Pacific Community
Communauté du Pacifique

Island Diagnostic Analysis Report for

Kiribati

Pacific R2R Ridge to Reef

gef

UNDP
Empowered lives.
Resilient nations

Island Diagnostic Analysis Report for **Kiribati**

Prepared by
Taboia Metutera

Produced and published by
GEF Pacific International Waters Ridge to Reef Regional Project,
Pacific Community (SPC), Suva, Fiji

Suva, Fiji, 2022

Original text: English

Citation: Metutera, T. 2022. Island Diagnostic Analysis Report for Kiribati. Prepared for the Ministry of Environment, Lands and Agricultural Development, Government of Kiribati. Produced and published by GEF Pacific International Waters Ridge to Reef Regional Project, Pacific Community (SPC), Suva, Fiji. 36 pp

Reviewed by John Carreon, Samasoni Sauni, Teema Biko, Fononga Vainga Mangisi-Mafileo, Aliti Vunisea, George Naboutuiloma and Jose Antonio.

Editing Support: Seema Deo, Footprints in the Sand consultancy

Conceptual Design: Navneet Lal, Pacific Community (SPC)

Layout and Design: Sailesh Sen, Tanisha Graphics

Cover photo: Aerial Image of South Tarawa, Kiribati Photo by Anesh Kumar Pacific Community.

Produced by GEF Pacific International Waters Ridge to Reef Regional Project, Pacific Community (SPC), Suva, Fiji.

Prepared for publication at SPC's Suva Regional Office,
Private Mail Bag, Suva, Fiji, 2022
www.spc.int | spc@spc.int

Printed by Quality Print, Suva, Fiji, 2022

Contents

Abbreviations v
Acknowledgement vi
List of Figures vii
List of Tables vii
Executive Summary 1
1 Introduction 2
1.1 Kiribati IW R2R Project 2
1.2 Scope of Baseline Assessment 4
2 Methodology 5
2.1 Description of Study Sites 5
2.2 Data Collection 6
2.2.1 Literature review 6
2.2.2 Marine habitat assessment 6
2.2.3 Terrestrial habitat assessment 7
2.2.4 Water quality assessment 7
2.3 Diagnostic Analysis Methodology 7
2.3.1 Identifying and prioritising environmental problems 7
2.3.2 Island Environmental Problem Prioritisation Criteria 7
2.3.3 Determining environmental and socioeconomic impacts 8
2.3.4 Developing causal chains 8
2.3.5 Report back and discussion 8
3 Demographic and Socio-Economic Considerations 9
3.1 Socio-economy 9
3.2 Employment 9
3.3 Social development (including gender assessment summary) 9
3.4 Health and hygiene 9
3.5 Cultural Heritage 10
3.6 Geology and geomorphology 11
3.7 Hydrology 11
3.8 Coastal Processes 12
3.9 Marine Ecology 13
3.10 Terrestrial Ecology 14
3.11 Water and Wastewater Management 14
3.12 Natural Vulnerabilities 15

4 Legislation and Policy Framework 17
4.1 Regional Multilateral Environmental Agreements 17
4.2 National and Local Legislation and Policy 18
4.3 Traditional Governance and Tenure Systems 18
4.4 Communities and other stakeholders 19
5 History of interventions 20
6 Key Environmental Problems 22
6.1 Diagnostic Analysis 22
6.2 Identify and agree on the scope, objectives and responsibilities pertaining to the focus area under investigation 22
6.3 Identify and analyse the issues, problems and impacts (and the environmental and associated socio-economic impacts) using problem-tree and causal-link analyses 24
6.3.1 Water Issues 24
6.3.2 Marine Issues 24
6.3.3 Land Issues 25
6.4 Problem-tree analysis 26
6.5 Develop priority systems and plans for actions and interventions 27
7 Main Findings 28
7.1 Summary of main findings 28
7.2 Opportunities 28
7.3 Risks 29
8 Actions to Reform 30
8.1 Shared key actions contributing to problem 31
8.2 Common underlying issues across identified environmental issues 31
8.3 Relevant institutional legal factors 31
9 References 32
Annex 1: Priority Issues 34

Abbreviations

ACP	African Caribbean and Pacific Group of States
BPC	British Phosphate Company
DLT	Dry litter technology
EC	European Commission
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIWA	Global International Waters Assessment
IDA	Island Diagnostic Analysis
IW	International Waters
KBA	Key Biodiversity Area
MEA	Multilateral Environmental Agreement
MHMS	Ministry of Health and Medical Services
MISE	Ministry of Infrastructure and Sustainable Energy
MLD	Mega-litres per day
PA	Protected Area
PICs	Pacific Island countries
PUB	Public Utilities Board
R2R	Ridge to Reef
SAPHE	Sanitation Public Health and Environment Project
SIDS	Small Island Developing States
SPREP	Secretariat of the Pacific Regional Environment Programme
STAR	System for Transparent Allocation of Resources
STWSP	South Tarawa Water Supply Project
TDA	Transboundary Diagnostic Analysis
UNCDF	United Nations Capital Development Fund
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children's Emergency Fund
WASH	Water, Sanitation and Hygiene

Acknowledgement

We would like to acknowledge the leadership of the Pacific Community (SPC) Kiribati International Waters Ridge to Reef Project Office through the Ministry of Environment, Lands and Agricultural Development (MELAD). Special acknowledgement to all stakeholders who provided information and data, which are reflected in this report.

List of Figures

Figure 1: Map of Kiribati (https://www.worldatlas.com/maps/kiribati) 5
Figure 2: Inhabited Islands of Kiribati 5
Figure 3: Freshwater lenses on atoll islands 12
Figure 4: Diagnostic workshop outcomes on priority problems, immediate causes and root-causes 26

List of Tables

Table 1: Summary of the components and outcomes of the Kiribati National STAR project. 3
Table 2: Population in the islands of Kiribati, distance from Tarawa and average annual rainfall 6
Table 3: Policy frameworks related to natural resource management in the Republic of Kiribati. 16
Table 4: Multilateral Environmental Agreements under the ACP MEAs 3 Programme signed by Kiribati 17
Table 5: Sustainable Development Goals (SDGs) directly linked to Multilateral Environmental Agreements (MEAs) on biodiversity and waste and chemicals. 17
Table 6: Legislative instruments and current status of strategies 18
Table 7: Plans and guidelines and the current status of strategies 18
Table 8: Corresponding roles of community types and the related stakeholders. 19
Table 9: Interventions since the year 2000 20
Table 10: Assigned level of severity of environmental issues in all islands in Kiribati. 22
Table 11: Identified environmental problems and relevant aspects for decision makers 30

Fish Pond at South Tarawa, Kiribati.
Photo by Anesh Kumar - Pacific Community

Executive Summary

The report presents the Island Diagnostic Analysis for the Republic of Kiribati. The environmental issues identified and documented in this report were, in the main, extracted from meeting papers and presentations of the House of Parliament Select Committee, which include issues on climate change. Four issues were raised during a visit to all islands by the Select Committee in Kiribati in the year 2017. These are: coastal erosion; adverse impact on drinking water; adverse impact of food crops; and decline in marine resources.

The diagnostic analysis identified three priority environmental issues for Kiribati: coastal erosion, adverse impact on drinking water, and decline in marine resources. A problem tree analysis was conducted to identify the root causes and determine potential intervention options. The interventions need to be carefully considered to avoid solutions that may be too costly or actions that are impossible to implement given the circumstances on the remote islands of Kiribati. For instance, bringing a drill rig to an islet to dig a deep 30 m vertical well for a desalination plant would be cost prohibitive for Kiribati. The key is to identify plausible solutions to the above issues that can be realistically carried out in remote outer islands.

Another solution is to encourage change in behaviour and increase awareness of the severity of the problems and the benefits of alternate interventions. Human interventions through innovations and community teamwork can offer support. People residing in the outer islands are dependent on root crops and other plants grown on infertile soil in order to survive. Regular farming and subsistence use of coconut trees, breadfruit, swamp giant taro, banana plants, sweet potatoes and other edible plants and root crops, coupled with fishing are regular, daily full-time jobs for the local populations. The problem is that plants and root crops such as giant taro can only be harvested after about five years. Switching farming practices to consider planting vegetables that are ready to harvest within a few months, such as cabbage, cucumber, tomatoes and some alternate root crops, will reap benefits of food security and access to healthier, balanced diets for households.

The Kiribati International Waters Ridge to Reef (IWR2R) project focuses on testing innovative dried litter technology in piggery and compost toilets with the aim of reducing pollution and therefore, contamination of underground water lenses and surface waters. Compost from animal and human waste provides an opportunity to support subsistence farming and 'home gardening' of edible root crops and plants. Broadly, the ridge to reef concept and its principles provides for better integrated management of natural resources, thereby increasing community resilience and improved livelihoods. This includes support for policy reforms and action that ensures clean and sustainable water, land-use and marine resources.

1 Introduction

In Pacific Island countries (PICs) the ridge to reef (R2R) approach is about managing natural resources cross-sectorally, taking into consideration connectivity and linkages between land, water and coastal ecological systems. The R2R approach also provides for integrated management of natural resources from upstream freshwater watersheds and down to coastal/marine areas. The examples demonstrating the R2R integrated management systems cross-sectorally include planning and management of freshwater use, sustainable land use and forestry practices, balancing coastal livelihoods and biodiversity conservation, sanitation, wastewater treatment and pollution control, hazard risk reduction, and climate variability and change.

The initial diagnosis of the Kiribati IWR2R project is a key part of the early stage of implementing preliminary project activities. The overall goal of the diagnosis is to allow for a precise characterisation and mitigation of environmental priority issues and challenges. Relevant stakeholders were consulted and engaged with effective dialogue to identify the problems and root causes and explore possible actions and reforms. This opportunity provided candid discussion and led to the identification and prioritisation of issues that affect the environmental and socio-economic landscapes in small island developing states (SIDS) like Kiribati.

Generally, the R2R Island Diagnostic Analysis (IDA) is a collaborative stepwise process to identify, quantify and set priorities for environmental problems that are cross-sectoral (ridge-to-reef) in nature and is intended to help identify potential leverage points and options for reform and intervention. As required under the R2R Regional Programme, all activities of the IDA processes have a gender and social inclusion component. This ensures meaningful participation of men, women, youths and all sectors of community in all adaptation work undertaken, including consultations, research, training and workshops.

1.1 Kiribati IW R2R Project

The International Waters (IW) ridge-to-reef (R2R) project in Kiribati aims to test the mainstreaming of climate resilient approaches to integrated land, water, forest and coastal management in the PICs through strategic planning, capacity building and piloted local actions to sustain livelihoods and preserve ecosystem services.

Kiribati's IWR2R project focuses on strengthening local capacity in the area of waste management through effective community engagement, testing of sustainable dry-litter technology (DLT) for reduction of nutrient offload and contamination, and increased information management and community awareness in support of sustainable animal waste management. Community engagements include the participation of men, women, youths and all vulnerable members of communities.

The Kiribati IWR2R project demonstration site is South Tarawa, where a heavy population migration has led to increased pressures on drinking water as well as sustainable waste management. A larger desalination plant with the daily capacity of 6.0 MLD (Mega-litres per day) has been proposed and would be implemented as part of the on-going South Tarawa Water Supply Project to remedy the shortage of drinking water. The project would also include rehabilitation of water supply systems with new pipes and storage tank and extension to Buota and unserved area at Bonriki water reserve to enable an efficient and operational water supply system. The introduction of the compost toilets was not socially accepted, but it will be reintroduced at a much smaller scale with performance closely monitored to ensure that it works with home gardening before it is to be considered for large scale replication. Gender considerations, especially cultural restrictions on women using such toilets need to be reassessed to ensure introduced infrastructure is culturally and socially appropriate.

An overview of expected results of the Kiribati IWR2R project include the reduction of waste to always ensure the integrity of the groundwater lenses and the protection of coastal seawater from land-based contamination activities. One option to reduce waste is the introduction of dry litter technology at Bonriki and Buota to make sure the waste from existing pig pens is contained and does not percolate into the underground water and nearby coastal areas. The result would also assist residents to be able to live a decent life that relies on land and marine resources for sustainable livelihoods.

The success of activities to control contamination of groundwater lenses and coastal areas would be replicated in other parts of South Tarawa and then Kiribati as a whole and to low lying coral atoll islands in the region with similar geological settings.

The Kiribati IWR2R result framework comprised of the following components:

1. **Local capacity for sustainable on-site sanitation management stimulated through community engagement and training.** These community engagements were inclusive of women, youths and all members of communities. This component was partially implemented under the South Tarawa Sanitation Improvement Sector project whereby on-site sanitation toilets were installed in Betio town and the rest of South Tarawa. There were two different types of toilets, dry or wet toilet, but only wet toilets were installed and are still being monitored by the Ministry of Infrastructure and Sustainable Energy (MISE). Planned volunteer sanitation management networks were not established to monitor the performance, nor was training conducted for the construction. This could be done in another project after major works under the South Tarawa Water Supply project (STWSP) are completed or be implemented in parallel with STWSP.
2. **Demonstration of innovative technological approaches assist in managing relatively poor on-site sanitation practices.** For instance, low-cost sanitation such as pit latrine is inappropriate and waste leakage will contaminate the groundwater. A centralised sewerage system is a likely solution, but it is very expensive. Compost toilets offer a cost-effective solution, but these are not socially accepted.
3. **Information management and community awareness supports national Integrated Coastal Management efforts.** With the recent completion of the South Tarawa Sanitation Improvement Sector project in 2019, raw sewage is piped out from households and disposed at three sites beyond the reef with pipes extending down to depths of over 30 m below mean sea level – below the thermocline[1]. There is minimal risk of the sewage waste discharged below the thermocline resurfacing to shallow waters and impacting on biodiversity and reef systems. The treatment of sewage prior to discharge involves screening at the outfall pump stations to remove solids.

There are three major components of the Kiribati national STAR (System for Transparent Allocation of Resources) projects currently in operation in Butaritari and North Tarawa. Another island where the STAR project will be implemented is Tabiteuea North. The table below summarises the components and outcomes:

Table 1: Summary of the components and outcomes of the Kiribati National STAR project.

R2R Resilient Islands, Resilient Communities	
Improve biodiversity conservation and landscape management to enhance socio-environmental resilience to climate variability and change.	
Component 1: Strengthened national network of Protected Areas (PA)	
Outcome 1.1	National Protected Area system expanded to include priority KBAs (Key Biodiversity Areas)
Outcome 1.2	Strengthened capacity of PA managers and communities to sustain PA management
Component 2: Promote sustainable and integrated landscape management	
Outcome 2.1	Integrated landscape management plans implemented in selected urban areas and outer islands
Outcome 2.2	Improved management of priority mangrove areas as part of broader land and marine use plans
Component 3: Knowledge management, dissemination of best practices, and monitoring and evaluation	
Outcome 3.1	Lessons learned from project identified and shared with national and regional partners

1 Thin but distinct layer in a large body of fluid in which temperature changes more drastically with depth than it does in the layers above or below. In the ocean, the thermocline divides the upper mixed layer from the calm deep water below.

1.2 Scope of Baseline Assessment

The expected output of the baseline assessment is the establishment of changes that occur between the start and the middle or end-point of the project. For instance, monitoring the changes in the level of nitrate/nitrite in the Bonriki borehole water over a certain period. If the trend increases, then one must determine the source of pollution and find ways to remove it. For example, if pollution is caused by human habitation, then that activity has to be removed. In the case of a cemetery located in the Bonriki restricted water reserve, this needs addressing through legislation and imposing penalties for non-compliance.

The assessment can be limited by several factors. The islands of Kiribati are spread over 3.5 million km^2 of ocean, which is equivalent to approximately the size of "mainland" United States. While data could be transmitted online, Kiribati is still experiencing several issues such as links to the satellites and island coverage. Another limit of the assessment is the absence of previous collected data which is often kept in written form only and thus can be lost during storage. There is also the issue of confidentiality of data and therefore accessibility to such information is restricted.

2 Methodology

2.1 Description of Study Sites

The Republic of Kiribati comprises of three groups of islands namely, the Gilbert group in the west, Phoenix Group in the middle and the Lines Group in the east. Kiribati is located in the Central Pacific and Western Pacific between 4° North and 3° South and 172° East and 157° West (Figure 1). The nation consists of 32 low-lying coral islands and one raised coral island. Eleven of the 32 islands are currently unoccupied. Most islands are usually not more than two km wide and, except for the raised island of Banaba, are about 2 m – 3 m above mean sea level. Banaba a former phosphate island, rises to 81 m above mean sea level.

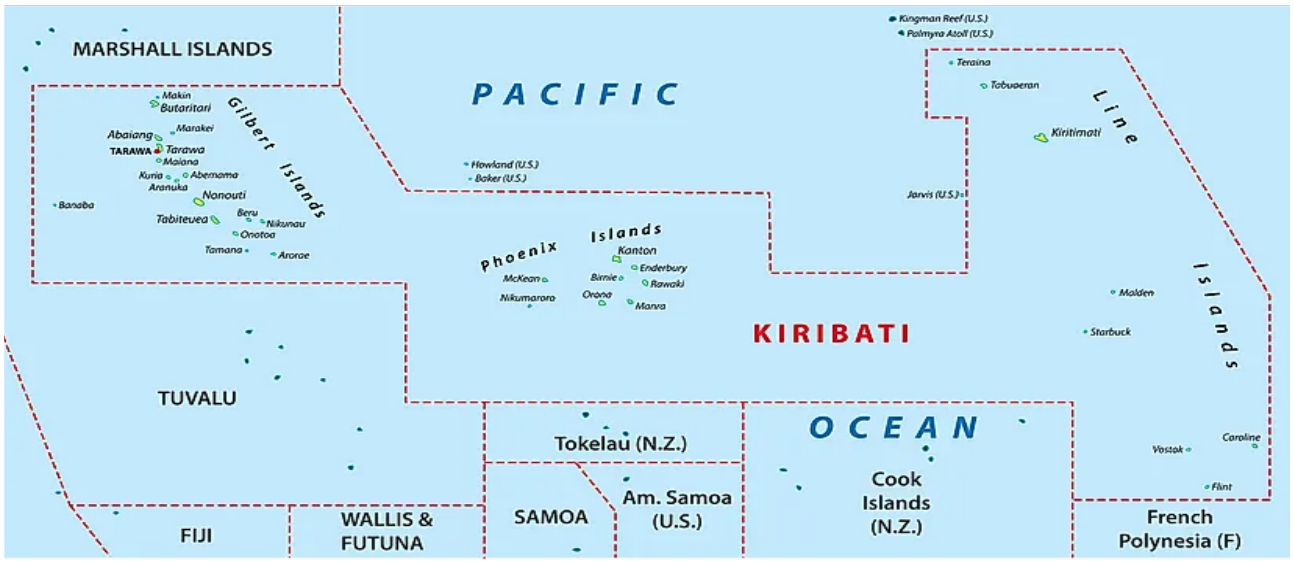

Figure 1: Map of Kiribati (https://www.worldatlas.com/maps/kiribati)

The total land area of Kiribati is 811 km^2. The Gilbert group has a land area of 286 km^2 and contains 90.6% of the country's population of 119,940, according to the preliminary 2020 census results (National Statistics Office 2020). The capital of Kiribati is South Tarawa, in the Gilbert group, and is highly populated with 52.9% of the nation's total population. The 2020 census showed the national population has more females (60,786) than males (59,154). The previous (2015) census showed that more people live in urban settings than in rural areas, with females outnumbering males in the urban areas.

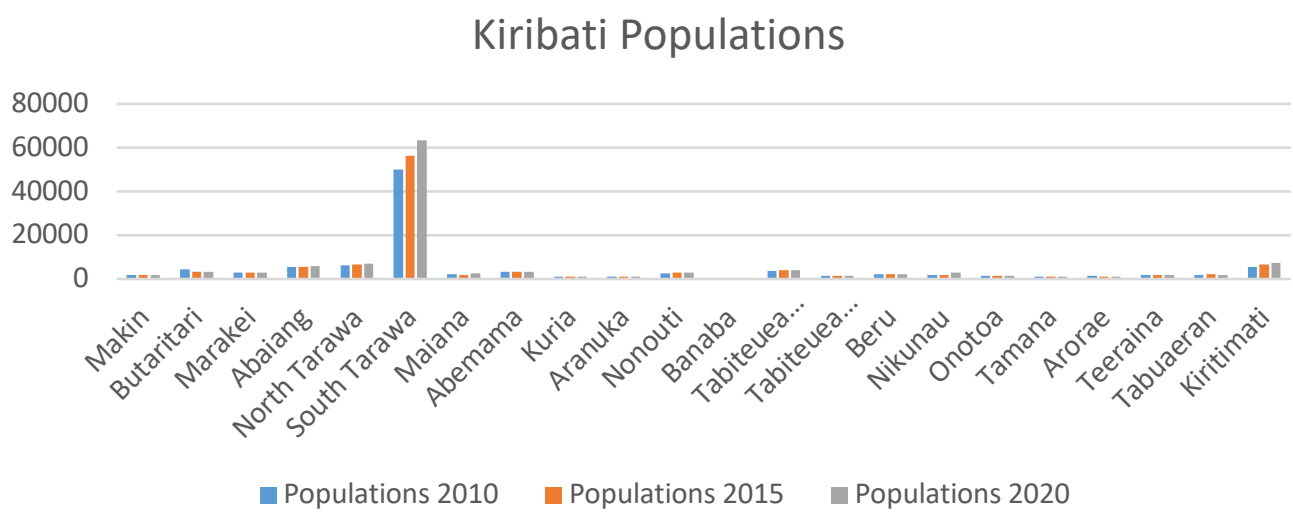

Figure 2: Inhabited Islands of Kiribati

Table 2: Population in the islands of Kiribati, distance from Tarawa and average annual rainfall.

Island	Population 2020	No. of Villages	Households	Distance from Tarawa (km)	Average Annual Rainfall (mm)
Makin	1914	2	374	190	2821
Butaritari	3241	11	624	173	3107
Marakei	2738	8	576	82	2053
Abaiang	5872	18	1110	51	2153
North Tarawa	7041	15	1328	0	2001
South Tarawa	63439	16	6923	0	2001
Maiana	2405	12	471	45	1543
Abemama	3257	14	690	152	1518
Aranuka	1223	3	267	140	1518
Kuria	1191	5	252	134	1518
Nonouti	2792	9	635	266	1507
Banaba	330	3	84	450	1847
Tabiteuea North	4120	13	758	294	1418
Tabiteuea South	1357	6	279	294	1418
Onotoa	1423	5	338	451	1230
Beru	2220	10	546	403	1355
Nikunau	2061	6	439	496	1242
Tamana	1054	3	197	544	1425
Arorae	983	2	208	620	1826
Kiritimati	7380	4	1253	3200	974
Tabuaeran	1992		398	3000	2107
Teraina	1907		536	2900	3021

2.2 Data Collection

2.2.1 Literature review

The collection of baseline data is the process of gathering and measuring information in an established systematic manner that enable one to answer research questions and evaluate outcomes. The collection of data is integral to completing a project. Data collection is a demanding job, which needs proper planning, hard work, and patience to be able to complete the task successfully (Syed Muhammad Saijad Kabir 2016)[2]. In the case of Kiribati, the collection of data from all islands of Kiribati is quite challenging given the vast distance between islands. In this case one has had to depend on data that has been collected from previous visits to the islands and questions raised during the sitting parliament, as preliminary collected data.

2.2.2 Marine habitat assessment

There is overpopulation and uncontrolled urban drift experienced in Kiribati, especially within the capital of Tarawa. Consequently, the demand to consume natural resources has increased, and some resources are overexploited. This includes the overexploitation of fisheries resources (e.g., seaweeds, finfish, bêche-de-mer, crabs and lobsters, shellfish, corals and other marine invertebrates) whose use was formerly restricted for local subsistence consumption but is now rapidly expanding to commercial production for local and export markets. Overexploitation is often associated with the use of more efficient and modern fishing technologies (i.e., better motorised boats, improved spear guns and line fishing methods, improved refrigeration and distribution, more efficient nets, and night spear fishing using SCUBA or hookah).

2 Methods of data collection Curtin University

2.2.3 Terrestrial habitat assessment

Kiribati is plagued with limited land area and terrestrial resources. However, the resources provided by its limited land and terrestrial biodiversity are also central to the Kiribati way of life. The coconut, swamp taro, breadfruit, etc. are the main food crops, but are now not popular compared with imported rice, which is becoming a staple carbohydrate in the diet. Despite the poor soil fertility, Kiribati people are using organic farming techniques to grow cabbages, cucumbers, sweet pepper and other green leafy vegetables for both subsistence and commercial activities.

2.2.4 Water quality assessment

There are two types of water sources in Kiribati – rainwater and groundwater. There is no surface water except for a few freshwater ponds existing on some islands, but these are not good for drinking. The ponds tend to go salty after long periods of drought. However, on the island of Banaba there is no groundwater and there is heavy reliance on rainwater to meet water related needs, which is only possible during periods of heavy rain. The occurrence of long drought in Kiribati is quite common, meaning that Banaba needs to use an alternative water source. There is a desalination plant installed on the island but is not always fully functional due to technical difficulties such as the low availability of spare parts. The water quality in Kiribati is quite saline with maximum allowable for drinking of 1500 micro-siemens/cm. This value is approximately equal to 500 ppm of chloride.

On some islands, the groundwater can be too high with EC[3] of over 3000 microsiemens/cm or even up to 5000 microsiemens/cm. However, people are used to drinking water with high EC values although it can be dangerous to small children. Nonetheless, there are islands with high saline water where children are very healthy, including the islet of Abamakoro on the island of Nonouti.

2.3 Diagnostic Analysis Methodology

The Island Diagnostic Analysis (IDA) for the Ridge to Reef Programme is derived from the Global International Waters Assessment (GIWA), GEF Transboundary Diagnostic Analysis (TDA), and Pacific IWRM Diagnostic Analysis methodologies. Due to the broader ecosystem context of the Ridge to Reef Programme which includes water management, terrestrial and marine ecosystems the methodologies have been adapted according to these changes. There are clear steps in the conduct of the diagnostic analysis which are clearly articulated in the R2R Regional Guidelines[4]. Aspects of these important steps are also captured below.

2.3.1 Identifying and prioritising environmental problems

i. With the aid of a facilitator and the predefined list of common environmental problems (Annex 1), the IDA Development Team was encouraged to brainstorm a complete list of the environmental problems in country.

ii. Once the list was refined, the participants focused on the 'real' environmental problems (as opposed to things categorised as governance causes or impacts).

iii. Finally, the participants prioritised the problems based on the criteria provided in Annex 1 using printed score sheets. Each team member was requested to score the environmental problems individually.

2.3.2 Island Environmental Problem Prioritisation Criteria

Based on the set of defined criteria, a score was assigned to each transboundary problem to determine the relevance of the problem. 0 (no importance), 1 (low importance), 2 (moderate importance) and 3 (high importance).

3 EC – Electrical Conductivity of water. Freshwater EC is around 1500 microsiemens/cm – Kiribati standard.

4 https://www.pacific-r2r.org/sites/default/files/2020-08/GEF-R2R%20-%20Developing%20an%20Island%20Diagnostic%20Analysis%20-%20final.pdf

https://www.pacific-r2r.org/sites/default/files/2021-07/Pacific_Ridge_To_Reef_Island_Diagnostic_Analysis_Gender_Guide_20210714.pdf

2.3.3 Determining environmental and socioeconomic impacts

i. IDA Development Team members worked in small groups that had been determined by the facilitator ahead of time. The groups were gender and socially inclusive, making sure there were women, youths and vulnerable represented.

One of the priority cross-sectoral problems was taken and the following were identified: • The environmental impacts • The direct and indirect socioeconomic impacts • Linkages between impacts and other island environmental problems • Geographical location(s) of impacts/consequences.

2.3.4 Developing causal chains

i. IDA Development Team members worked in facilitated groups to discuss a selected island environmental problem. Effort was made to have mixed discipline groups ensuring that a range of expertise areas was represented. This included natural scientists, social, legal, political, and economic experts.

ii. The priority problems were reviewed, and their associated environmental and socioeconomic impacts identified.

iii. For each problem, the following were identified and listed:

- The key sectors (e.g., industry, agriculture, fisheries, etc)
- The immediate causes
- The underlying resource uses and practices that contribute to each immediate cause
- The underlying social, economic, legal, and political causes of each immediate cause
- Link the resource uses and practices, and social, economic, legal, and political causes
- Determine the root causes. The groups also needed to make linkages, which was done on butcher paper. The causal chain was developed, and each group presented their results and discussion points.

2.3.5 Report back and discussion

In plenary, each group was asked for feedback. Critical discussions were then encouraged within the group; these comments and important points were captured by a rapporteur.

3 Demographic and Socio-Economic Considerations

3.1 Socio-economy

According to the 2020 census, the population of Kiribati comprised of I-Kiribati (114,316), i-Kiribati/Mixed (4491) and other ethnicities (631) (Government of Kiribati Ministry of Finance National Statistics Office 2020). Over the period of 10 years from year 2010 to 2020 the population increased from 103,058 to 119,940. This depicts an annual population growth rate of 2.0%.

The Kiribati economy, once centred on the mining of phosphates, now relies on foreign assistance, emigrants' remittances, fisheries, export of coconut products, and tourism. The current GDP (Gross Domestic Product) is expected to reach USD0.22 billion by the end of 2021, according to the Trading Economics global macro models and analysis expectations (Trading Economics 2021). The Republic of Kiribati also has a reserve fund of approximately AUD1.3 billion, which continues to provide significant budget support. In addition, the Kiribati government increased the buying price of copra from AUD1.00 per kg to AUD2.00 per kg, which has resulted in increase of revenue to the outer islands (AusAID 2012; World Bank 2013).

3.2 Employment

According to the 2015 population census, 16,360 people are employed, principally by Government. There are also 9292 people who are self-employed and 325 are employers. There are 4470 people who are reliant on subsistence means of living and 3855 who were not employed (Government of Kiribati Ministry of Finance National Statistics Office 2020).

3.3 Social development (including gender assessment summary)

According to the 2020 population census, the population of Kiribati comprised of 59,154 males and 60,786 females living in 20,731 households. Kiribati women play significant roles in the country's economic and development processes. According to Volume 2 of the 2015 Census Report, women represented 59.6% of the rate of labour force participation and unpaid work, caring for children, elders and household chores (Kiribati National Statistics Office and the SPC Statistics for Development Programme 2013).

The government recognises the importance of women's economic empowerment as a key pillar for building strong, resilient families. The diversification of livelihood activities and sources of income is a key strategy to enhancing resilience to the negative impacts of climate change (UNFCCC 2019). An unemployment benefit of AUD50 per month per person for people from age 18 years to 59 years is now available and those aged 60 years old and above now receive a monthly payment of AUD200.00 per month.

3.4 Health and hygiene

Following the cholera outbreak in 1977 to 1978, which resulted in 494 recorded infections (ADB 2011), people generally have now developed the habit of boiling water before consumption. However, the high incidence of diarrhoea and dysentery suggest that there is still a significant number that do not follow this practice, which results in the unsafe consumption of contaminated water.

Comprehensive WASH (Water, Sanitation and Hygiene) programmes for schools and communities also exist and go hand-in-hand with major water supply and sanitation projects in the past 40 years. These projects are externally funded by the Asian Development Bank, UNDP, UNICEF, European Union and other international donors.

The Kiribati International Waters Ridge to Reef (IWR2R) Project Bonriki & Buota Water Quality Monitoring Plan[5] has been implemented. Initial baseline data[6] and continued sampling and monitoring thereafter[7] shows promising results for future continuous monitoring beyond the life of the project. These plans include:

- Kiribati Water Quality Committee administered and revived by MISE to oversee all water quality activities, including water quality monitoring.
- Regular maintenance of Bonriki and Buota water reserves.
- Development of a bacteriological monitoring programme under the authority of MHMS.
- Sampling protocol to be reviewed by National Water Quality Monitoring Committee administered by MISE to ensure continuation of sampling at the same location to measure trends over time.
- Cabinet paper includes results of water quality monitoring and seeking of additional funding support for the provision of water quality testing equipment and kits.

3.5 Cultural Heritage

Ethnographic and ethnoarchaeological research was conducted in the mid-1990s with supplemental data from historical ecological collections and archaeological excavations undertaken by Thomas on atolls in the Gilbert Islands (2001, 2007a, 2007b, 2009). Radiocarbon dating on wood charcoal from swamp taro pit mounds in North Tarawa showed evidence of human activity approximately at around 1800 BP. Migrations and interactions between Polynesian islands such as Samoa have suggested ancient links of migration between the two countries. There is also the belief that the Samoans introduced the concept of the maneaba to the Kiribati people influencing development of specific sociocultural norms (MacDonald 2001, Petersen 2009, Fischer 2013).

The present governance in the Republic of Kiribati has aspects of contemporary and traditional systems controlled by elders in the Maneaba, which play a key role in social cohesion and community resilience especially in the southern outer islands. Chiefly families previously controlled the central and northern outer islands, through a traditional system. With the establishment of the island councils and village community groups, this system has now changed.

There exist in Kiribati distinct cultural norms and beliefs which influence women's roles, their allocated use of time when compared to men their involvement in development projects, thus the strategic inclusion of gender into R2R projects will ensure that consultations conducted address barriers and challenges to the free and open participation of women and other vulnerable groups. Based on traditional patterns, I-Kiribati women have had limited roles in community decision-making fora, such as those traditionally held in community meeting houses – the maneaba.

The traditional background of Kiribati, particularly regarding village-based fishing regulations is extensively documented by Johannes and Yeeting (2000). Key points include:

- Each island has its own rules about when, how, where to fish and what should be done before, during and after each fishing expedition.
- Seafood taboos also existed which related to sex, age, totem or for whole communities.
- Traditional taboo on fishing certain species may not necessarily be stated to be due to conservation efforts e.g., taboo on eating turtles to avoid inheriting their cowardly mannerisms during times of war. However, this is still uncertain as, perhaps, these reasons for the taboo may still have arisen due to the leaders' recognition of the need to conserve these species.
- Introduction of more efficient fishing gear in the 1950s was banned on several islands to adjust to new management regulations in sustainable harvesting.
- Shallow water invertebrates and algae are purposely reserved for consumption during times of fish unavailability and also as a form of "social security" for older people and others in the community who are not able to fish.

5 https://www.pacific-r2r.org/sites/default/files/2021-10/Kiribati_Water%20Quality%20Sampling%20Monitoring%20Report.pdf

6 https://www.pacific-r2r.org/sites/default/files/2020-06/Kiribati_Water_Quality_Training_Report.pdf

7 https://www.pacific-r2r.org/sites/default/files/2021-10/Kiribati_Water%20Quality%20Sampling%20Monitoring%20Report.pdf

According to Smith et al. (2021), relatively recent history of archaeological research in Kiribati is focused on cultural history where establishment of settlement chronologies are becoming recent research objectives. Sites of significance such as World War II relics on Betio have not had any archaeological research published to date.

There is growing recognition that historical buildings and cultural monuments should ideally have resources allocated to fund continuous management of these significant sites as a promising tourism industry. Further research in identifying and documenting these cultural sites upholds the values and agendas of the draft Kiribati 20-year Vision 2016 – 2036 (KV20 2016) as well as the mention of 'Culture' as the fourth pillar of sustainable development within the United Nation's Sustainable Development Goals (Ikhlef 2014).

3.6 Geology and geomorphology

The geomorphology across the South Pacific Islands shares common attributes such as remoteness, relatively younger aged geology, small in size, and soil patterns. However, there is much variation within the region which are seen as three major island types. These are volcanic islands, high limestone islands and atoll islands. Volcanic islands tend to be generally high, have broad coastal plains and river mouths, and are well vegetated. High limestone islands have dense vegetation (often locally) with little lowland close to the shore and are commonly cliffed. Atoll islands usually rise no more than 3 m above mean sea level and are mainly from unconsolidated materials accumulated on reef flats.

The Kiribati islands are mostly atoll islands composed mostly of skeletal carbonate material and the islands exist in the tropical zone where environmental conditions of temperature, water clarity and organic productivity are conducive to coral growth. The islands are elongated in a north-west orientation due to the submarine volcanic ridge that forms the base of the islands. Sands mostly make up the bulk of the islet and lagoon reef flat deposits, whereas gravels dominate the seaward reef flats and make up a significant percentage of some islets. Sediments tend to vary primarily with depth and proximity to reefs. It is important to note that Foraminifera are ubiquitous, and some beach deposits are almost entirely made up of Foraminifera.

Kiribati is situated on the large Pacific plate that underlies two thirds of the Pacific Ocean. During the Cretaceous period, hotspots under the Pacific plate developed into volcanoes that rose up from the sea floor. As the plate moved on to the north-east, the crust became colder and denser and the volcanoes started to subside (Neall and Trewick 2008). In the tropical waters the growth of coral formed a fringing reef and as the volcano continued to subside an atoll was formed (Watkins and Batoromaio 2004).

The soils of the low coral islands consist of unconsolidated Holocene coral sands and gravels overlying Pleistocene karst limestone. The hydraulic conductivity of the surface sediments is much higher than rainfall rates so that surface ponding occurs rarely (Wheatcraft and Buddemeier 1981) and surrounds relatively impermeable surfaces such as roadways and runways. This means that there are no perennial surface streams in Kiribati. The large hydraulic conductivity also means that surface contaminants are quickly transported into shallow groundwater and that the soils are generally infertile. The islands are also mainly covered with coconut and pandanus palms.

For the long-term water security and sustained health of communities that rely on groundwater, it is important to understand how anthropogenic activities may affect the surrounding environment of the freshwater lenses. Monitoring and data collection in these sites of significance is crucial for sustainable use of these resources.

3.7 Hydrology

Due to the low elevation and the porous nature of coral bedrock, there are no surface streams on atoll islands. Rainfall seeps through the soil surface creating the Ghyben-Herzberg lens (Bandon Ghijben 1889, Herzberg 1901).

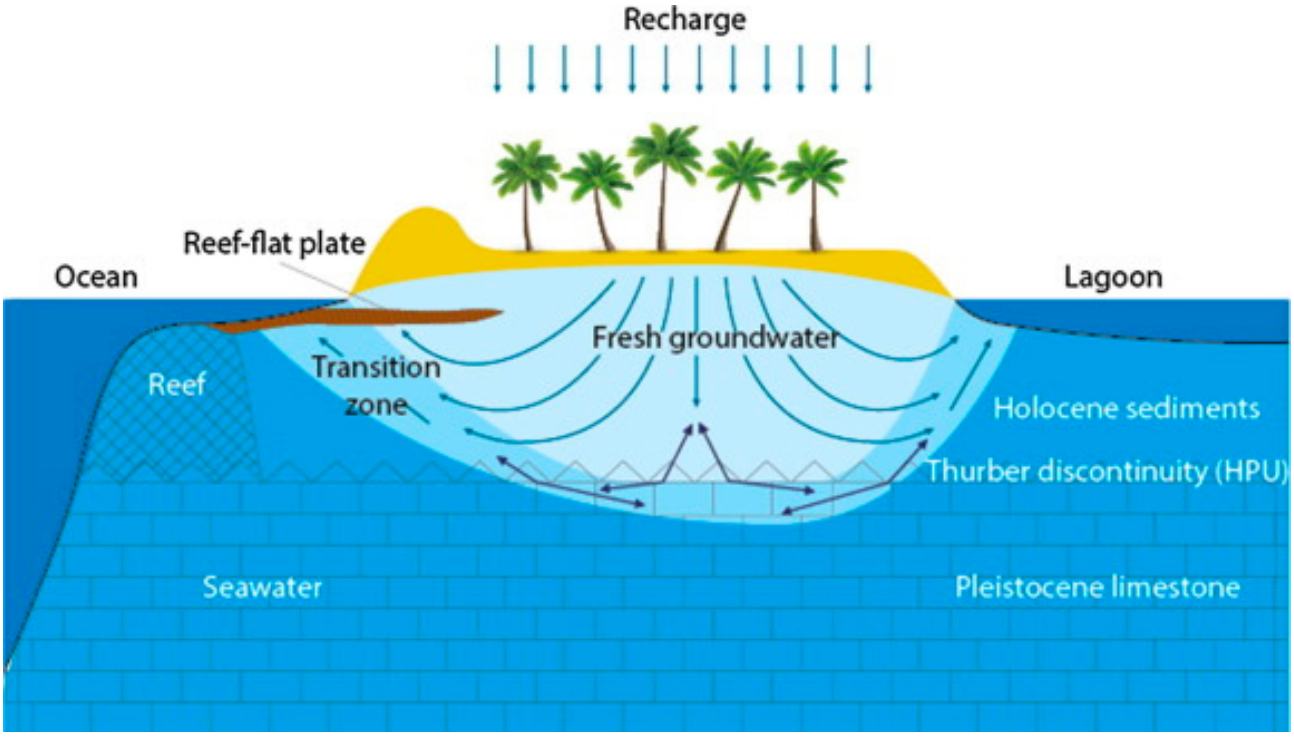

Figure 3: Freshwater lenses on atoll islands

Source: sciencedirect.com Freshwater lenses on atoll islands

On coral atoll islands, fresh groundwater occurs as a buoyant lens-shaped body surrounded by saltwater derived from the sea, forming the main freshwater source for island communities. The rainfall recharges the freshwater lens, which loses water through evapotranspiration by plants such as coconut trees, from extraction through pumping and through discharge to the lagoon or sea by gravity. (White et al. 2006).

When extracting water from the lens, the pumping rate should not exceed the sustainable yield to avoid saltwater intrusion, which can damage the lens that can only recover with heavy rain in the long-term.

3.8 Coastal Processes

The general findings of a survey conducted in 1993 (Gillie 1993) found that the cause of coastal erosion fall into two main categories: natural and anthropogenic causes. Natural causes include locations with a high variability of shoreline position such as depositional split complexes at the southern end of atolls, along lagoon shorelines and where the shoreline forms the inter-islet channels. Coastal erosion takes effect in years with higher-than-average sea level and westerly winds.

The anthropogenic causes include the deleterious effects of causeway construction across inter-islet channels which have cut off the supply of sand from the ocean reef to the lagoon, plus other built structures such as harbour and associated mole construction, dredging of the lagoon sediments and creation of borrow pits near to shores and land reclamation (Kiribati National Statistics Office and the SPC Statistics for Development Programme 2013).

- **Tides and circulation**

  The tides are semi-diurnal with a significant inequality between successive highs. The spring tides can reach up to 2.4 metres and the neap tides have an average of 0.5 metres.

- **Sea level**

  Satellite data indicate the sea level has risen across Kiribati by **1 mm – 4 mm per year since 1993**, compared to the global average of 2.8 mm – 3.6 mm per year. Sea level rise naturally fluctuates from year to year and decade to decade as a result of phenomena such as the El Niño-Southern Oscillation (Australian Government 2015).

- **Sediment transport**

  Comparison of the map of South Tarawa shoreline in 1992 with shoreline images from 1943 and 1967, shows land mass accretion on Betio East, due to frequent coastal erosion. This means that Betio land mass was moving from the Betio west to Betio east, creating huge land mass, but without increasing the elevation (Gillie 1993).

- **Coastline changes**

  Coastline changes are occurring in all islands in Kiribati as indicated in by Gillie (1993). This has resulted in the loss of residential houses, roads and trees along the coast.

- **Water quality**

  The island nation of Kiribati is one of the smallest, geographically dispersed, most remote countries in the world that is vulnerable to the effects of climate change. Due to population growth and development, the future impacts of climate change will continue to be exacerbated. Fresh groundwater reserves are rationed, with residents having access to the PUB potable water for two hours every second day. Insufficient potable water leads to water-borne diseases, unacceptable high rates of preventable deaths due to illnesses, large wastage of treated freshwater from the reticulation system (especially the domestic supply system), and a range of institutional and management issues (Ministry of Infrastructure and Sustainable Energy 2019).

3.9 Marine Ecology

Kiribati has one of the largest exclusive economic zones in the world with globally important tuna stocks. Many of the uninhabited atolls in the Line and Phoenix Island group boast excellent examples of healthy coral reefs without anthropogenic stresses, and are home to globally significant populations of seabirds. Recent deep-sea research suggests high biodiversity in benthic habitats below 200 ft. (60.9 m), with many species new to science. The limited flora of Kiribati is ecologically critical to wildlife on the atolls, as well as for the culture and survival of the i-Kiribati people. Although there are few published scientific studies, a review of technical reports suggests localised pollution, destructive fishing practices, overfishing, and unplanned coastal infrastructure have all contributed to the decline of coastal resources. Regionally, Kiribati has made significant commitments toward the protection of marine resources in the Pacific Ocean, the largest of which is the declaration of the 405,755 km^2 Phoenix Island Protected Area and World Heritage Area.

Atolls have more ecological diversity than other reef types due to the many types of habitats present. Atolls also lack the large-scale run off of nutrients that is characteristic of high islands with substantial vegetation and agriculture (Lovell et al. 2003). Compared to barrier reef systems, atolls tend to have lower species diversity during episodes of reduction of sea level where the reef flat and lagoon habitat can disappear, confining coral growth to the seaward fringes (Maragos and Holthus 1999).

Intertidal habitats are home to a variety of species such as clams (*Tridacna squamosa, Tridacna maxima, Hippopus hippopus, Tridacna gigas, Trochus niloticus),* gastropods *(Trochus niloticus, Tectus pyramis, Strombus luhuanus),* non-edible urchins *(Heterocentrotus mammillatus, Tripneustes gratilla),* and other bivalves *(Anadara holoserica, Gafrarium spp.). Pinctada margaritifera* has been considered commercially extinct in places like Abaiang and Kuria and generally sea cucumber stocks are limited.

Offshore habitats in Kiribati are home to finfishes. The ecological makeup depends on the types of coral reefs in the surrounding areas. Carnivorous fish such as Lutjanidae (*Lutjanus fulvus, L. gibbus, L. ehrenbergii*), and herbivorous fish such as Balistidae, Scaridae, Kyphosidae and Siganidae are found in all types of reefs.

The fisheries sector in Kiribati is divided into coastal fisheries and offshore fisheries. According to Gillett (2016), fish caught for subsistence purposes in 2014 was estimated at 11,400 mega tonnes (mt) valued at USD17.8 million and coastal commercial fish was estimated at 7600 mt at a value of USD16.9 million. Additionally, the export of aquarium fish in 2010 involved 11 companies exporting approximately 150,000 aquarium fish valued at over USD1.5 million.

3.10 Terrestrial Ecology

Terrestrial biodiversity in Kiribati is not particularly rich or endemic and what exists is threatened by human development and expansion activities across a limited land area. Its indigenous land-based flora and fauna are limited and among the poorest on earth. Much of this has to do with its soil quality as it is composed mainly of alkaline coral with high porosity. As reported in the Kiribati 5th National Report to the Convention on Biological Diversity, there is a decline in number of some traditional staple food crop species (GOK 2014).

The declining traditional staple food crop include the Pandanus (*Pandanus tectorius*), breadfruit (*Artocarpus mariennesis, A. altilis, A. mariennesis*), giant swamp taro (*Cyrtosperma merkusii*), native fig (Ficus tinctoria) and coconut (*Cocos nucifera*). Other important plants were observed to have declined and these are te kiaiai (beach hibiscus), te ukin (beach almond), te uri (*Guettarda*), te ren (tree and beach heliotrope) and te mao (Kiribati National Biodiversity Strategic and Action Plan 2016 – 2020).

According to Thaman (1992), estimated vegetation cover for the island groups is 75% for Gilbert Islands, 56% for the Phoenix Islands and 33% for the Line Islands. Four species of mangroves were recorded and were documented to be limited to the Gilbert Islands covering 258 ha in 1995 (Metz 1995).

A significant number of atolls in Kiribati are home to many species of nesting seabirds. Atolls that have previously been recorded as nesting colonies for seabirds include atolls in the Line Group (Kiritimati, Malden, Starbuck and Caroline islands), the Gilbert group (Buritari and Nonouti atolls) and the Phoenix Group (Enderbury, Rawaki, Birnie, McKean and Hull islands). Up to 23 species of nesting birds had been recorded in large numbers in the 1980s (Garnett 1983; Perry 1980). The Pacific reef egret (*Egretta sacra*) is found on all three island groups and birds are seen to mate at Caroline Atoll. Migratory shore birds such as the Pacific golden plover (*Pluvialis fulva*), wandering tattler (*Heteroscelus incanus*), bristle-thighed curlew (*Numenius tahitiensis*), sanderling (*Calidris alba*) and ruddy turnstone (*Arenaria interpres*) were found in all three island groups, making passage during the winter (Watkins and Batoromaio 2014). Many of these islands in Kiribati are also important nesting grounds for green turtles (*Chelonia mydas*).

Maintaining the ecological character is important in conserving the unique biodiversity of flora and fauna in Kiribati. One of the main issues of concern include the pollution of waters from urbanisation and increasing human population density. Proper waste management strategies would help reduce negative impacts on the environment and biodiversity.

3.11 Water and Wastewater Management

The water and wastewater management falls under the jurisdiction of the Ministry of Infrastructure and Sustainable Energy. The PUB under the MISE looks after the water and wastewater management on South Tarawa only. The Water and Sanitation Engineering unit of MISE looks after water supply and sanitation in the outer islands. The Ministry of Line and Phoenix Island Development looks after water and wastewater management on Kiritimati Island and the two outer islands – Tabuaeran and Teraina.

There is no official data on access to water and sanitation services in the country, but on South Tarawa, the number of people with access to water supply is just over 70%, while access to the saltwater flush sewerage system is only restricted to people living on Betio, Bairiki and Bikenibeu. There is an outfall pump station for these three areas and the sewage only receives screening treatment to remove solids before it is discharged into the ocean at 30 m below mean sea level. However, most people on South Tarawa who live in semi-urban areas do have access to water supply and some sort of toilet facility ranging from septic tanks to simple pit latrines.

Almost all households on South Tarawa have access to water supply house connections and water is supplied one or two hours every other day.

Water quality monitoring for *E. coli* and faecal coliform is the responsibility of the Ministry of Health and Medical Services. Monitoring is conducted on a monthly basis on the PUB water and at a few private wells on South Tarawa. The Kiribati IWR2R project also has a Bonriki & Buota Water Quality Monitoring Plan[8] with a first baseline study and collection of data[9] as well as a continued follow up data[10].

8 https://www.pacific-r2r.org/sites/default/files/2020-08/IWR2R_Water_Quality_Monitoring_Plan_Kiribati.pdf

9 https://www.pacific-r2r.org/sites/default/files/2020-06/Kiribati_Water_Quality_Training_Report.pdf

10 https://www.pacific-r2r.org/sites/default/files/2021-10/Kiribati_Water%20Quality%20Sampling%20Monitoring%20Report.pdf

3.12 Natural Vulnerabilities

The main risks for low-lying atoll nations such as Kiribati are assessed to be those arising from sea-level rise, coastal erosion and inundation, droughts, saline intrusion, and ecosystem degradation (World Bank n.d.).

Disaster records. In recent times storm surges, coastal erosion, droughts, and pandemics have been perceived as having the greatest impact on the country. In the last 50 years of global records the only disasters listed for Kiribati have been the coastal impacts of Cyclone Bebe in 1972, the 1977 cholera outbreak, and the drought from May 1998 to March 1999. These three reported major disasters do not reflect the perception within Kiribati, where frequent disasters are having a more regular impact on individual islands and communities, and which present a picture of a much more disaster-prone nation[11].

Natural threats include extended droughts (Scott et al. 2003). Low-lying islands are vulnerable to partial or complete overwash from storm waves or storm surge, particularly associated with major tropical cyclones (Terry 2007, Spennemann 2006). There are major concerns of frequency of enhanced cyclone activity, rising mean sea levels, increased frequency of drought and increased risk of island overtopping (Ali et al. 2001). Droughts in particular are closely associated with El Nino and La Nina episodes in the Pacific (White et al. 1999; Scott et al. 2003) where Kiribati is impacted by droughts during episodes of La Nina events (White et al. 2007). Drought events cause the fresh groundwater lens to contract. Seawater inundation due to storm surges and overtopping of low islands from storm waves also salinises fresh groundwater on low-lying islands (Richards 1991, Oberdorfer and Buddemeier 1984). Droughts and overwash of seawater are temporary but permanent changes occur with rising sea level. Erosion of the edges of an island, which reduce the island area, also decreases the volumes of the freshwater lenses.

Due to increase in population whether through natural growth or migration to urban centres, threats to freshwater lenses involve the over-abstraction of groundwater and also pollution from animal, human and industrial wastes.

The increase in ocean temperature leads to coral bleaching, which leaves the coral physiologically compromised (Wild et al. 2011). There is also the possibility of increased mortality rates, weakening of carbonate structure, increased susceptibility to disease, and compromised reproductivity of corals (Spalding and Brown 2005). The abovementioned effects cause reduced coral reef rugosity, thus also reduces the ability of reefs to dissipate waves which leads to lower coastal defences (Eliff and Silva 2017).

Reefs affected by climate change would also affect the fisheries and agriculture sectors and the natural biodiversity in Kiribati. More extreme droughts would put higher pressure on people to conserve water and use alternative sources of water. Earthquakes and tsunami are not of a high threat and are not expected to cause any significant damage. A tsunami caused by an earthquake was last seen in 1899 and caused moderate losses (PCRAFI 2011).

Efforts to develop disaster risk resilience in Kiribati have been extensive. The multi-sectoral goals and linkages to policies and international goals and frameworks are listed in Table 3.

Table 3: Policy frameworks related to natural resource management in the Republic of Kiribati

Sectoral Aim	Policies with Linkages to Sendai Framework for Disaster Risk Reduction	Policies with Linkages to Sustainable Development Goals	Policies with Linkages to the Paris Climate Agreement for Environment
National Development	Kiribati Development Plan 2016-2019	Kiribati Development Plan 2016-2019	Kiribati Development Plan 2016-2019
	Kiribati 20-Year Vision 2016-2036	Kiribati 20-Year Vision 2016-2036	
	Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management (2014-2023)		
Environmental Protection	Kiribati Integrated Environment Policy (2013)	Kiribati Development Plan 2016-2019	Kiribati Development Plan 2016-2019
Disaster and Climate Risk Reduction	National Adaptation Program of Action (2007)	National Adaptation Program of Action (2007)	National Adaptation Program of Action (2007)
	Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management (2014-2023)	Kiribati Climate Change Policy	Kiribati Climate Change Policy
Vulnerability Reduction	National Disaster Risk Management Plan (2012)	National Adaptation Program of Action (2007)	National Adaptation Program of Action (2007)
		Kiribati National Disability Policy and Action Plan (2018-2021)	
		Kiribati Approach to Eliminating Sexual and Gender Based Violence in Kiribati. Policy and National Action Plan (2011-2021)	Kiribati Climate Change Policy
Land Use Policy	Kiribati Development Plan 2016-2019	National Adaptation Program of Action (2007)	Kiribati Integrated Environment Policy (2013)
	National Adaptation Program of Action (2007)	Kiribati 20-Year Vision 2016-2036	

11 Ibid

4 Demographic and Socio-Economic Considerations

4.1 Regional Multilateral Environmental Agreements

Multilateral Environmental Agreement (MEA) is a generic term for protocols, conventions and treaties and other binding instruments related to the environment and is usually applied or referred to as instruments of a geographic scope wider than that of a bilateral agreement (Secretariat of the Pacific Regional Environment Programme 2021).

During the 1992 United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro, Brazil, five key documents on sustainable development were produced. Two of these were "hard law" – the Convention on Biological Diversity[12] and the Framework Convention on Climate Change[13] – and three were "soft law" – the Rio Declaration[14], Agenda 21[15, 16], and Forest Principles[17].

The African Caribbean and Pacific Group of States (ACP), European Commission (EC), Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP) and the Secretariat of the Pacific Regional Environment Programme (SPREP) have a joint partnership known as the ACP MEAs Programme. This programme aims to build capacity to support ACP States to meet obligations as Parties to MEAs and thus, to tackle environmental issues that they face, such as management of chemicals and waste (seen in agriculture), MEAs relating to biodiversity, strengthening of implementation of the Regional Seas Convention in the ACP States, and reinforce compliance and enforcement of measures. Phase 1 and Phase 2 has been completed and currently the Programme is in Phase 3 (2020 – 2024) (also known as ACP MEAs 3 Programme).

Table 4: Multilateral Environmental Agreements under the ACP MEAs 3 Programme signed by Kiribati

Multilateral Environmental Agreement	Website
Convention on Biological Diversity (CBD)	https://www.cbd.int/
Basel Convention on the control of transboundary movements of hazardous wastes and their disposal	https://www.brsmeas.org/
Stockholm Convention	https://www.brsmeas.org/
Minamata Convention	https://www.mercuryconvention.org/
Convention to ban the importation into Forum Island Countries of hazardous wastes within the South Pacific Region (Waigani Convention)	https://www.sprep.org/convention-secretariat/waigani-convention

The MEAs on biodiversity, and waste and chemicals link directly to the Sustainable Development Goals (SDGs). These SDGs are noted in Table 5.

Table 5: Sustainable Development Goals (SDGs) directly linked to Multilateral Environmental Agreements (MEAs) on biodiversity and waste and chemicals.

Goal 1 No Poverty	**Goal 2** Zero Hunger
Goal 6 Clean water and sanitation	**Goal 12** Responsible consumption and production
Goal 13 Climate action	**Goal 14** Life below water
Goal 15 Life on land	**Goal 17** Partnerships for Goals

12 https://www.cbd.int/doc/world/ki/ki-nbsap-v2-en.pdf (Summary: https://www.cbd.int/nbsap/about/latest/#ki)

13 https://unfccc.int/resource/docs/natc/kirnc1.pdf

14 https://www.sprep.org/att/IRC/eCOPIES/Countries/Kiribati/13.pdf

15 https://documents-dds-ny.un.org/doc/UNDOC/GEN/N92/836/55/PDF/N9283655.pdf?OpenElement

16 https://openresearch-repository.anu.edu.au/bitstream/1885/158076/1/082_south-pacific.pdf

17 https://www.are.admin.ch/dam/are/de/dokumente/statement_of_forestprinciples.pdf.download.pdf/statement_of_forestprinciples.pdf

4.2 National and Local Legislation and Policy

Table 6: Legislative instruments and current status of strategies

Name of legislative instrument	Year	Functional coordination	Operations strategy	Financial Strategy	Monitoring and reporting	Enforcement of regulations
Environment Act	2007	Y	Y	Y	Y	Y
Public Utilities Ordinance	1999	Y	Y	Y	Y	Y
Squatters Act	2005	N	N	N	N	N
Fisheries Act	2010	Y	Y	Y	Y	Y
National Disaster Act	1993	Y	Y	Y	Y	Y
Building Code	2010	Y	Y	Y	Y	Y

Table 7: Plans and guidelines and the current status of strategies

Name of Plans/ Guidelines	Year	Functional coordination	Operations strategy	Financial Strategy	Monitoring and reporting	Enforcement of regulations
Coastal Management Plan	1998	Y	Y	N	N	N
National Biodiversity Strategy and Action Plan	2007	Y	Y	Y	Y	Y
National Roadmap on Water and Sanitation	2011	Y	Y	N	N	N
National Action Plan Land for Degradation and Drought	2007	Y	N	N	N	N
Waste Management and Pollution Control	1998	Y	Y	N	N	N

4.3 Traditional Governance and Tenure Systems

In Kiribati society, leadership is consensual, avoiding confrontation or embarrassment of others. Leaders are expected to express and support the best interest of the community. The leadership is traditionally exercised by men; women seldom speak in public (Macdonald 1996). Based on traditional patterns i-Kiribati women have had limited roles in community decision-making forums, such as those traditionally held in community meeting houses – the maneabas. However, this has now changed, with more women holding high positions in the civil service and the election of the first female Speaker to the Kiribati House of Assembly (Parliament) in May 2020.

The land tenure system is traditionally passed from father to son and siblings. Women also have equal access to land as men. All siblings have equal right to land ownership. However, there are also state lands in the Line and Phoenix groups. The Government also signed a 99 lease agreement with landowners for the use of their land for government/public interest with annual lease payment.

Kiribati society is generally patriarchal, and women perform the vast majority of unpaid reproductive and domestic work, and are primarily responsible for the care of children, the ill and the elderly. Information on the population and demographic changes is available from the National Statistics Office.

4.4 Communities and other stakeholders

Table 8: Corresponding roles of community types and the related stakeholders

Category	Stakeholder	Role
Village	Community-based group	Decision making body for village Development
	Faith-based group	Different church group - spiritual growth and assistance to the congregation
	Private businesses	Serving villagers needs - business
Informal settlement	Health Group	WASH related activities
District	Local council	Oversee development needs of village

5 History of interventions

The interventions in the water supply and sanitation sectors started in the late 1960s with the construction of the water supply system for South Tarawa, funded under the Gilbert and Ellice Island Colony administrations. This was followed with the construction of water supply systems and on-site sanitation systems in the outer islands with funding provided by the then South Pacific Commission and construction supervision provided by the Ministry of Health. The project covered islands in the southern Gilbert group, which were provided with windmill fed water supply systems and diaphragm hand pump system and pit latrines for all households.

In the 1980s, the water supply systems in the outer islands were replaced with solar powered pumping water supply systems and some windmill pumps were also refurbished, funded by the Australian government and supervised by the then Public Works Department under the then Ministry of Works and Energy (now MISE). There was also major funding provided by the United Nations Capital Development Fund (UNCDF) in the late 1990s, which covered 75 villages on 13 outer islands in the Gilbert group. The villages were provided with either multi-hand pump systems or solar powered water supply systems depending on the distance of the good water source from the village. The stated policy was that when the water source was less than 750 m from the water source to the village, the multi-hand pump system was provided. However, if the water source is more than 750 m away, the solar pump would be provided. The UNCDF project took more than 10 years to complete because the target beneficiaries were expected to provide free labour, resulting in the very slow implementation.

Following the cholera outbreak in 1977/1978, the Australian Government through its Department of Housing and Construction, funded the saltwater flushing sewerage systems for the three main centres on South Tarawa, which are Betio, Bairiki and Bikenibeu, each with sewer lines, pump stations and outfall pump stations. Upon completion of the sewerage project, the water supply project started around 1983 to improve the old system that was constructed in the early 1970s. The water supply project, which covered all of South Tarawa, was completed in 1988 with all government residential buildings provided with a metered house connection.

Table 9 provides more recent interventions since the year 2000.

Table 9: Interventions since the year 2000

Name of Project	Implementing Agency	Outcome	IW R2R Linkage
Sanitation Public Health and Environment Project (SAPHE) 2002–2005	Funded by the Asian Development Bank and implemented by the Ministry of Infrastructure and Sustainable Energy	Improve in the South Tarawa Water supply and Sewerage systems, plus construction of landfills at Nanikaai, Bikenibeu and Betio.	Improve water supply, sewerage services and landfill development.
South Tarawa Sanitation Improvement Sector Project 2012–2019	Funded by the Asian Development Bank and implemented by the Ministry of Infrastructure and Sustainable Energy	Improvement of sewage disposal at the Betio, Bairiki and Bikenibeu. Sewage solids removed before discharge at about 30 m below mean sea level at three different sites.	Protect reef from destruction as sewage is discharged 30 m below sea level. Improve sanitation situation at Betio, Bairiki and Bikenibeu.
Modelling Sea-level and inundation effect of fresh water lens 1997-2014	Secretariat of the Pacific Community with MISE	Improve understanding of: Potential for wave overtopping of Bonriki water reserve. Probability of inundation of Bonriki Water Reserve is relatively low. Over-abstraction and low rainfall at Bonriki water reserve are more critical than inundation.	Improve knowledge on inundation due to climate change.

Name of Project	Implementing Agency	Outcome	IW R2R Linkage
Solar photovoltaic systems connected to PUB;s grid 2015 – 2016	United Arab Emirate – 500 kw solar arrays installed at Bonriki, plus others 400 kw by Japan and another 516 kw by World Bank	Result in PUB (Public Utilities Board) saving USD800,000 in fuel cost as the result of some 1.4 MW solar array capacity connected to PUB's grid.	
Protection of fresh water sources and fresh water supply at the cost of US$10.8 million	Funded by the World Bank through the KAPIII and MISE.	Replacement of gallery pump with variable speed pump and installation of pilot 24/7 water supply system in Tanaea, part of Eita village and Nanikaai villages on South Tarawa.	
Future Projects			
South Tarawa Water Supply Project 2020	Funded by Green Climate Fund, Asian Development Bank, World Bank USD58 million	Water supply would run consistently (24 h) including water system to Bonriki and Buota water reserve residents.	Improve water supply by installation of 6.0 Mega litre of water per day Reverse Osmosis Desalination Plants to supplement Bonriki and Buota water sources.

6 Key Environmental Problems

6.1 Diagnostic Analysis

Diagnostic analyses for the Kiribati IWR2R project were made possible from data collected by Members of Parliament. The aim was to identify environmental issues in all islands of Kiribati resulting from climate change in the years 2016 to 2017. Four main environmental issues were identified: 1) Coastal Erosion; 2) Adverse impacts on drinking water; 3) Adverse impacts on food crops; and 4) Decline in marine resources. Coastal erosion, impact on drinking water and the decline in marine resources were treated as priority and therefore investigated in the report.

The three prioritised environmental issues were further analysed using the problem tree analysis to determine the immediate causes, underlying causes and finally, the root causes. The ideas for reform and intervention were then derived based on the root causes. There is no easy way to solve issues such as coastal erosion (which will involve a huge investment to build a permanent seawall) or the drinking water issues. It is recommended that there is a need to conduct a feasibility study on the best option to tackle coastal erosion, while the drinking water issue can be tackled with installation of rainwater catchment systems for every household and the use of large community buildings such as church buildings, maneaba and other public buildings as catchments to fill large water tanks that can be used during the long drought. It is also suggested that rainfall for each island is collected and stored for rainfall analysis to determine the suitable tank volume and roof area.

6.2 Identify and agree on the scope, objectives and responsibilities pertaining to the focus area under investigation

The focus area under investigation was based on the data collected by Members of Parliament assigned to investigate environmental issues raised by all islands in Kiribati. The results are presented in Table 10.

Table 10: Assigned level of severity of environmental issues in all islands in Kiribati.

Island	Environmental Issues			
	Coastal Erosion	Adverse Impact on Drinking Water	Adverse Impact on Food Crops	Decline in Marine Resources
Makin	5	4	3	3
Butaritari	5	4	3	3
Marakei	5	5	3	3
Abaiang	5	4	3	3
North Tarawa	5	4	3	3
South Tarawa	5	5	5	5
Maiana	5	5	4	3
Kuria	5	5	4	3
Aranuka	5	5	4	3
Abemama	5	5	4	3
Nonouti	?	?	?	?
Tabiteuea North	?	?	?	?
Tabiteuea South	?	?	?	?
Nikunau	5	5	4	3
Beru	5	4	3	3
Onotoa	?	?	?	?

Island	Environmental Issues			
	Coastal Erosion	Adverse Impact on Drinking Water	Adverse Impact on Food Crops	Decline in Marine Resources
Tamana	5	4	3	3
Arorae	5	4	3	3
Banaba	?	?	?	?
Kiritimati	5	5	5	4
Tabuaeran	5	5	4	4
Teraina	5	5	4	4
Kanton	?	?	?	?
Explanations/Legends: 1 = No adverse Impact 2 = No action, needed Impact not severe, 3 = Severe impact if no action taken, 4 = Action is needed to avoid the issue, 5 = Action is needed as the problem is occurring, 6 =? Island is not yet visited.				

Based on the information in Table 10, **the top environmental issues relating to climate change are coastal erosion followed by adverse impact on the drinking water. The impact on food crops and the decline in marine resources are quite evident on Kiritimati and islands in the southern Gilbert group:**

i. Coastal erosion is a major environmental issue as indicated in Table 10 showing the rating of 5, meaning action is needed as the problem is severe. In all islands of Kiribati, coastal erosion is affecting land masses with the loss of trees, roads and homes constructed near the coastline. On the island of Abaiang, the village Tebunginako had been moved further in-land due to severe erosion washing away the road and houses. The erosion has also caused seawater to reach the church situated near the coast.

ii. Water issues related to brackish water are normally encountered during the long drought. The issue is quite common in all islands with low annual rainfall and thin island chains as they have very thin freshwater lens, which cannot meet water demand during long droughts. As more water is withdrawn beyond the sustainable yield, this will result in the upward movement of salt water in a cone-shaped manner from beneath an interface of freshwater and saltwater. This is especially true on islands in the southern Gilbert group and remote islets such as Kiebu on Makin Island, Nuotaea and Ribono on Abaiang, Aiwa in Tabiteuea North, and Abamakoro on Nonouti Island.

    Another island with a more severe water problem is Banaba where there is no groundwater, and the only source is rainwater. In colonial times, Banaba Island was phosphate rich and as ships came to collect and transport phosphate, a significant amount of freshwater was brought to the island. This is no longer possible following the cease of phosphate mining in 1979. The increase in the population is currently exacerbating the problem as high water demand is directly proportional with population.

iii. Adverse impacts on drinking water was ranked by the majority of the islands as requiring action as no action would lead to severe impacts. However, South Tarawa and Kiritimati ranked this as 5, meaning that action is needed as the problem is currently occurring. Since this is related to food, the quality of life through proper nutrition and livelihood are important factors to consider.

iv. There are also reports of the decline of marine resources such as ark shells (locally known as te bun), giant clams and lobsters due to overfishing and over-exploitation. This is quite evident on South Tarawa where te bun can no longer be harvested, and it is quite hard to find giant clams on South Tarawa and other islands.

6.3 Identify and analyse the issues, problems and impacts (and the environmental and associated socio-economic impacts) using problem-tree and causal-link analyses

6.3.1 Water Issues

Three environmental issues were identified under the water issues category. These issues were 1) Water in some parts of the island turn brackish; 2) Water in some areas becomes contaminated making it unfit for drinking; and 3) Water is insufficient to meet the growing water demand on the island. The water in some parts of the islands in Kiribati becomes brackish after long periods of drought, while some do not have fresh groundwater to meet the growing demand and increase in population. The issues are further exacerbated through water becoming contaminated due to human activities.

Environmental Problem	Environmental Impacts and socio-economic consequences	Sector	Locations
Water issues	Brackish water impacts human health due to excessive salt content. Food security is negatively affected due to excessive salt content in soil and therefore also affects revenue from sales of vegetables and fruits.	Agriculture – community and commercial	Settlement areas
	Contaminated water from human waste gives rise to diarrhoea and other water related diseases (such as skin diseases). Vulnerable groups include young children and the disabled. Increased stress on women and youth primarily tasked with boiling water. Possible increased cost of water treatment.	Community	Settlement areas
	Insufficient water in rural areas in Kiribati leads to unequal water distribution with increased pressure on women to look for potable water. Vulnerable groups are most affected such as the elderly and disabled as they would find it difficult to find potable sources of water. Taps would be left open and unsupervised which lead to potentially more wasted water if not being collected or used.	Community	Settlement areas

6.3.2 Marine Issues

Three marine issues were identified and documented by stakeholders, namely, 1) coastal pollution; 2) ecosystem destruction; and 3) decline in marine resources.

Environmental Problem	Environmental Impacts and socio-economic consequences	Sector	Locations
Marine Issues	Coastal pollution leads to decrease in marine resources such as the reef and edible marine life. This disrupts marine food web and ecosystems and increases pressure on women who are responsible for feeding their families. Demand for tinned imported sources of protein increases which then leads to possible increase in non-communicable diseases, which would put pressure on women and youth who are responsible for taking care of the sick.	Community	Settlement areas

Environmental Problem	Environmental Impacts and socio-economic consequences	Sector	Locations
	Ecosystem destruction leads to decrease in marine food supplies, decrease in land spaces (especially at the beach front) and leads to shifting of fish species away from fishing sites. Seagrass numbers also decrease due to the destruction of suitable habitats	Community and commercial	Settlement areas, shoreline.
	Decline in marine resources leads to reduction of fresh source of protein, which leads to poor health and increased cost of living due to natural food source being insufficient to feed families. There will be movement of people beyond the reef to look for fish and would also highly impact fishing activities of women who mostly fish along immediate coastal areas.	Community and commercial	Settlement areas, shoreline

6.3.3 Land Issues

Four land related issues were identified and documented from stakeholders, namely, 1) Coastal Erosion, 2) Plastic pollution, 3) Open defaecation and 4) Uncontrolled animals

Environmental Problem	Environmental Impacts and socio-economic consequences	Sector	Locations
Land Issues	Coastal erosion causes communities facing this issue to go through stress and experience feelings of great uncertainty regarding their land and home. The displacement of people can cause overcrowding due to limited space as well as political and social tensions over the use of land. Social inequality would mean that seawalls would only be built by those who are able to afford them. The youth, unmarried women and disabled would be disadvantaged due to seawall building being typically done by men. The unemployed would also face financial constraints as building seawalls is costly.	Community and commercial	Settlement areas
	Improperly disposed plastic would eventually contaminate the groundwater. Increase in non-degradable litter would be an added burden to the natural environment, both on land and at sea. Plastic pollution has been seen to be mistaken as food by animals, which negatively impact their health and, in some instances, end up killing them. Chemical and toxic waste would negatively impact the environment and sources of water.	Community and commercial	Settlement areas, shoreline.
	Open defaecation increases water borne diseases, causes unpleasant smell, affects human and animal health due to faeces being a source of bacteria, and attracts disease carrying insects, which would then lead to increase in vector borne diseases. The younger members of the population have weaker immune systems and are exposed and vulnerable to sicknesses caused by improperly disposed waste. Due to toilets not being available in some homes, incidents of gender-based violence have been recorded affecting women and young girls (though this is not a common occurrence).	Community	Settlement areas, shoreline
	Uncontrolled animals lead to uncontrolled increase in their populations, which increases risks to children who are vulnerable to wild dogs and pigs. Food gardens meant to sustain families would be at risk with increased numbers of uncontrolled animals such as roaming dogs, pigs and chickens. These lead to increase in animal waste, degradation of land and water resources and possibly increase in diseases.	Community and commercial	Settlement areas and commercial

6.4 Problem-tree analysis

The problems of water becoming brackish, coastal erosion and decline in marine resources, are best solved by attempting to correct, address or eliminate root causes as opposed to addressing the immediate apparent symptoms. This strategy lessens the probability of a recurrence of the problem.

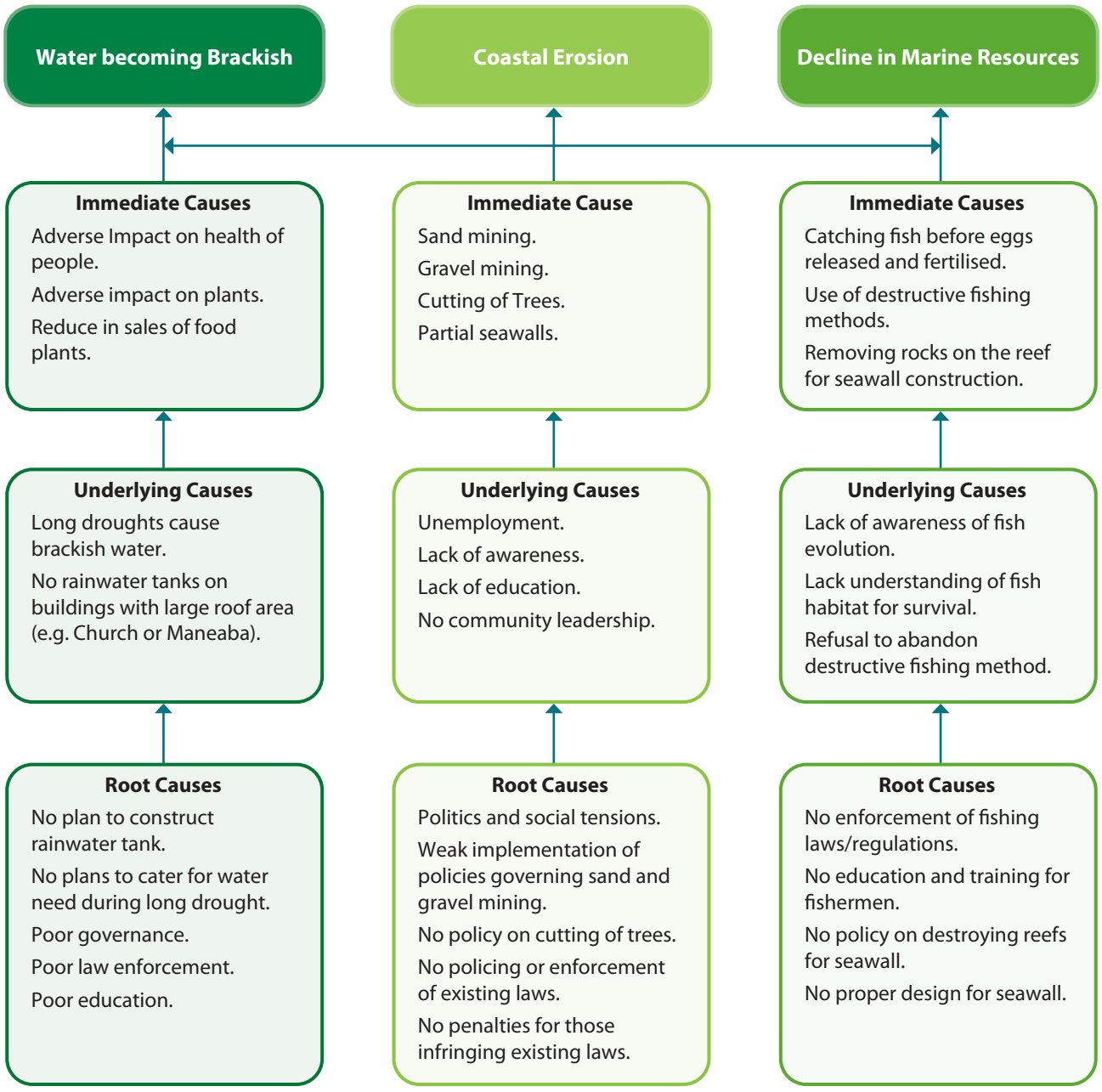

Figure 4: Diagnostic workshop outcomes on priority problems, immediate causes and root-causes

6.5 Develop priority systems and plans for actions and interventions

Based on the prioritisation criteria, the most pressing issues that were frequently raised in Parliament over the years were 1) water issues related to brackish water – no water at all on the island of Banaba in the central Gilbert group and 2) coastal erosion, which is affecting all islands in Kiribati due to human induced climate change.

On the water issue, the problem with brackish water only occurred on islands where there was a long drought and if the freshwater lens was very thin. On the island of South Tarawa, the freshwater lenses at Bonriki and Buota can survive a long drought of more than two years. However, in some parts of South Tarawa, some villages could experience brackish water after just a few months of no rain. This is what is occurring in a number of remote islets in Kiribati such as Aiwa in Tabiteuea North, and Abamakoro on Nonouti islands in the northern and central Gilbert group.

The water issue on Banaba is unique in that the island does not have a groundwater lens and this island has depended on rainwater in the past. The island used to be a phosphate mining island in the early 1900s. The mining of phosphate ceased in 1979, but during the period of time where mining was active, Banaba was supplied with freshwater from the Solomon Islands by ships coming to the island to collect phosphate. The freshwater was pumped into two large steel containers, each with a capacity of two million gallons of water. This water was supplemented by the rainwater catchment systems using huge roof areas of all buildings on the island. The system was operated and funded by the British Phosphate Company (BPC). At the end of the phosphate mining these facilities were no longer used nor maintained by the local council and are now run down.

The water issue should be considered as "everyone's business". The simple solution is for every household to have a simple roof catchment to collect rainfall. Community buildings such as Maneaba (meeting halls) and church buildings should all contain rainwater catchment systems to always collect available rain. The rainwater storage from these community buildings should be accessible to everyone living in the community in times of drought.

A rainfall analysis needs to be conducted to determine the volume of tank needed to sustain the longest drought period. One is available for South Tarawa, and this programme can be adapted to be used by all islands in Kiribati provided that monthly rainfall data is collected and stored for use.

The use of the desalination technology in the outer islands cannot be sustained due to high energy requirement to run the plant and the cost of maintaining the system on a remote island. The experience on Banaba can be used as an example. The desalination plant on Banaba had been running for a number of years since early 2000. The plant continued to malfunction on quite a number of occasions due to the lack of spare parts. A brand new desalination plant has just been acquired, but continues to malfunction due to lack of spare parts and local skills to maintain the plant. It is therefore wise to go for the simple rainwater catchment system.

To reduce the issue of coastal erosion, it would be quite costly to build a concrete retaining structure to protect the coastal area and could be a significantly large investment of millions of dollars to protect all islands that have been identified with this issue. Alternatively, the use of sheet piling to protect the coast is also quite costly, therefore a cost benefit analysis of various coastal protection options is suggested at this stage to be able to identify and determine the least costly option weighed with its benefits.

7 Main Findings

7.1 Summary of main findings

The summary of the main findings of the island diagnostic analysis includes the following:

1. The pressing issue that affects all islands in Kiribati is coastal erosion, which has resulted in the destruction of roads, homes and trees along the coastline. The cost of protecting the coast from further erosion is very expensive and beyond reach by Government.
2. The issue of the impact on drinking water supply is quite severe in urban areas of South Tarawa, which accommodates 52.9% of the total population of Kiribati. Government is now considering the installation of a 6.0 mega litre capacity desalination plant to make sure water supply is available at all times.
3. The outer islands of Kiribati have aquifers and underwater lenses adequate to sustain life in those locations; however, the remote islets have no groundwater, which severely impacts local population and biodiversity.
4. A special case is Banaba Island, which has unique water problems. It is a raised limestone island rising up to about 80 m above mean sea level. There is no groundwater on the island, except for 'perched water' stored in the caves and cannot be used to feed the whole island. The island is provided with a small desalination plant with a capacity of less than 10,000 litres per day, but the plant continues to break down due to lack of spare parts and local capacity to maintain it.
5. The solution for the water issue on Banaba and other remote islets with acute water shortage problem is the construction of rainwater catchment systems on all public buildings, with suitable roofing materials to make use of rainwater. Increasing rainwater storage with suitable rooves to collect rainwater on the islets can alleviate water shortage during the long drought.

7.2 Opportunities

Some of the factors and opportunities that exist in the Kiribati site (i.e. South Tarawa) that can be harnessed for successful implementation of the IWR2R project include:

1. Conduct a feasibility study and cost-benefit analysis on the design of an appropriate seawall that would help to protect the coastline. These include concrete retaining structure and sheet piling.
2. Support for the introduction of home gardening in the outer islands so households can grow cabbage, cucumbers, tomatoes and watermelons using modern farming techniques and compost from Dry-Litter piggery system or from composted vegetable matter. The Department of Agriculture can support this initiative for purposes of food security and, also for encouraging balanced diets in households or for sale.
3. Use properly designed rainwater catchment system to collect rainwater and conserve groundwater lenses to sustain life during the drought periods. The relevant government agency (e.g. MISE) can support monitoring and analysis of rainfall data over a period of time to enable calculations of a minimum storage for a particular roof area.
4. The country is facing decline in marine resources, and the relevant agencies in government and civil society can work together to educate the public and spread awareness of the importance of sustainable fishing methods and enforcement of the prohibition of less destructive methods.

7.3 Risks

Some of the risk factors that exist for the successful implementation of the IWR2R project at the Kiribati site include:

1. Donors may not be interested in financing infrastructure type proposals such as coastal protection work due to the very high cost involved. The islands and atolls of Kiribati have relatively large coastlines already inundated and eroded, which may require millions of dollars to fund construction of preferred and recommended coastal protection designs.
2. The home gardening proposal may not be attractive to most i-Kiribati in the outer islands due to intensive labour requirements for farming work compared to relatively small harvests. This will require change in behaviour which can be a challenge and will take time to take effect.
3. The issue with rainwater catchment systems is that most houses in the outer islands are locally built using materials such as pandanus leaves for roofing, which are not suitable for collecting rainwater. The country is situated at the equator, and it is very hot throughout the year. Building houses with local materials and designs are more comfortable to live in than a modern timber/concrete house with iron roofing sheet.
    a. There may be a need for all households to have at least one building in their yard that is built with a roof suitable for rainwater harvesting. A simple house with permanent roofing material, guttering and downpipe and a tank of approximately 500 litres capacity is quite sufficient to store rainwater for the duration of the rainy season.

8 Actions to Reform

The environment problems highlighted in this report and set out in Table 11 need to be the basis for formulating strategic policy and legislative actions and interventions. There are already in place policies and legislation aimed at addressing these problems. There have been many past and current projects implemented in the country, tackling the same problems.

It is recommended to support monitoring, control, surveillance and enforcement of policies and legislation outlined in Table 6 above. Equally, it is also important that relevant agencies undertake regular exercise and analysis of gaps and situations specific to current ongoing efforts. It is also recommended that the government encourages relevant line-ministries and agencies to ensure that annual work programmes reflect the priority actions for addressing environmental problems as set out in Table 11. Similarly, the government can raise these priorities in various fora, including the annual roundtable meetings and other opportunities where potential donors can be approached to assist with addressing environmental problems.

Table 11: Identified environmental problems and relevant aspects for decision makers

	Coastal erosion	Adverse impacts on drinking water and food crops	Decline in marine resources
Shared key actions contributing to the problem	• Increase in population and development. • Unsustainable harvesting of resources		
Linkage of underlying issues across identified environmental issues	• Need for education and awareness of the identified prioritised issues. • Need for improved policy and governance. • Enforcement of laws/regulations. • Proper management and planning of adequate designs for construction of technology to help solve issues.		
Relevant institutional legal factors	• Local Government Act (amended in 2013). • Environment Act 1999 (amended in 2007). • Native Lands Ordinance 1956 (amended in 2013). • Land Planning Ordinance 1977 (amended in 1980 and 2000). • Building Act 2006. • Foreshore and Land Reclamation Ordinance 1969.	• Local Government Act (amended in 2013). • Environment Act 1999 (amended in 2007). • Native Lands Ordinance 1956 (amended in 2013). • Land Planning Ordinance 1977 (amended in 1980 and 2000). • Building Act 2006.	• Local Government Act (amended in 2013). • Environment Act 1999 (amended in 2007). • Native Lands Ordinance 1956 (amended in 2013). • Land Planning Ordinance 1977 (amended in 1980 and 2000). • Building Act 2006. • Wildlife Conservation Ordinance 1975 (amended in 1997). • Phoenix Islands Protected Area Regulations 2007. • Phoenix Islands Protected Area Conservation (PIPA) Trust Act 2009. • Recreational Reserves Act 1996. • Marine Zones (Declaration) Act 2011. • Fisheries Act 2010. • Mineral Development Licensing Ordinance 1978.
Islands that currently do not have no data	• Nonouti • Tabiteuea North • Tabiteuea South • Onotoa • Banaba • Kanton		

8.1 Shared key actions contributing to problem

As populations increase, pressure on harvesting of natural resources also increases. The environmental issues faced are interconnected. For example, the decision to construct seawalls to reduce coastal erosion leads to destruction of reefs for raw materials. The destruction of coral reefs affects the natural habitat, which in turn disrupts the natural ecosystem negatively and leads to decline of marine resources. Destruction of reefs may also lead to significant loss of a source of food and livelihood, which increases pressure on other food sources (such as farm animals and crops).

8.2 Common underlying issues across identified environmental issues

The identified environmental issues of coastal erosion, adverse impacts on drinking water and food crops, and the decline in marine resources all share issues that can be addressed with common strategies. Education and awareness of the above issues would be very beneficial. In terms of decision making, there is a need for improved policy and governance as well as the enforcement of relevant laws/regulations. Whether it is proper planning to construct rainwater tanks or construction of a properly designed seawall, it is important that there are clear plans and structures that are proven to be technically and scientifically beneficial and sustainable within the context of the country. While the responsible sectors may differ for each of the identified environmental issues, a management strategy to approach these issues through a joint collaboration between responsible sectors would be highly efficient and would promote successful cross-sectoral collaboration.

8.3 Relevant institutional legal factors

Referring to Table 6:

- The Waste Management and Pollution Control, and National Roadmap on Water and Sanitation have functional coordination and an operational strategy but do not have a financial strategy, monitoring and reporting, or enforcement of regulations.
- The National Action Plan for Land Degradation and Drought only has functional coordination but does not have an operational strategy, financial strategy, monitoring and reporting or enforcement of regulations.
- The Squatters Act 2005 does not have all the above-mentioned strategies, monitoring and reporting or enforcement of regulations.

The identification of these gaps is the first step to being able to take further relevant steps for strategies and efforts to succeed.

Acts and ordinances relevant to the three prioritised environmental problems:

- The Local Government Act (amended in 2013), Environment Act 1999 (amended in 2007), Native Lands Ordinance 1956 (amended in 2013), Land Planning Ordinance 1977 (amended in 1980 and 2000) and Building Act 2006 are relevant to all three of the identified environmental issues in this diagnostic analysis.
- The Foreshore and Land Reclamation Ordinance is only relevant to the environmental issue of coastal erosion.
- The Wildlife Conservation Ordinance 1975 (amended in 1997), Phoenix Islands Protected Area Regulations 2007, Phoenix Islands Protected Area Conservation (PIPA) Trust Act 2009, Recreational Reserves Act 1996, Marine Zones (Declaration) Act 2011, Fisheries Act 2010 and Mineral Development Licensing Ordinance 1978 are the Acts and ordinances that are only relevant to the environmental issue of decline in marine resources.

The above information could inform decision makers in enacting of adequate policies that align with current legislation. The consideration of the inclusion of the Gender Policy when working with environmental legislation is suggested.

9 References

Asian Development Bank (ADB) 2011. Economic Analysis: South Tarawa Sanitation Improvement Project. Accessed: 24 December 2021. https://www.adb.org/sites/default/files/linked-documents/43072-013-kir-ea.pdf

Ali M., Hay J., Maul G. and Sem G. 2001. Chapter 9: Small island states. In: Watson, R. T., Zinyowera, M. C., Moss, R. H. and Dokken, D. J. (eds.) IPCC Special Report on the Regional Impacts of Climate Change.

Australian Government. 2015. Current and future climate of Kiribati, Pacific-Australia Climate Change Science and Adaptation Planning Program. pp 2. http://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/11_PACCSAP-Kiribati-11pp_WEB.pdf

Badon Ghijben W. 1889 Nota in verband met de voorgenomen putboring nabij Amsterdam. (Notes on the probable results of the proposed well drilling near Amsterdam). Tijdschrift het Koninklijk Instituut voor Ingenieurs. The Hague, pp 8-22

Damlamian H. 2008. Kiribati Technical Report Hydrodynamic Model of Tarawa Water Circulation and Applications. EU EDF – SOPAC Project Report 134. Reducing Vulnerability of Pacific ACP States.

Elliff C.I. and Silva I.R. 2017. Coral reefs as the first line of defense: Shoreline protection in face of climate change, Marine Environmental Research 127, pp. 148-154, ISSN 0141-1136, https://doi.org/10.1016/j.marenvres.2017.03.007.

Fischer S. 2013. A history of the Pacific Islands. 2nd ed. New York: Palgrave.

Garnett M.C. 1983. A Management Plan for Nature Conservation in the Line and Phoenix Islands. Government of Kirbati. 318 + 131 pp

Gillett R.D. 2016. Fisheries in the Economies of Pacific Island Countries and Territories. Pacific Community.

Gillie R.D. 1993. Coastal Erosion Problems in the Gilbert Islands Group of Kiribati. SOPAC Technical Report 167. South Pacific Applied Geoscience Commission (SOPAC) Coastal Program, Kiribati Project: KIA.

Government of Kiribati. 2014. Fifth National Report to the Convention on Biological Diversity http://www.cbd.int/doc/world/ki/ki-nr-05-en.pdf

Herzberg A. 1901 Die Wasserversorgung einiger Nordseebäder (The water supply on parts of the North Sea coast). Jour für Gasbeleuchtung und Wasserversorgung, München 44:815-819 45:842-844.

Ikhlef K. 2014. UNESCO's SIDS agenda: from Barbados via Mauritius to Samoa. World Heritage Papers 38: 8–17.

Johannes R.E. and Yeeting B. 2000. I-Kiribati Knowledge and Management of Tarawa's Lagoon Resources. Atoll Research Bulletin No. 489. National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.

Kabir S. M. 2014. Methods of Data Collection. Conference: Research methodology, BGC Trust. At: Chittagong, Bangladesh. Department of Psychology, University of Chittagong, Chittagong.

Kidd S. and Mackenzie U. 2012. Kiribati Country Case Study. AusAID Pacific social protection series: poverty, vulnerability and social protection in the Pacific. Australian Agency for International Development, Canberra.

Kiribati National Biodiversity Strategies and Action Plan (2016 – 2020). < https://www.cbd.int/doc/world/ki/ki-nbsap-v2-en.pdf>, (Accessed 23 December 2021).

Kiribati National Statistics Office and the SPC Statistics for Development Programme. 2013. Kiribati 2010 Census Volume 2: Analytical Report. Noumea, New Caledonia.

KV20. 2016. Kiribati 20-year vision 2016–2036. Consultation draft. http://www.mfed.gov.ki/sites/default/files/KV20%20VISION.pdf

Lovell E., Kirata T. and Tekinaiti T. 2003. Status report for Kiribati's coral reefs. Coral reefs in the Pacific: Status and monitoring, resources and management. pp. 163-192.

Perry R. 1980. Wildlife Conservation in the Line Islands, Republic of Kiribati (formerly Gilbert Islands). Environmental Conservation 7(4): 311-318.

World Bank. 2013. Policy Brief: Some Thoughts on Social Scheme for Protection and Promotion in Kiribati.

UNFCCC. 2019. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management (2019–2028). URL: https://www4.unfccc.int/sites/NAPC/Documents/Parties/Kiribati-Joint-Implementation-Plan-for-Climate-Change-and-Disaster-RiskManagement-2019-2028.pdf

Macdonald B. 1996. Governance and Political Process in Kiribati. Economic Division Working Papers, no. 2. Canberra: Research School of Pacific and Asian Studies, The Australian National University.

Macdonald B. 2001 (reprint from 1982 edition). Cinderellas of the Empire: Toward a history of Kiribati and Tuvalu. Suva: Institute of Pacific Studies, University of the South Pacific Press

Mangubhai S., Lovell E., Abeta R., Donner S., Redfern F.M., O'Brien M., Aram K.T., Gillett R., Rotjan R., Eria T., Teetu S.B. and Bebe R. 2019. Kiribati: atolls and marine ecosystems. In World Seas: an Environmental Evaluation (pp. 807-826). Academic Press.

Maragos J. E. 1997. Coral reef health in the Central Pacific. In Grigg R.W. & C. Birkeland (eds.) (1997). Status of coral reefs in the Pacific Scientific Committee on Coral Reefs of the Pacific Science Association. Sea Grant College Program.

Metz W.D. 1995. The Mangroves of Kiribati: An Inventory, Feasibility and Management Study Volume 1, prepared for Agriculture Division, MNRD, Republic of Kiribati prepared by US Department of Agriculture – Forest Service, unpublished (cited in SOE 2000-2002).

Ministry of Infrastructure and Sustainable Energy. 2019. Environmental and Social Impact Assessment. Kiribati: South Tarawa Water Supply Project. Asian Development Bank and World Bank. Available on: https://www.adb.org/projects/documents/kir-49453-002-rrp.

Neall V. and Trewick A. 2008. Review. The Age and origin of the Pacific Islands: A geological overview. Philosophical Transactions of the Royal Society B. 363, 3293-3308.

Oberdorfer J.A. and Buddemeier R.W. 1984. Atoll Island groundwater contamination: Rapid recovery from saltwater intrusion. Annual Meeting of the Association of Engineering Geologists. Boston, MA, 9–11 October 1984.

PCRAFI. 2011. Kiribati Country Profile. Suva: Pacific Community.

Petersen G. 2009. Traditional Micronesian societies: Adaptation, integration, and political organization in the Central Pacific. 1st ed. Honolulu: University of Hawai'i Press.

Richards R. 1991. Atoll vulnerability: the storm waves on Tokelau on 28 February 1987. In: Hay, J. (ed.) South Pacific Environments: Interactions with Weather and Climate. Environmental Science, University of Auckland, Auckland, New Zealand. pp. 155–156.

Scott D., Overmars M., Falkland T. and Carpenter C. 2003. Pacific Dialogue on Water and Climate, Synthesis Report, SOPAC Miscellaneous Report N. 491, Suva, Fiji.

Secretariat of the Pacific Regional Environment Programme. 2021. What are MEAs. Cited: 24 December 2021. https://www.sprep.org/acp-meas/what-are-meas.

Smith C. 2021. Encyclopedia of Global Archaeology Second Edition. Springer Nature Switzerland AG.

Spalding M.D. and Brown B.E. 2015. Warm-water coral reefs and climate change. Science 350 (6262), 769-771. http://dx.doi.org/10.1126/science.aad0349

Spennemann D. 2006. Gauging community values in historic preservation. CRM: The Journal of Heritage Stewardship 3: 6-20.

Terry J. P. 2007. Tropical Cyclones. Climatology and Impacts in the South Pacific. New York, NY: Springer.

Thomas F.R. 2001. Remodeling marine tenure on the atolls: A case study from western Kiribati, Micronesia. Human Ecology 29: 399–422.

Thomas F.R. 2007a. The behavioral ecology of shellfish gathering in western Kiribati, Micronesia 1: Prey choice. Human Ecology 35: 179–194.

Thomas F.R. 2007b. The behavioral ecology in western Kiribati, Micronesia 2: Patch choice, patch sampling, and risk. Human Ecology 35: 515–526.

Thomas F.R. 2009. Historical ecology in Kiribati: Linking past with present. Pacific Science 63: 567–600.

Trading Economics. 2021. Kiribati GDP. https://tradingeconomics.com/kiribati/gdp Accessed: 23rd December, 2020.

Thaman R. 1992. Vegetation of Nauru and the Gilbert Islands: Case Studies of Poverty, Degradation, Disturbance, and Displacement. Pacific Science (1992), vol. 46, no.2: 128-158.

Watkins D. and Batoromaio K. 2014. Directory of Wetlands of Kiribati – 2014. Report to the Secretariat of the Pacific Regional Environment Programme.

Wheatcraft S. W. and Buddemeier R. W. 1983. Atoll island hydrology. Groundwater 19:311-320.

White I., Falkland A., Crennan L., Jones P., Metutera T., Etuati B. and Metai E. 1999. Groundwater recharge in low coral islands Bonriki, South Tarawa, Kiribati. Issues, traditions and conflicts in groundwater use and management. UNESCO IHP-V, Technical Documents in Hydrology, Number: 25. Paris, France, UNESCO. 39 pp.

White I., Falkland A., Perez P., Dray A., Metutera T., Metai E. and Overmars M. 2007. Challenges in freshwater management in low coral atolls. Journal of Cleaner Production, 15, 1522–1528.

World Bank. (n.d.) Reducing the risk of disasters and climate variability in the Pacific Islands: Republic of Kiribati Country Assessment. Washington, DC: World Bank.

Annex 1 Priority Issues

Based on the prioritisation process, Environmental Issues with the highest points are further analysed and the problem tree is drawn for each of them. The prioritised environmental issues were 1) water becoming brackish or no groundwater on some islands under the water issues, 2) decline in marine resources under the marine resources category, and 3) coastal erosion under the land Issues category.

Water Issues	Marine Issues	Land Issues
Deterioration of water quality (Brackish)	Pollution Oceans	Coastal erosion
Deterioration of water quality. (Microbiology)	Ecosystem Destruction	Plastic Pollution
Insufficiency quantity of freshwater	Decline in marine resources	Open Defaecation
		Uncontrolled Animals

National Location		Water Issues			
		Brackish Water	**Contaminated Water**	**Insufficient Quantity**	
Criteria	**Weighting (1 – 4)**				
Whole-of-island nature of a problem – geographical and temporal scale.	1 = no importance 2 = low importance 3 = moderate importance 4 = high importance	4	3	3	
Future risk of the problem – (in 10 years)	1 = no importance 2 = low importance 3 = moderate importance 4 = high importance 4	4	4	3	
Relationship with other environmental problems.	1 = no importance 2 = low importance 3 = moderate importance 4 = high importance 4	4	3	3	
Expected multiple benefits that might be achieved by addressing a problem.	1 = no importance 2 = low importance 3 = moderate importance 4 = high importance 4	4	4	3	
Progress in addressing this problem at the national level	1 = high progress 2 = moderate progress 3 = low progress 3 4 = no progress	3	3	3	
Urgency of addressing this problem	1 = no urgency 2 = low urgency 3 = moderate urgency 4 = high urgency 4	4	4	3	
TOTAL		**23**	**17**	**18**	

National Location		Water Issues			
		Brackish Water	Contaminated Water	Insufficient Quantity	
Marking Summary					
Land Issues		Coastal Erosion	Plastic Pollution	Open Defaecation	Animals
TOTAL		23	18	20	14
Marine Issues		Marine pollution	Ecosystem Destruction	Decline in Marine Resources	
TOTAL		18	19	23	

Local Location Criteria	Rating	Weighting (1 – 4)	Brackish Water	Contaminated Water	Insufficient Quantity	
Size of the affected area (as percentage of the total national land area)	1- < 10sq.km 2- 10 to 100sq.km 3- 100 to 1000sq.km 4- 1000 to 10,000sq. km 5- >10,000sq.km	1 = no importance 2 = low importance 3 = moderate importance 4 = high importance	3x4=12	3x2=6	3x2=6	
Affected population (as percentage of national population)	1- < 1000 2- 1000 to 10,000 3- 10,000 to 100,000 4- 100,000 to 500,000 5- >500,000		3x4=12	3x3=9	3x2=6	
Extent to which the natural catchment, aquifer or receiving coastal and marine waters support the livelihood of local communities (e.g. subsistence or commercial farming, forestry, mining, tourism, fisheries)	1- very low importance (<10%) 2- low importance (10-30%) 3- average importance (30-50%) 4- important (50-80%) 5- very important (>80%)		5x4=20	5x3=15	5x3=15	
Extent to which the natural catchment, aquifer or receiving coastal and marine waters support the national development (e.g. commercial farming, forestry, mining, tourism, fisheries)	1- very low importance (<10%) 2- low importance (10-30%) 3- average importance (30-50%) 4- important (50-80%) 5- very important (>80%)		4x4=16	4x3=12	4x2=8	

Local Location Criteria	Rating	Weighting (1 – 4)	Brackish Water	Contaminated Water	Insufficient Quantity	
Extent to which the site is a recognised government priority (refer to National Sustainable Development Strategy, or other strategic action plans e.g. NEAPs)	1- no, not a priority 2- yes, low priority 3- yes, medium priority 4- yes, high priority 5- yes, very high priority		4x4=16	4x3=12	4x2=8	
Extent to which the site is of regional and/ or global significance and priority (see WWF ecoregions, IUCN categories, UNESCO world heritage sites, etc.)	1- no, not a priority 2- yes, low priority 3- yes, medium priority 4- yes, high priority 5- yes, very high priority		5x4=20	5x3=15	5x2=10	
Degree of Degradation at the site (e.g. type of degradation)	1- very low 2- low 3- average 4- high 5- extremely high		4x4=16	4x3=12	4x2=8	
Extent of degradation on catchment and/ or aquifer and any receiving coastal and marine resources and systems	1- very low 2- low 3- average 4- high 5- extremely high		4x4=16	4x3=12	4x2=8	
Cultural or traditional value of the site	1- very low 2- low 3- average 4- high 5- extremely high		5x4=20	5x3=15	5x2=10	
Extent of community management at the site	1- very low 2- low 3- average 4- high 5- extremely high		4x4=16	4x3=12	4x2=8	
TOTAL			**154**	**125**	**87**	
Summary Markings						
Land Issues			**Coastal Erosion**	**Plastic Pollution**	**Open defaecation**	**Animals**
TOTAL			**138**	**102**	**102**	**58**
Marine Issues			**Ocean Pollution**	**Ecosystem Destruction**	**Decline in marine resources**	
			104	**102**	**138**	