and Makin in northern Kiribati proper than on the islands farther south.

4.5 Water Resources

The only permanent freshwater resource on atolls is groundwater in the form of a "lens" of often slightly brackish freshwater, hydrostatically "floating" on the higher density saltwater beneath the island. The height of the lens above sea level and the level of salinity vary in relation to the elevation, shape and width of islets and the amount of water use and rainfall. In the case of Naa Islet, a small islet, the lens is very poorly developed. Replenishment or recharge of the lens is solely dependent on rainfall. In areas where the lens is close to the surface, pools are often found during excessively wet periods, especially during high tides.

The location and degree of development of the groundwater resource influences the nature of the vegetation as well as the location of village wells and cultivation pits. The quantity

and quality of groundwater and the habitability of islands is severely affected during times of extended drought. This is particularly true on Naa.

4.6 Soils

The atoll soils of Kiribati are very infertile. They are young, shallow, alkaline, coarse-textured and have carbonatic mineralogy. Because of their immaturity, they vary little from the original coral-limestone parent material. They are composed of a variable layer of organic matter and coral sand and fragments overlaying a limestone platform. They range from 25 cm to 1 m or deeper, with some accumulation of clays and H^2S near the centre of islets near the water table. Potassium levels are often extremely low, and pH values of up to 8.2 to 8.9 and high $CaCO^3$ levels make scarce trace elements, particularly iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn), unavailable to plants. Activity of soil micro-organisms is limited, soil water-holding capacity is very low because of coarse texture, and ground water is often saline. Fertility is highly dependent on organic matter to lower soil pH, to capture and recycle plant nutrients, and to retain soil water in the excessively fast draining soils. These factors together make conventional agriculture, as practiced on other larger Pacific islands, almost impossible in Kiribati.

Although the level of organic matter can be relatively high in undisturbed soils under natural vegetation, it can decrease dramatically as a result of clearance by fire or replacement by coconut plantations or other introduced plants.

4.7 Vegetation and Flora

The indigenous vegetation and flora of the atolls of Kiribati are among the poorest on earth. The coastal strand, mangrove, and inland forest vegetation of Kiribati has been severely modified due to: 1) thousands of years of habitation and selective removal of indigenous species for construction, boatbuilding, firewood, and other purposes; 2) the expansion of monocultural coconut groves for export production of coconut oil and copra; 3) the expansion of coastal settlements, which in urban South Tarawa, occupy much of the coastline; and, 4) the foraging pigs in inland sites and along beach flats. In the face of increasing pressures, it remains crucial to sustainable development and the cultural survival of the people of Kiribati that the uniquely adapted and culturally useful vegetation and flora of the harsh atoll environment be protected and enhanced.

4.7.1 Vegetation

The terrestrial vegetation associations of atoll Kiribati are limited to: 1) coastal strand vegetation; 2) limited areas of mangroves and coastal marsh vegetation; and, 3) relict stands of inland forest. Secondary and cultural vegetation associations include: 4)

coconut-palm-dominated agricultural lands, including giant swamp taro or babai pits, under various stages of cultivation and fallow; 5) houseyard and village gardens; and 6) extensive and variable areas of ruderal vegetation.

There is essentially no remaining primary inland forest in the main Gilbert group, with all of it, except for the rare relict stand or individual tree, having been replaced by coconut-dominated vegetation associations. Evidence indicates that the dominant inland forest species was probably *Pisonia grandis* (**te buka**), which is the typical woodland on many atolls, with other species including *Calophyllum inophyllum* (**te itai**), *Cordia subcordata* (**te kanawa**) and *Hernandia nymphaeaeifolia* (**te bingibing**), as the dominants, and *Barringtonia asiatica* (**te bairiati**), and *Terminalia samoensis* (**te ukin**). Still common in inland sites are *Guettarda speciosa* (**te uri**), *Pandanus tectorius* (**te kaina**), *Scaevola sericea* (**te amo**) and *Premna serratifolia* (**te ango**), although larger individual trees of these species, so important for construction, are now in short supply.

Coconut groves are the major vegetation type in Kiribati. They are found on both inhabited islands and on uninhabited islets. In most cases, plantations are comprised of randomly scattered trees of varying heights and ages. Stands with an almost continuous canopy are often found on limestone soils, both near the lagoons and along roads. More recent plantings, many of which were done under the Department of Agriculture's Grove Improvement and Replanting Programmes, are more regularly spaced and of single-age classes.

Trees occasionally found as scattered individuals, but most certainly more numerous in the past, possibly as components of the dominant pre-settlement and pre-European-contact vegetation, include *Calophyllum inophyllum*, *Cordia subcordata*, *Hernandia nymphaeaeifolia*, *Pisonia grandis*, and *Premna serratifolia*. These species have been almost totally replaced in the drive, over the past 40 years, to extend coconut plantings. Instead, clearings or open areas in the coconut canopy are commonly occupied by thickets of *Scaevola* and *Guettarda*, or by planted *Pandanus* groves or individual pandanus or native fig (**te bero**) (*Ficus tinctoria*) trees, both important staples, particularly in the drier southern islands.

Houseyard and village gardens contain a greater proportion of recently introduced exotics and traditional cultivated plants introduced by early settlers before European contact. Although exotic ornamentals are common in areas immediately surrounding dwellings, the dominant plants are tree crops: coconut palms (often planted for toddy production), pandanus, papaya, native fig or **te bero** (*Ficus tinctoria*) and breadfruit (*Artocarpus altilis* and *A. mariannensis*) (**te mai**). The latter two are found almost exclusively in villages around dwellings and bordering roads. Less widely cultivated food plants include sweet potato, cassava, pumpkin (*Cucurbita pepo*), lime (*Citrus aurantiifolia*), the one citrus species which seems to do well in alkaline atoll soils), sugarcane, hibiscus spinach (*Hibiscus manihot*), and a range of short-term vegetables, such as cabbages), long beans (*Vigna sequipedalis*), and cucurbits, all of which have been promoted in home food gardening programmes.

Other food plants include the ceremonial staple, giant swamp taro or **te babai** (*Cyrtosperma chamissonis*), which is cultivated in extensive systems of taro (**babai**) pits in the

central areas of the main islands of the Gilberts, and in and around villages. True taro (**te taororo**)(*Colocasia esculenta*) is also occasionally cultivated in the taro pits. These pits have been excavated to the level of the freshwater lens, through the limestone bedrock to depths of 1.5 to over 3 m. Due to increasing salinity and the declining importance of **te babai** relative to copra production, cash employment, increasing dependence on imported food, the labour involved in maintaining the gardens, a large number of the pits on some islands have been abandoned. In some cases, such as on Onotoa, this occurred so long ago that the inhabitants have no recollection of their origin. On the wettest island of Butaritari, there is only limited or periodic evidence of neglect or serious underutilization, with some households having over 2,000 m² in productive pits.

Extensive areas of highly disturbed ruderal vegetation are found in Kiribati. Major contributing factors include: 1) long settlement; 2) disturbance and weed introductions during World War II; 3) increasing urbanization and transportation network development (e.g., roads, causeways and airfields); and, 4) the widespread practice of keeping villages and plantations clean by continuous burning, sweeping and clearing of vegetation. These have created extensive areas of ruderal vegetation in settlements, waste places, along roadsides and airstrips. The dominant species in most areas are grasses, annuals and shrubby weedy species. Locally common in areas of North Tarawa is *Acalypha grandis* (**te aronga**), reportedly introduced from Abaiang, where it is widespread.

4.7.2 Flora

The flora of the Gilberts group consists of approximately 306 species, of which only 83 are possibly indigenous. None are endemic. The balance is made up of ornamentals, weedy exotics, food plants, and a limited number of other useful cultivated plants. Although greatly outnumbered by exotics, indigenous species still dominate some of the most disturbed habitats, as well as constituting the most culturally and ecologically important species. A large proportion of these indigenous species (40 of 83 for the Gilberts) are severely restricted in distribution, endangered or possibly extinct, due to removal and severe habitat modification or limitation.

Of the indigenous species, 8 are widespread pantropical or paleotropical pteridophytes or ferns, including *Psilotum nudum*, *Polypodium scolopendria* and *Ophioglossum*, *Pteris* and *Nephrolepis* spp. There are no indigenous gymnosperms (conifers), although the widespread cycad (*Cycas circinalis*) is occasionally found in cultivation. Indigenous monocotyledons are restricted to pandanus (*Pandanus tectorius*), some cultivars of which are undoubtedly aboriginal introductions, and a range of sedges and grasses (Cyperaceae and Poaceae), some of which could be aboriginal or recent introductions. The coconut palm is classified as an aboriginal introduction, although it is probably also an indigenous plant. The indigenous dicotyledons are comprised almost exclusively of salt-tolerant, widely-dispersed, pantropical coastal species.

Exotic species, which constitute 73 per cent of the current flora of the Gilberts, dominate the ruderal and houseyard vegetation in many areas. Such species include a wide range of ornamentals, weedy species, food plants and a number of other useful species. Ornamentals,

which are normally confined to houseyard and village gardens, comprise some 28 per cent of the total species, whereas weedy species and food plants comprise about 22 per cent each.

Although 22 per cent of the flora are food plants, many of these species are restricted in numbers or utility because of the harsh environment, and are often represented by experimental attempts to diversify food production or by individual, often immature, specimens. Particularly important food plants are the indigenous native fig (**te bero**)(*Ficus tinctoria*), the numerous edible pandanus cultivars (**te kaina**), some of which are undoubtedly aboriginal introductions, and the aboriginal introductions, coconut palms (**te ni**), breadfruit (**te mai**) and giant swamp taro (**te babai**). Recent introductions of more localized importance in recent urban home food production programmes in the Gilberts, include: the vegetables, hibiscus spinach (*Hibiscus manihot*), a range of Chinese cabbage cultivars (*Brassica* spp.), long beans (*Vigna sesquipedalis*), amaranthus spinach (*Amaranthus* spp.) and pumpkin (*Cucurbita pepo*); the staple root crops, taro (*Colocasia esculenta*), tannia (*Xanthosoma sagittifolium*), sweet potato (*Ipomoea batatas*) and cassava (*Manihot esculenta*); a range of banana and plantain cultivars (*Musa* cultivars); and the tree crops, lime (*Citrus aurantiifolia*), fig (*Ficus carica*), and the horseradish or drumstick tree (*Moringa oleifera*), all of which seem to do well in the harsh Kiribati environment. Important emergency or pig foods include Polynesian arrowroot (**te makemake**)(*Tacca leontopetaloides*) and purslanes (**te boi** and **te mtea**)(*Portulaca* spp.), and the leaves of *Morinda citrifolia* (**te non**), *Pisonia grandis* (**te buka**) and *Polyscias* spp. (**te toara**), which were eaten as part of a campaign in urban Kiribati to arrest vitamin-A-deficiency-induced night blindness among children (which currently is reported to be negligible by hospital sources, but should be monitored).

4.7.3 Ecological and Cultural Utility of Flora

Although highly disturbed, outnumbered and, in some ways, "enriched" by introduced exotics, the vegetation and flora of Kiribati constitute a critical component of the biodiversity and a substantial ecological and cultural resource. This is particularly true for the indigenous species, virtually all of which have wide cultural utility within the subsistence economy and represent non-cas and cash income which cannot be replaced, or which would be extremely expensive to replace, with imported substitutes.

Environmental (ecological) functions that plants provide include shade, animal and plant habitats, soil improvement, material for mulching, land stabilization, and protection from wind, erosion, flood and saltwater incursion, and the desiccating effects of salt spray.

Shade is important to humans, plants, and animals, especially in highly reflective low-lying coral island and lagoonal environments, and in villages and urban areas. As populations increase, shade and the role that trees and other coastal plants play as habitats for other animal and plant species will become more important.

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 *****hat mangrove reclamation for industrial expansion led to a substantial drop in catches per effort and to yield declines of 50 to 80 per cent in offshore fisheries.

Damage from wind, erosion, and flood increase when forests are removed; and mangrove and coastal strand forests stabilize tidal-zone soils and reduce the impact of storm surge and ocean salt spray. In Truk, in the Federated States of Micronesia, where mangroves were completely removed by the Japanese before World War II, the coast was washed away rapidly, leaving coconut trees to fall into the sea. The role of coastal plants in soil stabilization is critical to the success of land reclamation and other low-cost coastal engineering works. Species used for land reclamation in various areas of Asia and the Pacific have included *Bruguiera gymnorhiza*, *Calophyllum inophyllum*, *Casuarina equisetifolia*, *Cocos nucifera*, *Hibiscus tiliaceus*, *Lumnitzera littorea*, *Rhizophora* spp., *Scaevola sericea*, *Sonneratia alba*, *Terminalia catappa* and *Tournefortia argentea*, all of which are indigenous in Kiribati. Many of the coastal herbs, grasses, sedges, vines and shrubs also aid coastal stabilization and land reclamation. In the Gilberts, species of particular importance for the stabilization of the extensive reclaimed milkfish ponds at Temaiku on Tarawa are *Scaevola sericea* and *Tournefortia argentea*.

One of the most vital ecological roles played by coastal plants is the protection of inland agricultural areas, non-coastal vegetation and fauna, settlements, and water supplies from saltwater spray and storm surge. Of particular value are plants with a high tolerance to salt spray and saline soils. In this respect, farmers throughout the Pacific purposely leave strand or mangrove forests intact seaside of their gardens because they know that to remove these trees would make farming problematic. In the Gilberts, stands of *Pemphis acidula* are left seaward of agricultural areas to provide protection from salt spray, and *Casuarina equisetifolia* has been planted to protect newly planted coconuts. Species commonly used for living fences or hedging include *Clerodendrum inerme*, *Cocos nucifera*, *Ficus tinctoria*, *Hibiscus tiliaceus* and *Premna serratifolia*. *Crinum asiaticum* is commonly used for garden borders. Plant products such as woven coconut leaves or roots are used for sandcreens. Such practices will become even more essential if sea level does rise because of global warming.

The improvement of soil by the provision of organic material is another significant contribution that atoll vegetation makes to the success of agriculture in the nutritionally poor and highly permeable coastal soils. Organic material increases the soil's waterholding capacity, reduces soil pH to more favourable levels at which minerals become more available to plants. Organic matter also reduces runoff, water and wind erosion and water loss to evaporation. The I-Kiribati have evolved sophisticated systems of fertilization and mulching using the leaves of coastal plants. The leaves of *Guettarda speciosa* (**te uri**), *Tournefortia argentea* (**te ren**) and *Sida fallax* (**te kaura**) are placed in pandanus baskets, along with other leaves and topsoil, as part of an elaborate mulching system for giant swamp taro, pandanus and breadfruit. *Sida fallax*, in particular, is considered to be such a strong fertilizer that it is only occasionally added fresh to the soil for fear of injuring plants.

Atoll plants possess great cultural utility, being used for medicine, general construction, body ornamentation, fuelwood, ceremony and ritual, cultivated or ornamental plants, toolmaking, food, boat or canoe making, dyes or pigments, magic and sorcery, fishing equipment, cordage and fibre, games or toys, perfumes and scenting coconut oil, fertilizer and mulching, woodcarving, weapons or traps, food parcelization, subjects of legends, mythology, songs, riddles, and proverbs, domesticated and wild animal feed, handicrafts, cooking equipment, clothing, fish poisons, items for export of local sale, adhesives or caulking, and musical instruments. A recent study of the utility of atoll and coastal plants in the Pacific Islands shows the coconut to have the greatest number of uses — as many as 125 if distinct uses within categories (e.g., tools with distinct functions) are counted. Next in order of importance, all with 20 or more reported uses, are *Hibiscus tiliaceus*, *Pandanus tectorius*, *Calophyllum inophyllum*, *Cordia subcordata*, *Guettarda speciosa*, *Scaevola sericea*, *Pemphis acidula*, *Thespesia populnea*, *Rhizophora* spp., *Tournefortia argentea*, *Casuarina equisetifolia*, *Premna serratifolia*, *Morinda citrifolia*, *Pipturus argenteus*, *Terminalia catappa*, *Ficus tinctoria* and *Ficus prolixa* (Appendix 10).

Analyses of available data on Kiribati indicate 170 uses for 29 indigenous species and 104 uses for 39 exotic species. This gives a total 274 uses for 68 species, a clear indication of the cultural utility of plants in Kiribati.

Because modern technology has pre-empted them, many traditional uses have lapsed or are only employed in emergency. Modern medicine, clothing, fishing lines, matches, crockery, plastic bags, soap, and emergency food rations (food aid) have, for example, replaced traditional plant-derived products. Moreover, many of the current generation, schooled in the modern educational system and living in the cash economy, often know few of the traditional uses of plants, let alone their vernacular names, a state of mind which has undoubtedly contributed to the degradation of the indigenous and long-established aboriginal vegetation of Kiribati. In North Tarawa, however, many traditional uses of plants are still known and still important.

Particularly important are the traditional food and beverage crops, the replacement of which by imported foods such as sugar, white rice and flour, cabin biscuits, noodles, canned fish, softdrinks, alcohol and tea, has led to dangerous levels of food dependency and some of the highest, or most rapidly increasing, incidences in the world of vitamin and mineral deficiency and nutrition related diseases. Diseases such as iron-deficiency anaemia, night blindness induced by vitamin-A deficiency, diabetes, cardiovascular disease, hypertension and stroke, gout and hyperuricemia, some forms of cancer and dental disease, which were rarely encountered in the past are now serious causes of morbidity and mortality in Kiribati, and among other atoll populations.

Because the vegetation and flora of Kiribati still provide a strategic ecological and cultural resource for sustainable development, there is a need for planners and national development plans in Kiribati to place a high priority on vegetation protection. This will be one of the main objectives of the NTCAP.

4.8 Fauna

The diversity of animals in the Pacific generally decreases from west to east, from New Guinea, where the fauna is among the richest in the world, with a very high rates of endemism (uniqueness), to the atolls of the eastern Pacific where the fauna is very poor (has few species). For example, Kiribati's native terrestrial fauna has only one reported endemic vertebrate, the Line Islands reed warbler (*Acrocephalus aequinoctialis*), and probably no indigenous mammals. Papua New Guinea, in stark contrast, has about 100 species of mammals (mostly marsupials), 70 species of snakes, crocodiles, over 65 species of birds, and a very rich insect fauna, which includes some of the rarest and largest moths and butterflies, and the dreaded malaria vector, the *Anopheles* mosquito, which is fortunately absent from Kiribati.

The atolls are not as impoverished in marine fauna, although there is still a decreasing abundance of species with distance from Papua New Guinea, where there are about 600 species of finfish, compared with Kiribati's 300 to 400 species. Even though conservation initiatives target areas such as Papua New Guinea with their great biodiversity and very high degree of endemism (high proportion of unique species), the endangerment of many of the few species that Kiribati has may suggest that biodiversity conservation, if we are really worried about conservation by and for people, is of much higher priority in places like Kiribati.

4.8.1 Terrestrial Fauna

There are probably no indigenous land mammals in Kiribati, with the Polynesian rat (*Rattus exulans*) plausibly being an aboriginal introduction. The main indigenous land animals consist of birds, insects and some land crabs. With the exception of a few bird species introduced by humans, most birds are either sea birds or migratory species. The lagoonal and pelagic environments in Kiribati support an abundance of marine avifauna, which nest primarily on uninhabited atoll islets, and in vast numbers on the uninhabited atolls of the Phoenix and Line groups. Surveys carried out by the Smithsonian Institution Pacific Ocean Biological Survey Program in the 1960s and early 1970s indicated that the expanse of ocean and the areas encompassing the island groups of Kiribati form one of the largest marine avifauna flyways. Species include migratory species that use the north-south oriented island chains to stop and feed as well as those species that find the isolated atolls habitats ideal for breeding and nesting.

The rich avifauna constitutes an important resource both to the people of Kiribati and to the world and should be protected because of its important role in the oceanic ecosystem. Although no reserves exist in the Gilbert Islands, numerous reserves and wildlife sanctuaries have been established in the Line and Phoenix Islands. Naa Islet could be considered as a possible bird sanctuary within the NTCA.

The insect fauna constitutes the majority of the terrestrial animals found on atolls. Many are important to the functioning of atoll ecosystems, whereas other such as mosquitos and flies, which spread disease, and cockroaches, are noxious pests. The *Papuana* taro beetle, which seriously affects the production of *Cyrtosperma* and *Colocasia* taros and bananas (*Musa* cultivars) is considered a major constraint to sustainable agricultural production. It is currently

restricted to South Tarawa. A major concern within the proposed NTCA is the maintenance of effective quarantine measures to keep North Tarawa free of this serious pest. The "toddy beetle" (*Sessinia livida*), which contaminates and consumes toddy when it is found in large numbers, is another significant pest.

4.8.2 Marine Fauna and Fisheries Resources

Kiribati's relatively rich marine fauna includes between 300 and 400 finfish species alone. Industrial fisheries make an important contribution to the national economy and small-scale fisheries are an important source of cash income and have important nutritional and social roles to play in sustainable development.

In terms of subsistence, the sea provides virtually all the animal protein in the diet, with terrestrial resources (formerly land birds, lizards and rats, and today pigs, chickens, dogs and sea birds) providing an insignificant part of the diet. Virtually all non-toxic finfish species over a few centimetres in length and many shellfish and other non-fish marine organisms are eaten, and various shells, teeth and other hard parts are used for handicrafts or other purposes.

Because of the limited terrestrial protein and carbohydrate resources, fish consumption is among the highest in the world, with an estimated average consumption of 565 g/capita/day on rural atolls, thus satisfying both the minimum daily protein requirements and much of the daily energy requirements. Consumption in urban South Tarawa was estimated to be 320 g/capita/day.

Although living marine resources are also important to the larger island countries, they are for many of the smaller countries, such as Kiribati, the sole opportunity for substantial economic development. The main categories of fisheries resources in Kiribati include: 1) the lagoonal and reef, or "inshore" fishery; 2) the "offshore" fishery, which includes both the pelagic and near-shore deep water fisheries; and 3) mariculture or aquaculture of finfish and seaweed.

The main categories of lagoonal and reef resources include: 1) a wide range of finfish; and 2) a range of marine non-fish resources, including turtles, crustaceans, shellfish, holothurians (beche-de-mer), sipunculid sea worms and jellyfish; and 3) marine seaweed and other plants. Kiribati's EEZ of over 3.55 million km² has considerable potential for pelagic fisheries development of tuna and flyingfish, and, to a lesser extent, for the increased exploitation of deepwater bottomfish and sharks and harvesting of deepwater corals. Studies in the early 1980s showed that although the catch rate of saleable fish/reel-hour compared well with other small islands in the region, and although there are areas of relatively shallow deep water (120 to 250 m) off the western edge of Tarawa and between Maiana and Tarawa and Abaiang and Tarawa, the outer reef slopes of most of the atolls drop off steeply and the total area of deep bottom fishing grounds available adjacent to the islands is relatively limited.

The main traditional fishing methods consist of: 1) reef gleaning at low tide in the intertidal zone; 2) poling and trolling for small surf and schooling tunas using pearl-shell lures; 3) the use of gill nets and encircling nets for catching bonefish, mullet, milkfish, etc.; 4)

handlining for reef and lagoon fish (rarely at depths greater than 50 m); 5) underwater spearfishing; 6) scoopnetting for flying fish at night by the light of storm lanterns; and, 7) deepwater handlining, primarily for oilfish, which is also carried out at night in depths of up to 150 m. Within these categories fishermen have developed many specialised techniques involving different types of nets, hooks and lines, baits, lures, spears, nooses, traps and fences, poisons and gleaning strategies, with as many as 33 distinct techniques having been recorded for some atolls.

On most islands, fishing is carried out from traditional sailing or, more rarely, paddling canoes. In some areas, particularly in South Tarawa, these have been replaced by outboard-powered craft. In North Tarawa, non-motorised fishing craft are still important.

More modern methods include improved tackle, boats, nets and ice boxes used by local artisanal fishermen; and the increasing use of improved deepwater handreels for commercial deepwater snapper and shark fishing. A number of fish aggregation devices (FADs) have been deployed to increase both subsistence and commercial catches. Particularly concerning is the use of **orooro** fishing where crow bars are used to beat the water to scare fish, particularly bonefish into gillnets, the use of up to 2 to 5 km long-lines for shark and tuna fishing within Tarawa Lagoon, and the limited use of scuba or hookah gear to collect beche-de-mer.

4.8.3 Finfish Resources

The more important finfish species for subsistence and local sale in Kiribati include: 1) a wide range of shallow-water snapper, rockcod, grouper, or coral trout species (*Cephalophlis*, *Epinephelus* and *Lutjanus* spp.); 2) emperors or breams (*Lethrinus* spp.); 3) goatfish (*Mulloidichthys*, *Parupaneus* and *Upeneus* spp.); 4) mullets (*Liza* spp. and *Valamulgil seheli*); 5) milkfish (*Chanos chanos*), 6) trevally or jacks (*Caranx*, *Carangoides* and *Seriola* spp.); 7) bonefish (*Albula vulpes*); 8) small herrings, sardines, sprats and their relatives (*Dussumieria*, *Herclotsichthys*, *Sardinella*, *Spratelloides* and *Rhabdamia* spp.); and the larger deepwater or pelagic species including; 9) tunas (see below); 10) a wide range of sharks (*Aprionodon*, *Carcharhinus*, *Galeocerdo*, *Ginglymostoma*, *Mustelus*, *Negaprion*, *Odontaspis*, *Sphyrna*, *Squalus* and *Triaenodon* spp.); 11) barracudas and seapikes (*Sphyrna* spp.); 12) billfish (*Istophorus platypterus* and *Makaira* spp.) and, 13) flying fish (*Cheilopogon* and *Cypselurus* spp.). These species comprise the bulk of the subsistence and artisanal catch on most islands in Kiribati, with tunas, sharks, flying fish and billfish being of particular importance on those islands such as Arorae and Tamana, which have no lagoons, and from which sharkfin is the only fisheries export.

Other important species or groups of species include: parrotfish (*Scarus* spp.), rabbitfish or spinefoot (*Siganus* spp.), surgeonfish (*Acanthurus* spp.), squirrelfish (*Adioryx*, *Holocentrus* and *Myripristis* spp.), stingrays (*Aetobatus narinari* and *Himantura* and *Taeniura* spp.), wrasses (*Cheilinus* and *Cymolutes* spp.), silver biddy (*Gerres* spp.), moray eel (*Gymnothorax flavimarginatus*) and a range of other eels, barred garfish (*Hyporhamphus dussumieri*), topsail drummer (*Khyphosus* spp.), ponyfish (*Leiognathus* spp.), unicornfish (*Naso unicornis*),

pufferfish (*Diodon* and *Arothron* spp.), oilfish (*Ruvettus pretiosus*) and longtom (*Tylosurus crocodilus*), all of which are important food fish.

The pelagic species of increasing industrial, export or local commercial in Kiribati importance include: the tuna species, skipjack (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and dogtooth tuna (*Gymnosarda unicolor*); the tuna-like species (also members of family Scombridae), bigeye scad (*Selar crumenophthalmus*), queenfish (*Scomberoides* spp.); and a number of other species including rainbow runner (*Elagatis bipinnultaus*), wahoo (*Acanthocybium solandri*), and dolphin fish or mahimahi (*Coryphaena hippurus*). Skipjack stocks seem to be sufficient to sustain both a substantial commercial fishery and the existing subsistence and artisanal fisheries. Shark fishing is also of increasing importance, given the high demand for shark fin from Chinese traders.

Of particular importance to the tuna industry, are a wide range of baitfish species used by Kiribati's pole-and-line boats. The most important sp

*****e *H. quadrimaculatus* (tarabuti)

is also an important subsistence food resource, a serious conflict of interest exists if commercial-scale bait-fish operations continue to affect this resource, which is already seriously endangered in North Tarawa due to baitfish fishing, particularly **bauki-ami** fishing with underwater lights.

Deepsea bottomfish (demersal) species of increasing commercial importance include jobfish (*Aphareus* spp.) and the deepsea snappers (*Aprion*, *Etelis*, *Gnathodentex*, *Paracaesio*, *Pristipomoides* and *Tropidinus* spp.).

A range of other finfish species of more local or minor importance, which together also constitute a critical nutritional resource. It should also be mentioned that many of these species, often in their juvenile stages, such as the damsel, angel and butterfly fishes (*Chaetodon* and *Pomacanthus* spp.) are highly desired by tropical fish collectors and have been exported from Kiribati.

4.8.4 Non-fish Resources

Marine non-fish species of considerable importance in Kiribati include: turtles; a wide range of crabs, shrimps, prawns, lobsters and other crustaceans; shellfish, including both bivalves and gastropods; holothurians or beche-de-mer; and a number of other marine organisms.

Both the hawksbill and green turtles (*Eretmochelys imbricata* and *Chelonia mydas*) are

present in Kiribati. There are turtle nesting areas on some small islets and sandbanks in the Gilberts group. These include Teirio Islet on Abaiang, just north of Naa islet in North Tarawa. The green turtle is considered to be endangered, and turtles, in general, seem to be scarce as analysis of fisheries catch data for six islands in the Gilbert group recorded no turtle catches. Despite international efforts to protect these overexploited and endangered species, both are actively hunted and eaten and the shell used for handicrafts. Turtle eggs are also eaten and considered a delicacy.

Crustacean catches are generally minimal and primarily for subsistence purposes, although lobster (*Panulirus* spp.) and mantis shrimp or **te waro** (*Lysiosquilla maculata*) are caught commercially for local sale or for limited airfreight export to Hawaii and Singapore. There are a range of crabs, including the coconut crab (*Birgus latro*), which are considered endangered or overexploited.

Of the shellfish, the ark shell or **te bun** (*Anadara antiquata*), which is easily collected at low tide in the intertidal zone, is by far the most commonly consumed and marketed marine shellfish and, perhaps, the most commonly consumed marine food in Kiribati. It is found on Tarawa, Abaiang, Marakei, Tabiteuea and Nonouti, and studies are currently underway to determine if it can be introduced into other islands. It is collected and shipped in rice bags for sale in South Tarawa. The communities of North Tarawa are, however, concerned over the commercial fishing for **te bun** in North Tarawa by people from South Tarawa.

Also of major subsistence importance in terms of percentage of catch are giant clams. Four species are present in Kiribati. These include the rugose giant clam or **te were** (*Tridacna maxima*), which is most common, and the true giant clam or **te kima** (*T. gigas*), the fluted giant clam or **te were matai** (*T. squamosa*) and the horse's hoof, bear paw or strawberry clam or **te neitoro** (*Hippopus hippopus*). *T. derasa*, the second largest species of giant clam, and *T. crocea* and *Hippopus porcellanus*, which are found only in the central Indo-Pacific faunal region, have not been reported from Kiribati. Giant clams are generally under heavy pressure, both for subsistence and commercial purposes (commonly through poaching by Taiwanese tuna or clamming vessels because of the high demand for giant clam meat in Taiwan), with some species, such as *T. gigas* extinct or close to local extinction (extirpation) in some areas, and *H. hippopus* being a recent extirpation in both Tonga and Fiji, where its shells are found in coastal middens.

Because of heavy subsistence pressure on the resource, it has been suggested that commercial fishing for giant clams in Kiribati should not be promoted, and would only lead to a rapid depletion of stocks. In response to serious overfishing of giant clams by Asian fishing vessels, giant clam aquaculture has been promoted and shown considerable success in a number of areas in the Pacific and offers considerable potential in Kiribati.

Other shellfish of major subsistence and commercial importance, in terms of local sale, include **te koumara** (*Gafrarium pectinatum*), sanguin clam or **te koikoi** (*Asaphis violascens*), striate beach clam or **te katura** (*Atactodea striata*) and the gastropods, bloodmouth conch or **te nouo** (*Strombus luhuanus*) and the gibbose stromb or **te newenewe** (*Strombus gibberulus*).

Shell collecting for sale to shell collectors and tourists could have increasing importance because the range of shell species, often with a high degree of colouration. Sea shells are in great demand for their ornamental value and for local handicraft production. They are now sold at most handicraft outlets in South Tarawa. They will continue to form the basis of a promising but limited trade as long as the resource is not over-exploited. Most can be gathered using relatively simple techniques, such as reef gleaning, netting, trapping or dredging or diving. They can be marketed, locally and possibly overseas and form the basis of an important, and potentially sustainable, village-based industry. In the Philippines, an estimated 30,000 people make their living directly or indirectly in the specimen and commercial shell industry, as collectors, vendors, or in the shell jewelry and ornament trade.

Although Kiribati has a poorer shell fauna (malacofaunas) than those of the larger Melanesian and Polynesian countries, there is a significant range of species of value for the handicraft industry, sale to tourists and export for ornamental value and to serious collectors. A one-month survey in Tuvalu in 1983, for example, recorded 119 specimen shell species from 14 families commonly sought by collectors; the total reported species from 21 families commonly sought by collectors is 186. Some of these fetch reasonably high prices from overseas collectors. Kiribati probably has a richer shell fauna than Tuvalu.

Most of these shells can be found almost anywhere and in almost all habitats using relatively simple collecting techniques, available to even outer islanders. Unfortunately, only a few people who live in urban areas or near tourist resorts know the true value of shells, except for some of the more well known species, some of which can fetch from US\$500 to US\$2000. Although there are local vernacular names for most shells, to commercialise the resource there is a need for a universally recognised set of names, so that the owners of the shell resources know what they are selling and can receive a fair price. Latin nomenclature, which is known by few islanders, is used for this purpose.

Seaslugs or beche-de-mer (holothurians), known locally as **kereboki**, are currently exploited by a number of exporters and local communities. Studies carried out in the 1970s indicated that there were thirteen species from four commercially valuable genera (*Actinopyga*, *Thelenota*, *Bohadschia* and *Holothuria*) present in Kiribati. Many of these are eaten in Polynesia and Melanesia and are considered a delicacy in Southeast Asia and areas where ethnic Chinese communities exist. Some species are reportedly being eaten in South Tarawa in the past few years.

The four species of relatively high value in Kiribati include the white and black teatfish (*Microthele fuscogilva* and *M. nobilis*), prickly redfish (*Thelenota ananas*), blackfish (*Actinopyga miliaris*) and deepwater redfish (*A. echinites*). Most of the other species, including *Halodeima atra* and *Metriatyla scabra*, are edible, and have been exported to Asia in the past or are consumed in other areas of the Pacific. The best areas for exploitation are the shoals and reef slopes in deep water passes and the deeper outer reef flats, where the main stocks of valuable species are found, and the shallow sand flats of the lagoons, which produce the greatest biomass of the less valuable species, such as *Halodeima atra*, *Metriatyla scabra* and *Bohadschia* spp.

Although the density of these species is comparable to other Pacific lagoons, the potential for beche-de-mer as a money earner is limited because the more valuable species occur only in small localized habitats. Unfortunately, there is evidence that these resources are being overexploited in North Tarawa by a number of outside commercial interests which are currently using scuba gear and weighted spears to exploit deep-water beche-de-mer reserves. The North Tarawa Island Council wants restrictions placed on such practices because these deep-water habitats constitute the only reliable breeding populations that could make a small-scale, community-based industry sustainable. It also wants to restrict the harvesting to the local communities of North Tarawa, who could then sell the harvest to South-Tarawa-based exporters.

4.8.5 Seaweed

A range of indigenous marine seaweeds or algae make up an important nutritional and commercial resource in many areas of the Pacific, although few are traditionally eaten in Kiribati. The most important of the indigenous species is sea grapes (*Caulerpa racemosa*), which is very common in Tarawa Lagoon, but which is not eaten. It is an important subsistence food and commercial product for local sale in Fiji.

One of the main economic developments in Kiribati over the past decade has been maricultural production of eucheuma seaweed (*Eucheuma cottonii*, properly *Kappaphycus alvarezii*). The dried seaweed is baled and exported to Europe, where it is refined to extract carrageenan, a commercial name for a class of indigestible polymers containing carbohydrate and sulphate, which are used to thicken or stabilize food and pharmaceutical products. The export is currently controlled by the Betio-based Atoll Seaweed Company, with the total crop going to a single buyer in Denmark.

The Philippines now provides the bulk of the world's production. It has been estimated that Kiribati could eventually produce about 4 per cent of the world's production, which would contribute about \$US 2 million in foreign exchange to the economy. Seaweed farming in Kiribati is carried out exclusively in the outer islands and is often done in family groups. The production in 1993 was under 1000MT with a moisture content of 35 per cent, with a potential harvest of 4000-5000 tonnes with the development of more favourable areas. Production is not economically viable unless levels reach 2500 tonnes (Casa Tec 1993). There is, however, some potential for the mariculture of other seaweeds, such as *Eucheuma spinosum*, which has shown promise in Tarawa lagoon, and further local processing of seaweed into higher value food and petfood products could yield greater returns than the current export for industrial conversion.

Studies indicate that a family farming a 1 ha farm with about 600 lines and 13,230 plants, could realise a yearly income of about \$US 1917 (Casa Tec 1993:59). Based on measurement of the length of shoreline and the width and total useable area in favoured locations, it has been estimated that a maximum of about 22,000 MT of seaweed could be produced in the Gilbert (Tungaru) Group. Given low labour availability, the realistic maximum production, without the use of outside labour or labour-saving technology, is closer to 4000 MT. Of the estimated 40,000 MT maximum productive potential, North Tarawa, alone, with its extensive areas of tidal flats, has the greatest potential of about 2,700 MT, and perhaps the greatest potential for approaching

this production level due to its relatively high population. Moreover, the intertidal zones in the channels between islets may have the greatest productive potential.

The major producers up until 1992, based on 1985-1992 production figures were Abaiang (1578 MT), Abemama (408 MT), Onotoa (201 MT), S. Tarawa (105 MT), N. Tabiteuea (98 MT) and Maiana (8 MT). Production in N. Tarawa only started in 1991, with 990 and 2140 kg, respectively being produced. In short, there is great potential for expansion of export seaweed maricultural industry in Kiribati, particularly in North Tarawa, although it will require a "quantum leap in the level of management, size of output and ability to undertake its own development work . . ."(Casa Tec 1993:98).

To attain these targets there must be greater encouragement of seaweed production on the outer islands, adjustment of payments in relation to the quality of the seaweed produced and dried, and increased training at the community level to improve the technology, which is a priority of the Fisheries Division.

4.8.6 Importance of Marine Resources to Sustainable Development

These diverse marine resources, which have helped sustain the people of Kiribati since their first arrival over three thousand years ago, constitute a renewable subsistence and commercial resource if managed wisely. The potential sustainability of the resource is evidenced by the fact that, despite thousands of years of almost daily "reef gleaning" at low tide for almost anything edible, and of almost any size, it is still possible, even in South Tarawa and other densely populated areas, for poor families to glean their daily protein needs from the intertidal zone and fringing reef areas.

However, the scarcity of certain marine organisms, such as turtles, bonefish (*Albula vulpes*), large reef cods (Serranidae), snappers (Lutjanidae), goat fish (Mullidae) emperors (Lethrinidae) and giant clams (*Tridacna* spp.), and smaller catches and decreasing average size of some species, indicate that atolls have been overfished in the past. There is also evidence in North Tarawa of declining yields of flying fish, possibly due to local overfishing, and yellowfin tuna, attributed to overfishing by long-liners and purse-seiners.

Of perhaps greater concern is that increasing commercialisation of many of these species, such as tuna, baitfish, giant clams, beche-de-mer and a wide range of other finfish and crustaceans, has put increasing pressure on these resources, thus underlining the need for protective legislation and sustainable production strategies.

Fortunately, the conservation ethic remains strong among most of North Tarawa's communities, where the wide range of conservation practices still in use indicates that I-Kiribati traditionally attempted to manage their marine resources on a sustainable basis. Their management was based on an extensive knowledge of fish, fishing technology, and the sea. Some of the main mechanisms included secrecy about fishing grounds and techniques, temporary or seasonal taboos or bans on species or fishing grounds, restrictions on the consumption of certain species (e.g., some species such as turtles or giant clams were reserved for chiefs or priests), fines or penalties for resource abuses, and clan tenure or limited access to

reef and lagoon areas.

Unfortunately, the principle of limited access and some of the other marine resource management mechanisms are breaking down. The main causes seem to be the amalgamation and relocation of settlements during the colonial period, an imposed belief in open access for marine resources, increased use of motorised boats capable of fishing in the open ocean, and increased emphasis on commercial fishing, modern education and development along Western lines.

5 POPULATION DISTRIBUTION AND GROWTH

Ethnically, the indigenous peoples of Kiribati are Micronesians who have probably inhabited the islands for at least 3000 years. Of the estimated 1995 population of approximately 80,000, about 96 per cent are I-Kiribati. The balance are mainly Tuvaluans, a number of Chinese families and a few hundred expatriates working temporarily in the country, some married to I-Kiribati women. The people of North Tarawa are almost exclusively I-Kiribati, sharing a common culture, a common language, and a common resource-use tradition, so that consensus should be achievable regarding the promotion of sustainable development. Some of the main commercial fishermen and marine products exporters are, however, South Tarawa-based foreigners, or local Chinese who are married to I-Kiribati.

The average annual rate of natural population increase is 2.4 per cent. Emigration is estimated at 0.3 per cent, which results in a net annual population growth rate of 2.1 per cent, (i.e., with a doubling of the population in 35 years). The growth rate for South Tarawa is 3.1 per cent. Reliable figures on internal migration do not exist, but considerable migration can be observed from the outer islands to urban South Tarawa. Of the emigrants, about 1000 are working in the phosphate industry on Nauru and a few hundred others are engaged as merchant seamen. With the projected return of people from Nauru with the cessation of phosphate mining early next century, population pressure on resources in both urban and rural areas in Kiribati is expected to increase.

Because of the very limited land area, Kiribati has some of the highest crude population densities in the world, especially in the Gilbert group, where 96 per cent of the population of Kiribati live, and particularly in highly urbanised South Tarawa, with densities of 4,167 persons/km² (Table 5.1). On Betio, the southernmost islet of Tarawa, densities are approaching 5000 persons per square kilometre -- a density which is expected to rival that of Hong Kong by the late 1990s. Furthermore, by the year 2015 the Kiribati population is projected to have increased by at least 40 per cent, which will place even greater stress on the limited resources of the country.

Such population densities are a particularly serious obstacle to sustainable development, given the extreme infertility of the soils and scarcity of fresh water on most atolls, and, thus, constitute "nutritional population densities" (the average number of persons per unit of arable land) that are significantly higher than the crude population density figures indicate. High nutritional population densities and increasing commercial fishing by South Tarawa-based boats also put increasing pressure on the marine resources of both South Tarawa and North Tarawa and other nearby "outer islands". The population densities on North Tarawa itself, however, are lower, but still high, at just under 300 per km².

Table 5.1. Estimated 1990 populations for the entire Republic of Kiribati, the Gilbert Islands (Tungaru), urban South Tarawa and North Tarawa.

	Population	Land Area	Population Density
Republic of Kiribati	70,000	822.8 km ²	85
Gilbert Islands	67,200	278.4 km ²	241
Urban South Tarawa	30,000	7.2 km ²	4167
North Tarawa	3,700	12.7 km ²	291

Source: Adapted from Bakker, 1990; UNCED Report 1992.

Although reliable figures on internal migration do not exist, up until the early 1970s the population of the rural outer islands of Kiribati remained virtually static, and only grew by 0.8 per cent annually from 1973 to 1978. This suggests that there has been outmigration from the rural outer islands to urban South Tarawa and to work as contract workers in the phosphate industries of Banaba and Nauru. With the cessation of mining on Banaba in 1979, many I-Kiribati have returned to their home islands, leading to a population increase of 1,960, or 5 per cent. However, as suggested above, there continues to be considerable migration from outer islands to urban South Tarawa.

There is very limited opportunity for permanent outmigration overseas. There are currently about 1000 I-Kiribati contract workers in Nauru, several hundred seamen who work as merchant marines on overseas ships, and a small number of highly trained I-Kiribati working for regional organisations, most of whom send a large percentage of their earnings home to support their families. When mining operations end on Nauru just after the turn of the century, most I-Kiribati can be expected to return either to Tarawa or their home islands, thus placing increased pressure on already strained resources and eliminating a source of overseas income for families and the country. There are plans for major land resettlement schemes in the Line Islands to help relieve crowding the the Gilberts and to further develop the largest land area of the country.

6 THE NATIONAL ECONOMY

Over 80 per cent of the Kiribati workforce is engaged in subsistence agriculture and fishing, which provide most of the basic needs of the people in the outer islands. Attempts to encourage increased market orientation of the economy have met with only limited success.

6.1 The Cash Economy and the Modern Urban Sector

Kiribati has limited natural resources of commercial economic importance except for fish, primarily tuna (currently the major non-aid source of foreign exchange by value) and some possibility of mining sea-bed minerals in the distant future. Coconut products, mainly copra, have traditionally been the most important, generally the sole, agricultural export by value, although the export of *Echeuma* seaweed, which is used in food processing as a food stabiliser, has recently surpassed copra exports in value. Beche-de-mer or sea cucumber (**kereboki**), sharkfin and limited export of lobster and other specialty seafoods and some handicraft constitute other minor exports.

Tourism development is minimal, although there is some promise of expanding a specialised tourist industry on Kiritimati, based on avifauna and game-fishing, and limited ecotourism on some of Kiribati's outer islands, including North Tarawa. Because of Kiritimati's large size, small population and government ownership of land, there are plans for the resettlement of Gilbert Islands people there, and on Teraina and Tabuaeran, and for further development of the Line Islands coconut industry.

With little in the way of private sector activity, the public sector and public enterprises dominate economic activity, and there is very little infrastructural or other economic development outside of South Tarawa and Kiritimati. Most paid employment is in the public sector, with only 11,142 people reportedly in cash employment. Limited skills and the limited capital base outside government has meant that the government remains responsible for providing essential basic services such as electricity generation, fuel supply, communications, shipping, printing, and even hotel operation, generally through direct investment and the establishment of statutory bodies. The efficiency of these public sector enterprises has often been low and the government has established policy guidelines for the transfer of such service enterprises to the private sector. The government is actively encouraging the establishment of small-industry production of consumer goods to broaden the production base and foster import substitution.

Unfortunately, a legacy of British colonialism is that the one asset which could have provided the means to sustain higher levels of material well-being, the phosphate on Banaba, was exhausted just before independence in 1979, immediately cutting foreign earnings and government revenues in half. The resource gap resulting from the end of mining quickly turned a positive domestic savings rate into a highly negative one. The gap over the years has been covered by withdrawals from the interest income of the Revenue Equalisation Reserve Fund (RERF), which since 1956 had accumulated royalties on past phosphate exports from Banaba. Kiribati, until recently, has avoided drawing down that capital, except for its purchase of Teraina (Washington Island) and Tabuaeran (Fanning Island) in the Line Group. In 1985 Kiribati managed to do away with budgetary support from Great Britain. The trade deficit is met primarily through the fishing licence fees paid by foreign vessels fishing in the Kiribati EEZ, through grant aid and through significant levels of remittances from I-Kiribati working overseas.

The government has tried to live within its means and has followed a very tight fiscal policy. External debt and debt service remain at less than 1 per cent of exports of goods and services, while substantial external reserves are held in the RERF and in gross official foreign

exchange reserves (each account held approximately A\$260 million in 1991, which for the RERF represents a substantial increase in value from A\$70.3 million in 1979).

However, the Kiribati economy remains very open and vulnerable. Imports account for about 75 per cent of GDP. Customs revenue from imports, fish royalties and licensing fees and withdrawals from interest income on accumulated external assets abroad, contribute over 75 per cent of Government revenue. Imports (at around A\$30 million a year) continue to outstrip exports (at around A\$5-6 million a year) resulting in a trade deficit in the order of A\$24-25 million a year.

Kiribati is also highly dependent on external assistance, which has been estimated at nearly US\$300 per capita in the early 1990s. In fact since 1982, external assistance has been equivalent to around 40 per cent of GDP, and accounted for 95 per cent of gross investment.

Thus far, the government has managed to balance its books without having to destroy its limited resource base. But as the commercial imperative becomes more pronounced and as more and more I-Kiribati want modern technologies and social services, the government may find it increasingly difficult to balance the need for more cash income against long-term sustainable development.

With scant comparative advantage economically, the development process in Kiribati, and particularly in rural areas such as North Tarawa, has been slow. This is the development dilemma that the government and people of Kiribati are facing. Although the I-Kiribati have lived a relatively sustainable way of life for thousands of years in the atoll environment, this was at a relatively low level of material well-being, a level which is no longer considered adequate by many I-Kiribati. This is particularly so for people living in urbanised South Tarawa who desire some of the more appropriate modern technologies and social services that will make their life easier, safer, healthier and more enjoyable. A higher level of material well-being would require increased cash incomes, more foreign expenditure, and changes in lifestyles, which, if not pursued in the right manner, could undermine the cultural and traditional resource-use systems that have promoted sustainability in the past.

6.2 Agriculture and Forestry

Despite limitations of soil and water, a sophisticated subsistence agricultural system is still the basis of the outer island economy. It is based on the tree crops of coconut, breadfruit, pandanus, and native fig (*Ficus tinctoria*), and the cultivation of **te babai**, the giant swamp taro (*Cyrtosperma chamissonis*), and to a limited extent true taro (*Colocasia esculenta*) and bananas (*Musa* cultivars), in pits dug through to the freshwater lens and mulched and fertilised with the leaves of salt-tolerant coastal plants. Breadfruit, pandanus and coconut palms are given similar care to ensure their survival in the atoll environment. Due to the increasing salinity of the groundwater, infestation by the *Papuana* taro beetle (on South Tarawa only) and the declining importance of **te babai** relative to copra production, cash employment and imported food, a large proportion of the pits have been abandoned on some islands. *Babai*, however, still remains of

great cultural importance as a ceremonial food in North Tarawa and outer island Kiribati.

There are currently a number of projects encouraging the cultivation of short-term vegetables and appropriate food trees and the increased production of pigs and poultry to widen the local nutritional base, especially in rapidly urbanising South Tarawa.

Commercial export cropping is restricted to the coconut palm for the production of copra, the world price of which continues to fall relative to the cost of imported goods. Whereas 20 years ago a tonne of copra bought Kiribati 100 barrels of oil, it now buys only 10, a reality imposed on Kiribati and other developing countries by world trade relationships. Despite decades of coconut replanting and rehabilitation programmes to replace senile palms and to expand plantations, copra production continues to fall.

There is virtually no modern forestry activity, although casuarina, eucalyptus, leucaena (*Leucaena leucocephala*) and a number of other species have been introduced for windbreaks, fuelwood production and soil improvement. Traditional Kiribati forestry or agroforestry, which is still practised, is based on the planting and protection of pandanus and other large coastal trees, which are the main local sources of timber for house building, general construction, canoe-making, toolmaking and woodcarving. Many of these trees are in short supply due to increasing use, felling to expand coconut plantations, mainly during the colonial period, and the failure of the current generation to either replant or protect trees. There is considerable interest in mounting appropriate coastal reforestation, agroforestry and forest protection programmes, both for their ecological and cultural value and their role in ameliorating the potential impact of global warming and sea level rise.

A particularly important role of the agricultural system, in addition to food and export production, is the production of a wide range of other useful products such as medicines, beverages, animal feed, fuelwood, fertiliser, tools, fishing equipment, handicrafts, construction materials, canoes, fencing, fibre and cordage, dyes, oils, perfumes, body ornamentation and toys, the value of which, when added to the value of subsistence fishing, is estimated to constitute between 20 to 80 per cent of the real incomes of Kiribati's rural, outer island communities.

The main agricultural products produced in North Tarawa for sale in South Tarawa include firewood, pandanus thatching (**te rau**) for houses, fresh and cooked pandanus and breadfruit, mature and green coconuts (**te bene** and **moimoto**), concentrated toddy syrup (**kamaimai**), coconut coir rope, mats, fishermen's hats, fans and other handicrafts made from treated pandanus and coconut leaves. The protection of this time-tested subsistence and small-scale commercial production system is seen as a priority for sustainable development because of the limited opportunities for cash income in Kiribati and because the replacement of these products with imported substitutes would either be impossible or extremely expensive and subject to the same deterioration in terms of trade and inflationary pressures affecting all imports. The protection and strengthening of this systems will constitute one of the main components on the NTCAP.

6.3 Fisheries

Fishing continues to be an important commercial and subsistence activity throughout Kiribati and in North Tarawa, although some resources are under increasing pressure from outside commercial fishermen, especially from South Tarawa. Subsistence fishing, including fishing by men for finfish in the lagoon and, less commonly, in the open ocean, and reef gleaning, mainly by women and children on the expansive intertidal reef flats and fringing reef is an almost daily activity in North Tarawa.

As describe in section 4.8 above, there is a vast range of finfish, shellfish and some other marine products which constitute the major source of animal protein in the Kiribati diet. Shellfish are of great importance, being collected and eaten daily. Several are also used in handicraft production or are occasionally sold to shell collectors. Lobster, mantis shrimp, octopus and turtles constitute other products of subsistence and limited commercial importance.

Skipjack and yellowfin tuna, and a range of other finfish and the common shellfish, **te bun** and **te nuou**, are occasionally either taken to South Tarawa for sale or, in the case of lobster and mantis shrimp (**te waro**), sold to directly to commercial exporters who buy directly from villages in North Tarawa.

Among the main recent commercial developments have been the maricultural production of echeuma seaweed (*Eucheuma cottonii*, properly *Kappaphycus alvarezii*) and the harvesting of beche-de-mer for export.

The dried echeuma seaweed is baled and exported to Europe, where it is refined to extract carrageenan, a commercial name for a class of undigestible polymers containing carbohydrate and sulphate, which are used to thicken or stabilize food and pharmaceutical products. The export is currently controlled by the Atoll Seaweed Company, with the total crop going to a single buyer in Denmark.

Although the Philippines provides the bulk of the world's production it has been estimated that Kiribati could eventually produce about 4 per cent of the world's production, which would contribute about \$US 2 million in foreign exchange to the economy. Seaweed farming in Kiribati is carried out exclusively in the outer islands and is often done in family groups and is strongly a social activity. The production in 1993 was under 1000 MT with a moisture content of 35 per cent, with a potential harvest of 4000-5000 MT with the development of more favourable areas. Production is not economically viable unless levels reach 2500 MT (Casa Tec 1993). There is, however, some potential for the mariculture of other seaweeds, such as *Eucheuma spinosum*, which has shown promise in Tarawa lagoon, and further local processing of seaweed into higher-value food and petfood products which could yield greater returns than the current export for industrial conversion.

Studies indicate that a family farming a one-ha farm with about 600 lines and 13,230 plants, could realise a yearly income of about \$US1917 (Casa Tec 1993:59). Based on measurement of the length of shoreline and the width and total usable area in favoured locations, it has been estimated that a maximum of about 22,000 MT of seaweed could be produced in the

Gilbert (Tungaru) Group. Given low labour availability, the realistic maximum production, without the use of outside labour or labour-saving technology, is closer to 4000 MT. Of the estimated 40,000 MT maximum productive potential, North Tarawa, alone, with its extensive areas of tidal flats, has the greatest potential of about 2,700 MT, and perhaps the greatest potential for approaching this level of production due to its relatively high population. The intertidal zones in the channels between islets may have the greatest productive potential.

The major producers up until 1992, based on 1985-1992 production figures were Abaiang (1578 MT), Abemama (408 MT), Onotoa (201 MT), S. Tarawa (105 MT), N. Tabiteuea (98 MT) and Maiana (8 MT). Production in N. Tarawa only started in 1991. In short, there is great potential for expansion of seaweed mariculture in Kiribati, particularly in North Tarawa, although it will require a "quantum leap" in the level of management, size of output and ability to undertake its own development work (Casa Tec 1993:98).

To attain these targets there must be greater encouragement of seaweed production on the outer islands, adjustment of payments in relation to the quality of the seaweed produced and dried, and the training of community members to improve the technology.

7 ENVIRONMENTAL ISSUES OR CONSTRAINTS TO SUSTAINABLE DEVELOPMENT

This sections summarises the main issues or constraints to environmentally sustainable development that must be addressed at the national and international levels. It is stressed, however, that because most of these issues or constraints are interrelated, the Government is committed to addressing these issues, simultaneously, in a cross-sectoral effort to promote sustainable for the benefit of future generations. The specific constraints to sustainable use of biodiversity in the NTCA are discussed in section 9.2 below. The establishment of the NTCA is seen as a critical priority for addressing many of these issues at both the local and national levels. For simplicity's sake the issues will be broken down into: 1) broader cross-sectoral issues that affect all sectors and all environments or resources, and, 2) those which pertain to specific sectors or resources. These are summarised in Tables 7.1 and 7.2.

Highest on the list is the threat posed by climatic change or global warming and associated sea-level rise, which could make the atolls almost uninhabitable. This has caused serious concern at all levels in the community, and threatens the very existence of atoll societies. Although there is uncertainty as to the amount and rate of potential sea level rise, it remains a major consideration in planning for sustainable development.

Of almost equal concern is the constraint to sustainable development posed by increasing population, including rural to urban migration, which puts excessive stress on natural and cultural resources and undermines any hope of sustainability, particularly in urbanised South Tarawa. None of the problems associated with acute land shortage, land fragmentation, the poverty of terrestrial resources, the fragility of marine resources to overexploitation and the threat posed by pollution and waste disposal can be addressed unless something is done to control high rates of population growth and rural to urban migration.

Because of the susceptibility of biodiversity and natural resources to degradation and their significance to subsistence and to potential commercial development, high priority is placed on the conservation, protection and enhancement of freshwater resources, soils, terrestrial plants and animals, and reef, lagoon and ocean marine resources. In the same context, the conservation of biological diversity, of **both** wild and domesticated species, as a basis to support continuing human habitation of the atolls is a priority. Also of particular importance, as a basis for the maintenance of both biodiversity and the health of the human population, is the enhancement of rainwater catchment capacity and the protection of existing groundwater resources and coastal waters from pollution.

Because of the critical importance of good nutrition to society, and because of the critical role that subsistence production plays as a component in the real incomes of the people, the breakdown of subsistence production systems, perhaps most importantly the deterioration of the traditional food system, is seen as a major constraint to sustainable development. With the declining consumption of local foods and medicines that have provided the basis for the health of Kiribati society for thousands of years, there have been serious increases in the incidence of vitamin and mineral deficiency, obesity, diabetes and cardiovascular disease and increasing and costly dependence on other imported products which can be produced locally in a sustainable manner. Humans and their subsistence production systems, as integral and dominant components of the atolls ecosystem, **must** be protected along with the natural environment to ensure sustainability. This is an issue that will be addressed directly in the NTCA Workplan.

Table 7.1. Main issues of concern that affect all sectors and all environments or resources in relation to the promotion of sustainable development in Kiribati and in North Tarawa.

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1. CLIMATE CHANGE AND SEA LEVEL RISE (land loss, flooding, salt water incursion, property damage)
 2. POPULATION PRESSURE (rapid growth, urbanisation and pressure on limited resource base)
 3. CONSERVATION OF BIOLOGICAL DIVERSITY (terrestrial and marine animal and plant diversity of **both** wild and domesticated species as a basis for human survival)
 4. BREAKDOWN OF THE TRADITIONAL FOOD SYSTEM AND OF THE SUBSISTENCE PRODUCTION SYSTEMS, INCREASING DEPENDENCE ON AN UNSTABLE GLOBAL CASH ECONOMY AND ASSOCIATED INCREASING VULNERABILITY AND LOSS OF SELF-RELIANCE (declining consumption of local foods and increasing vitamin and mineral deficiency, obesity, diabetes and cardiovascular disease, declining availability of local medicines, fuel, fibre and other locally produced products, increasing monetisation, aid dependency and associated loss of self-reliance and environmental degradation)

5. ENVIRONMENTAL BLINDNESS AND LOSS OF TRADITIONAL KNOWLEDGE OF RELEVANCE TO SUSTAINABLE DEVELOPMENT/NEED FOR ENVIRONMENTAL EDUCATION (current lack of traditional and modern emphasis on environmental education and sustainable development in the formal education system, deterioration in the Kiribati language, ignorance of traditional fishing, agricultural, medicinal, navigational and other survival skills among the young)
 6. INADEQUACY OF DATA ON RESOURCES AND SUSTAINABILITY OF STRATEGIC ECOSYSTEMS (need for data on fish stocks and recruitment, lagoonal processes and ecosystems, etc.)
 7. NEED FOR ENVIRONMENTAL PROTECTION INFRASTRUCTURE (laws, agencies, training/expertise, funding, conservation area development, etc.)
-

Areas of major concern, with respect to specific sectoral responsibilities or resources, include protection of marine resources, conservation/protection of freshwater resources, protection and enhancement of terrestrial resources, land scarcity, coastal erosion and land reclamation, waste management and disposal, and energy dependency in the form of imported fossil fuel for transportation, cooking, lighting and other developmental purposes, a trend that is not sustainable in the long term. Coastal erosion and land degradation is particularly serious in the Gilbert group, where there has been causeway development, and on Kiritimati in the Line Islands. These issues are summarised in Table 7.2.

Finally, three major needs that affect the ability of Kiribati to address all these issues, and which thus must be considered a high-priority part of the NTCAP are: 1) the need for environmental education, including both traditional and modern environmental education, to eliminate "environmental blindness" and to stress, in both the formal and nonformal education systems, the constraints to and opportunities for sustainable development in Kiribati; 2) the need to overcome the inadequacy of data and the need for research on resources and sustainability of strategic ecosystems as a basis for informed national and local planning and development; and 3) the need for environmental-protection infrastructure in the form of legislation, agencies, research, training and conservation area development (the current state of these is discussed below in section 8).

Table 7.2. Main issues of concern that pertain to specific sectors or resources in relation to the promotion of sustainable development in Kiribati and in North Tarawa.

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1. PROTECTION OF MARINE RESOURCES (reef, lagoon, ocean and maricultural)
 2. CONSERVATION/PROTECTION OF FRESHWATER RESOURCES (groundwater and water catchment systems)
 3. PROTECTION OF TERRESTRIAL RESOURCES (combating deforestation, loss of soil fertility, declining food production, declining bird populations)

4. LAND SCARCITY, COASTAL EROSION AND LAND RECLAMATION (combating coastal erosion resulting from both natural causes and modern coastal development)
 5. WASTE MANAGEMENT AND DISPOSAL (foreign toxic and hazardous waste, local solid waste, sewage and industrial waste)
 6. ENERGY DEPENDENCY (increasing dependence on imported fossil fuels for transportation, cooking, lighting and other purposes and fuelwood shortage)
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Without a firm basis of traditional and modern environmental education, particularly public environmental education, and environmental infrastructural development, the promotion of sustainable development in Kiribati and biodiversity conservation in North Tarawa will be problematic. Because of the overemphasis on modern education along western lines, mainly to prepare the young for a role in the modern cash economy or monetised sector, and almost exclusively in English at the more advanced levels, there is increasing ignorance of the natural environment. This includes ignorance of traditional resource-use systems and of the Kiribati language relating to such issues. With many of the younger generation having little knowledge of the Kiribati names for plants, fish and other natural phenomena, it is no wonder that knowledge of traditional sustainable subsistence production systems is being lost.

8 INSTITUTIONAL ARRANGEMENTS: ENVIRONMENTAL AND CONSERVATION LEGISLATION, LAND USE POLICIES AND PROGRAMMES

Kiribati does not have a comprehensive national environmental policy, but there are already in place legislation and sectoral policies addressing specific environmental concerns. These need both updating (including, in the case of legislation, amendments to meet current environmental concerns and to relate to relevant international conventions) and integration into a national multisectoral umbrella arrangement encompassing resource and environmental protection and management. In this vein, one of the stated objectives of the 6th and 7th National Development Plan 1987-91 is "sustainable use of resources".

Similarly, the September 1991 "Policy Statement" of the newly created Ministry of Environment and Natural Resources Development stressed the serious concern that the Government, at the time, had over a number of environmental issues. The need to take into account environmental considerations as an integral part of the development process and to promote sustainable development were recognised in the statement.

Acknowledging the need to address environmental issues cross-sectorally, the government established an Environment Unit (EU) within the Ministry of Environment and Natural Resources Development (MENRD); appointed an Environmental Coordinator for the EU; and set up a Kiribati Task Force on the Environment (KTFE).

The EU, now within the new Ministry of Environment and Social Development, is the prime body responsible for the co-ordination and integration of environmental concerns into development policies and programmes, although many environmental responsibilities are still vested in various government departments, Island and Town Councils. The Unit has been strengthened by the hiring of an Environment Officer, an Environmental Education Officer and a number of other project-related staff. It now also has a SPBCP-funded Conservation Area Support Officer (CASO) who will be responsible for the implementation of the NTCAP (see Terms of Reference in Appendix 2). As stressed in the Kiribati NEMS, the operation of the EU is, however, still hampered by inadequate staffing for the size of the task, by a lack of specific scientific and environmental training, and by limited financial support, the result being that it has been re-active rather than pro-active.

The Kiribati Task Force on the Environment (KTFE) was initially set up informally for the sole purpose of preparing the National Report to the United Nations Conference on Environment and Development (UNCED). It has now been established formally to advise on environmental policies. Its composition, with members from all the relevant government agencies, the private sector and NGOs is intended to reflect the cross-sectoral nature of environmental concerns. There have been suggestions that KTFE establish operational sub-committees to focus on each of the main issues or problem areas, e.g., global warming, biodiversity conservation, waste management, etc., and that there be provisions made for greater involvement of the general public in the deliberations of the Task Force.

Most recently a *Kiribati State of the Environment Report* (Wilson 1994) and the *Kiribati National Environmental Management Strategy* (SPREP 1994) have been prepared as guidelines for sustainable development.

8.1 Environmental Legislation

The Constitution of the Republic of Kiribati does not include set clauses relating directly to environment policy, but its preambular declaration that "the natural resources of Kiribati are vested in the people and their Government" can be taken to imply the notion of sustainable resource use.

Existing legislation relevant to specific environmental concerns, such as 1) land or resource use and management and access to terrestrial and marine resources, 2) coastal management and protection, 3) conservation of strategic or endangered marine and terrestrial resources, 4) water, sanitation and environmental health, and 5) control of specific potentially polluting, dangerous or environmentally disruptive substances and materials, include:

Land or Resource Use and Management

1. Native Lands Ordinance (1957) which relates to native land and registration of titles thereof.
2. Neglected Lands Ordinance (1957) to provide for the purchase of neglected land

and to regulate the sale thereof to indigent natives.

3. Mineral Development Licensing (1978) to regulate the granting of licences to search for and win minerals, and for purposes incidental thereto and connected therewith.
4. Prohibited Areas Ordinance (1957) to provide for certain islands and their territorial waters to be declared prohibited areas.
5. Land Planning Ordinance (1973) to provide for the control of the development and use of land.
6. Marine Zones (Declarations) Act (1983) to make provisions in respect of the internal waters, archipelagic waters, the territorial sea, the exclusive economic zone (EEZ) and the contiguous zone of Kiribati.
7. Kiribati Public Protection Act (1989) to make provisions for the protection of Public Highways.
8. Fisheries (Pacific Island States' Treaty with the United States of America) Act (1988) to give effect to the Treaty on Fisheries between the Governments of certain Pacific Island States and the Government of the United States of America.

Coastal Management and Protection

9. Foreshore and Land Reclamation Act (1969) to declare the ownership of the foreshore and regulate certain reclamation projects

Conservation of Strategic or Endangered Marine and Terrestrial Resources

10. Wildlife Conservation Ordinance (1975) to provide for the conservation of wildlife, in particular birdlife.
11. Plants Ordinance (1976) to provide for the protection of endangered or culturally important plants species within Kiribati.
12. Fisheries Ordinances (1978) to make provisions for the regulations of fishing and fisheries industries and to provide for the protection of specified fish species in Kiribati and within its EEZ.

Water, Sanitation and Environmental Health

13. Quarantine Ordinance (1931) to regulate the importation of agricultural and other products which may harbour pathogens of danger to sustainable development.
14. Public Health Ordinance (1926) to maintain adequate standards of public health.
15. Importation of Animals Ordinance (1964) to regulate the importation of animals.

Control of Specific Potentially Polluting, Dangerous or Environmentally Disruptive Substances and Materials

16. Wrecks and Salvage Ordinance (1966) to provide for rights to wrecks and salvage.
17. Merchant Shipping (Oil Pollution)(Gilbert Islands) Order (1975) to apply provisions of the U.K. Merchant Shipping (Oil Pollution) Act of 1971.
18. Nuclear Installations (Gilbert and Ellice Islands) Order (1972) to apply provisions of the U.K. Nuclear Installations Act of 1965.

In addition, the Local Government Act of 1984, which provides for the establishment of local government through a system of Island Councils, includes, among the Councils' wide-ranging functions, several which relate to environmental management and protection in areas such as agriculture, livestock and fisheries, building/town/village planning, forestry and trees, land management/protection (including the prevention and control of land erosion by the sea or other causes) and public health.

An example of how Island Councils have exercised the powers conferred on them by the Local Government Act, is that several Island Councils have by-laws prohibiting certain fishing methods (e.g., the use of pressure lamps and fishing nets to catch flying fish and prohibiting the use of motorised canoes for trolling) with the view of either conserving existing stocks or ensuring more equitable benefit to all members of the community from the resource.

8.2 Land and Marine Tenure

Almost all land in Kiribati belongs to the indigenous people, except for the Phoenix and Line Islands, small portions of reclaimed land owned by Government, and lands belonging to the Catholic and Protestant churches. The Native Lands Ordinance of 1956 states that native land cannot be alienated by sale, gift, lease or otherwise to a person who is not a native, although this does not prohibit the alienation of land to the State, a Local Government Council, the Housing Corporation, a registered society under the Cooperative Societies Ordinance or the National Loans Board. "Native" is defined under the Ordinance as "any aboriginal inhabitant, whether wholly or partly of aboriginal descent, who has not acquired non-native status under the Native

Status Ordinance." Title to Native Land is acquired by registration by the Native Lands Commission and the Magistrate's Court. Such land can be transferred by the Magistrates Court. The Magistrate's Court has jurisdiction to hear and adjudicate in all cases both under the law and, where the law is not applicable, under customary law.

Provisions under law are also made for the granting of pieces of land and taro pits to neglected children, people who nurse children or who show kindness. Provisions are also included for the redistribution of property of absentee land owners and the sale of neglected lands to persons who have insufficient land to support themselves. There are also provisions for the exchange of lands, taro pits and fish ponds. There is also provision for the sale of land to other natives, as long as the Court considers the remaining lands sufficient to cater for family needs. The Courts can also give permission for someone to make a fish trap, a seawall, a pond, and eel burrow (**niba**) or a taro pit on another person's land, although such improvements must then be registered in the Register of Native Lands. There are also provisions that allow for the use or leasing of house plots on other people's land and native and non-native leases.

In terms of Marine tenure, the Marine Zones Act of 1983 demarcates the following areas: 1) the "territorial sea" which extends 12 nautical mile out to sea from "certain baselines", which are determined by the low-water line of the coast or of fringing reefs, where these exist; 2) "internal waters" which are on the landward side of the lines from which the territorial sea is measured; and, 3) "archipelagic waters", which also allows for the designation of an Exclusive Economic Zone (EEZ) which normally extends beyond the territorial sea to a point 200 nautical miles from the same base line, except where it would impinge on another country's EEZ, in which case compromise arrangements are made.

Kiribati has the same jurisdiction over its internal waters and territorial sea as it does over land, although it must allow passage to ships and aircraft (Pulea and Farrier 1994).

Under the Foreshore and Land Reclamation Ordinance, the general position is that the State owns the foreshore and the seabed, subject to public right of navigation, fishing and passing over the foreshore, as well as any private rights that may exist. Foreshore in this case includes areas affected by tidal movement and not areas of seabed permanently covered by water. It is stressed by Pulea and Farrier (1994), in their *Kiribati Environmental Legislation Review* that the legislation does not seek to override customary rights in marine areas, which under the *Laws of Kiribati Act 1989* apply to: 1) the ownership by custom of rights in, over, or in connection with any sea or lagoon area, inland waters or foreshore or reef, or in or on the seabed, including rights of navigation and fishing; and , 2) the ownership by custom of water, or of rights in, over or to water. Under the Foreshore and Land Reclamation Ordinance, foreshore can also be declared "designated foreshore", under which a licence is required from the Chief Lands Officer for the removal of sand, gravel, reef mud, coral, rock and any similar substances. It also stipulates that landowners who "may be affected thereby" must be consulted.

The main problems areas relating to the Ordinance and its enforcement relate to the reclamation of land by dumping rubbish and other possible toxic material, a problem almost exclusively in South Tarawa, and the collection of reef rock, shingle, coral and sand from beaches and the foreshore which increases the threat of coastal erosion (Pulea and Farrier 1994;

Woodroffe and McClean 1992).

Also relevant to the issue of marine tenure and resource use are the Fisheries Ordinances of 1977 and amendments and the Fisheries Act of 1984, which emphasise the Minister's role in "developing the fisheries of Kiribati by taking appropriate measures to ensure that fisheries resources are "exploited to the full for the benefit of the country". As stressed by Pulea and Farrier (1994:52), there are specific references to the President's power, with the advice of Cabinet, to make regulations relating to: 1) the conservation and protection of species of fish; 2) the establishment of closed seasons; 3) the designation of prohibited areas; 4) limits on size and quantity caught; 5) prohibitions on fishing practices and equipment likely to damage fish stocks; and, 6) the taking of coral and seaweed. Under this legislation immature and egg-bearing female lobsters (*Panulirus* spp.) are protected, and fishing has been prohibited in designated areas of Kiritimati in the Line Islands. The taking of coral has reportedly also been banned on Tarawa and restricted on other islands, although this may have no legal basis.

Although all "local fishing vessels" being used commercially must be licensed, this does not include native boats and those less than seven metres long, even if they have an engine and are being used for commercial fishing. Licensed vessels must not fish within three miles of the shores of any island, except when fishing for baitfish within a lagoon (Pulea and Farrier 1994:53).

8.3 International Conventions

Because of the small size and limited political leverage of Kiribati and other Pacific Island states, regional and international conventions and initiatives have shown to be among the most effective ways of addressing both global and many national environmental issues.

Kiribati is a signatory, or has succeeded to the following environment-related conventions:

1. Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention).
2. South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty).
3. Nuclear Non-Proliferation Treaty.
4. Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific (Tarawa Declaration)
5. London Dumping Convention
6. International Maritime Organisation Convention
7. Maritime Pollution Convention (MARPOL)

Kiribati continues to devote considerable diplomatic effort to environmental matters and issues. At the 1983 meeting of the London Dumping Convention, Kiribati and Nauru proposed a complete ban on the dumping of all nuclear wastes in the ocean environment. The proposal, which sought to reverse the prevailing practices of allowing certain categories of acceptable disposal, met strong objections from the nuclear nations. As a compromise, Spain proposed a moratorium on all kinds of ocean dumping of radioactive wastes pending the review of the Kiribati/Nauru proposals by an expert group.

During the drafting of the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention), Kiribati insisted on a more extensive coverage of the Convention area to include the Northern Pacific areas as well as the high seas between the country's component groups or archipelagos (EEZs).

More recently, with increased international attention being given to global warming and rising sea levels, Kiribati has been a regular participant in relevant forums including the Alliance of Small Island States and the Intergovernmental Committee Negotiating a Framework Convention on Climate Change.

8.4 UNCED Report

The *Country Report for UNCED: Kiribati* (Thaman *et al.* 1992), prepared in consultation with the Kiribati Task Force on the Environment (KTFE) and a wide range of other government and non-government agencies for the United Nations Conference on Environment and Development (UNCED) held in June 1992, is a detailed document providing information on the status of the Kiribati national and cultural environments, major constraints to environmentally sustainable development and suggestions as to priority areas for action to address these problems. Kiribati was very well represented at UNCED, which was seen as an important event in increasing national and regional awareness of the need to address environmental problems as a basis for sustainable development for future generations.

8.5 National Environmental Management Strategy

As a follow-on to UNCED, SPREP has had as one of its priority activities the strengthening of the capabilities of Pacific Island governments to integrate environmental considerations into their development planning process. The main component of this programme has been the preparation of "state of environment reports" and "national environmental management strategies. With the assistance of SPREP, and funded by UNDP, Kiribati completed its *Kiribati State of the Environment Report* (Wilson 1994) and the *Kiribati National Environmental Management Strategy* (NEMS) in 1993 (SPREP 1994). A *Kiribati Review of Environmental Legislation* (Pulea and Farrier 1994) and a *Kiribati Review of Environmental Education* (Taylor 1994) were also completed as part of the NEMS process.

The NEMS, provides a long-term perspective of a range of strategies and programmes

that could be used to promote sustainable development. These have been considered and endorsed by the Kiribati Task Force on the Environment (KTFE) and Cabinet. The NEMS stresses that the broad objective of the Kiribati government in the environment sector is "to achieve an environmentally sustainable development and a better quality of life" by "utilising the natural resources without compromising the ability of the future generations to live out of the same resources". Other long term objectives are:

1. To improve public understanding of the potential impacts of climate change and of other environmental issues;
2. To develop and implement a national programme to understand and mitigate the potential adverse impacts of global environment change;
3. To promote the concerns of Kiribati through international and regional fora, conventions and action programmes.

Specific objectives of the environment sub-sector are:

1. To manage and plan for ecologically sustainable development and conservation of coastal areas, habitats and resources;
2. To develop and implement coastal planning and management;
3. To improve administrative arrangements and legislation;
4. To control pollution and have an effective sanitary disposal of waste;
5. To strengthen the capability of national institutions to carry out pollution and monitoring and research;
6. To increase knowledge and understanding of Kiribati resources and environment; and
7. To improve policies, methods and technical advice on environment issues (*Kiribati Seventh National Development Plan, 1992-1996*).

The possible strategies to achieve these goals, particularly the goal of sustainable development, that are included in the NEMS include:

1. The integration of environmental considerations into economic development through the strengthening of environmental legislation and its enforcement, and the strengthening of institutional arrangements for implementing environmental programmes.
2. Human resource development, including environmental training to deal with specific environmental issues.
3. The establishment of an Environmental Impact Assessment (EIA) capability within the

planning process.

4. The introduction of a comprehensive framework of national environmental law, together with the means for enforcing it in a manner which is socially acceptable and culturally sensitive.
5. The establishment of mechanisms for open consultation with local communities and the pursuit of traditional consensus approaches to decision-making.
6. Strengthening of the KTFE to ensure the integration of economic, environmental and physical planning with the policy evaluation process.
7. Upgrading the capacity of the Environment Unit to carry out initial screening of project proposals and to make recommendations to the KTFE concerning the need (or otherwise) for the environmental impact assessment.
8. Improving environmental awareness and education.
9. Development and protection of the resource base, including activities such as preparing for the potential effects of global warming and sea-level rise, agricultural quarantine, energy conservation, development of coastal zone management and protection strategy and planning regulations, protection of the freshwater lens, protection of endangered flora and fauna, protection of mangroves, establishment of wildlife sanctuaries and an arboretum of traditional cultural and medicinal plants of Kiribati, and conservation and management of reefs and marine living resources.
10. Improving waste management and pollution control.

8.6 Land Use Management

Through its Lands and Survey Division, the Ministry of Home Affairs and Rural Development has been responsible for physical planning, particularly in South Tarawa. Under the provisions of the Land Planning Ordinance 1977 (cap 48), the Minister for Home Affairs and Rural Development appoints two Local Boards and a Central Board which are responsible for the administration of a General Land Use Plan for the three urban centres -- Bairiki, Bikenibeu and Betio.

The Lands and Survey Division is also active in coastal protection by designating areas from which sand and gravel may be removed. The division is also the national implementing agency for the South Pacific Applied Geoscience Commission (SOPAC) Beach Profile Project which is responsible for monitoring coastal erosion and changes in the foreshore.

8.7 Outer Islands Development

The Ministry of Home Affairs and Rural Development (MHARD) is also responsible for co-ordinating outer island development. Most of the projects under this programme aim at promoting self-reliance and sustainable development in the islands and rural areas outside South Tarawa. Recently, the Ministry has initiated a series of Integrated Island Profiling and Development Planning Workshops with the aim of achieving a wider and more meaningful participation of people in planning their island's development. It is noteworthy that environmental protection enjoys either the first or second priority in the overall development strategies for Aranuka and Kuria, the first two islands to complete their development plans.

The Government's decentralisation efforts and resettlement programme aim to reduce high population densities in the Gilbert Group and to develop the Northern Line Islands by resettling people from South Tarawa and other islands in the Gilbert Group to the Line Islands. The success of these policies will depend in large measure on the economic opportunities and quality of life offered to the new Line Islands communities.

8.8 Agriculture, Fisheries and Ecotourism

Apart from its environmental role, the Ministry of the Natural Resources Development, as its name suggests, is responsible for the development of the country's natural resources through its two main divisions, the Agricultural and Fisheries Divisions.

There are five main areas of activity under the Agricultural Division. These are:

1. Coconut Replanting, which involves encouraging landowners to replant and rehabilitate their coconut groves in the hope that the production of copra for export and coconut for domestic consumption would be improved on a sustainable basis.
2. Coconut Timber Utilisation which involves the milling of senile coconut trees felled as part of the Coconut Replanting scheme.
3. Crop Research and Development which has placed major focus on research and development of both exotic varieties and traditional food crops.
4. Livestock Investigation and Development which has focused on the improvement of local chicken and pigs by cross breeding with high-grade imported stock. Activities in this area also include the commercial production of eggs, chicken and pork with the aim of making the urban centres self-sufficient in these products.
5. Pest Control and Quarantine which includes research into, and control of, various pests, particularly the taro beetle, the breadfruit mealy bug (scale insect) and rats. The Division also implements restrictions on the importation of plant and animal materials in an attempt to control the introduction of further pests and diseases.

The Fisheries Division is directly responsible for co-ordinating development of fisheries and marine resources. The main areas of activity include:

1. Assessment of fish stocks and species to establish their commercial and subsistence development potential.
2. Monitoring of fish catches (particularly commercially and nutritionally important species).
3. Aquaculture/mariculture.
4. Licensing of foreign fishing vessels.
5. Surveillance of Kiribati's EEZ.

There are concerns that increasing population, particularly in the urban areas, together with increasing commercial fishing and exploitation of other marine resources is likely to lead to overfishing and unsustainable production systems. In an effort to regulate and counteract these adverse effects, the Fisheries Division has instituted a programme of long-term monitoring of catches by artisanal fishermen, the national fishing company (Te Mautari Ltd.) and foreign vessels fishing in Kiribati's EEZ.

The Fisheries Ordinance provides for the introduction of conservation regulations as deemed necessary. Existing measures to regulate overfishing and over-exploitation of marine resources include the prohibition of purse seine fishing by foreign fishermen close to land, regulatory measures relating to lobsters (crayfish) and the suspension of the exportation of corals by a local businessman pending a detailed impact assessment.

Further efforts in the development of conservation regulations and measures are constrained by the lack of scientific data relating to the resource (species, size, distribution, reproductive/recruitment characteristics, degree of current exploitation, endangerment status, and ecosystem/habitat status).

The Fisheries Division also undertakes constant monitoring of environmental effects from pollution, seaweed farming, causeways and other human activities and man-made structures on marine life and ecology. The Fisheries Division has been instrumental in ensuring that causeway designs include openings to minimise disruption of lagoonal circulation and lagoonal/coastal ecosystems.

The Ministry of Transport, Communication and Tourism (MTCT) is involved in ecotourism development, particularly on Kiritimati Island, where the industry is based primarily on wildlife observation, with particular emphasis on the island's extensive seabird populations. The Kiribati Visitors Bureau is the main agency for the promotion of tourism to outer islands

8.9 Water and Sanitation

Many of the basic community health problems in Kiribati are largely attributable to the contamination of water supplies from inadequate sewerage facilities. Following the cholera epidemic of 1977, a major sewerage project (with a capital cost of A\$6.4 million) was implemented in 1978. The project, funded under the Australian Government's bilateral aid programme to Kiribati, provided for a salt water system with electrical pumping of sewage to outfalls beyond the reefs. The system has been fully operational since 1982 and is currently under the direct responsibility of the Public Utilities Board (PUB).

The PUB is also responsible for the South Tarawa Water Supply system, a major Australian-funded project which began in 1983. The project is currently in its second stage, which involves the identification of potential water reserve areas in North Tarawa. In the case of the islands outside Tarawa, an Outer Island Water Supply Unit has been established within the Ministry of Works and Energy to co-ordinate and prepare policy and guidelines for outer island water schemes. The aim of the Outer Island Water Supply Unit is to provide safe drinking water from one handpump well (or tap) for every ten households. There are also plans to construct more rainwater tanks and to improve collection facilities on South Tarawa, and to charge a more (higher) economic rate for water, especially to commercial and industrial users and Government Departments in an effort to encourage water conservation. Consideration is also being given, in the planning stages of the new airport, to utilising the run-off from the runway.

The Ministry of Health, Family Planning and Social Welfare (MHFPSW) is involved in routine monitoring of water resources. In the urban areas of South Tarawa where there is a reticulated water system, the monitoring entails analysis of samples from specific points. In the rural areas, and in certain parts of South Tarawa where people depend on water from private wells, samples are taken randomly. The samples are analysed for their total coliform, faecal coliform and dysentery bacteria counts. Regular monitoring of sewage for faecal coliform is also carried out.

MHFPSW is also active in the area of waste disposal, including both human and solid wastes. In the rural areas, the ministry provide materials, supervision of the building of, and advice on the siting (e.g., at least 30 metres from nearby wells) of water-seal toilets. Its network of Island Health Workers also provide advice on sanitary disposal of garbage (including advice on disposal pits). In urban areas, the ministry provides professional advice to the two urban authorities -- the Teinainano Urban Council (TUC) and the Betio Town Council (BTC) -- on safe and sanitary disposal of garbage.

There are plans to expand the pollution monitoring roles of the ministry to include atmospheric monitoring, particularly of emissions of carbon dioxide, carbon monoxide and lead. It is hoped that this activity will begin in two years time following the training of the officer to be involved and the acquisition of necessary equipment.

8.10 Public Works, Coastal Protection and Energy

The Ministry of Works and Energy (MWE) is involved in several environmental efforts, including coastal protection, improvement of water supplies and the development of appropriate energy sources.

Coastal protection is a regular activity of MWE, for which funds are provided annually in the recurrent budget. The coastlines of many of the islands of Kiribati are subjected to erosion by heavy seas. Man-made structures, such as causeways, and human activities, including the removal of reef stones and coral, tend to exacerbate coastal erosion. In implementing coastal protection, the Ministry responds to requests from other ministries or individuals. In the outer islands, while the primary responsibility is vested in the Island Councils, the ministry does provide assistance if the work required is beyond the capacity of the Council. The main method of coastal protection is the provision of stone-filled gabion baskets or sand bags to the affected areas. This method offers protection in the short term, although MWE continues its efforts to identify the most effective means of coastal protection, one of which seems to be traditional seawall construction technology, employing layers of vertically arranged rocks and coral which absorb or disperse wave impact more effectively than gabion baskets and sand bags. The traditional technology does require, however, large amounts of rock and coral, often including living coral.

Many of MWE's construction and civil works require the use of materials from the foreshore, particularly sand, aggregate and coral. Fully aware of the impact of the removal of these materials in terms of accelerated erosion, attempts have been made to minimise their removal from the foreshore and intertidal zone. To this end, limestone rock from the reef is crushed to provide the aggregates required for construction. The environmental impact of the removal of limestone boulders from the reef is constantly monitored.

In a related area, the Ministry of Communication, Transport and Tourism is currently monitoring the impacts on coastlines and marine ecosystems resulting from blasting reef passages in the outer islands (see 8.11 below).

In the area of energy development, an Energy Planning Section was established within the Ministry of Works and Energy in 1984. Staffed by a UNDP-funded Energy Planner and an Assistant Project Engineer, the section has undertaken a number of activities, involving both local and overseas agencies such as the Public Utilities Board (PUB), the Kiribati Oil Company and the UNDP Pacific Energy Development Programme (PEDP).

The use of solar photovoltaic technology, for example, has been promoted, given its useful application in the outer islands where there are neither centralised power supplies nor regular fuel supplies for generators. A Solar Energy Corporation was established in 1985 with USAID assistance to provide appropriate infrastructural and technical services for the importing, retailing and servicing of photovoltaic equipment. Training courses, demonstrations and public education in the use of this technology, AND investigations of other renewable energy sources have also been undertaken in cooperation with PEDP and the Forum Secretariat Energy Unit. Taratai Village in North Tarawa is almost totally supplied with photovoltaic lighting, and other

villages have installed some photovoltaic equipment.

8.11 Reef Passages or Channels

Reef passages or boat channels, built by blasting of coral heads to clear a passage to the open sea, are common forms of outer island infrastructural development in Kiribati. The passages provide an all-tide access for fishermen to the open sea as well as for the transportation of cargo to and from ships. Passage development, however, has generally not taken into consideration the impact on fish stocks and marine resources, stability of the reef and islands and coastal erosion, particularly during storms, and the impact on the incidence of ciguatera fish poisoning.

In 1988, the New Zealand Ministry of External Relations and Trade commissioned ecologists at the University of Auckland to carry out an Ecological Impact Assessment of the effects of boat channel construction by blasting on Pacific atolls. The study was carried out in Tuvalu. The results of the study, which are currently being studied by the Ministry of Communication, Transport and Tourism, showed that channel construction:

. . . did not have a big effect on the numbers of the 229 animals (e.g., fish), algae and sediments. In about 9 per cent of cases, the number of animals declined, while in 7 per cent of cases they showed an increase. The general conclusion of the study was that provided certain limits were placed on how, where and when channels were built, they would not cause widespread damage to reef communities (Kaly, U.L. and G.P. Jones 1990).

The study recommended measures and guidelines to minimise negative impacts and to, perhaps, increase the number of fish in the channels. It was suggested that both old and new passages could be improved by:

1. Limiting the number of channels built on any island.
2. Building channels so that their walls and floors are complex, that is, the floors have several different types of materials and the wall contain holes and overhangs to attract and provide habitats for a wide variety of fish.
3. Minimising the size of channels and locating them away from the beaches (By keeping their ends well away from beaches, at least 10 metres, will help ensure that they do not drain the sand from the beach).
4. Minimising blasting damage to fish (This can be done by either blasting only after 11 am or by setting a small initial blast to frighten fish).
5. Avoiding building or enlarging channels which connect with lagoons (As tidal currents running through such channels can move large amounts of sand and can

kill off animal and algae communities in the lagoon and on the outer reef at the channel mouth).

6. Never building a channel connecting a ponding lagoon with the ocean (as this will cause the level of water in the lagoon to drop during low tide, thus killing corals, fish and other lagoonal life).
7. Building channels on protected sides of islands, avoiding points around the reef, or using areas which have already been damaged in other ways (This limits channels to areas of lower productivity, lower exposure to storms and minimises the total area of damaged reef on islands).
8. Not spreading spoil from the blasting over a wide area of the tidal rock platform (This practice unnecessarily disrupts the tidal platform, which is an important source of food for some fish during high tides. It could also make the reef more likely to have an outbreak of ciguatera by disturbing established communities of algae).
9. Lining channels with boulders, though not required (A wall of boulders running either side of a channel provides shelter which increases the number of fish species. They may also reduce some of the water flow into channels from the rock platform).
10. Stabilising the upper beach near the channels (This can be done by angling the access road to the village away from the channel, and by planting both sides of the roadway and top of the beach with coconut palms and low bushes for 20 to 50 m on either side to stabilise areas where people use the beach the most).
11. Replanting coral seed stock (This is to encourage natural populations of corals, fish and algae. It could be done by collecting 5 cm fragments of living coral from the surrounding reef and scattering them over damaged areas during long spells of calm weather. These fragments must be kept covered by seawater at all times. They may also help restabilise the blasted area and reduce the possibility of an outbreak of ciguatera).
12. Creating reef reserves (These are small sections of the reef set aside as permanent reserves to compensate for the loss of sections to channels).

8.12 Climate Change and Rising Sea Level

A major environmental concern is the potentially disastrous impact that climate change or global warming and associated sea level rise could have on the habitability of the low-lying atolls of Kiribati. Climatic data in Kiribati are collected by the Meteorological Service of the Ministry of Transport and Communication, which operates 20 stations, including its headquarters on Betio, Tarawa. Of these, only five make full daily climatological observations which include

wind speed and direction, rainfall and temperature and, in the case of 3 stations, barometric pressure. The remaining 15 stations record daily rainfall only.

As part of global efforts to monitor climatic change and rising sea levels, the Kiribati Meteorological Service is participating in the Tropical Oceanic Global Atmosphere (TOGA) programme, established by the World Meteorological Organisation and administered by the US National Oceanic and Atmospheric Administration (NOAA). The main emphasis of the programme is the study of the atmosphere and the oceans and the interface and interactions between them, in the area 20 degrees north and south of the Equator. As part of the programme, a TOGA project was started on Kanton Island in 1985. Operated by I-Kiribati personnel with technical backup provided by TOGA, the project observes and monitors tides, temperature, rainfall and upper wind velocity. The University of Hawaii also operates a tide gauge based at the Betio Harbour.

The 1989 South Pacific Forum in Tarawa agreed to establish a series of monitoring stations in the region, including Kiribati. The project is yet to be implemented.

As part of the increasing interest in climatic change and rising sea levels, the Meteorological Service is planning to establish the post of Scientific Officer with the responsibility, among other things, of collating and interpreting climate and sea level data.

8.13 Special Projects and the Tarawa Lagoon Management Plan

The growing concern about environmental degradation, whether caused naturally, or resulting from increasing population pressure or from specific development projects, has led the Kiribati Government to initiate a number of new environment projects or programmes. Of note, are two complementary programmes additional to the on-going sectoral concerns covered above. These include: 1) a pilot environmental study of the Outer Island Development Programme, and, 2) an applied atoll ecological study focusing on Tarawa Lagoon.

The pilot environmental study of the Outer Island Development Programme was commissioned in 1990 with the aim of strengthening the role of the Ministry of Home Affairs and Rural Development's Outer Island Development Programme for improving the quality of life in the outer islands and bringing about self-reliant and sustainable development. The study's main targets were the evaluation of the impact of the location and design of: 1) the new causeways/bridgeways to be built between the islets of North Tarawa; 2) the existing causeways which will be opened at Bonriki-Tanaea and North Tarawa; 3) the causeway at Onotoa Atoll; and, 4) the packages of island micro-projects in North Tarawa, Onotoa and Tabiteuea.

For each of these targets, the study looked at the impact of the proposed designs/plans on lagoon and island ecology, including water movements, salinity and sediment levels, marine biology, erosion, waste disposal, sand deposition and local vegetation (Gilmour and Colman, 1990). The study concluded by identifying the need for further data collection to facilitate improved environmental management. It also recommended further research, collection of data and the provision of a technical advisory service in relation to causeway design and construction

as well as to other small rural development projects in outer islands of Kiribati, with the emphasis being placed on environmental impact assessment (EIA), socio-economic impact assessment, baseline studies and engineering design. It is very likely that this study will give rise to environmental management guidelines for the outer islands.

The Applied Atoll Ecological Study, a study of Tarawa Lagoon, was a joint effort of the Government of Kiribati and US Agency for International Development (USAID). It covered the period from 1991-94, at an estimated cost of A\$1.6 million. The main objective of study was to produce a "Strategic Plan for the Restoration of Tarawa Lagoon", which is currently in the form of a Draft *Tarawa Lagoon Management Plan* (TLMP)(Volumes I-III)(BioSystems 1994). The project conducted for MNRD by BioSystems Analysis Inc. of Tiburon, California, in conjunction with the University of the South Pacific Marine Studies Programme, and funded by USAID, included shellfish and benthic ecology assessments, a finfish assessment, with special emphasis on bonefish, a study of primary and secondary production and food chains (food webs), and lagoon circulation, with particular emphasis on the impact of causeway development. It also included household surveys of 4 per cent of the households of South Tarawa and 2 per cent of the households of North Tarawa.

The study pointed out that a TLMP is urgently needed to address serious pollution problems and deterioration of the lagoon's natural resources. The suggested TLMP included the establishment of a "Lagoon Management Council", which would be seen as part of the private sector and independent from government, but which would interact with relevant government ministries and NGOs, fishermen, fisherwomen and business people (the user public), and with Island Councils and Unamwane (Councils of Elders). A key aspect of the TLMP would be "comanagement" (co-operative management) of lagoon resources between the central government and local communities adjacent to the resources. Local control is considered essential because government does not have the financial or human resources to impose and enforce regulations. The Lagoon Management Council is designed to facilitate community-based efforts to manage the lagoon resources, and to help identify and seek funding for projects that will improve the conditions of the lagoon and address constraints to sustainable use.

The report notes that the current use of the lagoon is based on English Common law, i.e., that the lagoon is open to all for any use, a "Tragedy of the Commons" wherein every individual takes what they can, leaving the resultant depletion and degradation for future generations. An important aspect of the TLMP is, thus, to change people's attitudes so that the use of the lagoon's resources is sustainable.

The major objective of the TLMP is to increase the productivity of the lagoon to approach its maximum sustainable yield. To do so, there are some resources that will need to be protected for many years so that they can build up sufficient populations for sustainable harvesting in the future. Major recommendations include:

1. The banning or dramatic restriction of the use of gill nets in the lagoon, including the banning of the use of gill nets on reefs, and possibly a 5-year moratorium on the use of all gill nets, seen to be the quickest way to restore the lagoon to full productive potential.

2. Ban the use of scuba and hookah equipment and swim fins for collecting and harvesting of shellfish to maintain deep water stock as a reservoir of spawning-size adults that can seed shallow water areas (the use of such equipment should be restricted to scientific, tourism and public education uses), and that studies be continued to study the life cycle of **te bun** (*Anadara antiquata*).
3. That other gill net or net-related restriction might include ban on a) net fishing for turtles, b) the use of heavy iron bars/cross bars to frighten fish into nets (**orooro** fishing), c) gill net use in all areas with living coral, d) the sale and importation of all gill nets, e) the connection of multiple nets to make long nets, f) the sale of lagoon fish caught using gill nets, g) loans for purchasing gill net equipment, and, h) the institution of a time restriction on the use of gill nets.
4. That, to re-establish stocks of bonefish (**ikarii**) and goatfish (**maebo**), a ban be placed on bonefish fishing three days before to three days after the full moon, a ban be placed on goatfish fishing during the period of the new moon, a ban be placed on the use of gill nets of less than 3.5-inch mesh in the lagoon, and that there be continued research on the life-cycle of the bonefish.
5. That a restriction be placed on fishing for baitfish (**tarabuti**) in the lagoon and adjacent to the lagoon along the western reef, with particular emphasis on the banning of the use of the use of underwater lights (**bauki-ami**) fishing, and that all baitfish resources be restricted to use by local subsistence fishermen.
6. That there be a five-year moratorium on the harvest of giant clams, and that efforts be made to introduce community-based giant clam mariculture, and that some giant clams be provided to Tarawa residents for a test culture programme.
7. That a 25-year moratorium be placed on the harvest of sea turtles or, alternatively, that there be adherence to the South Pacific Regional Marine Turtle Conservation Programme (SPREPMTCP) which limits harvest to local ceremonial purpose and bans the use of turtle nets, harvesting of eggs and the export of any turtle products, and that Naa be protected as a turtle-breeding sanctuary.
8. That beche-de-mer (sea cucumber) harvesting be restricted to hand collection, that the use of weighted spear points, and scuba and hookah for deep harvesting be banned to protect deepwater reserve breeding populations, that a minimum size limit be set, that Tarawa businessmen be involved in a management programme, and that a public education programme on beche-de-mer be initiated.
9. That the harvest of mangroves be minimised through the establishment of a "no net loss policy" where if mangroves are harvested, they must be replanted or allowed to regenerate, that a mangrove replanting programmes be set up, and that a public mangrove education programme be initiated.

10. That an aquaculture development plan be put into effect to assess the potential and to promote the culture of giant clams, seaweed, black-lip pearl oysters and sponges.
11. That a system of protected areas be established to re-establish populations of bonefish and other endangered species (it is recommended that 20% of the lagoon be set aside to restore fish populations as quickly as possible).
12. That the anchoring of boats on reefs be banned.
13. That increased open ocean fishing be encouraged to reduce pressure on lagoon resources and to exploit the considerable tuna, flyingfish and other pelagic species, deepwater bottomfish and possible squid resources, and the associated establishment of a 200-mile exclusionary fishing zone around Tarawa to make tuna resources available to only the residents of Tarawa (current policy allows licensed tuna vessels to come within 12 miles of the islands to catch tuna and other by-catch, including sharks).
14. That a significant number of openings or passageways be made in all existing causeways between the islets of Tarawa Atoll to increase circulation and allow more fish and invertebrate larvae and juvenile fish to enter the lagoon and to allow for fishermen to have easier access to the ocean (studies at Tenaia indicate that the larvae or planktonic juvenile stages of over 30 species of finfish and shellfish, including bonefish, enter the lagoon through this channel which has a bridge, rather than a causeway).
15. That studies be conducted to assess the degree of pollution of south Tarawa Lagoon and to develop strategies for minimising input of human waste and sewage into the lagoon.
16. That all avenues be explored to establish jobs for the growing population of Tarawa, with particular emphasis on reducing rural to urban migration (this would include the creation of private sector jobs in tourism, aquaculture, research and monitoring, commercial ocean fishing, outer reef tropical fish collection and limited harvest of selected lagoon resources).
17. That a community awareness programme be implemented which goes beyond the use of the existing media, with the possible development of a newsletter, books and public meetings to discuss the development of the lagoon.

Most of these suggestions have been incorporated, in one way or another, into the proposed workplan presented in section 9 below.

8.14 Training, Education and Public Awareness

Without improved environmental awareness and a firm educational basis (in terms of both formal and non-formal education), improved environmental management and sustainable atoll development will be problematic. Accordingly, considerable effort must be placed on improving formal environmental education in primary and secondary schools, providing training

in environment-related areas and in improving public awareness of environmental issues.

At the primary school level, there is currently an Environmental Studies course, which is more a "Nature Study" than a course that focuses on environmental change and human impact on the environment. There is obviously the need, as Sullivan and Gibson (1991) suggested, for materials on environmental change and human impacts on the environment to be introduced into the present Environmental Studies curriculum. This should include the concept of the climatic change and sea level rise and other issues/problems such as land degradation, loss of biodiversity, pollution and loss of traditional agricultural, fishing and environmental knowledge.

There is currently no formal Environmental Studies at the secondary level, although environmental issues are addressed in different subject areas such as Geography, Chemistry and Biology. There is a major focus on environmental issues and options for sustainable development in the Pacific Islands in the Geography component of the recently established Kiribati Seventh Form high school programme. This programme is based on University of the South Pacific's Foundation geography materials, with the major assignments and exams marked by USP staff. There is, nonetheless, the need for environmental studies to be taught as a separate multi-disciplinary subject examinable at the national Kiribati Junior and Form 6 levels.

Apart from plans by the Ministry of Health and Family Planning for overseas training in atmospheric monitoring in 1992, there are currently no plans for specialised training in environmental management, although a number of I-Kiribati graduates have Geography or Science (Environment-related) first degrees that may qualify them for postgraduate environmental studies. USP does offer a Bachelor of Science degree in Environmental Studies, a Diploma in Environmental Education, and a new Bachelor of Arts in Environmental Studies which are increasingly in demand from other regional countries, but which have not yet been utilised by Kiribati.

Although there is a considerable degree of public awareness of environmental issues, largely gained from personal experiences, only recently has there been an effort to heighten this awareness through radio programmes or other forms of public education. Radio Kiribati currently runs a regular programme on Public Health, which could become the model for a radio programme on environmental awareness. There has also been a major media campaign to promote water conservation. The Environmental Unit also has a radio programme and has worked with the local Itibwerere Drama Group to produce plays on turtle conservation and on the protection of marine resources.

8.15 Non-Governmental Initiatives

Several non-government and regional initiatives have addressed some of the major environmental issues and promoted sustainable development. At the national level, these include women's organisations active in promoting sustainable development among women; and youth associations which are instrumental in mobilising youth effort directed towards activities contributing to sustainable development. On individual islands, traditional political structures such as the **Unimwane** (Council of Elders) have also been instrumental in identifying

development needs. As repositories of local knowledge and experience, their advice and participation should be sought in the protection/management of the environment and in the promotion of sustainable development.

Almost all national non-governmental organisations (NGOs) are part of, or affiliated to, a wider network of regional or international networks of NGOs. Government should therefore facilitate the establishment of a national NGO umbrella arrangement which could be coordinated with and strengthened by national and regional or international efforts promoting sustainable development.

Several international agencies (both intergovernmental and non-governmental) have programmes supporting local NGO's initiatives in environmental management and education and the promotion of sustainable development, some of which have already benefited Kiribati, include: 1) the UNDP Integrated Atoll Development Programme; 2) the UNICEF and Foundation for the Peoples of the South Pacific (FSP)'s programmes promoting home food production and the strengthening of mixed food gardening; 3) the South Pacific Commission, which has active programmes in agriculture, fisheries, population, food and nutrition and health development, with a major Integrated Rural Development Project focused on North Tarawa; and 4) Save the Children Fund. Efforts should be intensified to strengthen links with these and other appropriate organisations.

With particular reference to North Tarawa, the South Pacific Commission's North Tarawa Integrated Rural Development Project (NTIRDP), which focused on a wide range of aspects of community development, including waste disposal, home food production and health education, was successful in establishing a system of "Village Development Banks", which have served as a model for similar developments elsewhere. The project did not, however, have a major focus on the conservation and sustainable use of biodiversity.

9 PROJECT OBJECTIVES, CONSTRAINTS, PROJECT MANAGEMENT AND DESIGN, SPECIFIC ACTIVITIES, BUDGET AND WORK PLANS FOR SPECIFIC ACTIVITIES

This section contains: 1) the objectives of the North Tarawa Conservation Area Project (NTCAP); 2) constraints to conservation and sustainable use of biodiversity in North Tarawa; 3) project management; 4) the specific activities that constitute the Work Plan during Phase I of the project; 5) the budget; and, 6) detailed work plans for each activity.

9.1 Project Objectives

The primary objective of the NTCAP and its Work Plan during Phase I (year 1) is to **PROMOTE THE CONSERVATION AND SUSTAINABLE USE OF "BIODIVERSITY" WITHIN THE NORTH TARAWA CONSERVATION AREA (NTCA)**. In pursuing this objective, emphasis is placed on: 1) participatory planning and community-based strategies of resource use; and, 2) the maintenance of biodiversity within the NTCA by means of the multi-purpose use of a large variety of species and ecosystems.

In the context of the NTCAP, "biodiversity", as defined in section 4.1 above, would include:

1. All terrestrial and marine ecosystems (e.g., coastal and mangrove forests, scrublands, coconut plantations, excavated taro pits, villages, beaches, tidal flats, reefs, lagoon, and open ocean);
2. All plant and animal species and varieties found in these ecosystems (e.g., all species of trees, shrubs, vines, herbs, grasses, seaweeds, shellfish, finfish, beche-de-mer, and crustaceans, as well as all varieties (cultivars) of food crops such as pandanus, coconut, breadfruit, native fig, and bananas); and
3. The knowledge, uses, beliefs and language by which the people of North Tarawa, and the people of Kiribati in general, relate to their biodiversity. This would include the "biodiversity-use systems" that have served as a basis for the relatively sustainable habitation of the atolls for over three thousand years, beginning long before European contact with the islands.

Because most resource-use decisions in Kiribati are made and enforced at the community and individual landowner or resource-user levels, emphasis in the NTCAP is placed on increasing the capabilities and involvement of local communities in the conservation of biodiversity. To achieve this goal will require awareness-raising and the identification, through community-level participatory planning, of priority activities that can be initiated and carried out at the community or resource-user level. Awareness-raising should include the preservation and re-teaching (in the case of the young) of those aspects of traditional knowledge about biodiversity and traditional strategies of resource use that might have relevance for biodiversity conservation within the NTCA.

Because there is no single sustainable development activity or single ecosystem or species that can satisfy all of the commercial and subsistence needs of the people of North Tarawa, emphasis will be placed on multi-ecosystem, multi-species and multi-purpose use of the biodiversity within the NTCA in order satisfy the short- and long-term needs for BOTH cash and subsistence.

In pursuing this approach, other specific objectives of the NTCAP include:

1. the identification of endangered or culturally and economically important terrestrial and marine ecosystems and plant and animals species within the NTCA that could become the focus of community-level protection and sustainable-use programs;
3. the identification of constraints to, and practices which do not favour, sustainable use and conservation of biodiversity in North Tarawa;
4. the identification of opportunities or programs for sustainable use and management of biodiversity that might increase cash and non-cash incomes and the quality of life of the people of North Tarawa (the emphasis here is on increasing cash incomes without undermining non-cash incomes, both of which largely depend upon the sustainable use of biodiversity);
5. the promotion of activities that foster the sustainable use, protection and enhancement of the biodiversity of North Tarawa;
6. the discouragement of practices that contribute to the loss of biodiversity or that undermine sustainable development in North Tarawa; and
7. the active involvement, in all of the above, of the local people of the NTCA, because the success or failure of the project will depend very much on the landowners and residents of the CA as the direct beneficiaries.

9.2 Constraints to Conservation and Sustainable Use of Biodiversity in North Tarawa

To develop a program of activities that will promote biodiversity conservation requires that constraints to conservation and sustainable use of biodiversity be identified and addressed.

Based on discussions with five local communities in their **maneaba** (traditional meeting houses), the Eutan (North) Tarawa Island Council and resource-development agencies in South Tarawa, major constraints to the conservation and sustainable use of biodiversity in North Tarawa include:

1. **Inadequate resource-management mechanisms.** For example, local communities lack control over inshore marine resources, and existing environmental legislation, by-laws or responsibilities are often not implemented

or enforced.

2. **Loss of ethnobiological and environmental knowledge among the young.** Increasingly, the older generation is failing to pass on traditional environmental knowledge to the younger generation, a generation that has increasingly had an urban-biased education with inadequate environmental content and very limited discussion of traditional I-Kiribati links with land and sea.
3. **Coastal soil erosion and saltwater incursion.** These increasingly apparent forms of degradation may result from sea-level rise induced by global warming, volcanic eruptions or earthquakes and associated tsunamis (seismic sea waves), removal of coastal littoral vegetation, and overdraught of water from the freshwater lens.
4. **Interruption of lagoon circulation by causeway construction between atoll islets.** The construction of causeways between individual atoll islets has interrupted tidal flows in and out of Tarawa Lagoon. This restriction of flushing (water renewal) and nutrient cycling within the lagoon may have affected the spawning cycles and behaviour of a wide range of marine organisms (e.g., it may be responsible for the failure of bonefish, *ikarii*, to spawn in their traditional North Tarawa spawning grounds since the late 1980s).
5. **Overexploitation of inshore fisheries resources.** Turtles, giant clams, beche-de-mer, ark shell (**bun**), bonefish (**ikarii**), goat fish (**maebo**), baitfish (**tarabuti**), large demersal species, some sharks and other commercially-important target species are overexploited by commercial fishermen from South Tarawa who have fast boats, scuba gear and use small-mesh gillnets, long driftnets and crowbars (**orooro** fishing) to frighten fish into nets.
6. **Deforestation and loss of culturally, economically and ecologically valuable trees, plants and associated wildlife.** Coconut palms and degraded scrub vegetation are replacing a more diverse mix of inland and coastal trees, which are felled for housebuilding, boatbuilding, firewood for cooking or drying agricultural and marine products, without provision being made by the current generation for replanting or the protection of seedlings.
7. **Declining indigenous bird and terrestrial animal populations due to habitat destruction, overexploitation or predation.** Sea birds and sea-bird eggs are overexploited on uninhabited islets, ground-nesting birds are eliminated by rats and/or feral cats, and avian habitats are destroyed by burning, forest clearance, and rooting of pigs — all processes that diminish a traditionally important food resource, and also lessen the ability of fishermen to use seabird flocks to locate schools of tuna and other pelagic finfish species.

8. **Absence of a system of marine and terrestrial reserves and sanctuaries.** Whereas there are designated reserves in the Line and Phoenix Islands, there are no established or designated reserves in North Tarawa even though its reefs and lagoon are among the most productive and most heavily fished areas in the Gilbert (Tungaru) Group.
9. **Water shortage and water quality.** The absence of surface water, the limited groundwater resource, an increasing demand for domestic and agricultural water, limited rainwater catchment capacity, poor maintenance and/or pollution of groundwater and rainwater all constrain development, especially agricultural development, in North Tarawa. Naa Islet particularly has a very limited freshwater lens and suffers severely during extended droughts, which seriously affect coconut production and make it difficult to grow more water-demanding plants, such as breadfruit.
10. **Poor soils and limited agricultural potential.** The very infertile soils of Kiribati make conventional agriculture, as practiced on larger Pacific islands, very problematic. Thus, despite over a century of experimenting with new food and cash crops in the atoll environment by the British, French, German, Japanese and American colonial administrations, and recent capital-intensive atoll agricultural research programs, few additions to the traditional atoll crops of coconut, pandanus, giant swamp taro, breadfruit, and banana have proven to be sustainable over the long run.
11. **Poor marketing structure for primary products.** Although there are private buyers for beche-de-mer, shark fin, lobster, and mantis shrimp, and the Atoll Seaweed Company and the Copra Marketing Board purchase seaweed and copra, there is a need for more systematic marketing of a wider range of products, particularly high-value handicrafts and other items that can be produced sustainably by the people of North Tarawa.
12. **Inadequate small-scale tourism development.** There is little or no promotion of North Tarawa as a tourist destination and an almost total absence of promotional materials on ecotourism in North Tarawa, a lack that reflects the limited ability of the Kiribati Visitors Bureau and local small-scale tourist operators to promote and to highlight the biodiversity of North Tarawa and to identify areas of particular ecological, cultural or scenic interest to tourists. Also lacking are trained local tour guides and suitable accommodation and facilities for tourists.

These constraints are addressed by the activities described in this section.

9.3 Project Management

Management of the NTCAP will derive from national and local (North Tarawa) levels with a Conservation Area Support Officer (CASO) serving as the main link between them (A summary of the terms of reference for the CASO is provided in Appendix 2).

9.3.1 National Level

At the national level, in terms of the NTCAP, the "Lead Agency" is the Environment Unit (EU) of the Ministry of Environment and Social Development (MESD). The EU will be responsible for the overall management of the NTCAP, with appropriate staff members contributing to and/or coordinating relevant components of the NTCAP. Activities which fall within particular sectors (e.g., agriculture, fisheries, education, home affairs, health, tourism, or women's affairs) will be implemented in consultation and cooperation with the relevant agencies in North Tarawa and nationally. Efforts will be made to avoid duplicating ongoing activities of government and non-government agencies, and to complement such activities in the context of the promotion of sustainable use of biodiversity with NTCA.

As the Lead Agency, the EU will be the main link with SPBCP and other agencies that may fund activities under the project. It will be responsible for administering project funds and for the submission of quarterly reports and work plans to SPBCP. The EU will report on all planned activities and the progress of the NTCAP to the National Environment Coordinating Committee.

9.3.2 North Tarawa Level (Conservation Area Level)

A Conservation Area Support Officer (CASO), funded under SPBCP, but working for the EU, will be responsible for the day-to-day management of the NTCAP, and will be the link between EU and the North Tarawa-level management of the NTCAP. The CASO will act in consultation with a Conservation Area Coordinating Committee (CACC) and representatives of participating communities.

The composition of the CACC includes high-ranking North Tarawa-based representatives of relevant North Tarawa-based government agencies, representatives from the traditional Unamwane (Council of Elders) and government representatives from participating communities. Provisions are made for the co-option of additional appropriate members as the need arises and/or the inclusion of appropriate persons who are not resident in North Tarawa. The suggested composition of the CACC is shown in Table 9.1.

An initial meeting was held with the North Tarawa Island Council, which gave its support to the project and helped to coordinate and facilitate the activities of the PPD team in North Tarawa — particularly by organising meetings with each community in its Maneaba.

Table 9.1. Composition of the proposed North Tarawa Conservation Area Coordinating

Committee.

Patron:	Minister of Environment and Social Development
Chair:	Chief Councillor North Tarawa Island Deputy
Secretary:	Conservation Area Support Officer (EU)
Membership:	Councillor and Unimwane Representative from Buariki Village Councillor and Unimwane Representative from Tearinibai Village Councillor and Unimwane Representative from Nuatabu Village Councillor and Unimwane Representative from Taratai Village Councillor and Unimwane Representative from Notoue Village Councillor and Unimwane Representative from Abaokoro Village Councillor and Unimwane Representative from Marenanuka Village Councillor and Unimwane Representative from Tabonibara Village Councillor and Unimwane Representative from Nabena Village Councillor and Unimwane Representative from Tabiteuea Village Councillor and Unimwane Representative from Abatao Village Councillor and Unimwane Representative from Buota Village Fisheries Officer (North Tarawa) (MNRD) Agricultural Officer (North Tarawa) Ministry of Health Representative Women's Development Committee Representative North Tarawa Youth Council Representative Church Representatives Principal, Ootan Marawa Baha'i High School Principal, Taborio High School
Co-opted:	Social Welfare Officer (Women and Development) Kiribati Visitors Bureau Representative Ministry of Home Affairs and Rural Development Representative, Foundation for the Peoples of the South Pacific Representative, USP Atoll Research Program Other Appropriate Co-opted Members

9.4 Specific Activities

Specific activities or projects proposed for implementation during Phase I include:

1. Participatory planning meetings/workshops;
2. Biodiversity use and baseline studies;

3. Key ecosystem and species protection;
4. Marine ecosystem management enhancement;
5. Terrestrial biodiversity enhancement;
6. Education and public awareness campaigns;
7. Small-scale tourism development; and
8. Handicraft marketing and training.

These activities have been identified by, or in consultation with, local communities of North Tarawa, the North Tarawa Island Council, relevant North Tarawa-based government and non-government representatives (see composition of the CACC above). With administrative and logistic support from the CASO, the activities will be implemented, monitored and modified by the same groups. Selected government agencies, NGOs and private businesses from South Tarawa have also indicated their interest in facilitating and actively supporting the implementation of such activities. The activities are not listed in order of importance, and to achieve best results several of the activities will have to run simultaneously. Experience elsewhere shows that conservation efforts which focus on only one environmental issue or on only one environmentally-sound economic enterprise have failed or met with only limited success.

To implement most of the activities, there will need to be training or workshops to learn, share or develop skills. Most of these workshops and attachments can be done locally in North Tarawa, using either local expertise, both within and between communities and within North Tarawa-based government and non-government institutions. In some cases, however, persons with specific skills could be brought to North Tarawa from South Tarawa or overseas to run community or North Tarawa-based workshops, depending on the focus of a given activity.

9.5 Budget

The proposed budget is divided into: 1) salaries and cost of the management and implementation of the project; 2) costs of the individual activities suggested for inclusion in Phase 1 of the project; and, 3) Kiribati Government contribution. The costs of transport, fees, per diems, materials production, equipment and contingencies are included within each of the suggested individual activities (Table 9.2). The main costs in terms of salaries and project management include the salary and support for the CASO, and limited funds to allow relevant representatives from Environmental Unit and other relevant South Tarawa agencies to make field visits to North Tarawa to support the CASO and to visit participating local government agencies and communities. The total estimated cost of Phase 1 of the North Tarawa Conservation Area Project (NTCAP) is \$US 59,750.

The Kiribati Government contribution would include:

1. A commitment of A\$5,000 for the financial year 1995/96.
2. Government staff time and subsistence allowance.
3. Use, depending on availability, of North Tarawa-based government boats.
4. Office space in South Tarawa and the establishment of a focal point in Abaokoro, the Administrative centre for North Tarawa.
5. Fax, telephone and photocopy services in South Tarawa.

As can be seen from the summary budget provided in Table 9.2, most of the funds go to activities to be conducted at the community and North Tarawa levels. The estimated costs per year for years 2-5 would drop from \$59,750 during Year 1 to \$36,700, \$31,950, \$26,200 and \$25,200 respectively. These are shown in Table 9.3.

The main variables in the budgets over the last four years of the project include: 1) inflationary effects and cost of living increases in the CASO's salary; 2) decreasing frequency of need for visits to North Tarawa by the CASO as the project becomes more community driven; 3) need for computer equipment, discs, maintenance for the computer purchased during year 1; 4) provision for limited film and processing, after the purchase of camera; 5) reduced need for as many participatory planning workshops; 6) completion of biodiversity and baseline studies; 7) reduced need for funding for key ecosystem and species protection and marine resource management as they becomes more community-based; 8) slightly reduced need for funding for terrestrial biodiversity enhancement as plant propagation procedures are mastered and after original plantings are completed and maintenance, establishment and enrichment of plantings become the main focus; 9) slightly reduced need for funding for education and public awareness, small-scale tourism development and handicraft marketing and promotion and as project activities become well-established and as other agencies (e.g., education department, KVB, radio station, MNRD, the private sector, local communities themselves, and schools) take on responsibility.

The total estimated cost of the NTCAP over its five-year duration would be US\$179,800, an amount that gives flexibility for necessary modification of the project or the change of emphasis to other activities identified by the participating communities within the NTCA.

Table 9.2 Proposed summary budget for Phase 1 of the North Tarawa Conservation Area Project.

1	CONSERVATION AREA SUPPORT OFFICER (CASO)	
	Salary (Including emoluments)	\$10,000
	Internal Travel (Annually)	
	10 Trips S. Tarawa-N. Tarawa @ \$US50 per trip	\$500

	Internal Boat Travel in North Tarawa	\$500
	Internal Land Transport	\$500
	Travel Allowance @ \$25 per day x 30 days	\$750
	*Computer Equipment (lap top, printer, etc.)	\$3500
	Camera, Film, Processing	\$500
	Contingencies (office supplies, etc.)	\$1000
	SUBTOTAL	US\$17,250
2	VISITS BY SUPPORT STAFF TO NORTH TARAWA	
	10 Boat Trips to North Tarawa @ \$US50	\$500
	Travel Allowance @ \$25 x 30 days	\$750
	SUBTOTAL	US\$1,250
3	PROJECT ACTIVITIES	
	Participatory Planning Meetings/Workshops	\$5,000
	Biodiversity Use and Baseline Studies	\$8,250
	Key Ecosystem and Species Protection	\$1,500
	Community Management of Marine Resources	\$5,500
	Terrestrial Biodiversity Enhancement	\$6,500
	Education and Public Awareness	\$9,500
	Small-Scale Tourism Development	\$2,500
	Handicraft Marketing and Training	\$2,500
	SUBTOTAL	\$41,250
	GRAND TOTAL FOR PHASE 1	US\$59,750

Table 9.3 Estimated costs of the NTCAP during years 1-5, showing those activities and budget items that will and will not be continued over the life of the project, and taking into consideration inflation, cost of living increases and possible modifications to the project.

Item	Year 1	Year 2	Year 3	Year 4	Year 5
1 CASO					
Salary	\$10000	\$11000	\$12000	\$13000	\$14000
Internal Travel	\$2250	\$2000	\$1750	\$1500	\$1500
Computer/Equipment	\$3500	\$500	\$500	\$500	\$500
Camera, Film, etc.	\$500	\$200	\$200	\$200	\$200
Contingencies	\$1000	\$500	\$500	\$500	\$500
SUBTOTALS	\$17250	\$14200	\$14950	\$15700	\$16700
2 SUPPORT STAFF					
travel/allowances	\$1250	\$1000	\$1000	\$1000	\$1000
SUBTOTALS	\$1250	\$1000	\$1000	\$1000	\$1000
3 PROJECT ACTIVITIES					
Participatory Planning					
Meetings/Workshops	\$5000	\$3000	\$2000	\$1000	\$1000
Biodiversity Use and					
Baseline Studies	\$8250	-	-	-	-
Key Ecosystem and					
Species Protection	\$1500	\$1000	\$1000	\$500	\$500
Community Management					
of Marine Resources	\$8500	\$2000	\$2000	\$1000	\$1000
Terrestrial Biodiversity					
Enhancement	\$6500	\$4000	\$3000	\$2000	\$1000

Education and Public Awareness	\$9500	\$7500	\$5000	\$3000	\$2000
Small-Scale Tourism Development	\$2500	\$2000	\$1500	\$1000	\$1000
Handicraft Marketing and Training	\$2500	\$2000	\$1500	\$1000	\$1000
SUBTOTALS	\$41250	\$21500	\$16000	\$9500	\$7500
TOTALS YEARS 1-5	\$59750	\$36700	\$31950	\$26200	\$25200
GRAND TOTAL YEARS 1-5	US\$179,800				

9.6 Work Plan for Specific Activities

The suggested Work Plans for the implementation of the suggested activities (9.4) are provided below. Each includes a detailed outline of the nature of proposed activities, lead agencies, timing and estimated costs. Although the most of the proposed activities will be continued, with modification, over the entire five years of the Project, emphasis is placed on specifying those activities (1 to 8 above) that will be carried out during the first year of the Project. New activities can be added in later stages of the project in response to the changing needs of the communities of North Tarawa and after evaluation of activities carried out during Phase I.

Because of limited funding, there will need to be a balance between (1) those activities which can be supported with funding from the NTCAP or other Government agencies or by external funding, and (2) those activities which communities can initiate and carry out with their own resources. In the latter case, the identification and initiation of such activities and some technical advice could come from the project. To achieve economies of scale, to maximise local participation in planning, implementation, monitoring, and to maximise capacity building within the NTCA, an effort has been made to maximise use of local expertise and to base activities in North Tarawa.

9.6.1 Participatory Planning Meetings/Workshops

Because the main emphasis of the SPBCP is the conservation and sustainable use of biodiversity by resident communities, the emphasis of the project during Phase I will be participatory rural assessment (PRA) and planning activities.

Nature of Activity: The main objectives of these activities will include:

1. Discussions with local communities of the objectives of SPBCP and the NTCAP and the need/rationale for the conservation of biodiversity as a basis for sustainable development. This would include in-depth discussions on the biological, economic and cultural rationale for environmental legislation, nature conservation, and the importance of marine and terrestrial parks and reserves.
2. Identification of endangered or culturally and economically important ecosystems and plant and animals species within the NTCA that could become the focus of community-level protection and sustainable management activities.
3. Identification of activities and resource-use strategies that constitute serious constraints to conservation and the sustainable use of biodiversity within the NTCA.
4. Identification by local communities, both individually and collectively, of activities which offer the most promise for promoting the sustainable use of biodiversity to improve cash and non-cash incomes and the quality of life.
5. Identification and prioritisation of activities, at the community, regional and national levels, which could promote the sustainable use of biodiversity and eliminate or minimise unsustainable practices in the NTCA.

The participatory planning component of the Project, already initiated during the Project Preparation Document phase, is seen as the most important component of the entire Project. It must continue throughout the entire five years of the Project. Depending on the nature of a given activity, a range of different forums will be used. These include official village meetings in the Maneaba and with the North Tarawa Island Council, workshops, meetings with women's, fishermen's and farmer' groups, church groups, youth organisations, parent-teacher associations, and other relevant groups.

Suggested models for the conduct of this component include:

1. Initial one-day meetings/workshops in each of the participating communities and schools to address items 1-5 above. These meeting would include the entire village or PTA (in the case of the two schools) and would be organised by the elders (Unimwane) and North Tarawa Island Council representatives in each village and by the school administrators.
2. Specialised meetings/workshops to discuss and plan the implementation of specific activities given priority by the communities. In later stages, such meetings could focus on the evaluation, monitoring and modification of activities. Such activities are discussed in detail below under other project activities.
3. Combined meetings at the North Tarawa level. These meetings would involve representatives from each participating community/school — for example, the elected Council representative and the leader of the local women's committee and members of the

CACC discussing together the implementation, status and success of the work plan as it evolves.

Lead Agencies: The meetings/participatory planning workshops (PPWs) will be planned, scheduled and coordinated by the CASO and the CACC. They will involve appropriate persons/bodies when need arises and when deemed necessary by the CACC, in consultation with the Project management.

Timing: These meetings/workshops should begin immediately after the PPD has been finalised, ideally no later than October 1995. The exact timing and number of the workshops will be determined by the CASO in consultation with the CACC.

Estimated Costs: Given an estimated number of 25 meeting/workshop-days and an average of at least 20 participants per meeting/workshop, the estimated cost of the workshops is as follows:

1. Preparation (@ \$30/work-shop day x 25)	\$750
2. Transport (boat and road)	\$1500
3. Subsistence/participant (@ \$3 per x 500 days)	\$1500
4. Contingencies	\$250
5. Technical expertise	\$1000
TOTAL	\$US5,000

9.6.2 Biodiversity Use and Baseline Studies

Surveys of the living resources and traditional knowledge about and use of biodiversity will be required to assess the nature, endangerment status and cultural and economic importance of ecosystems and species. These surveys should use of existing information and minimise expenditure by involving local people in the surveys.

Nature of Activity: The rationale for such surveys includes: 1) the information acquired can be used to assess the resident community's perspective on the major biodiversity issues as well as the true endangerment status and management/protection priority of a given ecosystem or species; 2) the surveys can provide valuable ethnobiological knowledge as well as recording traditional knowledge on the names and cultural importance of biodiversity which is in danger of being lost; 3) the information will be of value to local communities, the CACC and Project management as a basis for planning and prioritising Project activities; and 4) the information can be used in public-awareness campaigns and for the preparation of educational materials and materials to promote biodiversity conservation and ecotourism in the NTCA.

When information is gathered, efforts should be made to: 1) involve local people to enhance local capabilities and knowledge of their biodiversity; 2) provide appropriate remuneration to informants and field or technical assistants; and 3) provide copies of all acquired information to the communities and local schools so that they can use it for their own education and development.

Although the exact priority of such surveys will be decided by Project management, in consultation with the CACC, suggested Priorities include:

1. Rapid surveys, in each participating community, of the marine and terrestrial plants and animals that each community considers to be of particular cultural or economic importance, their endangerment and management status and management strategies associated with different ecosystems or species. There may be a need for the collection of some voucher specimens, possibly by the USP Atoll Research Program (ARP), to correlate Kiribati names with scientific (Latin) names for some organisms.
2. Rapid compilation of existing information on the living resources of North Tarawa (e.g., existing lists or studies of marine vertebrates and invertebrates, flora, birdlife, etc.). This compilation should include suggestions for protection strategies, especially those which could be implemented by the local communities (Much of this information is available from the 1994 BioSystems *Tarawa Lagoon Management Plan* or from MNRD and the USP Atoll Research Program).
3. In-depth surveys of ecosystems and species of particular ecological, economic or cultural importance. Areas and species which would seem to warrant priority for survey include the ecosystems and species listed in Table 9.4.

Table 9.4. Ecosystems and species tentatively identified by local communities and local officials in North and South Tarawa as meriting priority for survey as part of Phase I activities of the NTCAP (Note: where such information already exists, only collation or updating of information will be required; * indicates those species for which North Tarawa surveys have already been completed).

ECOSYSTEMS

- Naa Islet and associated reefs
- the northern half of the Western Reef
- mangroves
- reef passes
- less-disturbed inland and littoral forest stands
- bird and turtle nesting sites
- marine spawning grounds (e.g., bonefish spawning grounds)
- particularly diverse pandanus and giant swamp taro agroforestry systems or garden

areas

SPECIES

Marine Animals

- bonefish, **te ikarii** (*Abula vulpes*)
- hump-backed red snapper, **te ikanibong** (*Lutjanus gibbus*)
- goatfish, **te maebo** (*Upeneus taeniopterus*)
- rainbow sardine, **te tarabuti** (*Dussumieria acuta*)
- goldspot herring, **te tarabuti** (*Herklotsichthys quadrimaculatus*)
- flying fish, **te onauti** (*Cheilopogon* and *Cypselurus* spp.)
- sea turtles, **te on** (*Eretmochelys imbricata*), **te on tabakea** (*Chelonia mydas*)
- sea birds
- beche-de-mer/sea cucumber **te kereboki**, etc. (Holothuroidea)
- arc shell, **te bun** (*Anadara* sp.)
- bloodmouth conch, **te nuou** (*Strombus luhuanus*)
- triton shell, **te buu** (*Charonia tritonis*)
- giant clams vasua - **te kima**, **te were**, **te neitoro** (*Tridacna* spp. and *Hippopus hippopus*)

Plants

- rare coconut varieties, **te ni** (*Cocos nucifera*)
- rare pandanus varieties, **te kaina** (*Pandanus tectorius*)
- beach hibiscus, **te kiaiai** (*Hibiscus tiliaceus*)
- Alexandrian laurel, **te itai** (*Calophyllum inophyllum*)
- **te kanawa** (*Cordia subcordata*)
- **te uri** (*Guettarda speciosa*)
- tropical almond, **te kunikun** (*Terminalia catappa*)
- native fig, **te bero** (*Ficus tinctoria*)
- lantern tree, **te bingibing**, **te nimareburebu** (*Hernandia nymphaeifolia*)
- **te buka** (*Pisonia grandis*)
- fish-poison tree, **te bairiati** (*Barringtonia asiatica*)
- Tahitian gardenia, **te tiare** (*Gardenia taitensis*)
- **te ukin** (*Terminalia litoralis*)
- native hop bush, **te kaiboia** (*Dodonaea viscosa*)

A reconnaissance botanical survey of the NTCA is seen as a priority in order to determine the locations of particularly undisturbed and diverse areas of indigenous and cultural vegetation and to document the locations of endangered species and seedlings which could be designated

for protection or replanting. This survey could include an inventory of all mangrove sites to assess the feasibility and need for their protection or re-establishment inasmuch as mangrove species, in addition to enhancing coastal protection, water purification and serving as important fisheries habitats, also have very important cultural and economic value.

Where possible, the survey should involve personnel from appropriate North Tarawa agencies, so that these agencies are strengthened through interaction with both local Kiribati experts (village people) and, when appropriate, visiting experts or scientists.

There is also a need to obtain books and other reference materials on Kiribati and Pacific Island biodiversity for use in North Tarawa (e.g., survey reports, books on plants, birds, fish, shellfish or beche-de-mer). Although such books are often very expensive, they will provide a critical service by helping to strengthen the scientific capabilities of North Tarawa-based agencies.

Lead Agencies: The lead agencies coordinating these surveys would be the CACC, EU and the residents of the survey areas. The involvement of local North Tarawa agencies will depend on the nature of the surveys (e.g., MNRD for vegetation and marine surveys, etc.).

The CASO will coordinate the rapid surveys of the marine and terrestrial plants and animals that each community considers to be of particular cultural or economic importance. The surveys, which will be carried out by members of participating communities and possibly local students and teachers, should include consideration of the endangerment and management status and management strategies associated with different ecosystems or species.

When the compilation of existing data on biodiversity can best be done by a recognised expert on a short-term consultancy, that person will be selected by EU in consultation with the CACC. Such persons should also be responsible for identifying appropriate reference materials that can be lodged with the CASO in South Tarawa and other appropriate agencies in North Tarawa. Most inventories should, however, be conducted by local Kiribati experts, possibly with some assistance from USP's Atoll Research Program, or other agencies, with an eye to strengthening North Tarawa capabilities.

Timing: The rapid surveys in the Pilot Communities, which were commenced on a reconnaissance basis during the PPD visit to North Tarawa in June 1995, should be carried out as soon as possible as the results will affect future Project activities.

The compilation of existing data on specific resources and protection strategies should be determined by the CASO in consultation with the CACC and the EU. Data on some resources has already been collected and are included in this PPD.

The in-depth surveys of critical ecosystems could begin as early as late 1995, but should be completed by mid-1996. The first priority is to identify the location of endangered plants and areas which could be considered for protection, with emphasis on the location of seedlings of endangered species which could be transplanted to and protected in appropriate locations, as part of a NTCA-wide biodiversity enhancement program (see activity 9.6.5 below).

Estimated Costs: The estimated costs of the three survey components are as follows:

1. Rapid surveys of community-based biodiversity (12 x 2 days per community, including analysis)

Nominal subsistence to community members/teachers/students (25 days x 4 persons @ \$10)	\$1000
Local transport (boat and road)	\$1000
Reference materials	\$250
Materials/computer analysis/compilation	\$250
Contingencies	\$200
Subtotal	\$2,700

- ## 2. Compilation of existing data on biodiversity

4 person-days @ \$200 (consultancy fee)	\$800
5 days per diem @ \$80	\$400
Materials, photocopying, contingencies, etc.	\$200
Subtotal	\$1,400

- ### 3. Rapid botanical surveys of NTCA

5 person days @ \$200 (consultancy fee)	\$1000
5 days per diem @ \$80	\$400
Cost/subsistence for local field assistants	\$500
Air-Fares to Kiribati	\$1500
Internal Transport	\$500
Contingencies	\$250
 Subtotal	 \$4,150

TOTAL (1, 2 AND 3)	US\$8,250
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9.6.3 Protection of Key Ecosystems and Species

Some of the unique, endangered and economically or culturally important ecosystems and species within the NTCA could be designated parks or reserves, or areas of limited entry or restricted exploitation — for example, relatively undisturbed or particularly diverse coastal forest and mangrove ecosystems (e.g., the lagoon forest just south of Notoue Village and the *Calophyllum*-rich lagoon forest north of Nuatabu), and important marine ecosystems, such as the reef and lagoon areas and large sand bank off of Naa Islet; and bonefish spawning areas or turtle and sea bird nesting sites.

Some marine and terrestrial plant and animal species (and varieties or cultivars in the case of cultivated food plants) could be declared endangered or deliberately protected and/or propagated at the community level (See Table 9.4 above). Particularly good examples of endangered trees (e.g., the large **te baireati**/*Barringtonia asiatica* near Uekera School near Tearinibai Village or the large **te bingibing**/*Hernandia nymphaeifolia* just south of Notoue Village) or cultivars (e.g., rare pandanus or coconut varieties) should be identified, and their locations recorded on a map or GIS matrix. A register of endangered or "treasured trees", their locations and "owners" could also be prepared. These suggestion received very strong support from both local communities and government representatives.

Nature of Activity: The main activities in the area of ecosystem and species protection during Phase I would include the following:

1. The identification (see Activity 3 above) and location of endangered or economically and culturally important ecosystems and species.
2. Assessment of the feasibility, desirability and means of protecting or restricting the exploitation of key ecosystems and species.
3. Implementation or initiation of programs or plans to protect or restrict the exploitation of key ecosystems and species. This would include the designation of given species or individual trees as protected species or "objects for cultural preservation" (national treasures or living monuments). Related to this, is the preparation of a list or register of "treasured trees", or people or landowners who have particularly large or good examples of endangered or culturally important species on their land. Such lists could be used as a resource for the promotion of ecotourism and environmental and cultural education materials.
4. A one-day North Tarawa-level workshop to identify specific ecosystems and plants and animals that require protection or management, or which could serve as points of educational of ecotouristic interest, because of their ecological, cultural and economic importance.

Areas or ecosystems identified for immediate protection include:

1. The reef and lagoon ecosystem surrounding Naa Islet and areas known to be spawning grounds for bonefish and other important marine species. The extent and location of these marine protected areas will be determined after the feasibility studies.

2. The entire NTCA, roughly within a triangular area enclosed by a line joining the southern end of Buota Islet, the mid-point of the Western Reef and the northern end of the reef system off Naa Islet, will be placed under the management of the North Tarawa Island Council. Fishing within this area will be restricted to the communities of North Tarawa, although selected fishing rights can be granted to outside fishers by the Council, under revised legislation and by-laws (see 9.6.4 below).
3. Coastal littoral and mangrove forests which protect inland garden areas and coastal settlements from cyclone damage, storm surge, saltwater/tidal incursion, coastal erosion and saltspray. Areas of relatively intact forest with the highest number of rare or endangered species will receive highest priority as protected/gazetted reserve areas (See Appendix 3 for coastal species which could receive priority for protection or propagation); and
4. Sea turtle and sea bird nesting sites.

Lead Agencies: The lead agencies for investigating the possibility of protecting key ecosystems and species will be EU, in cooperation with appropriate divisions of MNRD and MHARD, and other appropriate government and non-government agencies, and in consultation with the CACC and pilot communities.

Timing: Investigations of the feasibility of designating key ecosystems and species as reserves or protected species should begin immediately. This should include the search for outside funding for the establishment of such reserves, possibly through UNESCO, as part of a consideration of establishing North Tarawa as a UNESCO World Heritage Site. The North Tarawa workshop should be held in conjunction with the community-based workshops discussed in 9.6.1 above, and could be coordinated by the CASO, with input from EU. Initial discussion could centre on lists developed during the rapid surveys conducted during the PPD preparation visit to North Tarawa. The CASO in cooperation with local communities could also begin to make a list or register of trees of particular importance.

Estimated Costs:

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|--|------------------|
| 1. Investigations of potential and feasibility of establishing reserves and/or protected species | \$1000 |
| 2. Preparation of a registrar of a list or register of "treasured trees", or people or landowners who have particularly large or good examples of endangered or culturally important species on their land | \$500 |
| TOTAL | US\$1,500 |

9.6.4 Community Management of Marine Resources

Fundamental to the success of the NTCAP is community-based marine resources management. Without the participation of local communities, efforts to conserve endangered species, establish effective marine reserves, reduce fishing pressure on over-exploited species, establish giant-clam circles, or to produce high quality *Echeuma* seaweed cannot be successful. Because the NTCAP is directed toward local communities, the Project could be an ideal mechanism to initiate the process of increasing community based management.

Because current legislation allows open access to all areas below mean high tide, effective community management is very difficult. Consequently, the most serious concern of communities in North Tarawa is that, even if they conserve and manage their marine resources wisely, outsiders, mainly from South Tarawa, can move in and over-harvest. Local communities need some degree of management control over nearby in-shore marine resources. Fortunately, some communities, such as Buariki, have strong traditional systems of marine tenure, which although not legally recognised under law, are still known by the people and influence their local resource use. These could serve as a basis for the reintroduction or enforcement of local marine tenure arrangements within the NTCA, which could lead to more sustainable use of marine resources in the area.

Discussions on this issue with senior Government officials in South Tarawa indicate that there is strong support for moves to enact legislation or use local by-laws under current legislation to return some control over the use of inshore marine resources to local communities. It also appears that existing legislation offers several possibilities for increasing local control and the implementation of by-laws (by local Island Councils or Unimwane) which give local communities control over specific resources or types of fishing. Outside technical expertise may, however, be required to support such efforts.

The people of North Tarawa strongly believe that the erection of a series of six markers and signs to delineate the boundary between the NTCA and the southern half of Tarawa Lagoon would facilitate community-based management of the CA as well as serving as a symbol and heightening public awareness and pride of the NTCA as a sustainable resource use zone. These markers and signs would be placed on appropriate reef outcrops or shoals with one on the CA boundary on the Western Reef, one on the lagoon shore at Buota in the south of North Tarawa, and four place in the lagoon at appropriate positions between these.

Nature of Activity: Activities which could increase local community management of marine resources include:

1. North Tarawa (CA)-level and community-level workshops/discussions on the problems, prospects, strategies and benefits of community-based marine resource management. This is a priority program (3.6.6) under the "Development and Protection of the Resource Base" in the Kiribati national Environmental Management Strategy.

2. Media campaign (radio, newspaper) to sensitise the public and policy makers to the importance of community-based marine resource management.
3. Discussions with policy makers in South Tarawa and the North Tarawa Island Council on issues related to increasing community-based marine resource management by formally modifying marine tenure to give local communities greater ability to manage their inshore fishery.
4. Liaison with the Fisheries Division of MNRD to encourage interest in the community approaches to marine resource management, as an alternative or to complement the currently relatively ineffective centrally administered management of the use of inshore resources.
5. Support/encourage, in cooperation with the Fisheries Division of MNRD, establishment and/or improvement of giant-clam sanctuaries, *Echeuma* seaweed farms, black-lipped pearl farming and other environmentally sustainable maricultural activities.
6. The identification and designation, by local communities in consultation with appropriate persons, of a limited system of community based or NTCA-controlled marine reserves or parks. Such areas could serve as breeding/spawning sanctuaries or areas of ecotouristic or educational importance.
7. Establishment of markers and signs to delineate the boundary between the NTCA and the southern half of Tarawa Lagoon.

Lead Agencies: The activities will need to be a cooperative effort involving the CACC, the North Tarawa Island Council and community leaders, local marine resource users, the EU of MESD, MNRD, MHARD, the USP Atoll Research Program, other relevant government (e.g., Public Works to erect markers) and non-government agencies, and appropriate representative from the private sector.

The technical expertise required for the establishment and strengthening of giant clam sanctuaries, seaweed farms and other maricultural activities (e.g., the proposed mariculture of black-lipped pearl oysters) is beyond the terms of reference of the SPBCP. Such expertise will have to come either from the Fisheries Division of MNRD, the USP Atoll Research Program, private enterprise (e.g., Atoll Seaweed Company) or through external technical/developmental aid. Technical expertise on the designation and establishment of selected marine reserves or marine parks may require outside expertise either from South Tarawa or overseas.

Timing: Discussions and workshops on community marine resource management could occur as soon as the PPD is approved. Subsequent activities to modify legislation or to implement by-laws could also begin concurrently in consultation with appropriate persons or government agencies. Seaweed farming is already being done by some villages within the CA. Its expansion could be encouraged immediately, under the supervision of the Fisheries Division, as studies show that the greatest potential for seaweed cultivation in the Gilbert group is on the tidal flats of North Tarawa.

The identification of appropriate sites, the collection of sufficient giant clams (*Tridacna* spp. and *Hippopus hippopus*), and the establishment of clam spawning sanctuaries (along the lines of the giant-clam circles established in Tonga) could also begin immediately.

Discussions regarding the identification and designation, by local communities in consultation with appropriate persons, of a limited system of community based or NTCA-controlled marine reserves or parks could also commence immediately.

Erection of the series of six markers and signs to delineate the boundary between the NTCA and the southern half of Tarawa Lagoon could commence as soon as the boundaries are finalised in consultation with Government.

Estimated Costs: The importance of the need for community-based marine resource management is such that major expenditure is justified.

1. North Tarawa and community workshops on community fisheries and marine resources management	\$2000
2. Media campaigns on the importance of community-based marine resource management (including the promotion, in support of ongoing Fisheries Division, of the establishment and maintenance of giant clam sanctuaries and improvement and expansion of seaweed farms, as bases for sustainable development	\$1000
3. Consultations between government and NTCA representatives on the implementation of marine tenure reform and the enforcement of community-based marine resource management and/or the establishment of a limited systems of marine reserves or parks	\$2000
4. Erection of boundary markers/CA signs	\$3000
5. Contingencies	\$500
TOTAL	US\$8,500

9.6.5 Terrestrial Biodiversity Enhancement

North Tarawa communities are concerned about the loss of terrestrial biodiversity in and around villages, in agricultural areas and inland sites and in lagoon and ocean-side littoral forest areas. One of the most commonly mentioned issues in the Pilot Communities was the loss of valuable trees from agricultural areas because of an over-emphasis on commercial monocropping of coconuts, indiscriminate use of fire, deliberate tree removal, and the failure of the current generation of farmers to replant trees and minor supplementary crops that used to be important in the Kiribati mixed agroforestry system.

The failure to maintain cultivar diversity of giant swamp taro in excavated taro (**te babai**) gardens was also an area of concern, as was the destruction of some valuable plant species by free-ranging pigs, which suggests the need to improve systems of pig pens and pig-feeding areas.

The protection of existing trees and tree groves and tree replanting in and around villages, in **babai** pit areas, and in inland agricultural areas and coastal sites is an immediately practical activity that could be promoted during phase I of the Project. Agroforestry is currently a high priority of MNRD, although the emphasis in the past has been mostly on nitrogen-fixing species, coconuts and fruit trees. NTCAP should focus as well on the protection and planting of a wider range of trees, including traditionally important species and varieties (See Appendices 3-9 for trees and plants that should be considered for planting in North Tarawa).

Included as part of this activity is the promotion of mixed "organic" farming which does not depend on commercial fertilisers and pesticides. Such an activity could provide long-term ecological, economic and cultural benefits to the people of North Tarawa, among them protection from groundwater pollution resulting from the use of inorganic fertilisers on low-lying limestone islands.

Nature of Activity: Priority activities to enhance village biodiversity include:

1. The active discouragement of tree removal and the encouragement of protection of trees when clearing new garden areas and seedlings when weeding (i.e., selective weeding), and the protection and replanting of salt-tolerant coastal littoral species (See Appendix 3).
2. The preparation, by the Pilot Communities, of lists of "endangered" or culturally important species that could constitute protected species and which could be assigned priority status for protection, propagation and replanting, both at the community and regional levels in the NTCA (Lists of most of the important Kiribati agroforestry species are shown in Appendices 4-6).
3. Replanting and rehabilitation of culturally important tree species, and important varieties of important food plants such as pandanus, coconut, breadfruit, bananas, native figs (**te bero**), papaya, and other appropriate fruit and cultural trees in villages, around taro pits,

and in appropriate inland and coastal sites.

4. The active planting of pandanus varieties and other handicraft plants for sale as raw or partially processed materials or for the production of marketable handicrafts. Particularly important is the propagation and planting of endangered and especially high-value pandanus cultivars, many of which are rare or in short supply.
5. Protection and planting of appropriate nitrogen-fixing plants, with particular emphasis placed on the intensified planting of indigenous legumes, such **te kaimatu** (*Sophora tomentosa*), **te kitoko** (*Vigna marina* and *Canavalia cathartica*), and **te burukam** or **te katurina** (*Casuarina equisetifolia*), plants with which the people of North Tarawa are very familiar.
6. The designation of North Tarawa as an "Organic Farming Zone" where diversified mixed cropping is encouraged and where the use of agrochemicals is prohibited or minimised. This idea has been strongly supported by MNRD and could include an awareness campaign to highlight the ecological and health problems created by pesticides and the use of inorganic fertilisers on low-lying atolls.
7. Improvement or establishment of pig pens and pig fences, using traditional fencing materials and living, preferably edible, fencing (e.g., the use of **te buka** or other plants which have edible leaves).
8. Planting and improvement of living hedges/fencing around, or bordering roads on all town allotments (see Appendix 7).
9. Strengthening the capacity of the MNRD in North Tarawa to provide appropriate planting material (not available locally) and to promote village nursery and plant propagation efforts.
10. Establishment of village-based nurseries or strategies for the propagation and distribution of trees and other desired plants in all Pilot Communities and, where possible, at all secondary and primary schools.
11. Establishment of small nurseries and diverse mixed tree plots or groves at primary and secondary schools which have sufficient available land. This would be done by the students with the assistance of the school Parents-Teachers Association and MNRD (See Appendices 3-9 for possible species).
12. Workshops, at both the North Tarawa and community levels, to develop appropriate strategies for the location, development and maintenance of a system of village-based nurseries to propagate, care for, and distribute the trees seedling and plants required for village and rural tree-planting and revegetation programs.
13. Workshops on the post-transplanting care of plants which have been distributed or sold from the nurseries. The workshops will also focus on agroforestry, organic farming, the

dangers of chemical farming in low-lying islands, and other environmental and health issues.

14. Award of yearly prizes by the CACC at an annual "North Tarawa Conservation Area Festival". These would include prizes for the three best community-based nurseries, coastal revegetation efforts, and overall revegetation and environmental improvement effort. Prizes would also be given to the schools that establish the best nurseries or plant the most trees. These competitions would be done on a community or school basis. Prizes could also be awarded to individual families/landowners in each village for the best houseyard garden, best **babai** pit and associated agroforestry system, best new or recently developed/rehabilitated **babai** pit, and the most trees replanted on their family land.

Lead Agencies: The local MNRD representative has indicated a willingness to assist in the establishment of the village nurseries and the identification and propagation of appropriate species. The main assistance needed will be in site selection, potting or propagation techniques and the provision of some planting materials. Most villages will be able to gather their own planting material in the form of seeds, cuttings and self-sown seedlings for most species, with possibly some exchange among communities. Lists of trees which communities could select for nursery propagation and/or planting in and around villages are provided in Appendices 6-9. Local women's organisations could be made responsible for the maintenance or management of the nurseries and general village revegetation efforts (e.g., re-establishment of important cultural plants and hedging); the men could be responsible for establishment and maintenance of improved pig pens and fencing in and around villages and towns and the coastal revegetation efforts. The Ministry of Health and the local Police will also be involved in aspects related to environmental health and prosecution/enforcement of laws relating to public health and free-ranging livestock.

Timing: The identification of planting sites and establishment of community- and school-based nurseries and the collection and propagation of target species should begin in 1995 and will continue throughout the project. Assistance from MNRD in site selection and establishment can also start immediately, with more specialised assistance with the propagation of species unfamiliar, or unavailable to local communities beginning in 1996. Some communities, e.g., Tearinibai, have indicated that they will begin reforestation and village improvement activities immediately, using their own resources, but welcome the formal assistance that will be forthcoming from SPBCP.

Estimated Costs: The main costs of the biodiversity enhancement activity will be related to the establishment and maintenance of the nursery and the distribution to communities of selected species by MNRD and possibly the European Union Pacific Regional Agricultural Program's Atoll Agricultural Experimental farm at Tenaea. These costs are shown below:

1. Village nursery establishment (materials, tools, incentive payments, logistical support, etc.)

\$2000

2. Propagation and transport of selected species by MNRD	\$1000
3. Prizes and conduct of competitions (additional prize money/prizes could also be solicited from other agencies, e.g., NGOs, international agencies, private businesses, etc.)	\$2000
4. Village workshops	\$1000
5. Contingencies	\$500
TOTAL	US\$6,500

9.6.6 Education and Public-Awareness Campaigns

Experience has shown that a development initiative has a better chance of success when its rationale and objectives are understood by the general public, resource users and owners, the business community concerned (e.g., in the case of the NTCAP, the commercial fishers of shark, beche-de-mer, and tuna, handicraft buyers, and tourist promoters) and decision makers. In the NTCAP, therefore, major emphasis is placed on education and public awareness.

Nature of Activity: Topics that need to be covered in the education and awareness programs include:

1. Ecological, economic and cultural importance of biodiversity and biodiversity conservation as a foundation for sustainable development.
2. Constraints to biodiversity conservation, and activities that destroy or degrade biodiversity.
3. Ecological and biological rationale for environmental legislation, biodiversity conservation, and the establishment of terrestrial and marine reserves.
4. Models for, or case studies of, activities which promote the sustainable use of biodiversity.

Specific objectives and target audiences of the education and public-awareness program during phase I include:

1. Sensitisation of decision makers to the key issues related to legislation and regulation of sustainable use of biodiversity in Kiribati. This would be coordinated and conducted by EU and would include meetings with appropriate department and agency heads, the Environment Management Committee, the North Tarawa Island Council, and representatives of funding agencies, research agencies and NGOs.
2. Increase public and NTCA community awareness of the role of biodiversity conservation as a foundation for sustainable development. This would have two main components. The first would be a national public awareness campaign and the second a continuing effort at the community level in North Tarawa to strengthen the resource users' resolve to promote the sustainable use of their resources. The national campaign would include the following components: 1) a newspaper column on biodiversity conservation and the NTCAP; 2) a weekly radio program on conservation of biodiversity and the NTCAP; and 3) the production of two plays on the importance of biodiversity as a basis for sustainable development.
3. Preparation of appropriate curriculum materials for use in the schools, teacher training and for tourism promotion. The development, by means of field workshops, of fieldwork/fieldtrips as a basis for improved environmental education, making use of biodiversity authorities from local North Tarawa communities (i.e., knowledgeable local men and women) and teacher training and curriculum development personnel as resource persons, with the target audiences being school teachers (from Ootan Marawa Baha'i and Taborio High Schools and primary schools) and prospective local tourist guides.

Lead Agencies: The lead agency will be EU in cooperation with the Curriculum Development and Research Centre (CDRC), the Tarawa Teachers College (TTC) and the Kiribati Visitors Bureau. EU will be responsible for identifying the appropriate parties/contractors to produce the required materials and conduct field workshops. At the North Tarawa-level the CASO in cooperation with the CACC, appropriate Education Department personnel and the local KVB representative, will coordinate activities.

The "Itibwerere Drama Group" which has already produced excellent plays in the Kiribati language on marine turtle endangerment and AIDS, will produce the plays. The first will focus on the importance of marine biodiversity, the second on terrestrial biodiversity and the importance of plants and ethnobiological knowledge to the future of Kiribati.

Timing: The preparation of a short brochure on the NTCA, to be launched and distributed as part of the Kiribati National Environment Week activities in 1996 will be completed for distribution by June 1996. As part of this effort, North Tarawa will be designated as the national focal point for 1996 Environment Awareness Week activities.

Preparation of information for radio and print media will begin as soon as the PPD is accepted and will continue for the duration of the project.

Preparation, updating and circulation of lists (data bases) of plants and animals found in the NTCA has already begun and will continue throughout the project.

The production of the first play on the overexploitation of marine biodiversity, by the Itibwerere Play Group, will begin as soon as funds are available.

The planning for and preparation of a 30 minute video on the importance of marine and terrestrial resources in the NTCA and the importance of preserving traditional knowledge about biodiversity and its use will begin in early 1996. This will be used in schools as well as by other agencies to inform the public and policy makers about the NTCA and the importance of biodiversity conservation.

Teacher and tourist operators/guides field workshops will begin in mid-1996, although short workshops or meetings (e.g., with tourist operators, host villages, tourist guides, etc.) could be conducted during the first half of 1996 to begin to enhance the benefits of the NTCAP to small-scale tourism development.

The preparation of short curriculum units for use in biology, geography, social science, English and Kiribati cultural and language studies will begin, in conjunction with the CDU, in late 1996, under funding for year two of the NTCAP.

Estimated Costs: the estimated costs are as follows:

1. NTCA Brochure for Environment Week 1995	\$1000
2. Production of one 30-minute video	\$4000
3. Teachers/Tourist Guide Field Workshops (with KVB)	\$2000
4. Production and performance (transport of group) for two plays by Itibwerere	\$2500
TOTAL	\$9,500

9.6.7 Small-scale Tourism Development

Small-scale tourism offers potential as an environmentally friendly means of increasing cash incomes in North Tarawa. The Kiribati Visitors Bureau currently organises package tours to the outer islands of Butaritari, Marakei and Abaiang, and is interested in promoting tours to North Tarawa.

Nature of Activity: The main activities in this area would include:

1. Enhancement of the ability of local Kiribati-based tourist operations to optimise the attractions provided by the terrestrial and marine environments and the resource-use traditions of North Tarawa;
2. Promotion of environmentally sustainable cultural tourism and ecotourism (e.g., snorkelling, SCUBA diving, sport fishing, shell collecting, etc.). The identification of particularly spectacular dive sites, swimming beaches, picnic sites, etc. is especially important. The preparation of a short brochure listing and briefly describing key attractions is important.
3. Promotion of, and training for, short-term ecocultural tourism, based on short-term village visits, which could include snorkelling, tours of traditional garden areas, short hikes or walks through village gardens and cultural sites, handicraft displays and sales, with information provided about the materials used, their sources and manufacture of traditional handicraft items, and locally prepared feasts/meals and entertainment. The cultural, economic, and ecological importance of biodiversity to the Kiribati people could be stressed. Trips to the Government Rest House at Abaokoro, the Japanese scuba diving operation at Buariki and/or stays at participating villages could be promoted by the Kiribati Visitors Bureau or other appropriate agencies, e.g., the North Tarawa Island Council.

This activity would include appropriate training workshops and the preparation of appropriate handouts for tourists. A local "Ecocultural Tourism Workshop" could be held in Abaokoro to discuss constraints and opportunities for sustainable cultural and ecotourism tourism in North Tarawa. This would be attended by representatives of the KVB, all existing tourist accommodation and interested members of participating communities in North Tarawa. The main issues covered would be the development of improved nature- and culture-based tours and hikes and the development of materials/handouts that could enhance the capabilities of accommodation owners and guides to capitalise on these niches in the tourism market.

4. Exploration of funding sources for the development or rehabilitation of existing cultural sites as a means of increasing tourist interest and satisfaction.

The main emphasis, during Phase I should be on an assessment of the feasibility and desirability of promoting such activities. Emphasis should also be placed on the sensitisation of both the participating villages and tourists so that tourist-host community interaction benefits both parties and serves to highlight and protect the environment and living resources within the NTCA.

Lead Agencies: The lead agency would be the Kiribati Visitors Bureau, which with the assistance of the CASO the CACC, would organise workshops, prepare materials and develop the local infrastructure needed to support biodiversity dependent tourism activities. The workshops could be run representatives of the Kiribati Visitors Bureau in conjunction with the CASO. Local North Tarawa and community leadership should be responsible for greater control over activities of visiting boats, picnickers, etc. that pose a threat to the local environment.

Timing: This activity should begin soon, with a preliminary meeting of appropriate parties taking place by November 1995 to discuss trial excursions, locations and biodiversity and ethnobiological information that could enrich the tourism experience of visitors to North Tarawa. A local "Ecocultural Tourism Workshop" could be planned for mid-1996.

Estimated Costs: The estimated costs for the development of small-scale ecotourism are as follows:

1. Meetings, workshops, planning and preparation of trial promotional materials	\$2000
3. Background research and contingencies	\$500
TOTAL	US\$2,500

9.6.8 Handicraft Marketing and Training

A need for improved marketing of North Tarawa handicrafts is widely felt. Handicrafts, particularly mats and plaited ware made from coconut and pandanus leaves, constitute one of the main agricultural exports from North Tarawa to South Tarawa. With improved marketing, handicraft export could be increased considerably. There are also a number of other activities or handicraft items (e.g. shell necklace, fans, hot plates and other items incorporating cowrie shells), the production and sale of which could be increased considerably, with little or no harmful impact on the environment. All of these activities seem to be environmentally sustainable and would serve to reinforce Kiribati handicraft traditions, some of which are being lost by the younger generation.

Nature of Activity: The main activities that could be promoted during Phase I, some of which are already being promoted by the Women and Development Program of MESD, AMAK and other women's organisations and the Kiribati Visitors Bureau, include:

1. Improved local and export marketing of fine mats, baskets fans and other quality weaved products.
2. Protection or promotion of the sustainable use of marine and terrestrial species needed for handicraft production, and the planting of important pandanus and coconut cultivars that are used in handicraft manufacture.
3. Promotion of increased production, for local sale and export, of necklaces and other handicrafts made of local sea shells and beads.
5. A review of handicraft potential and the development of a handicraft improvement and marketing plan for North Tarawa. Aid sources would be solicited for this activity, which would be planned along the same lines as the Tuvalu Women's Handicraft Project initiative which revolutionised handicraft production and marketing in Tuvalu in the mid-1980s.
6. A two-day workshop on improved production and marketing of local handicrafts for local sale (to ecotourists in North Tarawa) and export to South Tarawa and/or overseas. This could include focus on the production and marketing of high quality pandanus mats, baskets, fans and other plaited ware, the production of necklaces, leis and head garlands (**te mae** and **te bau**), woodcarvings, other handicrafts, etc. from sea shells, local seeds, flowers, etc. The proper collection, care and marketing of specimen sea shells could also be a topic of such a workshop.

Lead Agencies: These activities could be coordinated by a combination of local North Tarawa crafts people, the Women and Development Program of MESD, representatives of the recently established national Advisory Council for Women's Affairs (ACWA), Kiribati Visitors Bureau, the University of the South Pacific Extension Centre in South Tarawa (which has just organised a workshop on the utilisation of shells and other marine resources for handicraft production), and representatives of AMAK and other women's organisations that currently promote the

production and sale of handicrafts, and handicraft marketers and exporters from the private sector.

The consultant to conduct the review of handicraft development potential and prepare a handicraft improvement and marketing plan will probably have to be recruited from overseas, preferably from within the Pacific Islands.

Timing: These activities could be commenced, by local women's groups and tourism representatives immediately. A major review of handicraft potential and the development of a handicraft improvement and marketing plan should probably be initiated in early 1996. Funding should be solicited as soon as possible.

Estimated Costs:

Local workshops and planning	\$2000
Review of handicraft potential and marketing (outside funding)	(\$6000)
Contingencies	\$500
TOTAL	\$US2,500

BIBLIOGRAPHY AND REFERENCES

- AIDAB. 1989. North Tarawa and Outer islands causeway study. Australian International Development Assistance Bureau, Canberra.
- Austen, R. 1988. *Handcrafts of Kiribati*. Ministry of Trade, Government of Kiribati, Tarawa.
- Baitika, T. 1987. Leases. In Crocombe, R.G. (ed.). *Land tenure in the atolls*. Institute of Pacific Studies of the University of the South Pacific, Suva. Pp. 50-55.
- Bakker, M.L., 1990. Some demographic characteristics of the atoll populations of the South Pacific. Paper prepared for a Regional Symposium on Population, Food and Development. Institute of Social and Administrative Studies, University of the South Pacific, Suva, November 9-13.
- Betero, T. 1987. Boundaries. In Crocombe, R.G. (ed.). *Land tenure in the atolls*. Institute of Pacific Studies of the University of the South Pacific, Suva. Pp. 40-49.
- BioSystems. 1994. *Tarawa Lagoon Management. Volume I. Project Summary* (First draft/July). Prepared for United States Agency for International Development RDO/Philippines, Ministry of Environment and Natural Resources Development, Government of Kiribati and Atoll Research Programme, University of the South Pacific, Suva. Pacific Islands Marine Resources Project (Project No. 879-0020). BioSystems Analysis, Tiberon, California.
- BioSystems. 1994 *Tarawa Lagoon management plan . Volume III. Technical Report* (First draft/August). Prepared for Ministry of Environment and Natural Resources Development, Government of Kiribati and Atoll Research Programme, University of the South Pacific, Suva. Pacific Islands Marine Resources Project (Project No. 879-0020). BioSystems Analysis, Tiberon, California.
- Bolton, L.A. 1982. Shellfish harvesting in Tarawa Atoll Lagoon, Republic of Kiribati. Report. Atoll Research Unit, University of the South Pacific, Tarawa.
- _____. 1982. The intertidal fauna of southern Tarawa Atoll Lagoon, Republic of Kiribati. Report. Atoll Research Unit, University of the South Pacific, Tarawa.
- Booth, H., Undated. 1985 Population Census of Kiribati. Demographic Analysis. South Pacific Commission, Noumea, New Caledonia. (Unpublished).
- Brechtefeld, N. 1987. Land courts. In Crocombe, R.G. (ed.), *Land tenure in the atolls*. Institute of Pacific Studies of the University of the South Pacific, Suva. Pp. 56-62.

- Carter, J.(ed.). 1984. *Pacific islands yearbook* (15th edition). Pacific Publications, Sydney.
- Casa Tec. 1993. Report on seaweed processing and marketing study (7-KI-04). Submitted to the government of the Republic of Kiribati and the EEC Delegation under study contract KIR/4-92. Casa Tec GB Ltd, Sherborne, Dorset, Great Britain.
- Catala, R. L. A. 1957. Report on the Gilbert Islands: Some aspects of human ecology. *Atoll Research Bulletin* 59:1-187.
- Central Planning Department (Kiribati). 1983. *National Development Plan 1983-1986*. Central Planning Department, Bairiki, Tarawa.
- Cheatham, C. 1990. Energy use in Pacific island countries: A Kiribati case study. PEDP Report REG 90-6. Pacific Energy Development Programme, Suva.
- Christophersen, E. 1927. *Vegetation of Pacific equatorial islands*. Bulletin 44. Bernice P. Bishop Museum, Honolulu.
- Coyne, T. 1984. *The effect of urbanization and western diet on the health of Pacific island populations*. Technical paper no.186. South Pacific Commission, Noumea.
- Curran, C.A. 1985. Report on a visit to Kiribati to advise on fisheries products. R1250(R). Tropical Development and Research Institute, London.
- Dahl, A.L. 1980. *Regional ecosystems survey of the South Pacific area*. Technical paper no. 179. South Pacific Commission, Noumea.
- Douglas, N., and N. Douglas. 1989. *Pacific islands yearbook* (16th edition). Angus and Robertson, North Ryde, Australia.
- Eys, S. van and Philipson, P.W. 1989. The market for beche-de-mer from the Pacific Islands. In Philipson, P.W. (ed.), *The marketing of marine products from the South Pacific*. Institute of Pacific Studies, University of the South Pacific, Suva. Pp. 207-223.
- Fosberg, F.R. 1952. Vegetation of central Pacific atolls, a brief summary. *Atoll Research Bulletin* 23:1-25.
- Fosberg, F.R., and M.-H. Sachet. 1987 Flora of the Gilberts, checklist. *Atoll Research Bulletin* 29:1-30.
- Fosberg, F.R., M.-H. Sachet, and R. Oliver, R. 1979. A geographical list of the Micronesian dicotyledonae. *Micronesica* 15(1-2):41-295.
- . 1982. Geographical checklist of the Micronesian Pteridophyta and gymnosperms. *Micronesica* 18(1):23-82.

- Geddes, W.H. 1975. *Tabiteuea North report: Economic and social response in the Gilbert and Ellice Islands*. The Ministry of Local Government and Rural Development, Bairiki, Tarawa.
- Gillet, R. 1989. Tilapia in the Pacific Islands: Are there lessons to be learned?. FAO/UNDP Fishery Support Programme, Suva.
- Gilmore, A.J. and Colman, R. 1990. Report of a consultancy on a pilot environmental study of the Outer Island Development Program, Republic of Kiribati. Graduate School of the Environment, Macquarie University, Sydney.
- Holmes, S. 1953. *Nutrition survey in the Gilbert Islands*. South Pacific Health Service, Suva.
- Ianelli, J. 1989. The status of the Kiribati live-bait fishery. Background paper 59. South Pacific Commission Workshop on Pacific Inshore Fishery Resources, Noumea, New Caledonia, 14-25 march 1988.
- IMCC. 1994. Trip report for IMCC/MARC and ATA participation in the Pacific Islands handicraft exhibition, June 13-17, 1994 (Submitted to USAID). International Management and Communications Corporation, Key Biscayne, Florida.
- Johannes, R.E., Kimmerer, W., Kinzie, W., Shiroma, E. and Walsh, T. 1979. The impacts of human activities on Tarawa Lagoon. Report for the UNDP and South Pacific Commission, Noumea.
- Kaly, U.L. and Jones, G.P. 1990. The construction of boat channels by blasting on coral reefs: Final report. Report No. 4. New Zealand Ministry of External Relations and Trade, Wellington.
- Khoo, K.M. 1976. Optimal utilisation and management of fisheries resources. In Proceedings of a seminar on the development of the fisheries sector in Malaysia. *Journal of the Malaysian Economics Association* 13:40-50.
- Kleiber, P. and Kearney, 1983. An assessment of skipjack and baitfish resources of Kiribati. Final Country Report No.5. Skipjack Survey and Assessment Programme. South Pacific Commission, Noumea.
- Koch, G. (G. Slatter, translator). 1986. *The material culture of Kiribati*. Institute of Pacific Studies, University of the South Pacific, Suva (originally published in German in 1965 by Museum fur Volkerkunde, Berlin).
- Lal, P.N., Swamy, A. and Singh, P. 1983. Mangroves and secondary productivity: Fishes associated with mangroves in Wairiki Creek, Fiji. In Lal, P.N. (ed.), *Proceedings of an interdependent workshop, 24 February 1983, Suva, Fiji*. Technical report 5. Fisheries

Division, Ministry of Agriculture and Fisheries, Suva.

- Lambert, M. 1982. The cultivation of "taro" *Cyrtosperma chamissonis* Schott in Kiribati. In Lambert, M. (ed.), *Regional Technical Meeting on Atoll Cultivation, Papeete, Tahiti, French Polynesia, 14-19 April 1980: Collected papers*. South Pacific Commission, Noumea. Pp. 163-165.
- Lawrence, R. 1977. *Tamana Island report: Economic and social response in the Gilbert and Ellice Islands*. The Ministry of Local Government and Rural Development, Bairiki, Tarawa.
- Luomala, K. 1953. *Ethnobotany of the Gilbert Islands*. Buletin 213. Bernice P. Bishop Museum, Honolulu.
- Macrae, S., 1983. *Report on the 1978 Census of Population and Housing, Volume II: Analytical Report*. Ministry of Home Affairs and Decentralisation, Bairiki, Tarawa, Kiribati.
- McCarthy, D. 1985. Fishery dynamics and biology of the major wild baitfish species, particularly *Spratelloides delicatulus* from Tarawa, Kiribati. Atoll Research and Development Unit, University of the South Pacific, Tarawa.
- McCoy, M.A. 1991. *Survey of safety at sea issues in Pacific Island artisanal fisheries*. Field document 91/3. FAO/UNDP Regional Fishery Support Programme, Suva.
- McElroy, S. 1990. Beche-de-mer survey of the Gilbert Islands. Fisheries Division, Ministry of Natural Resource Development, Bairiki, Tarawa.
- McLean, R.F. 1989. Kiribati and sea level rise: Report of field visit in May 1989 to consider implications of projected sea level rise for Kiribati. Department of Geography and Oceanography, Australian Defence Academy, Canberra.
- Maragos, J.E., Soegiarto, A., Gomez, E.D. and Dow, M.A. 1983. Development planning for tropical coastal ecosystems. In R.A. Carpenter (ed.), *Natural systems for development: What planners need to know*. Macmillan, New York and Collier Macmillan, London. Pp. 229-298.
- Mees, C.C. c.1985. The fisheries of Tamana and Arorae. Report. Fisheries Division, Ministry of Natural Resource Development, Bairiki, Tarawa.
- . 1988. Resource survey in Kiribati. Background Paper 11 presented at the South Pacific Commission Workshop on Pacific Inshore Fishery Resources, Noumea, New Caledonia, 14 - 25 March 1988.
- MENRD. 1993. Proposal for a seaweed development programme. Ministry of Environment and Natural Resources Development. Bikenibeu, Tarawa.

- Merrick, J.R. 1990. Battery disposal report: Possible effects of battery decomposition on lagoon ecosystems. Appendix 5 in Gilmore, A.J. and Colman, R. (eds.), Report of a consultancy on a pilot environmental study of the Outer Island Development Program, Republic of Kiribati. Graduate School of the Environment, Macquarie University, Sydney. Pp. 148-151.
- Merrick, J.R. 1990. Fisheries report: Impact on fisheries of causeways between atoll islets. Appendix 4 in Gilmore, A.J. and Colman, R. (eds.), Report of a consultancy on a pilot environmental study of the Outer Island Development Program, Republic of Kiribati. Graduate School of the Environment, Macquarie University, Sydney. Pp. 138-147.
- Ministry of Finance and Economic Planning. 1990. 1991 Recurrent Revenue and Expenditure Estimates. Ministry of Finance and Economic Planning, Tarawa.
- _____. 1990. 1991 Development Fund Estimates. Ministry of Finance and Economic Planning, Tarawa.
- _____. 1991. Kiribati Economic Situation. Ministry of Finance and Economic Planning, Tarawa.
- Morrison, R.J. 1987. Chemistry and classification of Pacific low atoll soils. *Alafua Agricultural Bulletin* 12(3):25-30.
- Moul, E.T. 1957. Preliminary report on the flora of Onotoa Atoll, Gilbert Islands. *Atoll Research Bulletin* 57.
- Munro, J.L. 1986. *Status of giant clam stocks and prospects for clam mariculture in the central Gilbert Islands group*. International Centre for Living Aquatic Resources and Management, Manila.
- _____. 1988. Status of giant clam stocks in the central Gilbert Islands group, Republic of Kiribati. Background paper 54. South Pacific Commission Workshop on Pacific Inshore Fishery Resources, Noumea, New Caledonia, 14 - 25 March 1988.
- Namai, B. 1987. The evolution of Kiribati tenures. In Crocombe, R.G. (ed.), *Land tenure in the atolls*. Institute of Pacific Studies of the University of the South Pacific, Suva. Pp. 30-39.
- Overy, R., Polunin, I. and Wimblett, D.W. 1982. Some plants of Kiribati: An illustrated list (unpublished manuscript). National Library and Archives, Tarawa.
- Paeniu, B. 1995. Evaluation of the North Tarawa Integrated Rural Development Project (NTIRDP). Executive Summary of Minister of Home Affairs and Rural Development). ESCAP/POC, Port Vila, Vanuatu.
- Pargeter, K.A., Taylor, R., King, H., and Zimmet, P. 1984. *Kiribati: A dietary survey*. South Pacific Commission, Noumea.

- Parkinson, B. 1984. The specimen shell resources of Tuvalu. Report 400/86. South Pacific Commission, Noumea.
- _____. 1989. The collection and sale of specimen shells. In Philipson, P.W. (ed.), *The marketing of marine products from the South Pacific*. Institute of Pacific Studies, University of the South Pacific, Suva. Pp. 124-142.
- Paulay, G. 1994. Benthic ecology and biota of Tarawa Atoll Lagoon: Influence of equatorial upwelling, circulation, and human predation. In *Tarawa Lagoon management plan. Volume III. Technical Report* (First draft). Prepared for Ministry of Environment and Natural Resources Development, Government of Kiribati and Atoll Research Programme, University of the South Pacific, Suva. Pacific Islands Marine Resources Project (Project No. 879-0020). BioSystems Analysis, Tiberon, California. Pp. 96-138.
- Polunin, I. 1979. A study of local medicinal plants, Tarawa, Kiribati. Assignment report. Regional Office for the Western Pacific, World Health Organisation, Suva.
- Pratt, H.D., Bruner, P.L. and Berrett, D.G. 1987. *A field guide to the birds of Hawaii and the tropical Pacific*. Princeton University Press, Princeton.
- Preston, G.L. 1991. Fish aggregation devices in the Pacific Islands region. In Pietersz, V.L.C. (ed.), *Papers presented at the Symposium on Artificial Reefs and Fish Aggregation Devices as Tolls for the Management and Enhancement of Marine Fishery Resources, Colombo, Sri Lanka, 14-17 May 1990* (RAPA Report:1991/11). Food and Agricultural Organization of the United Nations Regional Office for Asia and the Pacific (RAPA), Bangkok. Pp. 279-294.
- Pulea, M. and Farrier, D. 1994. *Environmental legislation review - Kiribati: 1993*. South Pacific Regional Environment Programme, Apia.
- Republic of Kiribati. 1988. *Kiribati Sixth National Development Plan: 1987-92*. Ministry of Finance, Bairiki, Tarawa.
- _____. 1993. *Kiribati Seventh National Development Plan: 1992-95*. Ministry of Finance and Economic Planning, Bairiki, Tarawa.
- Roy, P. and Connell, J. 1989. The Greenhouse Effect: Where Have all the Islands Gone. *Pacific Islands Monthly* 59(16):16-21.
- Sewell, B. 1979. *Butaritari Island report: Economic and social response in the Gilbert and Ellice Islands*. The Ministry of Local Government and Rural Development, Bairiki, Tarawa.
- Small, C.A. 1972. *Atoll agriculture in the Gilbert and Ellice Islands*. Department of Agriculture,

Tarawa.

- Soucie, E.A. 1983. *Atoll agriculture for secondary schools: Soils and major agricultural crops of Micronesia*. Ponape Agriculture and Trade School, Ponape.
- SPREP. 1993. *Kiribati national environmental management strategy*. South Pacific Environmental Regional Environment Programme, Apia.
- Sullivan, M. and Gibson, L. 1991. *Environmental planning, climate change and potential sea level rise: Report on a mission to Kiribati*. SPREP reports and studies no. 50. South Pacific Regional Environment Programme, Noumea.
- Taniera, T. 1988. Status of giant clam stocks in Kiribati. In Copland, J. and Lucas, J.S. (eds.), *Giant clams in Asia and the Pacific*. Australian Centre for International Agricultural Research, Canberra. Pp. 47-48.
- Taumaia, P. and Gentle, M. 1983. Report on the Deep Sea Fisheries Project's visit to the Republic of Kiribati (23 April - 18 November 1980). South Pacific Commission, Noumea.
- Taylor, N. 1993. *Review of environmental education - Kiribati*. Report for the South Pacific Regional Environment Programme and the Government of Kiribati. SPREP, Apia.
- Tekinaiti, T. R. 1991. Status of giant clam stock at the four atolls in Kiribati (Abaiang, Maiana, Tarawa, Abemama). Resource Assessment and Extension Unit, Fisheries Division, Ministry of Natural Resource Development, Bairiki, Tarawa.
- Terubea, E. 1990. Kiribati. In UNDP Regional Workshop on Environmental Management and sustainable development, 17-21 April, 1990: Country reviews and technical papers. UNDP, Suva. Pp. 24-39.
- Thaman, R.R. 1982. Deterioration of traditional food systems, increasing malnutrition and food dependency in the Pacific islands. *Journal of Food and Nutrition* 39(3):109-121.
- _____. 1987. Plants of Kiribati: A listing and analysis of vernacular names. *Atoll Research Bulletin* 296:1-42.
- _____. 1988. Health and nutrition in the Pacific Islands: Development or Underdevelopment. *GeoJournal* 16(2):211-227.
- _____. 1990. Kiribati agroforestry: Trees, people and the atoll environment. *Atoll Research Bulletin* 333:1-29.
- _____. 1990. Coastal reforestation and coastal agroforestry as strategies to address global warming and to promote sustainable development in the Pacific islands. Pages 5-84 in Hughes, P.J

- and McGregor, G. (eds.), *Global warming-related effects on agriculture and human health and comfort in the South Pacific*. South Pacific Regional Environment Programme (SPREP), Noumea and United Nations Environment Programme, Nairobi.
- _____. 1992. Vegetation of Nauru and the Gilbert Islands. *Pacific Science* 46(2):128-158.
- _____. 1992. Batiri kei Baravi: The ethnobotany of Pacific Island coastal plants. *Atoll Research Bulletin* 361:1-62.
- _____. 1994. Community-based biodiversity management: A foundation for sustainable island development. In Thomas, P., Bliss, E. and Hussain, R. (eds.), *Managing resources in the South Pacific. Development Bulletin* (Special issue) 31:76-78. Australian Development Network, Australian National University, Canberra.
- _____. 1994. Land, plants, animals and people: Community-based biodiversity conservation (CBBC) as a basis for ecological, cultural and economic survival in the Pacific Islands. *Pacific Science Association Information Bulletin* 46 (1-2):1-15.
- Thaman, R.R., Neemia, U. and Teuatabo, N. 1992. *Country report for UNCED - Kiribati report prepared for the United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 1992*. South Pacific Regional Environment Programme, Apia.
- Thaman, R.R. and Tebano, T. 1994. *Kiribati plant and fish names: A preliminary listing*. Atoll Research Programme, University of the South Pacific, Fisheries and Agricultural Divisions, Ministry of Environment and Natural Resources Development, and Curriculum Development and Resource Centre, Ministry of Education, Science and Technology, Tarawa.
- Turbot, J. 1954. Portulaca, a specialty in the diet of the Gilbertese in the Phoenix Islands. *Journal of the Polynesian Society* 63 (1).
- Watling, D. 1985. *A Mangrove management plan for Fiji. Phase 1. Zonation requirements and a plan for the mangroves of the Ba, Labasa and Rewa Deltas*. Government Printer, Suva.
- Ward, R.G. 1980. Agricultural Options for the Pacific Islands. In Shand, R.T. (ed.), *The Island States of the Pacific and Indian Oceans: Anatomy of Development*. Monograph No. 23. Development Studies Centre, Australian National University, Canberra. Pp. 23-40.
- Watters, R.F. and Banibati, K. 1977. *Abemama Island report: Economic and social response in the Gilbert and Ellice Islands*. The Ministry of Local Government and Rural Development, Bairiki, Tarawa.
- Wester, L. 1985. Checklist of the vascular plants of the northern Line Islands. *Atoll Research Bulletin* 287:1-38.

- Whistler, A.W. 1980. *Coastal flowers of the tropical Pacific*. The Pacific Tropical Botanical Garden, Lawai, Kauai.
- Wiens, H.J. 1962. *Atoll environment and ecology*. Yale University Press, New Haven.
- Wilmott, J.V. 1968. Gilbert and Ellice Island Colony: Report on a visit by a nutritionist. South Pacific Health Service, Suva.
- Wilson, C. 1994. *Kiribati state of the environment report 1994*. South Pacific Regional Environment Programme, Apia.
- Woodroffe, C.D. and McLean, R.F. 1992. *Kiribati vulnerability to accelerated sea-level rise: A preliminary study*. South Pacific Regional Environment Programme, Apia.
- Yeeting, B.M. 1988. Fisheries research and management problems in Kiribati. Background Paper 8 presented to the South Pacific Commission Workshop on Pacific Inshore Fishery Resources, Noumea, New Caledonia, 14 -25 march 1988.
- Zann, L.P. 1983. Traditional management and conservation of fisheries in Kiribati and Tuvalu atolls. In Ruddle, K. and Johannes, R.E. (eds.), *Contending with global change. Study 2. Traditional marine resource management in the Pacific Basin: An anthology*. UNESCO/ROSTSEA, Jakarta. Pp.78-101.

Appendix 1. Persons consulted in North Tarawa, South Tarawa and overseas during Project Preparation Consultancy.

NORTH TARAWA

TABWATAU KABAUA
Councillor, Mareuanuka Village,
Chairman
Island Development Committee
Abaokoro North Tarawa

RUBENE RUTERU
Agricultural Assistant (N. Tarawa)
Agricultural Division
Ministry of Natural Resources Development
Abaokoro, North Tarawa

TAWITA TEIBIRA
Clerk
North Tarawa Island Council
Abaokoro, North Tarawa

NAKIBAE TEUATABU
Principal
Ootan Marawa Baha'i High School
Naa Islet, North Tarawa

BAKAATI TIBWERE
Councillor, Tearinibae Village
Chief Councillor
North Tarawa Island Council
Abaokoro, North Tarawa

SOUTH TARAWA

CHARLES CORBETT
Director
Kiribati Island Exports
Bairiki, Tarawa

BWENAWA IO
Agricultural Officer
Foundation for the Peoples of the Sotuh Pacific

IATAAKE KING

Assistant Tourism Officer (Marketing Promotion)
Kiribati Visitors Bureau
Bikenibeu, South Tarawa

TABOKAI KIRITOME

Secretary for Environment and Social Development
Ministry of Environment and Social Development
Bikenibeu, South Tarawa

KOKIAKAI KOAE

Social Welfare Officer (Women and Development)
Ministry of Environment and Social Development
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MARY G. McMURTRY

Country Representative
The Foundation for the Peoples of the South Pacific
Bairiki, South Tarawa

BRIAN MARSHALL

High Commissioner
New Zealand High Commission
Biriki, South Tarawa

KABURORO RUAIA

Deputy Secretary for Natural Resources Development
Ministry of Natural Resources Development
Bairiki, Tarawa

TEKAREI RUSSELL

Director
Aia Meae Ainen Kiribati (AMAK)
Bikenibeu, South Tarawa

MIKE SAVINS

Managing Director
Teikabuti Fishing Company Ltd.
Bikenibeu, South Tarawa

KINTOBA TEARO

Fisheries Officer
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Ministry of Natural Resources Development
Tenaya, South Tarawa

ETERA TEANGANA

Programme Assistant, University of the South Pacific Centre, Teorareke, and
Vegetable Farmer
Tarawa Farms
Temaiku, South Tarawa

KATAOTIKA TEKEE

Minister
Ministry of Health, Family Planning and Social Welfare
Kiribati National Hospital
Nawerewere, South Tarawa

NEIBETA TENTOA

Director
University of the South Pacific Centre,
Teorareke, South Tarawa

TEWAREKA TENTOA

Vice-President, Republic of Kiribati
Minister of Home Affairs and Rural Development
Bairiki, South Tarawa

WILLIE TOKATAAKE

Honourable Minister
Ministry of Education, Training and Technology
Bikenibeu, South Tarawa

JAMES UAN

Fisheries Research Officer (Mariculture)
Fisheries Division
Ministry of Natural Resources Development
Tenaya, North Tarawa

LINDA UAN

Manager Itibwerere Play Group
Junior Health Educator
Foundation for the Peoples of the South Pacific
Abarao, South Tarawa

ROBIN WHITE

Artist, Baha'i Member and long-term resident in Kiribati
Bikenibeu, South Tarawa

OVERSEAS

BOB FULLER

Forum Secretariat Consultant (Air Drying)

Faculty of Engineering

International Development Technologies Centre

University of Melbourne

Parkville, Victoria, Australia

BRIAN RUDOLPH

Marine Biologist (Eucheuma Seaweed Research)

Copenhagen Pectin A/S (Division of Hercules Incorporated)

Lille Skensved, Denmark

Appendix 2. Terms of reference for the Conservation Areas Support Officer (CASO).

The Conservation Area Support Officer shall be an employee of the Ministry of Environment and Social Development (MESD) and will be directly responsible to the Head of Environment Unit (EU) of MESD. The CASO will be based in Bikenibeu, South Tarawa, but will be required to travel frequently to the North Tarawa Conservation Area (NTCA), and less frequently to the Cook Islet Conservation Area (CICA) in Kiritimati in the Line Islands.

The specific terms of reference or responsibilities of the CASO shall be to:

1. Implement the Work Plans of both the NTCA and CICA in consultation with the EU, the Conservation Area Coordinating Committees (CACC) and the local communities.
2. Serve as a member of both CACCs and to, when possible, attend all regular meetings.
3. Establish and maintain a Kiribati Conservation Areas Projects office (desk) within the EU in Bikenibeu, South Tarawa.
4. Be responsible for the day-to-day administration and management of the North Tarawa and Cook Islet Conservation Area Projects.
5. Collect, catalogue (keep inventories) and maintain appropriate reference and educational materials in the EU Office in Bikenibeu and for use by the CACCS and local communities in both CAs.
6. Regularly visit and hold participatory planning meetings with members of the CACCs and participating communities.
7. Distribute/disseminate information and materials related to HCAP activities.
8. In conjunction with the CACCs, the local communities and the EU, monitor activities and plan future activities of the HCAP.
9. Submit quarterly progress reports on the CAPs to SPBCP and the EU.
10. Follow all SPREP and MESD administrative and financial procedures.

Appendix 3. Inland forest or disturbed area (I), coastal littoral (L) and mangrove (M) species of priority status for protection, replanting or sustainable use in North Tarawa (* = non-indigenous).

HIGH PRIORITY (scarce or endangered)

te aitoa (*Lumnitzera littorea*)(M)
te aroa (*Suriana maritima*)(M,L)
te baireati (*Barringtonia asiatica*)(L)
te bararuku? (*Ximenia americana*)(L,M)
te bingibing, te nimareburebu (*Hernandia nymphaeifolia*)(L,I)
te buka (*Pisonia grandis*)(I)
te itai (*Calophyllum inophyllum*)(L,I)
te kaiboia (*Dodonaea viscosa*)(I)
te kanawa (*Cordia subcordata*)(L)
te kaura (*Sida fallax*)(I)
te kiaiai, te rau, rao (*Hibiscus tiliaceus*)(L,I)
te kiaiai (*Thespesia populnea*)(L,I)
te kiebutinang (*Neisosperma oppositifolium*)(L,I)
te kunikun, te ntarine? (*Terminalia catappa*)(L,I)
te nikabubuti (*Sonneratia alba*)(M)
te nimatore (*Macaranga carolinensis*)(I)
te reiango? (*Cerbera manghas*)(L,I)
te tiare (*Gardenia taitensis*)(I)
te tongo buangi (*Bruguiera gymnorrhiza*)(M)
te ukin (*Terminalia samoensis*)(L,I)

PRIORITY (Important, but not endangered)

te ango (*Premna serratifolia*)(I,L)
te aroma (*Pipturus argenteus*)(I)
te aronga (*Acalypha grandis*)(I)
te bero (*Ficus tinctoria*)(I)
te ngea (*Pemphis acidula*)(I,L,M)
te kaina (*Pandanus tectorius*)(L,I)
***te katurina, te burukam** (*Casuarina equisetifolia*)
te mao (*Scaevola taccada*)(L,I)
te ni (*Cocos nucifera*)(L,I)
te non (*Morinda citrifolia*)(I,L)
te ren (*Tournefortia argentea*)(L,I)
te tongo (*Rhizophora stylosa*)(M)
te uri (*Guettarda speciosa*)(L,I)

Appendix 4. Fruit, nut and multipurpose tree species or plants that could be protected and

planted to maintain or strengthen agroforestry and tree groves in agricultural and fallow areas of Kiribati (* = non-indigenous).

FRUIT AND NUT TREES

native fig, **te bero** (*Ficus tinctoria*)
pandanus, **te kaina** (*Pandanus tectorius*)
*breadfruit, **te mai** (*Artocarpus altilis* and *A. mariannensis*)
*papaya, pawpaw, **te mwemwera**, **te babaia** (*Carica papaya*)
coconut, **te ni** (*Cocos nucifera*)
*guava, **te kuawa** (*Psidium guajava*)
*pilinut, *Barringtonia procera*
*jujube, *Zizyphus mauritania*

GENERAL PURPOSE/USEFUL TREES

High Priority (scarce, endangered or of high utility)

te baireati (*Barringtonia asiatica*)
te bingibing, **te nimareburebu** (*Hernandia nymphaeifolia*)
te buka (*Pisonia grandis*)
***te burukam**, **te katurina** (*Casuarina equisetifolia*)
te itai (*Calophyllum inophyllum*)
te kaiboia (*Dodonaea viscosa*)
te kanawa (*Cordia subcordata*)
te kiaiai, **te rau**, **rao** (*Hibiscus tiliaceus*)
te kiaiai (*Thespesia populnea*)
te kiebutinang (*Neisosperma oppositifolium*)
te kaura (*Sida fallax*)
***te kunikun** (*Terminalia catappa*)
***te nimatore** (*Macaranga carolinensis*)
te ren (*Tournefortia argentea*)
te uri (*Guettarda speciosa*)

Priority (important, not endangered or with some potential)

te ango (*Premna serratifolia*)
te aroma (*Pipturus argenteus*)
***te kaibakoa** (*Acacia farnesiana*)
***te kaitetua** (*Leucaena leucocephala*)
te nikamatutu (*Sophora tomentosa*)
te non (*Morinda citrifolia*)
te ukin (*Terminalia litoralis*)
**Gliricidia sepium*

Appendix 5. Tree species that could be planted or protected around excavated taro pit areas to

increase food production, provide valuable products or to provide mulching to improve soil fertility in and around pit areas (* = non-indigenous).

FOOD TREES AND FOOD PLANTS

- *banana, ***te banana, te umuumu, te kaburoburo** (K) (*Musa* ABB Group "Bluggoe" plantain)
- *hibiscus spinach, **te bere, nambere** (*Abelmoschus manihot*)
- *native fig, **te bero** (*Ficus tinctoria*)(all varieties)
- te buka** (*Pisonia grandis*)
- pandanus, **te kaina** (*Pandanus tectorius*)
- *sugarcane, **te kaitioka, tugage** (*Saccharum officinarum*)
- *tropical almond, **te kunikun** (*Terminalia catappa*)
- *guava, **te kuawa** (*Psidium guajava*)
- *breadfruit, **te mai** (*Artocarpus altilis*)
- *papaya, pawpaw, **te mwemweara, te babaia** (*Carica papaya*)
- *coconut, **te ni** (*Cocos nucifera*)
- ladyfinger banana, ***te oraora, te tabonibae** (*Musa* AAB Group "Pisang Raja" banana)
- *lime, **te raim** (*Citrus aurantifolia*)
- *spinach tree, chaya (*Cnidoscolus chayamansa*)
- *Horseradish tree (*Moringa oleifera*)

TREES USED FOR MULCHING

- te aroma** (*Pipturus argenteus*)
 - te buka** (*Pisonia grandis*)
 - *te burukam, te katurina** (*Casuarina equisetifolia*)
 - te kaina** (*Pandanus tectorius*)
 - te kanawa** (*Cordia subcordata*)
 - te kaura** (*Sida fallax*)
 - te kiaiai, te rau** (*Hibiscus tiliaceus*)
 - te kiaiai** (*Thespesia populnea*)
 - *te kunikun** (*Terminalia catappa*)
 - te mao** (*Scaevola taccada*)
 - te ni** (*Cocos nucifera*)
 - te nikamatutu** (*Sophora tomentosa*)
 - te nimatore** (*Macaranga carolinensis*)
 - te ren** (*Tournefortia argentea*)
 - te uri** (*Guettarda speciosa*)
-

Appendix 6. Fruit or food trees and other multi-purpose trees and plants suitable for planting in houseyard gardens, villages and urban areas in Kiribati (important considerations are resistance to windfall, size, cultural utility and proven acceptance)(* = non-indigenous).

FRUIT AND FOOD TREES

- *te abuka (*Crateva speciosa*)
- *te banana (*Musa* banana and plantain cultivars)
- *te banana, te umuumu, te kaburoburo (*Musa* ABB Group "Bluggoe" plantain)
- *te bere, nambere (*Ablemoschus manihot*)
- te bero (*Ficus tinctoria*)(all varieties)
- *te biku (*Ficus carica*)
- te buka (*Pisonia grandis*)
- te kaina (*Pandanus tectorius*)
- *te kaitioka, tugage (*Saccharum officinarum*)
- *te mai (*Artocarpus altilis*)
- *te mangko (*Mangifera indica*)
- *te mwemwera, te babaia (*Carica papaya*)
- *te kunikun (*Terminalia catappa*)
- *te kuawa (*Psidium guajava*)
- *te ni (*Cocos nucifera*)(all cultivars, especially toddy cultivars)
- *te oraora, te tabonibae (*Musa* AAB Group "Pisang Raja" banana)
- *te raim (*Citrus aurantifolia*)
- *te remen, remon (*Citrus limon/hystrix?*)
- *bilimbi (*Averrhoa bilimbi*)
- *calamondin lime/orangequat (*Citrus mitis*)
- *carambola (*Averrhoa carambola*)
- *giant sugar apple (*Annona domestica*)
- *spinach tree, chaya (*Cnidoscolus chayamansa*)
- *horseradish tree (*Moringa oleifera*)
- *Indian jujube (*Zizyphus mauritania*)
- *Otaheiti gooseberry (*Phyllanthus acidus*)
- *Rangpur lime (*Citrus x limonia*)
- *sapodilla (*Manilkara achras*)
- *Volkameriana lime (*Citrus volkameriana*)
- **Barringtonia procera*

MULTI-PURPOSE TREES/ORNAMENTAL

- *te bam (*Cycas circinalis*)
- *te bam (*Pritchardia pacifica*)
- *te baubau (*Gossypium barbadense*)
- te aitoa (*Lumnitzera littorea*)
- te angu (*Premna serratifolia*)
- te baireati (*Barringtonia asiatica*)

te bingibing, te nimareburebu (*Hernandia nymphaeifolia*)
 ***te bitati** (*Jasminum sambac*)
 ***te bumatoritori** (*Calotropis gigantea*)
 ***te burukam, katurina** (*Casuarina equisetifolia*)
te itai (*Calophyllum inophyllum*)
 ***te kaibaba** (*Bambusa vulgaris*)
 ***te kaibakoa** (*Acacia farnesiana*)
 ***te kaibuaka** (*Lantana camara*)
te kaiboia (*Dodonaea viscosa*)
 ***te kaitetua** (*Leucaena leucocephala*)
te kanawa (*Cordia subcordata*)
 ***te katuru, te kaitiru** (*Ixora casei*)
te kaura (*Sida fallax*)
te kiaiai, te rau (*Hibiscus tiliaceus*)
te kiebutinang (*Neisosperma oppositifolium*)
 ***te meria** (*Plumeria obtusa*)
 ***te meria** (*Plumeria rubra*)
 ***neikarairai** *Tecoma stans*
te nikamatutu (*Sophora tomentosa*)
 ***te nimatore** (*Macaranga carolinensis*)
te non (*Morinda citrifolia*)
 ***te orion** (*Nerium oleander*)
te rauti (*Cordyline fruticosa*)
te ren (*Tournefortia argentea*)
 ***te roti** (*Hibiscus rosa-sinensis*)
 ***te tiare** (*Gardenia taitensis*)
 ***te tua** (*Delonix regia*)
te ukin (*Terminalia samoensis*)
te uri (*Guettarda speciosa*)
 **Gliricidia sepium*

Appendix 7. Common hedge, living fence or border species from houseyard gardens on South Tarawa, Republic of Kiribati, based on a survey of 100 households conducted in September 1991 (K = Kiribati names; * = non-indigenous; NT = important species introduced into North Tarawa from the Marshall Islands, but not found on South Tarawa).

Species	
Total	(x/100)
<hr/>	
* <i>Polyscias scutellaria</i> (te batatara?)	
	NT
* <i>Polyscias guilfoylei</i> (te toara)	73
<i>Clerodendrum inerme</i> (te inato)	30
<i>Morinda citrifolia</i> (te non)	26
* <i>Pedilanthus tithymaloides</i>	20
<i>Premna serratifolia</i> (te ango)	18
* <i>Casuarina equisetifolia</i> (te butukam, te katurina)	18
* <i>Cocos nucifera</i> (te ni)	10
* <i>Lantana camara</i> (te kaibuaka)	10
* <i>Pseuderanthemum reticulatum</i> (te iaro?)	9
* <i>Pseuderanthemum carruthersii</i> (te iaro)	8
var. <i>atropurpureum</i>	
<i>Pandanus tectorius</i> (te kaina)	5
<i>Scaevola taccada</i> (te mao)	4
* <i>Bougainvillea</i> spp. (te akanta)	3
* <i>Polyscias tricochleata</i> (te kaimamara)	2
<i>Guettarda speciosa</i> (te uri)	2
* <i>Ixora casei</i> (te katuru, te katiru)	2
* <i>Tecoma stans</i> (nei karairai)	1
* <i>Codiaeum variegatum</i>	1
* <i>Cordyline fruticosa</i> (te rauti)	1
<i>Ficus tinctoria</i> (te bero)	1
* <i>Leucaena leucocephala</i> (te kaitetua)	1
* <i>Acalypha wilkesiana</i> (te aronga)	1
* <i>Polyscias fruticosa</i> (te kaimamara?)	1
* <i>Acalypha amentacea</i> f. <i>circinata</i>	1
<i>Terminalia samoensis</i> (te ukin)	1
* <i>Saccharum officinarum</i> (te kaitioka)	1
* <i>Gliricidia sepium</i>	1
* <i>Nerium oleander</i> (te orion)	1
<hr/>	

Note: Trees commonly planted just behind or inside, but not constituting an integral part of the actual hedge or border planting include: the food trees *Cocos nucifera* (te ni), *Artocarpus* spp. (te mai), *Ficus tinctoria* (te bero), *Carica papaya* (te babaia, te mwemwera) and *Musa* cultivars (te banana); the culturally useful, ornamental or flower-bearing trees and shrubs, *Guetarda speciosa* (te uri), *Plumeria* spp. (te meria), *Ixora casei* (te katuru, te katiru), *Calotropis gigantea* (te bumatoritori), *Delonix regia* (te tua); and the useful indigenous or aboriginal introductions, *Hernandia nymphaeifolia* (te bingibing), *Tournefortia argentea* (te ren), *Hibiscus tiliaceus* (te kiaiai) and *Macaranga carolinensis* (te kimatore, te nimatore?). Some of the other species, which although commonly found as integral components of the hedge are also planted and protected inside the hedge.

Appendix 8. Trees that offer potential as roadside or parkland trees in the atoll environment because of their attractiveness, provision of shade and resistance to wind damage and drought (* = non-indigenous).

- *te akanta** (*Bougainvillea* spp.)
 - te baireati** (*Barringtonia asiatica*)
 - te bingibing, te nimareburebu** (*Hernandia nymphaeifolia*)
 - *te burukam, katurina** (*Casuarina equisetifolia*)
 - te itai** (*Calophyllum inophyllum*)
 - te kaina** (*Pandanus tectorius*)
 - te kanawa** (*Cordia subcordata*)
 - *te kiaiai, te rau** (*Hibiscus tiliaceus*)
 - *te kunikun** (*Terminalia catappa*)
 - *te mai** (*Artocarpus altilis*)
 - *te meria** (*Plumeria obtusa*)
 - *te meria** (*Plumeria rubra*)
 - *te ni** (*Cocos nucifera*)(**all cultivars, especially toddy cultivars**)
 - *te nimatore** (*Macaranga carolinensis*)
 - te ren** (*Tournefortia argentea*)
 - *te tua** (*Delonix regia*)
 - te ukin** (*Terminalia samoensis*)
 - te uri** (*Guettarda speciosa*)
 - *Gliricidia sepium**
 - *Cordia sebestina**
-

Appendix 9. Endangered plants and plants of particular cultural importance that should receive priority for protection in reserves, and other plants that could be included in village or household collections or botanical gardens because of their educational importance and utility in Kiribati * = non-indigenous).

PRIORITY (endangered or of particular cultural importance)

te aitoa (*Lumnitzera littorea*)
te aroa (*Suriana maritima*)
 ***te babai** (*Cyrtosperma chamissonis*)(all cultivars)
te baireati (*Barringtonia asiatica*)
 ***te banana** (*Musa* banana and plantain cultivars)
te bararuku (*Ximenia americana*)
 ***te baubau** (*Gossypium barbadense*)
te bero (*Ficus tinctoria*)(all cultivars)
 ***te biku** (*Ficus carica*)
te bingibing, te nimareburebu (*Hernandia nymphaeifolia*)
te buka (*Pisonia grandis*)
te itai (*Calophyllum inophyllum*)
 ***te kaibaba** (*Bambusa vulgaris*)
 ***te kaibakoa** (*Acacia farnesiana*)
te kai boia (*Dodonaea viscosa*)
te kaina (*Pandanus tectorius*)(all cultivars)
 ***te kaitioka, tugage** (*Saccharum officinarum*)
te kaitu? (*Vitex trifolia*)
te kanawa (*Cordia subcordata*)
te kaura (*Sida fallax*)
te keang, te keang ni Makin (*Phymatosorus scolopendria*)
 ***te kiaiai, te rau** (*Hibiscus tiliaceus*)
te kiaiai (*Thespesia populnea*)
te kiebutinang (*Neisosperma oppositifolium*)
 ***te kunikun** (*Terminalia catappa*)
 ***te mai** (*Artocarpus altilis/mariannensis*)(all cultivars)
 ***te makemake** (*Tacca leontopetaloides*)
 ***te mangko** (*Mangifera indica*)
 ***te mwemwera, te babaia** (*Carica papaya*)(all cultivars)
 ***te ni** (*Cocos nucifera*)(all cultivars, especially toddy cultivars)
 ***te nimatore** (*Macaranga carolinensis*)
te nikabubuti (*Sonneratia alba*)
te nikamatutu (*Sophora tomentosa*)
te reiango? (*Cerbera manghas*)
te tiare tiale, siale (T)(*Gardenia taitensis*)
te tongo buangi (*Bruguiera gymnorrhiza*)
te ukin (*Terminalia samoensis*)
te uri (*Guettarda speciosa*)

MULTI-PURPOSE/EDUCATIONAL TREES

- te ango** (*Premna serratifolia*)
 - te aroma** (*Pipturus argenteus*)
 - te aronga** (*Acalypha grandis*)
 - *te aronga** (*Acalypha amentacea* ssp. *wilkesiana*)
 - *te bam** (*Cycas circinalis*)
 - *te bam** (*Pritchardia pacifica*)
 - *te bitati** (*Jasminum sambac*)
 - *te bumatoritori** (*Calotropis grandis*)
 - *te iaro** (*Pseuderanthemum* spp.)
 - te inato** (*Clerodendrum inerme*)
 - te ngea** (*Pemphis acidula*)
 - *te kaibuaka, te kaiterea** (*Lantana camara*)
 - *te kaitetua** (*Leucaena leucocephala*)
 - *te katurina** (*Casuarina equisetifolia*)
 - *te katuru** (*Ixora casei*)
 - te kiaou** (*Triumfetta procumbens*)
 - *te kuwawa** (*Psidium guajava*)
 - te mao** (*Scaevola taccada*)
 - te non** (*Morinda citrifolia*)
 - te ren** (*Tournefortia argentea*)
 - te tongo** (*Rhizophora stylosa*)
 - *te tua** (*Delonix regia*)
 - te rauti** (*Cordyline fruticosa*)
 - *drumstick tree, horseradish tree** *Moringa oleifera*
-

Appendix 10. Atoll and coastal plant species found in Kiribati which are of particular cultural utility in Melanesia, Polynesia and Micronesia (Notes: not including a wide range of ecological functions or uses; based on studeis by Thaman, 1990).

Latin Name (Kiribati Name)	Uses
<i>Cocos nucifera</i> (te ni)	125
<i>Hibiscus tiliaceus</i> (te kiaiai)	57
<i>Pandanus tectorius</i> (te kaina)	53
<i>Calophyllum inophyllum</i> (te itai)	43
<i>Cordia subcordata</i> (te kanawa)	40
<i>Guettarda speciosa</i> (te uri)	36
<i>Scaevola sericea</i> (te mao)	32
<i>Pemphis acidula</i> (te ngea)	30
<i>Thespesia populnea</i> (te bingibing?)	26
<i>Rhizophora</i> spp. (te tongo)	25
<i>Tournefortia argentea</i> (te ren)	23
<i>Casuarina equisetifolia</i> (te katurina, te burukam)	22
<i>Premna serratifolia</i> (te ango)	22
<i>Morinda citrifolia</i> (te non)	22
<i>Pipturus argenteus</i> (te aronga?)	21
<i>Terminalia catappa</i> (te kunikun)	21
<i>Ficus tinctoria</i> (te bero)	21
<i>Ficus prolixa</i> (te kiriawa?; common on Banaba)	20
<i>Hernandia nymphaeaefolia</i> (te nimareburebu, te bingibing)	18
<i>Lumnitzera littorea</i> (te aitoa)	17
<i>Pisonia grandis</i> (te buka)	17
<i>Bruguiera gymnorhiza</i> (te tongo buangi)	16
<i>Barringtonia asiatica</i> (te baireati)	14
<i>Gardenia taitensis</i> (te tiare)	12
<i>Sida fallax</i> (te kaura)	11
<i>Triumfetta procumbens</i> (te kiaow)	11
<i>Vitex</i> spp. (te kaitu)	11
<i>Dodonea viscosa</i> (te kaiboia)	11
<i>Cerbera manghas</i> (te reiang)	10
<i>Clerodendrum inerme</i> (te inato)	10
<i>Cassytha filiformis</i> (te ntanini)	10
<i>Tacca leontopetaloides</i> (te makemake)	9
<i>Crinum asiaticum</i> (te kiebu)	9
<i>Polypodium scolopendria</i> (te keang)	8
<i>Ipomoea pes-caprae</i> (te ruku)	7