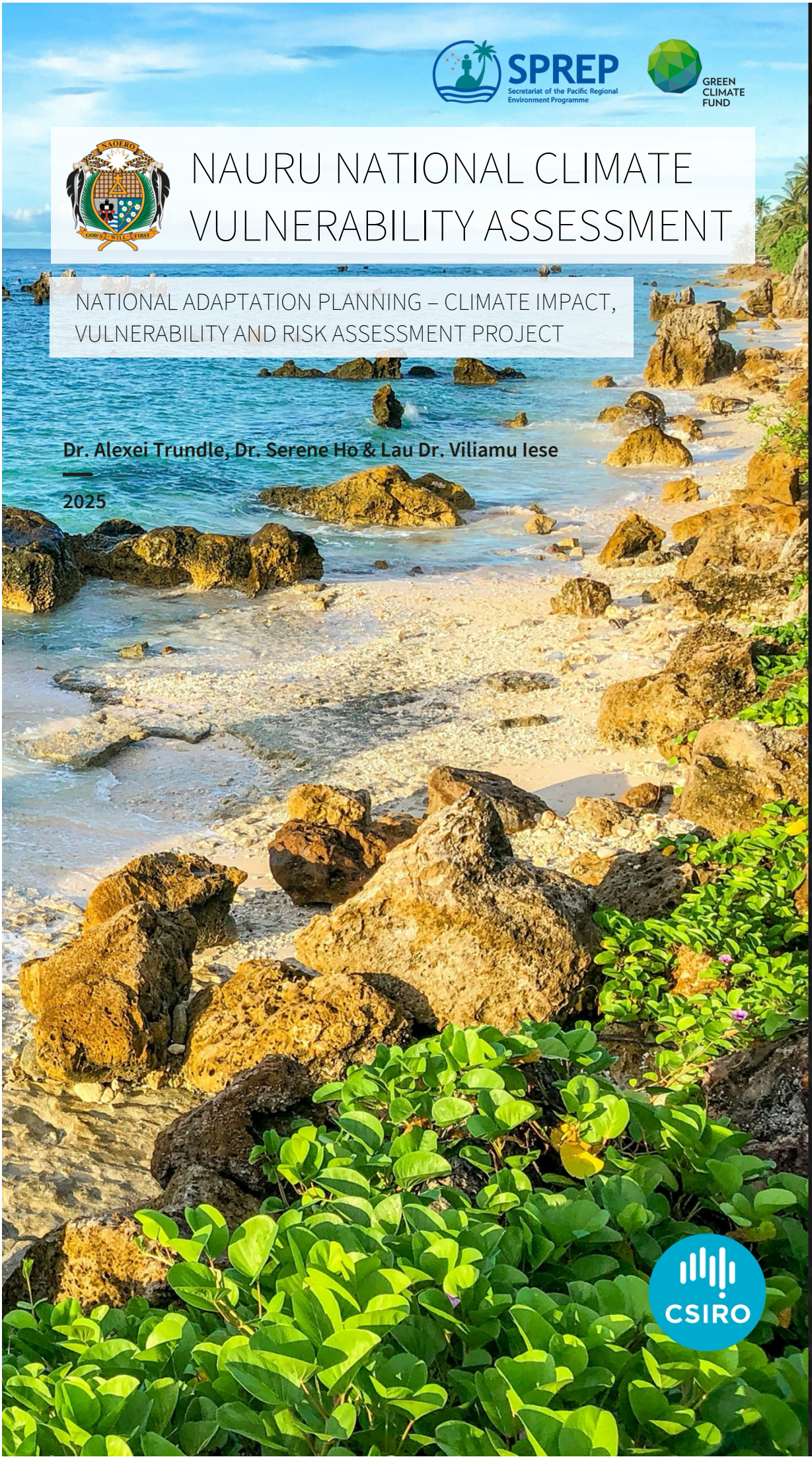

SPREP
Secretariat of the Pacific Regional Environment Programme

GREEN CLIMATE FUND

NAURU NATIONAL CLIMATE VULNERABILITY ASSESSMENT

NATIONAL ADAPTATION PLANNING – CLIMATE IMPACT, VULNERABILITY AND RISK ASSESSMENT PROJECT

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2025

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THE UNIVERSITY OF MELBOURNE

Melbourne Centre for Cities

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Citation

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The authors have sought to ensure the accuracy of the material in this document, but they, the Centre and the University of Melbourne will not be liable for any loss or damage incurred through use of this report.

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Cover Photo: Nauru Island Ring Road View – Winston Chen, 2019 (Unsplash Free to Use License)

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I. INTRODUCTION

This report provides an overview of Nauru's current vulnerability to climate change, as part of a wider national integrated Climate Impacts, Vulnerability and Risk Assessment (CIVRA). The CIVRA is an official Government of Nauru initiative, being developed by a consortium of technical partners led by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO). The project is being facilitated by the Secretariat of the Pacific Regional Environmental Programme (SPREP) and financially supported by the Green Climate Fund.

The Vulnerability Assessment represents a standalone analysis of Nauru's national climate vulnerability. The Vulnerability Assessment draws on the current and future hazards and impacts, which in tandem inform the overarching integrated risk assessment conducted by Deloitte Risk Advisory. Analysis of Nauru's current and future climate hazards and impacts – which are integrated throughout this report – have been conducted by CSIRO's Climate Intelligence Asia Pacific Team. Findings represent current climate vulnerability, however, also consider key dynamic changes that are evident in secondary historical data, as well as wider regional trends, and planned climate adaptation actions that may significantly affect key vulnerability metrics.

THE CIVRA APPROACH

The Intergovernmental Panel on Climate Change (IPCC) frames vulnerability to climate change as "a multi-dimensional, dynamic phenomenon shaped by intersecting historical and contemporary political, economic and cultural processes of marginalisation" (Pörtner et al., 2023, p. 52). Within the CIVRA, climate vulnerability is primarily considered as one of three constituent components of climate risk, alongside climate hazards, and the national current and future level of exposure to these hazards.

However, vulnerability can also be an effective sub-national analytical approach to disaggregate these national climate risks in ways that better express distributional variances in these risk levels sub-nationally. This provides a critical consideration of equity and inequality in risk distribution, enabling targeted adaptation actions that prioritise groups, areas, and system components that most need resilience building and support.

By defining vulnerability as "the propensity or predisposition to be adversely affected", as a function of "sensitivity, susceptibility to harm, and a lack of capacity to cope and adapt" (Pörtner et al., 2023, p. 48), consistent with the IPCC, consideration of vulnerability to climate change is necessarily subjective and contingent upon both historical observations and presumed trajectories of future change. Whilst climate projections can be expressed with some level of certainty (being contingent on emissions scenarios and data quality at the relevant scale), non-climate futures are in many ways more uncertain.

Implementation of adaptation initiatives going forward will, by definition, reduce vulnerability in varying ways, making future projections of vulnerability hypothetical and reflective of inherent, rather than residual, risk. As a result, future possible changes to vulnerability have not been explicitly considered as elements of future risk/opportunity within the CIVRA risk assessment methodology. This contrasts with the climatic variables, which are considered within the corresponding climate hazards report in such a way, consistent with global norms of application of climate projections.

The CIVRA addresses climate risk in a manner as consistent as possible with the methodology being applied within Nauru's National Adaptation Plan (NAP), with the aim of supporting adaptation action development at the national scale. This ensures elements of the CIVRA can be used to directly inform national priorities, including sub-sectors, themes, or domains that are being used within the forthcoming NAP.

In the case of Nauru, current NAP progress indicates that the forthcoming NAP will be a continuation of the 2015 Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction (RONAdapt) in the form of a 'RONAdapt 2.0' (GRN, 2015; RON, 2021). Under the 2015 RONAdapt, six Resilience Goals were proposed: water security; energy security; food security; a health environment; a health people; and productive, secure land resources. A series of Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) priority actions were also put forward and grouped into eleven key sectors.

The CIVRA team, building on in-country consultations with cross-sectoral stakeholders, has refined these sectoral classifications to 9 sectors and domains for the purpose of the integrated climate risk analysis, as shown in Figure 1 below.

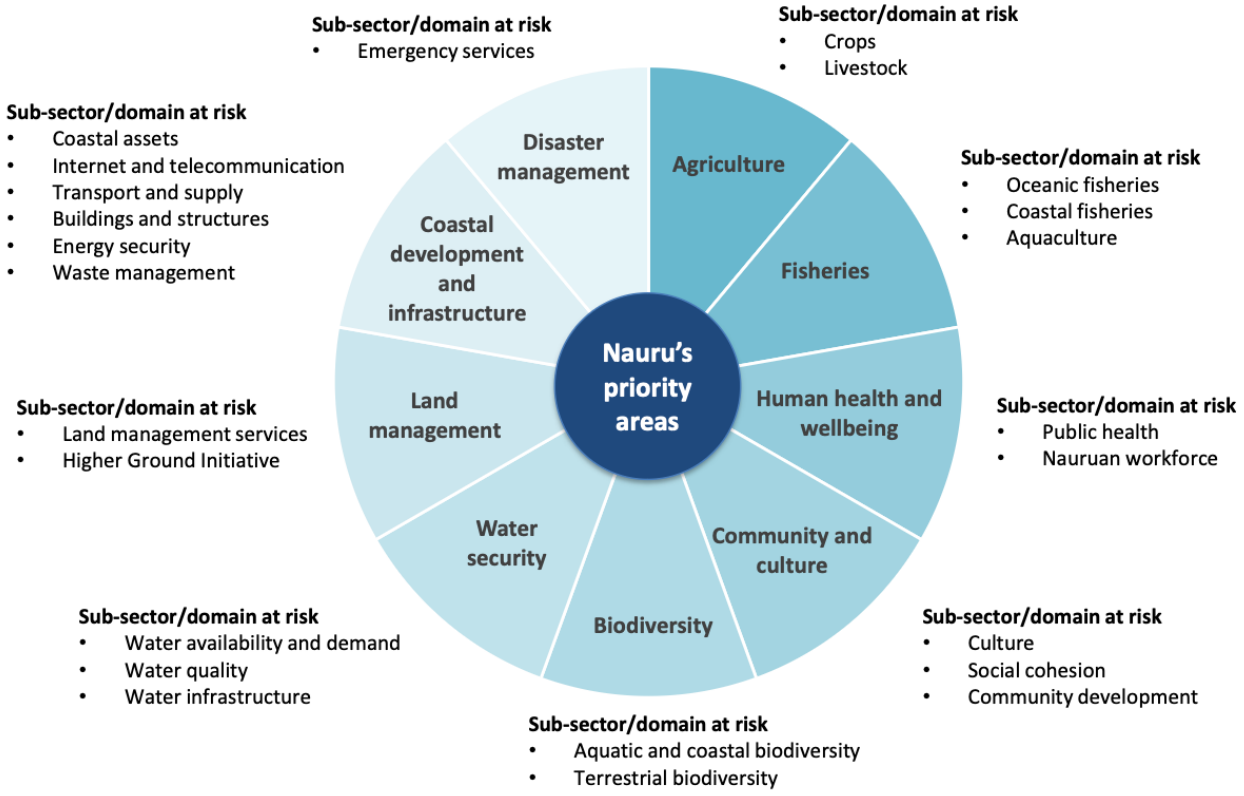

Figure 1: Priority sectors and domains assessed through the CIVRA

As the figure illustrates, the formerly standalone 'energy' sector has been clustered with 'Coastal development and infrastructure', whilst 'education and human development' has been considered under a wider 'human health and wellbeing' category.

Across each of the CIVRA priority sectors and domains, data availability, currency, and quality vary significantly, however in each case a wide range of secondary data sources and reports have been drawn upon. For the Nauru Climate Vulnerability Assessment, central data sources include: the 2021 Nauru National Population and Housing Census (SPC & RON, 2023); 2011 and 2002 National Census Reports (SPC & NBS 2006; SPC, 2012); data from the Nauru Environment Data Portal (SPREP, 2021a); and Nauru's 2021 Draft State of the Environment Report (SPREP, 2021b).

RISK-VULNERABILITY METHODOLOGY

Vulnerability assessments, as noted above, are applied in a range of fields, including climate change adaptation, with a significant variation in methodological approach, as well as the breadth and depth of data considered. In the Pacific context, Council of Regional Organisations of the Pacific (CROP) agencies, United Nations entities, academia, and a range of national departments and sub-national bodies have applied climate vulnerability assessments on both sectoral and spatial bases, ranging from Oceania-wide fisheries analyses (Bell et al., 2011), to socioeconomic hardship analysis (World Bank, 2014), to individual cities and towns (McEvoy et al., 2020).

The climate vulnerability assessment approach here is primarily designed to align with the overarching CIVRA methodology, which is built on the latest IPCC Assessment report cycle's framing of the interconnections between risk, hazards, climate exposure, and vulnerability. Consideration of climate vulnerability has been informed by CSIRO *et al.*'s analysis of climate hazards and associated impacts (2024), as well as in-country consultations by the CIVRA team with government stakeholders and other sectoral representatives.

These have been considered through a sectoral lens, as determined by the National Adaptation Plan development process, which has focused these impacts across key domains prioritised by the Republic of Nauru. Key socio-economic, environmental, and institutional structures and features have then been analysed for each sector in relation to these hazards to assess the relative vulnerability of each sector to the suite of current day climate hazards that Nauru faces, with further consideration given to the potential impacts of both emergent hazards and the potential

for existing hazards to worsen under future climate change scenarios.

Figure 2 provides an overview of the four components of climate vulnerability assessed for each sector. In each case, a 'headline' level of climate vulnerability has been provided, including an overall vulnerability rating of either low, moderate, high, or extreme. This climate vulnerability 'average' is designed to provide an overall level for consideration within the risk assessment process, operating at a national scale in a manner comparable with other national sectoral contexts elsewhere within the South Pacific. Critically it is designed to provide an indication of whether consequences of a similar level of climate hazard exposure across these contexts would be likely to differ within a risk assessment framework.

Disaggregating vulnerability data is also critical for adaptation planning, with 'average' vulnerability levels at the national level often masking sub-national inequalities that must necessarily be understood to target adaptation actions to those that need them most (Nalau et al., 2021; Waters et al., 2023). By differentiating spatial areas, socio-cultural subgroups, and personal attributes such as gender and age, adaptation actions can be targeted and prioritised in a more granular way.

Vulnerable communities can also provide critical insights into the adaptation planning process itself through participatory input, and often exhibit locally-developed informal and community-based adaptive capacities and resilience that can – and should – be supported and scaled up into surrounding communities (Trundle et al., 2019).

This sub-category of vulnerability can therefore be considered directly in the adaptation planning process, beyond the overall sectoral risk management strategies deployed in response to the CIVRA risk ratings and attributes reported elsewhere.

The assessment of climate vulnerability is contingent on consideration of *current* levels of sensitivity and susceptibility to harms and damage from climate impacts, with future socio-economic conditions and non-climate changes at the local scale generally harder to project than anthropogenic changes to the climate system. Additionally, in the context of a changing climate, active adaptation is concurrently occurring – both in the form of institutionally-driven actions, as well community, household, and individual adjustments – resulting in vulnerability 'projections' being confounded by existing responses to observed or expected climatic stimuli (Barnett & Waters, 2016).

Future climate scenarios – as applied, for example, in the climate impacts report for Nauru developed in parallel to this vulnerability assessment – also integrate Representative Concentration Pathways (RCPs) for greenhouse gas emissions with Shared Socioeconomic Pathways (SSPs). The latter is derived from global socio-economic scenarios, considering attributes such as the advancement of sustainable technologies and policies and shifts in globalisation. However, it is not within the scope of the CIVRA project to consider the local implications of these different scenarios over time.

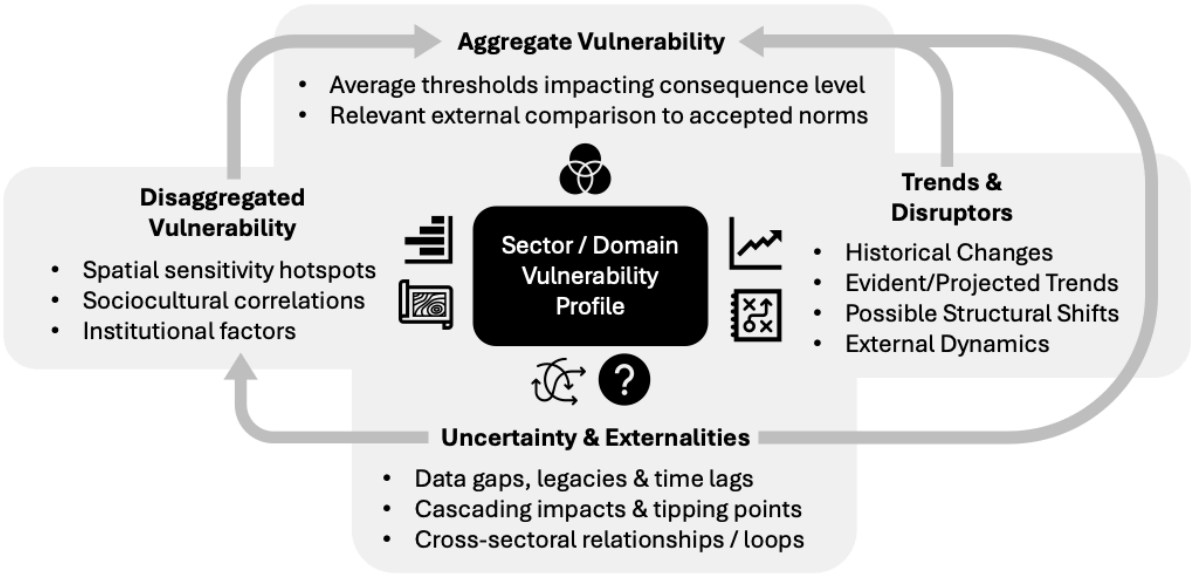

Figure 2: Sectoral Vulnerability Assessment Framework (source: authors)

Instead, the vulnerability assessment approach here has examined recent observed changes in the key variables assessed across each sector. This has included where possible drawing upon earlier records of socio-economic data; in particular, that available in the reports on the 2011 and 2002 National Censuses. These trends have been tabulated in each of the sectoral reports in Section 4, with a focus on shifts that are likely to substantively modify the consequences of observed or projected climate impacts. Any evidence of structural internal or external shifts that may be driving these changes is also included, drawing upon a wider literature analysis conducted as part of this assessment process.

Some consideration has been given to likely near-term future changes, scoped strictly to initiatives, policies, or investments that can be feasibly enacted over the lifespan of the NAP. Examples include significant infrastructure projects (i.e. those being actively constructed or financed), as well as policy directives (such as regional employment visas schemes) and technological changes (e.g. the emergence of low-cost household solar systems). Possible major disruptors have also been flagged that may impact on vulnerabilities but with a lower level of confidence in their occurrence; for instance, rehabilitation of phosphate mining areas for agriculture has been proposed under future phases of the Higher Ground Initiative but does not yet have a feasible financing pathway.

As a final component of the vulnerability framework, uncertainties within and co-dependencies beyond each sector have been flagged as areas that need to be considered as part of any sectoral adaptation planning process.

REPORT OVERVIEW

The remainder of this report is divided into three core sections. The first of these – Section 2 – provides a detailed review of Nauru's historical and regional context, including climatic, geographical, and sociocultural features that provide the foundation for current day climate vulnerabilities. Some detail is also provided on the quality and extent of climatological records, as well as key interannual features and variability. Colonisation in varying forms (both in terms of occupation and more extractive, short-term arrangements) is also examined as a precursory consideration to both the country's formation, as well as the extractive economic processes that continue to define its heavily degraded environmental condition. A second, interrelated consideration is the deep social harms resulting from World War II, which had a devastating impact on the Nauruan populus.

Nauru's socio-economic trajectory over the last century is unique, both within and beyond the Pacific. The middle portion of Section 2 attempts to summarise the extraction of and – in most cases – failure to equitably invest the proceeds from – phosphate, the resource whose exploitation maps closely to the volatile socio-political trajectory of Nauru over the last 50 years. The ongoing environmental, economic, and social consequences of phosphate mining and its associated revenue underpin much of Nauru's national climate vulnerability, in a myriad of negative and positive ways. A high-level overview of current day socio-economic, demographic and cultural characteristics closes out the section, along with some key external connections relating to foreign aid, revenue, and migration patterns.

Section 3 provides a cross-sectoral overview of Nauru's climate vulnerability profile, outlining the data used to inform both the aggregated climate vulnerability ratings, and the more detailed sectoral analysis provided in the subsequent section of the report. An overview of these sectoral vulnerability ratings is also provided in order that the subsequent sector-specific assessments can be contextualised within the wider national profile. The outputs of a composite cross-sectoral vulnerability profile then illuminate sub-national vulnerability 'hotspots' that warrant targeted community-level participatory climate adaptation action planning.

Section 4 provides a detailed sector-by-sector breakdown of climate vulnerability across the nine priority domains set out in Figure 1 above. Each sub-section outlines aggregate vulnerability, local, disaggregated vulnerability levels, trends and step changes through time, and possible externalities and uncertainties in the data. The section includes maps of key variables for each sector and highlights individual enumeration areas that are 'most vulnerable' based on the individually assessed census metrics.

The report concludes with a brief discussion of areas of vulnerability – and, conversely, locally relevant adaptive capacity, that have not been able to be discerned through the assessment process. In some cases, it is recommended that assessment of these elements is included as a preliminary stage in adaptation planning, where they may form a critical role in decision-making and design of adaptation actions.

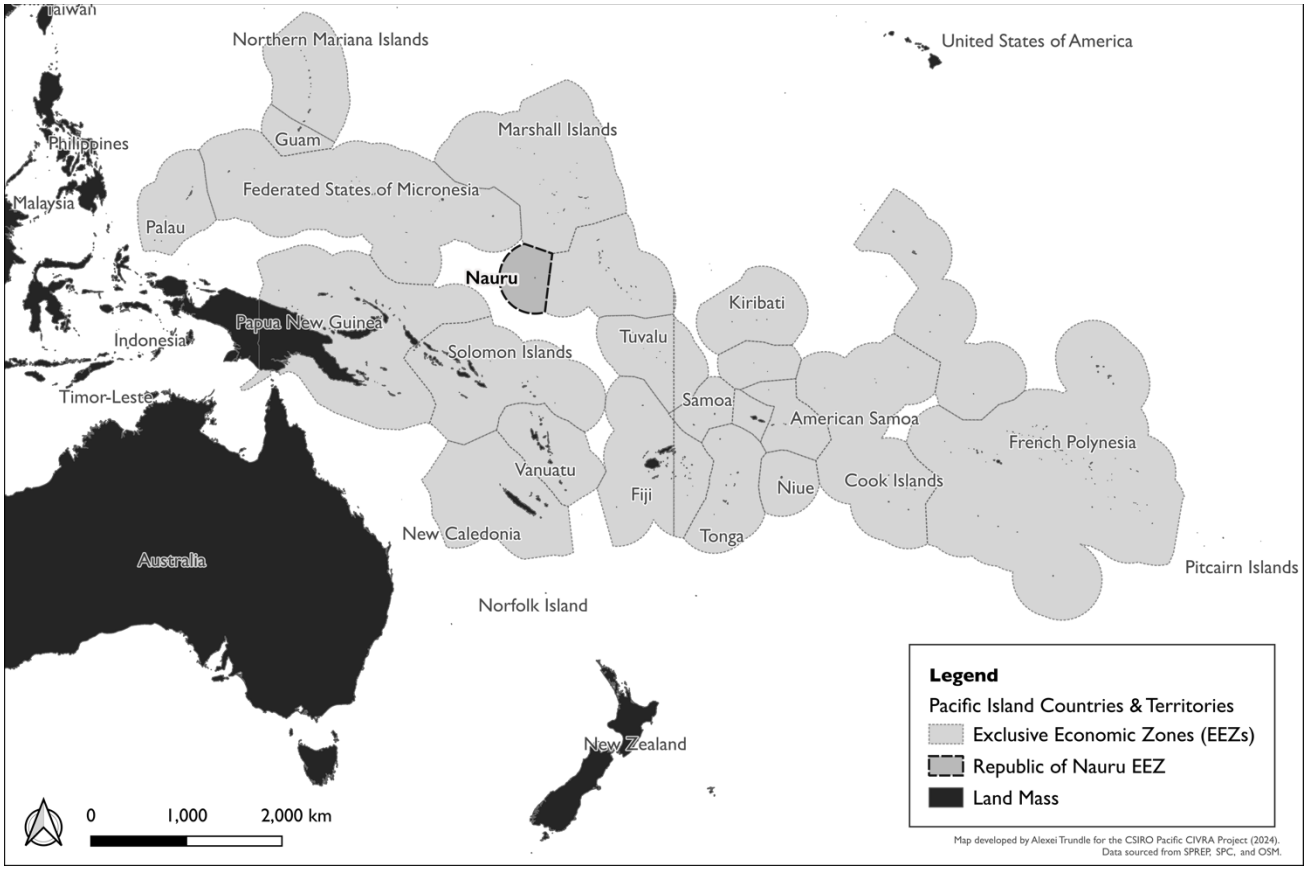

Figure 3: Map of Nauru within the Pacific Region

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II. VULNERABILITY IN CONTEXT

Nauru is one of fourteen Pacific Islands Countries (PICs) and a member of the Pacific grouping of Small Island Developing States (SIDS), which includes a further seven Pacific territories (without UN Member State status) (Manoa, 2017). This grouping of 21 countries and territories is widely cited for its distinct vulnerability to climate change (Barnett & Waters, 2016; Mcnaught et al., 2022; Trundle & Organo, 2023).

This categorisation is a function of its heightened exposure to current and future hazards and impacts, and because of the socio-economic conditions and resource access limitations presented by each state's national circumstance. An overview of the Pacific highlighting the Republic of Nauru is shown in Figure 3.

Of the seven regional groupings considered by the IPCC in the AR6 Working Group II contribution on Impacts, Adaptation, and Vulnerability, small islands were rated as having the highest level of cross-sectoral vulnerability (Pörtner et al., 2023, p. 78). This was a result of severe constraints across areas ranging from governance to finance to indicators associated with technology and socio-cultural attributes at the national scale. A national climate vulnerability assessment must therefore be considered within this wider relative framing, particularly with reference to the limited national financial, technical, and material resources that can be drawn upon in response to major climatic impacts (J. Birkmann et al., 2023).

GEOGRAPHICAL & CLIMATIC BACKGROUND

Located within the Micronesian sub-region of the Pacific, Nauru is one of the world's smallest countries by land mass but has a significant Exclusive Economic Zone of more than 310,000km^2 (D. Harris et al., 2016). Comprising a singular island of raised limestone near the centre of the Pacific Ocean, Nauru's geographic attributes have distinct impacts on its vulnerability to climate change. A raised coral atoll capping an ancient volcanic seamount, Nauru has distinctive topographic and bathymetric features that have defined both its biological and socioeconomic structure.

Nauru is positioned near the southern extent of the Nauru Basin, which stretches from between the Republic of the Marshall Islands and Kiribati's Gilbert Islands cluster to the north, to Solomon Island's most northern reaches around Ontong Java Atoll. This oceanic basin is between 4,000 and 5,000 metres deep,

with much of Nauru's EEZ sitting at the mid-point of that range (Krüger & Sharma, 2008). Nauru's land mass is perched upon an ancient volcanic seamount comprised of basalt, which, following millennia of erosion to sea level, in turn formed a coral atoll cap (Hill & Jacobson, 1989a). This limestone cap is estimated to extend to approximately 500m below sea level, much of which has been dolomitised by sea water, resulting in a complex array of semi-porous and 'concretised' subterranean structures (SPREP, 2021b). At the surface-level this process led to the formation of karsts that were filled with avian guano (sedimentary bird droppings accumulated over several millennia that formed the source of phosphate that has been mined over the last century) (RON, 2003).

A shallow intertidal fringing reef flat extends between 50-300m beyond the shoreline around the island, covering an area of approximately 3.4km^2 (D. Harris et al., 2016), as shown in Figure 4. From this reef area outwards the Nauru shelf descends rapidly but steadily to nearly a kilometre of depth at an average of 1.5 kilometres from the shore, apart from Anibare Bay to the island's east, where the descent is more rapid (Krüger & Sharma, 2008).

This fringing area plays a critical role in nearshore fishing by Nauruan inhabitants (in contrast with elsewhere in the EEZ). Onshore, a narrow coastal area known as 'Bottomside' forms a distinctive lowland fringe around the island, ranging from 100-400m wide and rising to approximately 10m above sea level (Alberti et al., 2017). This area consists of sandy or rocky beaches, followed by a combination of beach ridges or foredunes and low-lying brackish lagoons (ibid). The bulk of human settlements, infrastructure, and the country's road network are situated throughout this lower area.

Bottomside encircles a limestone escarpment rising 30 metres to a central plateau, known as "Topside"; an area of 16km^2 that covers roughly 70% of the island (SPREP, 2021b). As discussed later in this report, the environment of Topside has been heavily degraded throughout the latter half of the 20th Century as a result of extensive phosphate mining, destroying landscapes previously used for agriculture and forest harvesting and habitat, including the indigenous *tomano (iyo/ijo)* tree, which was a critical resource for building, canoe construction, fruit, oil, and noddy bird habitat (Thaman et al., 2009, p. 118).

As shown in Figure 4, most of Topside is now degraded scrubland, interspersed with patches of secondary forest and bare mined sites. Exceptions to this are a series of lagoon areas: Ewa Wetlands, a 20ha area in the north in a 'dried' state; Ijuw-Anabar Wetlands, a 46ha site in the north-east covered primarily in mangrove scrubs; and Buada Lagoon, a body of water surrounded by the only substantive inland settlements to the islands south-west.

Buada Lagoon occupies a depression that extends down to only 5m above sea level, with brackish water covering approximately 5ha, surrounded by a 12ha marshy expanse (used by the local community for various forms of agriculture) (SPREP, 2021b). Despite its reduced elevation, Buada Lagoon is understood to be partially separated from the island's groundwater lens, providing a highly unusual, if modified, ecosystem within the island (Hill & Jacobson, 1989b). Groundwater sources to the north of the island are resilient to saline intrusion, with a similar freshwater lens found to the south of the island) (SPREP, 2021b). However, the central sections of Topside are brackish and unsafe for drinking (ibid).

Analysis of these geophysical conditions at a global or regional scale in risk-based indices does not suggest, on aggregate, a particularly high level of vulnerability to climate change. For example, the WorldRiskIndex cited in the IPCC's AR6 WGII report, ranked Nauru 180th out of 193 countries in terms of the latent level of disaster risk faced at the national scale in 2023 (BEH & IFHV, 2023, p. 59). In another peer-reviewed, 'exogenous' vulnerability index, the Physical Vulnerability to Climate Change Index (PVCCI), Nauru was ranked as one of the three least vulnerable countries out of a cohort of 191, alongside Montenegro and Finland (Feindouno et al., 2020, p. 8). To this extent, Nauru is somewhat atypical in terms of the levels of climate hazard exposure generally associated with both the Pacific Region and Small Island Developing States more generally.

Located 60km south of the equator, Nauru sits at the juncture of the South Pacific Convergence Zone (SPCZ) and Intertropical Convergence Zone (ITCZ), resulting in exposure to regional interannual fluctuations driven by the El Niño Southern Oscillation (ENSO) (Kelman, 2022). ENSO also impacts two other key climatic features: the Western Pacific Warm Pool and the Western Pacific Monsoon. As a result, despite reasonably moderate average monthly distributions of rainfall and average monthly temperatures, significant variations in annual averages of both are evident in historical records (CSIRO & SPREP, 2021).The former is especially distinctive, with fluctuations from 310mm to 4400mm of annual rainfall being observed since 1951, with high and low rainfall years correlating strongly with El Niño and La Niña years respectively (BoM & CSIRO, 2014). The annual maximum daily rainfall in Nauru varies from around 24-349 mm/day over this same period (CSIRO et al., 2024).

Figure 4: Overview of the Geography and Land Use Types of Nauru

Nauru has an average annual rainfall of over 2100mm, with average temperatures ranging from 22°C to 33°C (Fenner, 2018). There is a distinct wet season between December and April with average monthly rainfall above 200mm per month, and 60 percent of annual rainfall occurring during this season (Mcgree et al., 2022). Droughts usually occur during La Niña events when the surrounding sea temperature is cooler than normal for Nauru, resulting in less evaporation, cloud and rainfall (BoM & CSIRO, 2014).

At the seasonal scale of 3-month periods, CSIRO identified that over the last 72 years Nauru experienced three moderate droughts, eight severe drought periods, and eight extreme drought periods. Over a 12-month, annual basis over the same period Nauru experienced two moderate, two severe, and seven extreme drought periods (CSIRO et al., 2024).

Nauru's proximity to the equator negates the risk of cyclonic events – a key climate-related natural hazard that features highly in the exposure profiles of many Pacific Island Countries. However, significant mid-latitude storms have been observed to have major impacts because of wave action and swells extending well beyond the storm cells themselves (CSIRO et al., 2024).

The presence of much of Nauru's built infrastructure adjacent to coastal areas heightens the impact of strong wave action and storm surge events. Nauru's dominant wave direction is from 80°E, with an average significant wave height of 1.31m and average wave period of 10.54s (Mcgree et al., 2022, p. 87).

Locally collected data on temperature extremes are poor, with significant gaps in air temperature records meaning that reanalysis of records, coupled with global measure simulations, has been conducted (BoM & CSIRO 2014, p. 168; see Mcgree et al., 2022). These estimated changes – and uncertainty in their extent – are critical to heat-related mortality and morbidity (M. Loughnan et al., 2012).

Nauru exhibits a high annual level of humidity ranging between 70-80 percent (Fenner, 2018), as a function of its equatorial location, which presents an additional heat health risk (The World Bank Group, 2021). Data on marine temperatures over the last four decades shows a significant number of moderate marine heatwave events occurring over the last decade, with an average of approximately two events per year since 1981 (CSIRO et al., 2024).

MIGRATION, COLONISATION & INDUSTRY

Nauru was first inhabited by Micronesians an estimated 3,500 years ago, with the first contact with Europeans being in 1798, when British merchant captain John Fearn named it Pleasant Island (Connell, 2006, p. 48). Early estimates put Nauru's early population between 1,000 and 1,400 inhabitants at that time, with Fearn observing "at least 300 people in canoes, many more on the beaches, and a great many large sturdy houses" (Viviani, 1970, p. 10).

It was not until the 1830s when regular European contact was recorded, with 'beachcombers' deserting whaling and other ships that frequented the island for food and water (ibid). At this time, Nauruan tribal membership was matrilineal, with age-based classes divided between *Temonibe* elders and younger *Amengename* (Connell, 2006, p. 48). Newer arrivals were granted status as a new class, *Itiso*, which attached them as residents and workers to a particular tribal chief (ibid). Although much of the island's history through the remainder of the 19th century is contested, records suggest a growing number of penal escapees occupying the island drove an escalation of violence, along with sporadic trade, in complex interplay with the twelve Nauruan clans (Storr, 2017).

In 1888 the German government annexed the island of Nauru, incorporating it into the Imperial German Protectorate of the Marshall Islands (Viviani, 1970, p. 15). The process of establishing colonial control included the disarmament of each of the Nauruan clans, with 765 firearms recorded as being taken from the island's then inhabitants (Storr, 2017, p. 84).

Initial German interests in Nauru focused on trading copra, alongside wider geopolitical considerations, with little attention paid to mining of mineral deposits. However, in 1899 an Australian, Albert Ellis, tested a rock sample in Sydney and identified the high levels of phosphate contained within (Tate, 1968, p. 177). Ellis and his company formed the Pacific Phosphate Company as a British corporation and negotiated a 99-year mining lease from the German company that was administering Nauru in 1906 (ibid).

Nauru was surrendered to Australian forces near the beginning of World War I (Turner, 2007, p. 898). Following heavy negotiation by New Zealand and Australia, the League of Nations Pacific Mandate of 1920 saw Nauru assigned to the "British Empire" rather than Great Britain, being jointly controlled by Britain, Australia, and New Zealand (Tate, 1968, p. 178).

Under this agreement a Board of Commissioners was formed, comprising members from each of the three countries, with phosphate proceeds distributed

between these three parties under the guise of the British Phosphate Corporation (BPC). Records show that it was from this time that Nauruan leaders such as Head Chief Timothy Detudamo began to object directly to the failure to share phosphate wealth with the Nauruan people, who were themselves neither party to nor mentioned in the Nauru Island Agreement itself (Pollock, 2014, p. 110).

World War II saw eventual occupation of Nauru by Japanese forces, who exiled two-thirds of the island's population to Chuuk (in the now Federated States of Micronesia), of which only 40 percent survived to return home (Pollock, 2014, p. 116). This deep social disruption compounded physical damage to the island by the Japanese – who destroyed Nauruan houses, schools and churches, with the aim of deporting the entire population – and subsequent bombing by American forces (Pollock, 2014, p. 116; Viviani, 1970, p. 85). Following the conclusion of World War II, Nauru became a United Nations Trust Territory administered by Australia, under an arrangement centred around the country's 42 percent share of phosphate extracted by the BPC (Connell, 2006, p. 48).

Phosphate mining accelerated through the middle of the 20th Century to the point that the Australian Government began formulating plans to fully relocate the population of Nauru to Curtis Island of the coast of Queensland in the early 1960s, in order that the entirety of the surface of Nauru could be exploited by the BPC (Tate, 1968, p. 181). However, in contrast to the earlier Pacific Mandates, the United Nations Trusteeship Council set out an explicit objective of self-government for Trust Territories (Gale, 2019, p. 744). Despite Australian Government prevarication, including refusing to set a target date when requested by the Trusteeship Council in 1961 ((Viviani, 1970, p. 150), a co-ordinated campaign led by Nauruan leader Hammer DeRoburt saw the achievement independence in 1968 (Gale, 2019, p. 744).

AN EXTRACTIVE ECONOMY

At the time of independence 30 percent of Nauru's land, encompassing most of the southern half of Topside outside of the Buada Lagoon area and a stretch along Topsides western extent, had been mined out (Gale, 2019, p. 738). Up until this point (from 1920-1967), the only direct proceeds from phosphate that were directed to Nauruans had been in the form of royalties held within Australian-controlled trust funds, including a 'Community Long Term Investment Fund' and a 'Rehabilitation Fund' (Pollock, 2014, p. 112). Significant fees were extracted from these funds by the Australian administrators to cover the costs associated with running the island, without effective oversight nor transparency in investments. At independence, the funds that were held in trust by the newly formed Nauruan Government were valued at $A111 million (Cox, 2009, p. 182).

The rights to extracted phosphate were nationalised at this time, with the total mined-out area of Nauru doubling over the next three decades to 1998, at which point primary reserves were effectively exhausted (Pollock, 2014, p. 112). However, much of the royalties accumulated through national trusts prior to Independence had been depleted, largely as a result of external mismanagement (Cox, 2009, p. 182). In 1993, Australia agreed to pay $A107 million for investment in Topside's rehabilitation through the Nauru/Australia Compact of Settlement Treaty, with New Zealand and the United Kingdom paying a further $A12 million (Pollock, 2014, p. 109).

Income at the household level also saw dramatic shifts in the post-independence landscape, with differing social, economic, and cultural implications. By some estimates per capita income in 1975 had reached US$31,000 (equivalent to $181,000 today), one of the highest levels globally at that time and significantly higher than any other Pacific Island Country or Territory (Connell, 2006, p. 48).

Significant inequalities in the distribution of royalties existed between landowner groups because of familial tribal and class membership and status (Pollock, 2014). However, with free education, utilities, and healthcare, as well as government-subsidised housing and no tax, households were able to operate "effectively [in] a comprehensive welfare state" (Connell, 2006, p. 50).

The exhaustion of phosphate resources through the 1990s saw GDP decline by 5.9 percent annually until it reached a per capita income level of US$2,830 in 1999 (Connell, 2006, p. 54). Following the collapse of mining revenue, the only substantive revenue stream that emerged through the 1990s was purse seine tuna fishing; funds distributed through the regional Forum Fisheries Agency (FFA) following signatory of the Nauru Agreement in 1982 (Pretes & Petersen, 2004, p. 300).

In 2014 Nauru remained the Pacific Island Country with the highest level of Official Development Assistance (ODA) relative to Gross Domestic Product, with Australia alone providing one-fifth of domestic revenue in 2013-14 (Arrowsmith & Parker, 2015, p. 8). However, the agreement to support an Australian offshore asylum-seeker processing camp – referred to as the Regional Processing Centre (RPC) in 2012 as part of the Australian Government's so-called 'Pacific Solution' resulted in a sustained and significant revenue stream for the country (Maclellan, 2020). Continued income

from offshore tuna fishing and the RPC saw Nauru being re-classified once again as a high-income country in 2020 (albeit not at the levels reached in the late 1970s), with government revenue having doubled since 2014 (Howes & Surandiran, 2021). As of 2023, Nauru's Gross National Income (GNI) per capita has reached US$22,090, comparable to that of Greece and the Slovak Republic (World Bank Group, 2024).

SOCIO-DEMOGRAPHIC CHARACTERISTICS

Nauru is a fully urbanised country and has been classified as such since the first national census in 1921 (NBS et al., 2009), being the only Pacific SIDS to formally lack rural areas (Trundle, 2020). As discussed above, several factors (including forced in- and out-migration) led to significant fluctuations in population size in the interwar period, however recent growth rates have slowed significantly, as shown in Figure 5.

An additional notable impact on Nauru's population levels was an influenza pandemic around 1920 that was recorded as reducing the population by nearly 1,000 people (NBS et al, 2009, p. 3). Current United Nations demographic projections, produced by the UN Department of Economic and Social Affairs (UN DESA), suggest that population growth will continue at a similarly low rate to reach 11,454 in 2030, before peaking slightly thereafter and falling to 11,337 by 2050 (UN-DESA, 2018).

These differ significantly from analysis in the Nauruan 2021 National Census, which estimates a 2050 peak of near 15,000 (SPC & RON, 2023, p. 117).The only area to see a significant population decline over the last two decades is Location (an annex of Denigomodu District), primarily because of the cessation of phosphate mining (with Location housing most of mine's employees) (SPC & RON 2023, p. 12).

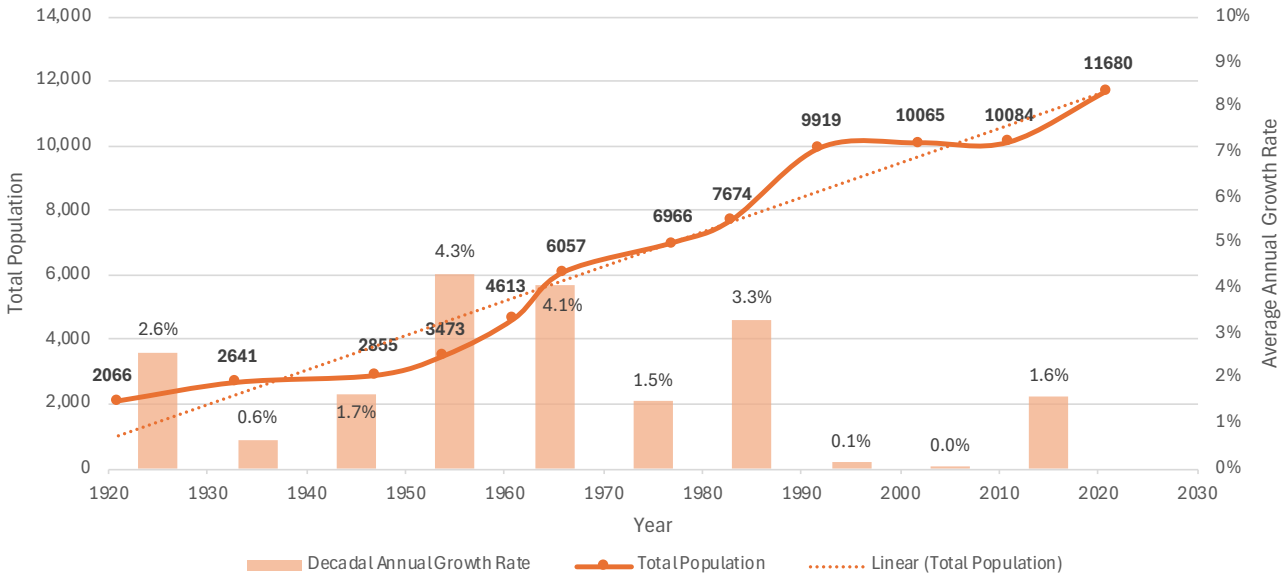

Figure 5: Population growth in Nauru over the last 100 years (source: author)

More specific elements of the sociocultural and demographic profile of the Nauruan populous are detailed in the sector-specific chapters of the report below, however some overarching demographics are summarised here. Beyond the significant historical fluctuations noted above, Nauru has a particularly young population, with 38 percent of the population younger than 15 years of age in 2021, whilst only 4 percent were 60 years or older (SPC & RON 2023, p. 16).

Almost all of the inhabitants of Nauru were born there – 92.1 percent in 2021 – with a further 2.4 percent born in Kiribati, followed by 2.2 percent born in Fiji and 1.2 percent born in Australia (SPC & RON 2023, p. 49). Life expectancy is the lowest out of any Pacific Island Country or Territory, being only 60.9 years at birth for men and 67.1 years for women in 2021 (ibid).

In 2021, 89.2 percent of households received wages or salaries, with one-third receiving income from land leases, and 12.2 percent receiving income from pensions or retirement benefits (SPC & RON 2023, p. 68). Nearly one-third of households were involved in fishing (20.6%), particularly in the districts of Anetan, Ewa, and Denigomodu (excluding Location), whilst nearly half of the households in Anetan raised livestock.

Only 5.2 percent of households were found to be growing food crops, whilst 9.5% of households engaged in catching noddy birds, a customary food source (ibid). Employment heavily centres on the public service, state owned enterprises, and the RPC, with limited private sector enterprise (Arrowsmith & Parker, 2015).

Literacy in Nauru is high, with 89.6 percent of the population aged 15 and older being literate as of the 2021 census (SPC & RON 2023, p. 58). More than two-thirds of households spoke only Nauruan at home, of which slightly more than half – 52.4 percent – could read and write in the language (ibid).

School attendance rates of primary school aged children were reasonably high, with 81.1 percent of children aged 7-12 attending school. However, this number reduced significantly for secondary schooling ages, with only 59.5 percent of children aged 13-18 attending regularly. Of the total populated aged 15 and over, only one quarter had completed the final two years of secondary schooling, with 5 percent of the national population having some form of tertiary qualification (primarily TVET, Diploma, or Certificate levels) (SPC & RON 2023, p. 56).

CONTEMPORARY TRENDS & EMERGENT NON-CLIMATE CONTINGENCIES

The heavy dependence of Nauru's economy on fisheries licensing, foreign aid, and dividends from visas associated with the Regional Processing Centre present high levels of future risk that could impact significantly on the country's overall vulnerability to shocks and stresses. The RPC, which has had varying levels of domestic support, along with a history of partisan political support in Australia, remains a contentious and tenuous core element of government revenue.

At the same time, foreign aid is increasingly becoming contingent on loan facilities and financial structures that are extremely limiting in terms of small-scale economies such as Nauru, which would require extremely high levels of investment to establish conventional small island pathways such as tourism that are present elsewhere in the Pacific.

Increasing geopolitical competition in the Pacific, however, does present an opportunity for increased levels of foreign aid, at least in the short term. The inclusion of Nauru in Australia's Seasonal Worker Programme may also introduce a new substantive revenue stream however to date the number of participants has been low, with only twenty-five Nauruans active in the Pacific Australia Labour Mobility (PALM) Scheme as of June 2024 (DEWR, 2024).

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III. CLIMATE VULNERABILITY OVERVIEW

As set out in Section 1 of this report, the CIVRA process identified nine sectors or domains that will be prioritised in Nauru's National Adaptation Planning process. Section 4 goes through each sector in detail, providing rationales for vulnerability ratings, as well as outlining key evidence and data relating to each of the elements of vulnerability (aggregate, disaggregated hotspots, currently evident changes and potential disruptions, and uncertainties and externalities unable to be considered in this report). However, a collective overview is provided here in order that each of the sectoral sub-components can be contextualised at a national scale.

SECTORAL VULNERABILITY SUMMARY

Compared with many other Pacific Islands Countries and Territories, Nauru currently faces fewer and less intense disaster-related hazards, including climate-related shocks and stresses as discussed in Section 2. However, consideration of climate vulnerability, particularly in relation to rainfall variability, significantly increases the consequences of existing exposures to climate hazards, with implications for future climate change. These heightened aggregate vulnerabilities are an outcome of existing infrastructure deficits, as well as the wider structure of Nauru's economy and legacies of colonial and commercial exploitation of land, the biosphere, and traditional socio-cultural systems.

At a sub-national level, disaggregated vulnerability is also exacerbated by wide inequalities relating to economic capacity, land rights (and associated compensation), and levels of skill, education, and health and wellbeing. Observable trends and near-term potential step-shifts, as well as uncertainties and relevant externalities, have also been considered across each sector, as shown in

Table 1 below.

Two sectors are classified as extremely vulnerable at the national scale in Nauru: water resources and health and wellbeing. Although elaborated on in subsequent sections of this report, it is notable that the two sectors are closely interconnected in several ways.

Potable water infrastructure systems, for instance, are highly fragmented, with privately-owned rainwater tanks and associated collection systems in varying states of disrepair, whilst centralised desalination supply facilities are both energy intensive and expensive.

High levels of rainfall variability, as discussed in Section 2, correlate with drought being the most frequent climate-related hazard impacting on households nationally in the last ten years, whilst historical droughts have been attributed to major crop failure events, driving uptake of imported low nutrition food.

Table 1: All Sector / Domain Vulnerability Summary

CIVRA Sector / Domain for National Adaptation Planning	Aggregate Vulnerability	Disaggregated Vulnerability	Trends/Future Disruptions	Uncertainties, Externalities
Water Resources	Extreme	Extreme	Moderate	High
Health & Wellbeing	Extreme	Extreme	High	High
Agriculture	Moderate	High	Low	Moderate
Fisheries & Marine Resources	High	Extreme	Moderate	Low
Disaster Management	Moderate	High	Low	Low
Coastal Protection & Infrastructure	High	Extreme	High	Low
Biodiversity & Environment	High	Extreme	High	High
Land Management & Rehabilitation	Moderate	High	Low	Moderate
Community & Culture	High	High	Extreme	High

With nearly one-third of all households lacking sealed sanitation facilities, and many household and institutional septic systems having fallen into disrepair, feedback loops between sanitary pollution and limited groundwater sources have exacerbated sectoral vulnerabilities relating to health and wellbeing. Examples of the heightened sensitivity of WASH-related systems include recurrent E. coli outbreaks, a key indicator of faecal contamination in freshwater sources. The intrusion of salt water into these same water sources also increases Nauru's susceptibility to a range of adverse health conditions such cardiovascular disease, with likely implications for maternal and child health (Berrang-Ford et al., 2021; Bowen et al., 2024).

A broader suite of health-related vulnerabilities stem from nutrition and dietary issues, with high levels of comorbidities – driven by difficulties in accessing fresh and nutritious foods – severely compounding the health impacts of a range of climate-related hazards. Variability in water availability puts further pressure on nascent efforts to grow fresh produce locally, with drinking water being prioritised in historical periods of drought. Limited capacity at the national hospital also results in a higher overall level of sensitivity to the impacts of climate hazards, with access to the hospital itself also prone to being impacted by floodwaters (Morris, 2022, p. 565).

Sectors associated with ecosystem services (Agriculture, Fisheries & Marine Resources, and Biodiversity & Environment) have been assessed at the national scale in relation to their current condition, however it is important to note that each has been severely degraded and highly modified over the past century, as discussed earlier in Section 2. However, given their currently degraded state, their propensity to be further adversely affected by climate change is somewhat mitigated. Nonetheless a focus on rehabilitation and adaptation through nature-based solutions is not only likely to be extremely impactful from an adaptation planning perspective but has wider potential to enhance cross-sectoral resilience (through, for example, re-enabling traditional cultural practices and livelihoods).

CLIMATE VULNERABILITY DATA

A wide range of data were assessed across each sector, including government reports and studies, peer-reviewed academic publications, and in-country interviews and workshop outputs from key stakeholder representatives. A summary of key evidence has been provided in the sectoral vulnerability summary tables provided in Section 4 as part of the rationale for each sector's overall vulnerability rating.

The core data examined at the sectoral level, however, was primarily derived from the 2021 National Population and Housing Census, which was compiled and examined spatially across Nauru. A summary of key census variables that were used throughout Section 4 is provided in Table 2 below, with shading indicating the number of subsidiary categories reported on.

As shown in Table 2, more than 100 variables have been analysed across eight of Nauru's nine priority sectors, including 5 subsidiary elements of employment and income (P34). Although household variables were not able to be disaggregated by gender, all population variables have been separated between men and women, as well as considered in aggregate (P01, P34, P17, and P12a-f).

As a function of the focus of the census questionnaire, variables in the sectors relating to Land Management and Biodiversity & Environment were limited; data gaps are acknowledged in the respective sub-sections of this report. Other spatial inputs include the distribution of nationally significant infrastructure (such as schools, health facilities, and utilities), as well as evidence of climate hazard exposure (the latter being partially evident at the household level through the census data summarised below).

Census and other variables can be grouped into three categories that affect the level of vulnerability of each locality:

- Factors that increase the **sensitivity** of households or individuals to climate impacts (e.g., persons who have a disability or lack income);
- Factors that make households or individuals more **susceptible** to these impacts (e.g. those dependent upon private rainwater tanks in the case of drought); and
- Factors that reflect levels of individual, household, or community **adaptive capacity** (e.g. those who did not take preventative measures following a natural disaster, or don't identify with a Nauruan tribal group).

Table 2: Census data extracted by Sector / Domain (shading designating number of sub-variables assessed)

Code	2021 National Census Variable Description	Water	Health	Agri-culture	Fisheries	Disaster	Coastal	Bio-diversity	Land	Culture
Housing										
H01	Type of Living Quarters						✓			✓
H02	Wall Materials						✓			
H06	Number of Bedrooms						✓			
H08	Material of Roof		✓				✓			
H32	Appliances						✓			✓
H36	Disasters in Last 10 Years					✓		✓		
H37a	Post-Disaster Action					✓				
H37b	Non-Preparedness Rationale					✓				
Water and Sanitation										
H09	Guttering	✓	✓				✓			
H10	Downpipe/Gutter Condition	✓	✓				✓			
H12	Drinking Water Source	✓								
H13	Cooking Water Source	✓	✓							
H14	Groundwater Use	✓	✓							
H17b	Downpipe Disrepair	✓								
H18a	Water Supply Failure	✓	✓							
H18b	Shared Water Supply									
H19	Drinking Seawater in Drought		✓							
H20	Septic / Sewerage Facilities		✓				✓			✓
H30	Waste Disposal		✓				✓			
Communications and Energy										
H23	Cooking Fuel						✓			
H24	Kitchen Type						✓			✓
H25	Electricity Source						✓			
H33b	Internet Access						✓			
H33a	Mobile phone Access						✓			
Agriculture and Fisheries										
H39	Crop Production		✓	✓				✓		
H41	Fruit Production		✓	✓				✓		
H43	Livestock Production			✓				✓		
H38	Catching Noddy Birds			✓				✓		
H46	Deepsea Fishing				✓			✓		
H47	Involvement in Fishing		✓	✓	✓			✓		
Economy										
P34	Employment and Income									✓
Food Insecurity										
H51a	Insufficient Food		✓	✓						
H51b	Poor Nutrition		✓	✓						
H51g	Hunger		✓							
H51h	Whole Day(s) w/o Food		✓							
Demography										
P01	Ethnicity									✓
P17	Language									✓
Disability										
P12a	Difficulty Seeing									✓
P12b	Difficulty Hearing									✓
P12c	Mobility Difficulties									✓
P12d	Difficulty Remembering									✓
P12e	Self-care Difficulties									✓
P12f	Communication Difficulties									✓

LOCAL VULNERABILITY HOTSPOT SUMMARY

At the sub-national scale vulnerability has been disaggregated through analysis of National Population and Housing census variables as elaborated on in Section 1, with sectoral summaries provided in further detail in Section 4. In addition to these sector-specific findings, an overarching cross-sectoral vulnerability map has been developed so that those communities that are most vulnerable to climate change impacts can be prioritised at the local scale, as shown in Figure 7. This output combines a subset of 22 socio-economic, demographic, and built environment related variables for households in the decile (i.e. top or bottom ten percent) most vulnerable to climate impacts. The model used to develop this national vulnerability overview is shown in Figure 6 below.

As Figure 7 on the following page shows, even cross-sectoral climate vulnerability varies significantly at a sub-national scale, despite the compilation of a wide range of variables. Notable spatial hotspots include the portion of Aiwo inland of the Island Ring Road to the north of the Phosphate Treatment Centre (Aiwo EA4), which had the highest vulnerability rating overall.

Despite not recording previous impacts from coastal inundation this community measured poorly in terms of measures of adaptive capacity, with nearly half of all households going without food for a day or more in the last twelve months and more than one-third of households resorting to drinking seawater during periods of drought. A lack of money or other resources was attributed by four-in-five households in this community as the reason for their households lacking access to nutritious food.

In contrast, the eastern-most section of Anetan (Anetan EA3) is not only highly vulnerable to climate impacts but is also one of Nauru's most climate exposed communities, facing regular inundation from storm surges and king tides. Although these current-day climate impacts are not directly included in Figure 7 above, the heightened susceptibility to inundation consolidates the heightened level of localised climate risk faced by this community. These households are distinctive due to their high levels of engagement in more traditional subsidence livelihoods activities, with nearly two-thirds of households fishing regularly, one-in-five raising livestock, and one in six catching noddy birds on a regular basis.

Every enumerated household in Anetan EA3 stated that they did not take preventative actions post-disaster, despite the high levels of exposure discussed above, with 82 percent responding that this was because there was "nothing that they could do". Four in five households also reported not eating healthy or nutritious food due to limited resources.

Two areas of the Location section of Denigomodu District – Location Enumeration Areas (EAs) 3 and 4 – were also identified as vulnerability hotspots. Although only partially exposed to storm surge (21% and 25% of households respectively), both EAs had high levels of inhabitants with seeing, hearing and mobility difficulties. Seven percent of Location EA3's inhabitants identified as having difficulty seeing, for instance, well above the national average of 2.7 percent. More than a quarter and a fifth of each respective locality's inhabitants didn't identify with a Nauruan tribe, whilst eight percent of Location EA4 inhabitants were unemployed and looking for work.

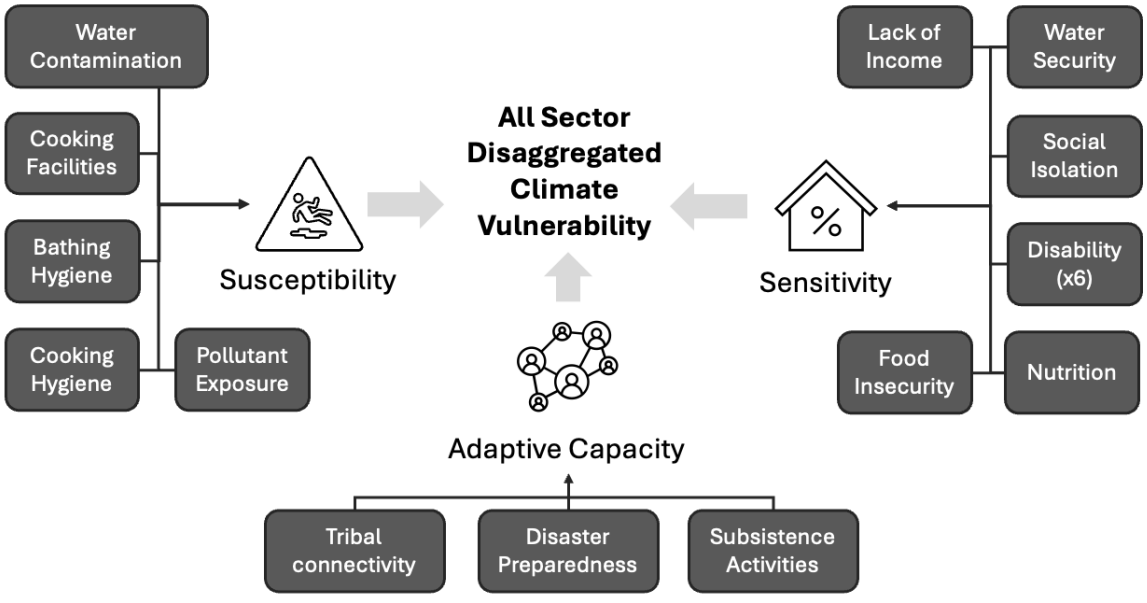

Figure 6: All-Sector Climate Vulnerability Model (source: authors)

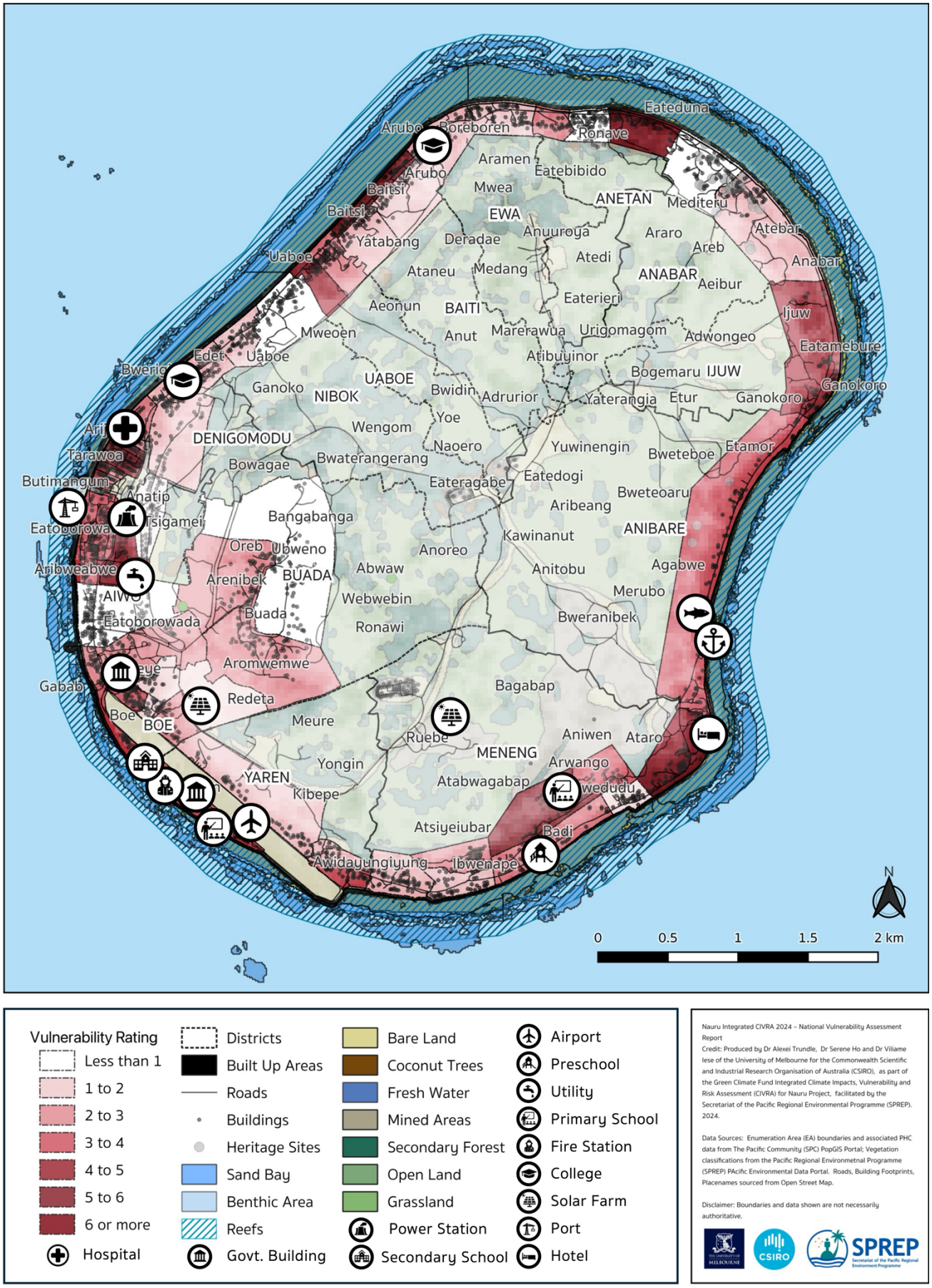

Figure 7: All-Sector Climate Vulnerability Map of Nauru (source: authors)

More than 86 percent of households in Location EA3 lacked a sealed sewerage system, compounding existing risks associated with storm-surge exposure.

Meneng EA1, covering the district's northern coastal extent, was also rated as highly vulnerable, primarily because of severe food and water insecurity. Almost all households in the locality, 97 percent, reported not taking preventative measures following recent disasters, with more than three in four households not eating for an entire day due to food insecurity, and four in five not eating healthy or nutritious food due to a lack of income or other resources. One-third of households were also reliant on groundwater for bathing; risks compounded by nearly one-in-four households lacking sealed sanitation. Meneng EA3 was also highly vulnerable, with slightly higher water insecurity (90 percent of households having water supplies that dried up, compared with 77 percent). However, this community, located inside the Island Ring Road to the west of EA1, had significantly worse sanitation conditions, with 92 percent of households lacking sealed sewerage facilities or septic tanks.

Baitsi EA1 encompasses the entirety of the district's coastal extent, including properties on both sides of the Island Ring Road. Although two-thirds of dwellings have rainwater tanks 93 percent of households stated that their water supplies dry up, with half of all households lacking guttering and a quarter of those that did have guttering stating that it needed repair. Consequently, 14 percent of households reported having to drink non desalinated sea water in periods of water scarcity. Nearly one-third of households did not have access to the internet.

TRENDS AND FUTURE DISRUPTIONS

The prevalence of existing comorbidities, as well as the country's high levels of dependence upon imported food goods, means that external risks such as pandemics, and more indirect potential impacts to global supply chains, present the most likely source of external disruption to Nauru's existing climate vulnerability. The biggest likely impact of these external vulnerabilities is to the health and wellbeing sector, which already faces acute vulnerability levels at the national scale. However, pressures on existing cultural practices and community structures – features which have demonstrated remarkable resilience through profound disruptions due to colonisation, global war, and severe environmental degradation – remain the biggest threat to Nauru's overall adaptive capacity. Previous attempts to fully relocate the Nauruan population, although ultimately unsuccessful, highlight how potentially damaging any dilution of these sources of community resilience may be. At a smaller scale, the dwindling material sources for supporting cultural practices – from noddy birds to remnant traditional outrigger canoes – alongside a steady reduction in engagement in local food production and fishing over the last two decades demonstrates ongoing pressure on current sources of community and cultural strength.

Shifts in vulnerability attributes over time have been shown in the tables provided in Section 4's sectoral analysis where possible, drawing upon data from 2011 and 2002 census records. However, the most fundamental shift over that period, as shown in Figure 5, has been a 16 percent increase in Nauru's total population, following a period of relative population stability since 1990. From a climate vulnerability perspective, this steady increase in total population continues to further pressure limited local supplies of land, water, further stretching inadequate services.

UNCERTAINTIES AND EXTERNALITIES

Uncertainties relating to vulnerability have been expressed here primarily in relation to key variables and data sources that were unavailable for this assessment but are considered to have a critical impact on either sectoral or more generalised climate risk ratings. The overall condition of Nauru's groundwater, in terms of saline ingress, contamination from sewerage and other pollutants, and capacity to be drawn down upon for household and other uses, was one such uncertainty with critical implications for both the water resources sector and for health and wellbeing. Data relating to human vulnerability to extreme heat impacts was another area that was noted to be highly likely to have worsening impacts under future climate scenarios but was not able to be linked to sources such as hospital records (with no references to extreme heat impacts in national census consideration of disasters experienced by households over the last ten years).

The largest uncertainties, however, relate to external financing of both development programs – such as the prospective elements of the Nauru Water and Sanitation Master Plan – and other revenue streams, most critical the Regional Processing Centre for refugees, and indirectly the support of the regional purse seine fisheries licensing process. Other potential disruptions to community and culture relate also to international movements through both seasonal worker programs and other migration initiatives, as well as the nascent penetration of widespread internet access across the island's communities (with mixed community and cultural outcomes).

IV. SECTORAL VULNERABILITY

4.1 WATER RESOURCES

Water resources – and the periodic lack thereof – is the domain that presents the highest level of climate vulnerability for Nauru under present conditions. With limited surface water in the form of brackish lagoon systems, and the regular historical occurrence of droughts, the impacts on ecosystems, households, and the economy have been widespread over the last 100 years. As shown in Figure 8, this exposure is not evenly distributed across the island, but irregular rainfall has nonetheless impacted two-thirds of households across the island in the last decade, more than any other climate hazard (SPC et al., 2023, p. 100).

An overview of the water sector's climate vulnerability rated in aggregate, by key hotspots at a sub-national level, and in relation to potential future changes and uncertainties, is shown in Table 3 below. As shown in the table, both aggregate and disaggregate vulnerability levels are extreme, considering both poorly maintained and fragmented water infrastructure systems, fragile and polluted groundwater systems, and a patchwork of private rainwater storage systems in varying levels of disrepair.

Table 3: Water Resources Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	Extreme	➢ Water shortages relating to irregular rainfall impacted 2/3 households over the last decade ➢ Collapse of agricultural initiatives, ecosystems in previous droughts ➢ Widespread dependence upon poorly maintained private rainwater collection infrastructure ➢ Limits to desalination plant production, with previous instances of emergency water importation	• 2021 National Census: Water scarcity (H18a) • Integrated Water Resource Management Diagnostic Report – Nauru (SOPAC 2007) • Rapid Biodiversity Assessment of Nauru (SPREP 2014)
Disaggregate Vulnerability	Extreme	➢ Households in locales resorting to drinking saline seawater in drought ➢ Poor maintenance of private tanks ➢ Localised contamination issues	• 2021 National Census: Drinking seawater in drought periods (H19) • Nauru 2021 State of the Env. Draft Report
Trends & Future Disruption	Moderate	➢ Ongoing risk of the occurrence of drought (although reduced) with ENSO being the key short-term factor in water availability ➢ Various water supply & sanitation initiatives proposed but unfunded	• CSIRO et al. 2024 Nauru Climate Impacts Report • 2022 Nauru Water & Sanitation Master Plan
Uncertainty & Externalities	High	➢ Unclear risk to freshwater lens in groundwater, with Buada Lagoon potentially exposed to sea level rise ➢ High levels of interannual variability ➢ Changes to ENSO are uncertain (La Niña correlating to more droughts)	• Jacobson & Hill (1987) vs. Alberti et al. (2022) • CSIRO et al. 2024 Nauru Climate Impacts Report • Nauru Climate Risk Profile (WBG 2021)

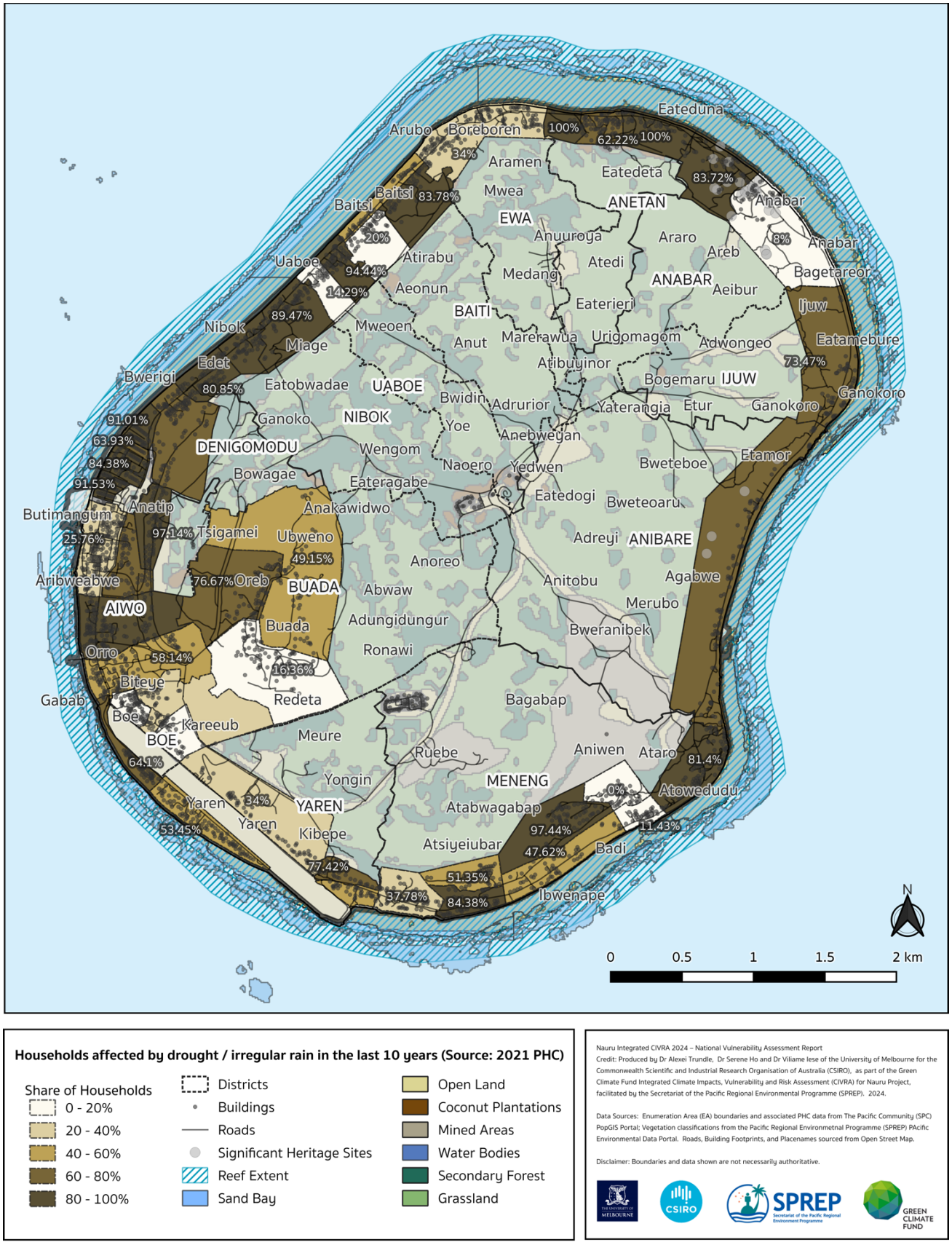

Figure 8: Households affected by drought / irregular rain in the last decade – 2021

Aggregate Vulnerability

As noted in the introductory background section of this report, drought has historically been the most significant climate-related disaster event to affect Nauru, with records from as early as 1918 showing impacts, at that time leading to a collapse in the copra export industry (Viviani, 1970, p. 42). Annual rainfall variability is very high, with data from 1946 to 2006 ranging from less than 220 mm in 1950 to more than 4400 mm a few years later in 1953, deviating significantly from a long-term average of 2,200 mm (Wallis & Russ, 2007). Prolonged droughts also impact upon the availability of groundwater, which is used as a secondary water source (in most cases for uses other than drinking water).

At the seasonal scale of 3-month periods, CSIRO has identified that over the last 72 years Nauru experienced three moderate droughts, eight severe drought periods, and eight extreme drought periods (CSIRO et al., 2024). Analysis of Nauru's rainfall records shows that El Niño events generally correlate with wetter conditions, while La Niña events tend to bring drier conditions and drought. On an annual basis over the same period Nauru experienced two moderate, two severe, and seven extreme drought years (ibid).

During a drought in 1998-2000 Nauru's desalination plant failed, resulting in widespread use of contaminated groundwater, and a heavy reliance on imported and bottled water, presenting further equity issues. In previous water shortage events, Nauru imported water from the neighbouring PICs including the Republic of the Marshall Islands and Solomon Islands at great expense.

Much of the water sector's vulnerability stems from Nauru's limited surface water resources, with Buada Lagoon, a brackish lake, being the only water system that doesn't regularly dry out. Rainfall harvested in water-tanks provides a critical water resource for communities, agriculture, businesses, livelihoods, food security, sanitation and drinking water. Although 96.3 percent of households had some form of water storage, the capacity of these private storage facilities – as well as the nature of their repletion – varies significantly. Nauru's national water storage capacity is 8 days, with schools often having to be closed due to failures in the water delivery system (ibid).

Tank capacity, as assessed in the 2021 census, was primarily split between 3-5,000 litre tanks (42 percent of households) and 5-10,000 litre tanks (33.9 percent of households).

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Table 4: Water Resources – Disaggregated National Census Attributes & Trends

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Drinking Water									
Households drinking tank rainwater	36.6%	0.9%	86.3%	100%	Boe (EA1)	14%	29%	36.6%	↗
HHs needing downpipe repair / replacement	21.6%	0.0%	55.0%	100%	Boe (EA4)	0%	19%	21.6%	↗
Households whose water supply dries up	72.6%	30.9%	94.2%	100%	Multiple	79.8%	80%	72.6%	↘
Households supplied by desal plant tanker	48.6%	2.3%	96.5%	100%	Multiple	81%	68%	48.6%	↘
Households without Guttering	35.9%	10.7%	59.3%	84.0%	Anabar (EA1)	-	30%	35.9%	↗
Other Water Uses									
HHs using Groundwater in the Kitchen	19.0%	0.0%	65.2%	90.5%	Uaeboe (EA1)	-	15%	19.0%	↗
HHs using Groundwater for Gardening / Outside	24.6%	0.0%	68.2%	95.2%	Uaeboe (EA1)	-	7%	24.6%	↗
Households using Groundwater for Bathing	36.3%	0.0%	75.9%	95.2%	Uaeboe (EA1)	-	19%	36.3%	↗

However, capacity is often mismatched with household size and therefore needs, with the average household size of 5.8 persons already likely to pressure household storage capacities under most circumstances. The function of these storage facilities was not assessed (whether for drinking, washing, or other purposes). More than 70 percent of households with a water storage facility stated that they had a downpipe, however only 61.5 percent of those were connected to a tank, and roughly half of these downpipes were functioning correctly. This might be reflective of only two-thirds of households having guttering, of which one-third was reported as needing repair or replacement.

Roughly one-third of households used rainwater as their primary drinking water source, as shown in Table 4 below. A larger share – 48.6 percent – were dependent upon tanker trucks supplying water from the desalination plant. As noted in CSIRO et al. (2024), desalination via reverse osmosis (RO) uses a high level of energy consumption, being dependent upon diesel generators, as well as substantial ongoing maintenance and water transport costs. Currently (2024) there are six utility-owned delivery trucks in operation nationally, supported by six privately-owned contractor delivery trucks (ibid).

Disaggregate Vulnerability

Disaggregation at the local scale was used to evidence spatial hotspots in Nauru's already extremely high levels of climate vulnerability across the country's water sector. This approach correlates to a wider range of localised climate risks, with different sub-national areas facing more severe localised consequences of each of the climate-related hazards examined in the wider CIVRA project. Importantly, exposure to these hazards, whilst also discussed here, does not correlate directly with these differing vulnerability levels.

As highlighted in Table 4, nearly three-quarters of all households reported that their water supply dries up, with 8.4 percent of households reporting that this occurs frequently. However, the share of households experiencing water supply shortages reaches as high as 100 percent in enumeration areas in a diverse range of settings across the island, encompassing Meneng (EA2b), Location (EA1), Aiwo (EA4) and Boe (EA4). Even the lowest decile of EAs averaged more than 30 percent of households experiencing some form of water stress.

Wide variations in use of desalinated water via the national utility's tanker supply service suggest that this component of the water sector needs tailored responses in the event of a plant or transport failure, with lowest and highest deciles ranging from 2.3 percent to 96.5 percent respectively.

These households are, however, less likely to face water contamination issues (discussed further in Section 4.2), with the state of household water catchment equipment being generally poor and highly variable. Areas of Boe, particularly EA4, were assessed as being particularly vulnerable in this regard. Use of rainwater tanks for drinking water is shown in Figure 9, while use of utility-provided desalinated water via tanker is shown in Figure 10. Although most households across Nauru had some form of water tanks for storage – a product of centralised systems being distributed by tanker in almost all localities – the presence of guttering around housing is also a critical consideration in the adaptability of rainwater systems.

A lack of guttering can also present additional health-related vulnerabilities, because of water pooling that can lead to breeding of mosquitos and other issues associated with stagnant water. This figure rose to 84.0 percent of households in Anabar (EA1), with 59.3 percent of households in the highest decile lacking guttering systems. Relatedly, more than 10 percent localities had most of their downpipes feeding into rainwater tanks that were in a state of disrepair, a figure that rose to as high as 100 percent of households in the case of Boe EA4.

Whilst groundwater was rarely used for drinking purposes, its continued use in kitchens for cleaning, as well as for bathing, both presented ongoing health risks (as discussed subsequently in Section 4.2), as well as heightening household exposure to water shortages during periods of drought. Levels of groundwater use across these categories, including for purposes such as gardening and other outdoor uses, was highest in Uaeboe EA1. Use for bathing varied from zero percent to more than three-quarters of households between the lowest and highest deciles respectively, with the latter being a slightly lower 65.2 percent for groundwater use in kitchens.

Trends & Future Disruption

Although the desalination plant and associated tanker supply system remains the largest source of drinking water across Nauru, the share of households using reverse osmosis (known locally as 'RO') water for drinking has fallen significantly over the last decade, from 81 percent in 2002 to less than half of all households – 48.6 percent – in 2021 (see Table 4). Conversely the number of households using rainwater tanks for drinking water has increased from only 14 percent in 2002 to 36.6 percent in 2021.

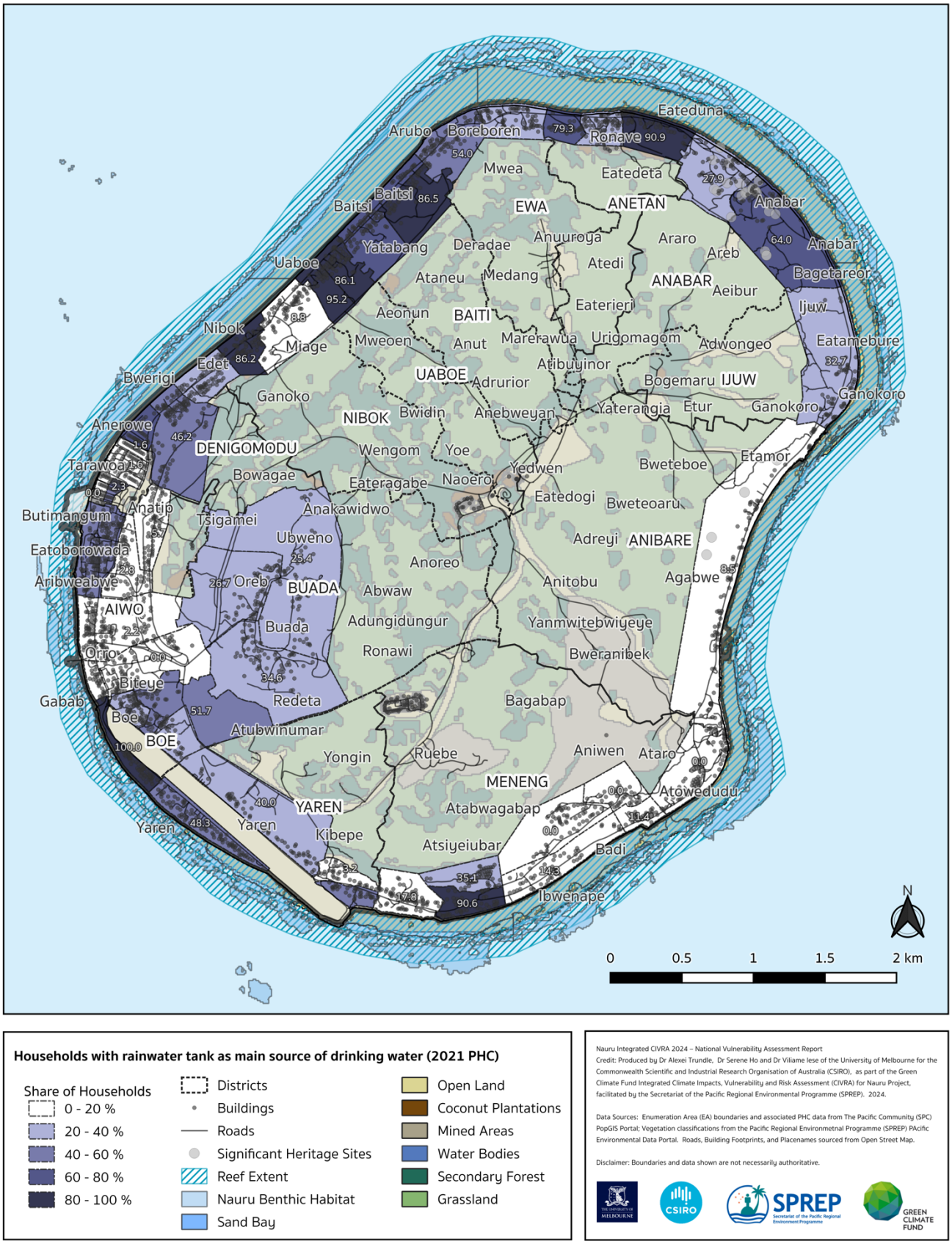


Figure 9: Households using rainwater tanks as their main source of drinking water – 2021

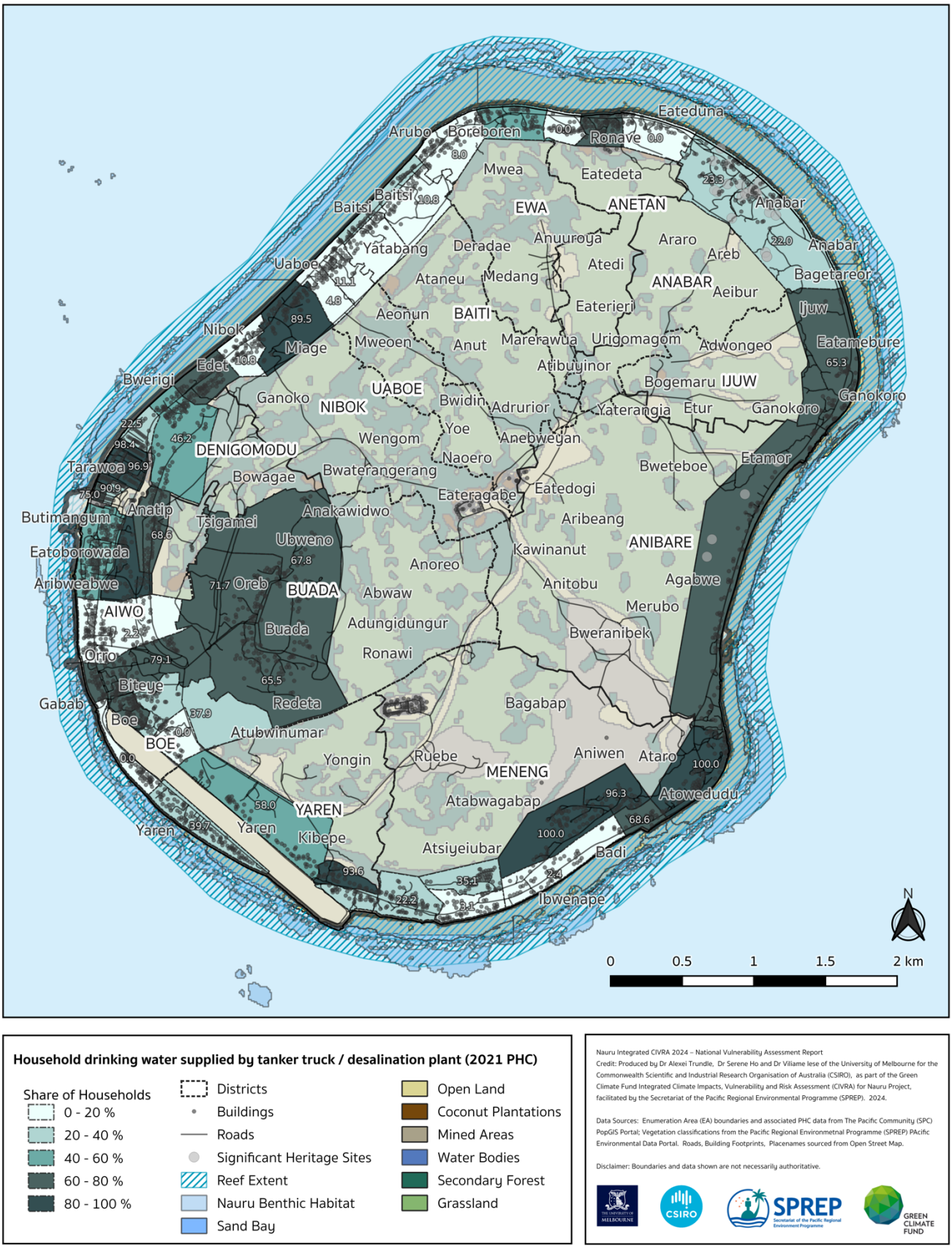


Figure 10: Households primarily using tanker-distributed desalinated water for drinking – 2021

A 13 percent decline in household use of RO between 2002 and 2011 was significant given the relative stability in the total number of households over that period (1,652 and 1,647 total households respectively). However, changes in primary drinking water source between 2011 and 2021 represented a net 'shift' of households from RO to rainwater, with 138 less households using RO in 2021 than in 2011, despite the significant population growth over that period.

The number of households experiencing water scarcity between 2002 and 2011 was relatively stable. Whilst the share of households whose water supplies 'dried up' fell from 80 percent of households to only 72.6 percent over the subsequent decade, this represented a net increase of 149 households experiencing water scarcity in 2021 because of the population growth over that period.

The subset of households that stated that their household water supply dried up 'frequently' fell significantly between 2002 and 2021, from 22 percent to only 8.4 percent, representing a net reduction of 194 households experiencing regular water scarcity nationally.

Although groundwater use was not assessed in the 2002 census other than for drinking water purposes, its extraction for non-drinking water purposes has increased considerably over the last decade. One-quarter of households now use groundwater for outdoor purposes, including gardening; a significant jump from 7 percent in 2011 equating to an additional 381 households.

Use for bathing – with potential health consequences resulting from the contamination of groundwater from untreated sewerage – has risen to one-third of households in 2021 (up from one-fifth in 2011), a net difference of 420 households. Use for kitchen purposes, presenting similar health risks, has also increased, albeit less substantially, to 19 percent of households, from 15 percent in 2011.

Uncertainties & Externalities

Much of the uncertainty in Nauru's water resources sector stems from that relating to interannual rainfall patterns, as discussed in both CSIRO et al. (CSIRO et al., 2024) and Deloitte Risk Advisory (2024), which are not assessed here due to the wider range of uncertainties in shifting sociocultural, economic, and environmental factors across Nauru over the equivalent forward timelines to 2030 and 2050. However, a range of existing uncertainties and more immediate possible changes are set out below, specific to water resources, their use, and currently proposed initiatives relating to their improvement (and adaptation of the sector more widely).

The proposed Sustainable and Resilient Urban Development Project (SRUDP) includes a suite of water sector improvements, ranging from pumping stations to a new septage treatment facility. The proposal also includes development of a reticulated water supply network that would extend to more than 1,200 households and businesses in the high-density area between Baitsi and Yaren, alongside a review of household rainwater systems (which would address the significant uncertainties associated with the current state of these critical pieces of private infrastructure). The project is nearing completion of a preparatory phase, with timelines, budgets, and finance for implementation yet to be finalised (DCCNR, 2024).

The Higher Ground Initiative (HGI) is a 50-year climate adaptation 'managed retreat' plan being developed by the Republic of Nauru. Guided by a high-level, whole-of-government steering committee, HGI is undergoing detailed design for the initial phase, which focuses on master planning a new town centre on rehabilitated land in a section of south-east Topside, known as Land Portion 230 (Baches, Baches, Rickersey, et al., 2022).

The 'LP230' proposal, including adjacent public infrastructure sites beyond the land portion itself, proposes several water sector upgrades, including stormwater run-off ponds, water storage tanks, and a gravity-fed sewerage treatment system.

The LP230 infrastructure plan also puts forward upgrading the second RO desalination plant in Meneng, connected with a trunk water line that traverses the island, as part of a wider set of upgrades, including reticulated water services for the new town area. However, the plan is highly speculative, with rehabilitation costs presenting significant financial barriers for the initiative at this stage.

The steady Increase in groundwater extraction as noted earlier represents a significant pressure on limited groundwater supplies, which have historically been noted to be both easily depleted in periods of drought and increase significantly in levels of salinity when extraction and replenishment is high. In addition to the direct impacts on the water sector itself, from a human consumption perspective, extraction thresholds have potential but to date unquantified cascading impacts on other sectors, such as impacts on biodiversity and aquaculture around Buada Lagoon, as well as longer term ecosystem change around the northern Ijuw-Anabar Wetlands.

4.2 HEALTH AND WELLBEING

Human health and wellbeing have extensive and highly diverse data in most national contexts, and Nauru is no exception. However, by even a subset of high-level measures, such as life expectancy, disease prevalence, and information on dietary intake and levels of mental health, Nauru faces particularly acute health and wellbeing pressures.

This report does not delve into specific medical data in detail but takes an approach to assessing the vulnerability of this sector that is consistent with the other eight sectors analysed (drawing primarily upon census information, accounting for change over time and spatially). An overview of these attributes is shown in Table 5:

Aggregate Vulnerability

By several global standards Nauru's general health indicators are poor, correlating to an extremely high level of aggregate vulnerability to climate impacts, as well as a wider array of external non-climate shocks and stresses. Much of this stems from nutrition, however the extent to which this is directly correlated with the importation of foods and the rapid acceleration of household income in the post-Independence phosphate mining boom is unclear. Dietary practice prior to colonisation is only partially documented, with early records from the 1920s and 1930s noted that seasonal food events and the sharing of fresh fish was commonplace, with cultural practices based upon feasting and food-related rituals (A. McLennan, 2020, p. 258).

Table 5: Health & Wellbeing Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	Extreme	➢ Life expectancy at birth is the lowest of any Pacific country, more than 10 years less than the global average ➢ Stunting and anaemia are highly prevalent in Nauruan children ➢ Health services are highly limited ➢ Water scarcity issues for more than 72% of households	• WHO Pacific STEPs Survey 2002-2019 (Reeve et al. 2022) • Nauru Demographic & Health Survey 2007 (NBS et al. 2009) • Regional Health Assessment (McIver et al. 2016)
Disaggregate Vulnerability	Extreme	➢ Half of all households were unable to eat healthy or nutritious food in the last year due to unaffordability ➢ High prevalence of NCDs ➢ Frequent E. coli outbreaks cause localised issues for groundwater dependent households	• Nauru Demographic & Health Survey 2007 (NBS et al. 2009) • 2021 National Census: Water scarcity (H18a) • Nauru 2021 State of the Env. Draft Report
Trends & Future Disruption	High	➢ Proposed large scale agriculture developments through the Higher Ground Initiative Phase 2 would significantly increase local produce ➢ Potential for scalable behavioural change & education initiatives	• HGI Land Planning & Resiliency Report (Baches et al. 2022) • Ampofo & Boateng (2020)
Uncertainties & Externalities	High	➢ Volatile patterns in subsistence production, heavily dependent upon rainfall & water accessibility ➢ External vectors a high transmission risk factor with complex impacts on climate adaptation pathways	• Pacific Food Systems Report (O'Meara et al. 2023) • COVID-19 P-SIDS Transmission Report (Filho et a. 2020)

After several attempts by colonial and church-based authorities to modify these ritualistic eating practice, including the introduction of 'home economics', dietary practices had shifted significantly by the 1950s, at which time a nutritional survey identified "a pattern of two main meals per day, with the main meal consisting of white rice and tinned meat" (ibid).

The continued focus on processed foods, as well as those with high sugar and fat intake, has become heavily ingrained as local food production has declined. A regional survey found adults in Nauru consumed more than 3.4 serves of sugary beverages per day, with two-thirds of Nauruans adding salt to meals before eating 'always or often' (Reeve et al., 2022, p. 4). Overall life expectancy has remained at near 50 years for men and 60 years for women since independence, a level below most other Pacific Island Countries and Territories (A. McLennan, 2020). As of the 2021 census, life expectancy at birth was 63.9 years; 60.9 for men and 67.1 for women (SPC et al. 2023). Cardiovascular disease (CVD) is the main cause of diabetes, accounting for 30 percent of all global deaths according to the World Health Organisation (WHO). It is the leading cause of death in several Pacific countries, killing more people across the region than cancer or injuries (Gani, 2009, p. 180). Nauru has the region's highest mortality rate from CVD, correlating with Nauru having one of the world's highest rates of type 2 diabetes – nearly one-in-three adults – and 71.7 percent of Nauruan adults being classified as obese (Ampofo & Boateng, 2020; Wardhani, 2023).

Communicable diseases also present risks, although the lack of a significant tourism economy has been argued to have some benefits in terms of disease transmissibility, such as in the case of the COVID-19 pandemic (Filho et al., 2020). Despite this, Nauru was one of the first Pacific Island Countries to record the zika virus, whilst a dengue outbreak in 2017 saw 901 cases of reported dengue in three months, infecting one-tenth of the total population (GRN, 2019, p. 45).

Disaggregate Vulnerability

Whilst the specific health attributes discussed above are not able to be disaggregated spatially across Nauru, Table 6 highlights key environmental and behavioural attributes that impact upon Nauru's overall mortality, morbidity, and wellbeing profile. Data in the table considers four key areas: the built environment; water and sanitation facilities; nutrition; and capacity to procure adequate food.

Housing plays a critical role in influencing exposure to climate (and non-climate) hazards but can also itself present specific environmental risks. Several houses across Nauru continue to contain asbestos sheeting materials, with health concerns increasing as housing materials wear over time. Although extensive asbestos containment and removal work has been undertaken across Nauru over the last decade, a 2015 survey found that Nauru had two-thirds of the Pacific's highest risk asbestos-containing material, and one-quarter of the region's asbestos by volume (SPREP, 2015). Exposure risk increases significantly with large winds and storms that deteriorate surfaces over time, with asbestos presenting a risk to human health when damaged materials release small fibres into the air that damage lung tissue when inhaled. Whilst the share of household roofing built out of asbestos in 2021 had fallen to only 1.1 percent more than 5 percent of outer walls in Denigomodu, Nibok, Anetan, Ijuw and Meneng were still made of asbestos, as well as 6.7 percent of guttering in Denigomodu (SPC et al., 2023, p. 84).

Provision of guttering on housing is necessary to either capture or divert rainwater, without which pooling of stagnant water can occur around buildings, providing breeding areas for mosquitos that accelerate the spread of vector-borne diseases such as dengue and zika. Two-thirds of Nauruan households in 2021 were reported as having no guttering (as shown in Table 6), with differences in guttering prevalence between both EAs and Districts; in Anabar EA1, for example, only 16 percent had guttering. Of those households with guttering one-third required replacement or repair.

Nearly two-in-five households use rainwater for cooking. This figure varies substantially between EAs, ranging from 0.9 percent for the lowest decile to 86.3 percent for the highest. This dependence on rainwater exacerbates localised exposure to drought and rainfall shortages, with rainwater storage capacities also varying between households (as discussed elsewhere in this report). Roughly three-quarters of all households experienced shortages in water supply; 64.2 percent 'sometimes', and 8.4 percent 'frequently'.

Multiple enumeration Areas in Aiwo (EA4), Boe (EA4), Location (EA1) and Meneng (EA2b) reported 100 percent of households having water supplies that dried up, with the highest overall share of frequent water shortages being reported across Meneng District (including 40.7 percent of households in EA2b alone). During periods of water shortage 3.7 percent of households nationally were resorting on drinking saline seawater; a figure that was also highly spatially varied, up to nearly two-in-five households in Aiwo EA4. Consumption of saline water, coupled with high salt diets, is likely to be compounding NCD impacts, particularly CVDs, with additional effects on infant mortality because of hypertension (Mueller et al., 2024).

Table 6: Health & Wellbeing Vulnerability Attributes

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Built Environment									
Main Material of Roof - Asbestos	1.1%	0.0%	1.8%	3.7%	Meneng (EA2b)	-	28%	1.10%	↘
Households without Guttering	35.9%	10.7%	59.3%	84.0%	Anabar (EA1)	-	30%	35.9%	↗
Guttering needs repair / replacement	34.8%	8.3%	45.1%	65.9%	Location (EA3)	-	31%	34.8%	↗
Water and Sanitation									
Households cooking using rainwater	38.7%	0.9%	86.3%	100%	Boe (EA1)	-	-	38.7%	-
HHs bathing using groundwater	36.3%	0.0%	75.9%	95.2%	Uaeboe (EA1)	-	19%	36.3%	↗
HHs whose water supply dries up	72.6%	30.9%	94.2%	100%	Multiple	79.8%	80%	72.6%	↘
Households drinking seawater in drought	3.6%	0.0%	10.9%	38.9%	Aiwo (EA4)	-	-	3.6%	-
Households lacking septic or sewerage	29.4%	0.0%	77.4%	92.3%	Meneng (EA3)	5.9%	55.0%	29.4%	↘*
Household primarily burning waste	2.3%	0.0%	8.0%	16.3%	Ijuw (EA1)	-	-	2.3%	-
Nutrition									
Households Growing Crops	5.2%	0.0%	14.4%	19.4%	Yaren (EA3)	17.3%	13%	5.2%	↘**
Households Growing Fruits	4.9%	0.0%	13.1%	18.3%	Buada (EA1)	-	-	4.9%	-
Households Fishing	29.6%	12.7%	56.2%	100%	Location (EA1)	49.0%	51%	29.6%	↘
Lack of Money or Resources for Food									
Concerned / Worried about food	44.8%	8.2%	78.3%	97.4%	Boe (EA1)	-	-	44.8%	-
Can't eat healthy or nutritious food	49.2%	11.4%	81.5%	94.9%	Meneng (EA3)	-	-	49.2%	-
Were hungry and didn't eat this year	13.7%	0.0%	26.0%	94.9%	Meneng (EA3)	-	-	13.7%	-
Went without eating for a whole day	11.0%	0.0%	17.2%	94.9%	Meneng (EA3)	-	-	11.0%	-

** The exact wording of the question from the 2002 is unclear, suggesting this figure may exclude some pit latrines and other unsealed toilet facilities*

*** The 2021 Census is the first to explicitly identify 'fruit trees' separately from crops, which may account for some of this decline*

Nearly one-in-three households lacks safe sanitation facilities, being dependent upon pit latrines with varying levels of seepage. This figure rises to as high as 92.3 percent of Households in parts of Meneng (EA3), with the highest decile of households having an average lack of access level of 77.4 percent. Nauru's most recent water and sanitation master plan notes that many existing septic tanks are damaged and leaking, resulting in discharge to adjacent soil, with widespread contamination of groundwater across the island presenting a range of health risks (GRN, 2022).

Household waste collection systems across Nauru are quite effective, with almost all households at the 2021 census stating that they used collection services for waste disposal or took it directly to the dumpsite. A small number of households – 2.3 percent – continued to burn waste; a practice most prevalent in Ijuw (EA1) where 16.3 percent of households burnt their rubbish. Rates of composting nationally were low, except for Location, with 17 percent of households in Location EA2 composting waste, however a significant further share of households feed food waste to household animals and livestock. The open dumping at the waste disposal site has, however, been noted as presenting a risk to groundwater through leaching, with additional health risks presenting due to air quality concerns associated with regular dumpsite fires (Tonkin+Taylor, 2018). These fires occur most frequently under hot and dry conditions (Pers Comm: Inception meeting 2024).

Beyond wider dietary considerations a substantial number of households identify a range of levels of food stress. Half of all households in 2021 stating that they we unable to eat healthy or nutritious food in the last year, a figure that rose to 94.9 percent of households in Meneng EA1, but was generally broadly distributed across the island, as shown in Figure 11. Significant levels of sustained food stress were present in Meneng district, with more than 75 percent of households in EAs 1 and 3 stating that they were hungry and didn't eat for an entire day or more over the last 12 months.

Trends & Future Disruption

Much of the data used in the previous sections were newly collected as part of the 2021 National Population and Housing Census process and are therefore unable to be compared longitudinally. However, some significant trends were observable across the built environment, water and sanitation, and local food production (with impacts on nutrition), as shown in Table 6. The large reduction in asbestos roofing prevalence is likely to have substantially reduced earlier vulnerabilities to strong winds and heavy rainfall events, whilst the share of housing with guttering increasing slightly was somewhat offset by the proportional increase in the number of households with guttering in need of repair or replacement. A small improvement in water security was also evident, with the decrease in households whose water supply dries up either 'sometimes' or 'frequently' of 7.2 percent between 2002 and 2021 even more notable given the 16 percent increase over that same period. Conversely, declines in the percentage of households growing crops and fishing – from 17.3 percent to 5.2 percent and 49.0 percent to 29.6 percent respectively – mask large increases in the number of households not engaging in subsistence food production. The number of households involved in both crop production and fishing declined over the period 2002-2021, despite population growth overall. There is, however, some discrepancy between 2021 and earlier census figures relating to crop production due to the separation of fruit trees from other forms of crop production.

Uncertainties & Externalities

The Sustainable and Resilient Urban Development Project (SRUDP) advocated by the Asian Development Bank sets out a range of significant investments across water supply systems, sanitation infrastructure, and solid waste management. These initiatives include pumping stations, a new septage treatment facility, as well as composting and resource recovery facilities. The project has concluded a preparatory phase with timelines, budgets, and finance for implementation yet to be finalised (DCCNR, 2024).

Although climate projections have high levels of certainty regarding the increased frequency of 'extreme heat' days per year, as well as the overall increase in the average temperatures of these days, their relationship with existing productivity, morbidity, and mortality levels requires further analysis. Empirical evidence suggests heat stress is impacting airport workers in Nauru, and reducing physical activity (Pers Comm: Inception meeting, 2024). However, hospitalisation records are yet to be analysed for any spikes in presentations during extreme heat. Thresholds of both diurnal and nocturnal air temperatures have also not been considered to analyse Extreme Heat Factor prevalence in either current records or in relation to future climate change, with the former being a critical combination for considering extreme heat impacts on human health (Trundle & Mcevoy, 2015).

HGI aims to relocate housing and critical infrastructure inland, to higher ground, and better harness prevailing winds to passively cool homes and buildings (Baches, Baches, Rickersey, et al., 2022). Earlier colonial records suggest Nauruan populations occupied the island's

coastal fringe at least in part due to the cooler sea breezes there, along with the ability to bathe in ocean water to regulate temperatures. 'Phase 2' HGI proposals to establish widespread agricultural areas across the northern half of Topside would improve the availability of locally grown, healthy produce, and further encourage more active lifestyles and livelihoods.

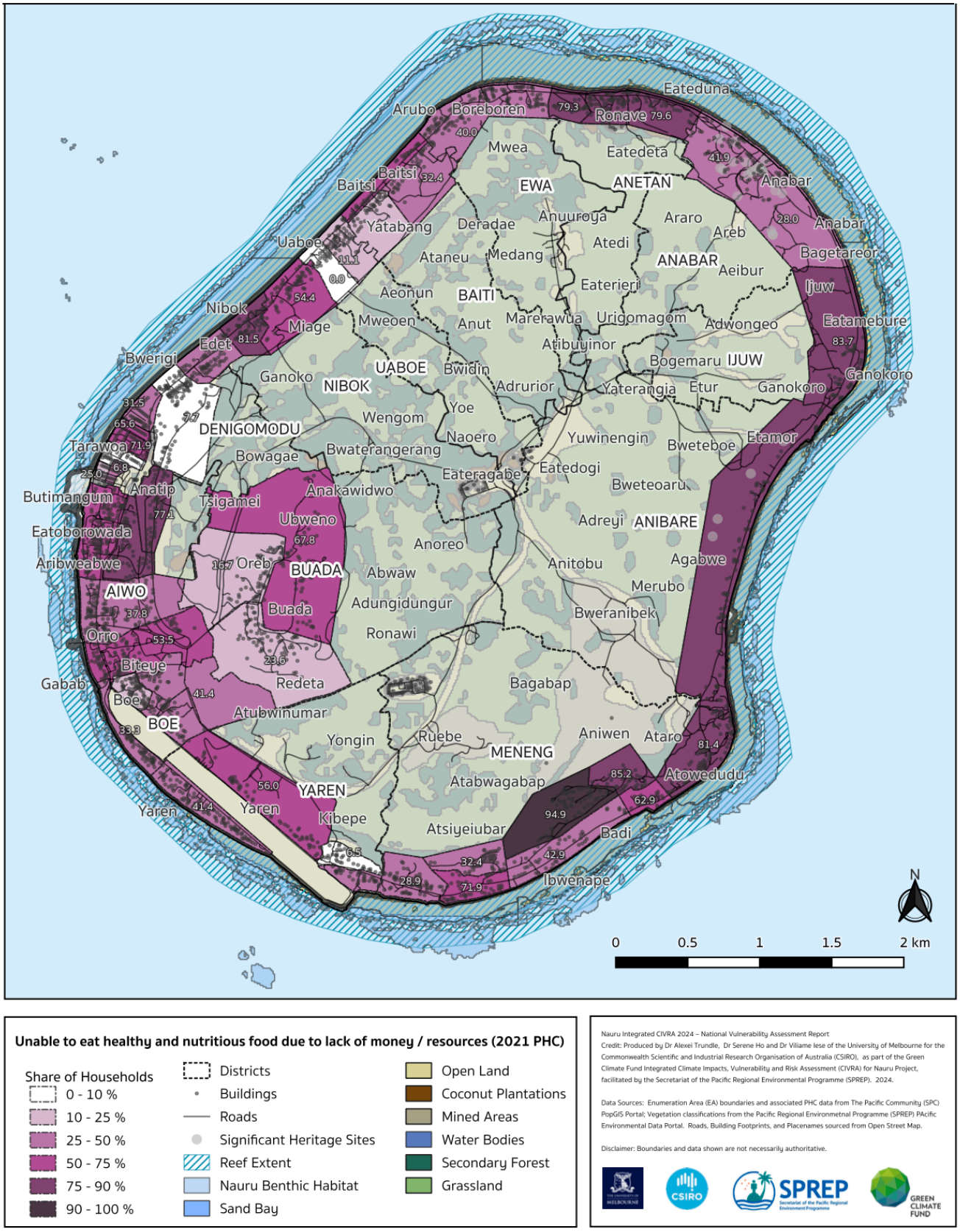


Figure 11: Households unable to eat healthy and nutritious food – 2021

4.3 AGRICULTURE

The agriculture sector in Nauru is set out as a national priority in a different manner to the other sectors assessed in this report. By most international measures local agriculture production is low, both in terms of local consumption, and in terms of economic productivity by way of sales or exports. However, historically, agricultural outputs were a substantive component of Nauru's economy. The regeneration of areas of Topside that were previously forested and harvested, alongside the creation of a sustainable and nutritious local food supply, are viewed nationally as a key pathway for sustainably developing Nauru going forward and are therefore assessed here with the eventual aim of providing a focal area for future adaptation actions.

At present there is only about 4 km^2 of arable land in Nauru, with much of the arable land occupied by residential dwellings. This limited space is a result of the encroachment of phosphate mining areas through the second half of the 20th century, with landowners compensated for the removal of agricultural land and plants, including coconut palms, pandanus, breadfruit, banana, pawpaw, mango, lime, tomano (Calophyllum inophyllum) and almond (Pers Comm: Inception visit 2024; RoN, 2011). Prior to this much of the 16 km^2 of Topside was occupied by these and other species.

As Hoare elaborates, "wood from the tomanu tree … was used in canoe building and house construction; the tree's oil was used for medicine; Pandanus tectorius (screwpine) was so important that they labelled Topside 'pandanus land' and would camp for weeks on end to harvest the fruit in season; it was also the place where people would catch black noddy birds (Anous minutus) for household consumption" (2023, pp. 91–92). Production of copra historically peaked at 277 tons in 1916, but the trade collapsed following a 'severe and prolonged drought', falling to 10 tons in 1918 and barely recovering subsequently, reaching 93 tons in 1922 (Viviani, 1970, p. 42).

It is in this context of both historical volatility of water availability, as well as the currently degraded state of previously available arable land, that agriculture is being assessed. However, its currently limited footprint and use providing the present-day baseline for this study, and the basis of the ratings set out below, in order that these elements are consistent with other nationally significant sectors. Critical interconnections between local food production and food security, as well as nutrition and human health and wellbeing set out in Section 4.2, also provide context to these ratings, summarised in Table 7 below.

Table 7: Agriculture Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	Moderate	➢ Relatively low levels of dependence on local produce for consumption ➢ Historical evidence of multiple commercial agricultural enterprises failing due to existing rain variability ➢ Negligible income from agricultural produce as a share of GDP	• 2021 National Census: Households growing crops (H39), fruit (H41), and producing livestock (H43) • Nauru 2023-24 Budget (GRN, 2024)
Disaggregate Vulnerability	High	➢ Localities missing meals and experiencing malnutrition worsened by a lack of fresh food production ➢ Local livestock for subsistence & cultural practices at risk from extreme heat events	• 2021 National Census: Household Food Insecurity (H51) • CSIRO et al. (2024) Nauru Climate Impacts Report
Trends & Future Disruption	Low	➢ Previous declines in crop production have resulted in low current day exposure ➢ High rainfall variability an existing feature of Nauru's climate	• Pacific Food Systems Report (O'Meara et al. 2023) • Nauru Climate Risk Profile (WBG 2021)
Uncertainty & Externalities	Moderate	➢ Changes to rainfall patterns are likely to be within existing variability ➢ Future upscaling of local production is proposed but likely to require substantive investment in rehabilitation and storage	• CSIRO et al. 2024 Nauru Climate Impacts Report • HGI Land Planning & Resiliency Report (Baches et al. 2022)

Aggregate Vulnerability

The agriculture sector in Nauru is small in terms of household involvement and total output. In total, 5.2 percent of households were involved in crop production at the time of the 2021 census, with a total of six households doing so engaging in sale of these crops. Crop production was also predominantly small scale, with the most frequently grown crop being chilli (3.0 percent of households). Forty-nine households (2.4 percent) were producing cabbage, with slightly fewer producing eggplant, cucumber and cherry tomatoes (1.6 percent of households respectively). Other crops included pumpkin, sweet potato, cassava, watercress, and long bean, all of which were produced by between 15-30 households nationally. It was noted in the census report that the plots for growing these crops were almost exclusively less than 100 square metres.

A similar number of households grew fruit, again primarily for home consumption rather than sale. Fruits being produced in 2021 included banana (2.9 percent of households), lime (2.7 percent), papaya (2.3 percent), breadfruit (1.8 percent), dwarf coconut (1.5 percent), and pandanus (1.3 percent). Other less common reported fruit crops included sweet melon and mango. Due to the separation of fruit cultivation from crop production in the 2021 census questionnaire it was not possible to assess the aggregate number of households engaged in these practices, however there was a significant spatial correlation, suggesting that several households were involved in fruit and crop production simultaneously.

Involvement in livestock production was slightly higher nationally, with 7.6 percent of households raising either pigs (6.7 percent) or chickens (2.3 percent). More distinct, however, was that more than one-third of these households did so for the purpose of generating income, with nearly one percent of households nationally keeping livestock primarily for the purposes of sale, and a further 1.7 percent doing so for both home consumption and income.

The catching of Noddy birds has also been included in this sector as Nauru's only significant land-based hunting practice, as well as a distinctive cultural practice for the country. 'Noddying' – the practice of catching and eating wild noddy birds – was activity that nearly one-in-ten households were engaged in at the time of the 2021 census. Despite the destruction of much of the bird's habitat on Nauru due to phosphate mining, Buden observed that many of the birds present in Nauru are likely to be breeding elsewhere, with retrieved bird bands identifying several having been fledged as far away as the Northwest Hawaiian Islands, 4,000km from Nauru (2008, p. 13)

Disaggregate Vulnerability

Spatial analysis detailing small scale agricultural areas has not been completed for Nauru, however, coconut palms were classified as part of the vegetation analysis shown in Figure 4. In addition to a more general distribution along the coastal extent of Bottomside, key groupings of coconut crops exist around Buada lagoon, as well as a small cluster around the Nauru Rehabilitation Centre near the centre of the island.

Table 8: Agriculture Data – Household Level Distribution and Trends (source: RON Census Data)

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Households growing crops	5.2%	0.0%	14.4%	19.4%	Yaren (EA3)	17.3%	13%	5.2%	↘*
Households growing fruit	4.9%	0.0%	13.1%	18.3%	Buada (EA1)	-	-	4.9%	-
Households raising livestock	7.9%	0.0%	19.2%	34.5%	Anetan (EA1)	-	-	7.9%	-
Households catching Noddy Birds	9.5%	0.0%	23.4%	37.8%	Anetan (EA2)	-	14%	9.5%	↘
HHs unable to eat healthy and nutritious food	49.2%	11.4%	81.5%	94.9%	Meneng (EA3)	-	-	49.2%	-
HHs didn't eat because of no income or resources	13.7%	0.0%	26.0%	94.9%	Meneng (EA3)	-	-	13.7%	-

** The 2021 Census is the first to explicitly identify 'fruit trees' separately from crops, which may account for some of this decline*

Other identifiable agricultural areas include the Taiwanese vegetable gardens at Buada, and a patchwork of gardens on the lower escarpment to the south-east of the island near the airport (SPREP, 2021b). The Nauruan Government's Department of Environmental Management and Agriculture (DEMA) also operates small scale farms at Buada, Anabar and Meneng, selling produce and distributing seedlings and compost to households for their gardens.

Table 8 demonstrates the spatial variability in engagement with agricultural practices, as well as the levels of food insecurity in the island that could be addressed through an uptick in local agricultural production. Many localities did not engage in either crop production, fruit cultivating or livestock raising, reflected in the lowest deciles for all three categories being zero percent. In contrast, one-fifth of communities in the top decile raised livestock, rising to as high as one-in-three households in Anetan EA1. The share of households across Nauru engaged in livestock production is shown below in Figure 12.

No locality had more than 20 percent of households growing either fruit or crops, with the highest levels in Buada (EA1) and Yaren (EA3) respectively. Those areas cultivating fruit trees did not always correlate with those growing crops, although Anetan EA2, Yaren EA3, Aiwo EA1, Uaeboe EA2 and Denigomodu EA1 all had more than 10 percent of households engaged in both practices. Overall, the district with the highest level of subsistence food production was Buada; an unsurprising result given its adjacency and access to the Buada Lagoon. The share of households growing food crops across Nauru in 2021 is shown in Figure 13.

Trends & Future Disruption

The agriculture sector has undergone numerous historical disruptions and changes as detailed earlier in Section 2. These shifts have been primarily because of changing livelihood practices and trading patterns but are also due to high interannual rainfall variation.

As noted in CSIRO *et al.* (2024), during an El Niño event, wetter conditions are usually experienced in Nauru, while La Niña events tend to bring drier conditions, including droughts. These impacts have led to the collapse of parts of the agriculture sector, such as the copra export industry in 1918 (Viviani, 1970, p. 42).

Ironically it is the mining of phosphate – primarily for the purposes of fertilizing agricultural enterprises in Australia and New Zealand – that has had the most profound impact on the capacity to grow agriculture in Nauru (Gale, 2019). Remediation of these mined areas under the HGI Island Wide Master Plan proposes extensive agricultural lands and farm lots covering the north-eastern half of the island, integrated with a network of reservoirs (Baches, Baches, Walters, et al., 2022, p. 64). Although less than one-tenth of the land area estimated to be required to feed Nauru's present population, this would go some way to addressing the high prevalence of food insecurity, as well as lack of access to nutritious and healthy food.

More recent changes can be observed in the apparent decline of household involvement in agricultural production. As noted in Table 8, a sharp decline in the share of households engaged in growing crops is evident over the last two decades. Although the separation of fruit cultivation from crop-growing figures in the 2021 census may account for some of this difference, this decline was already evident in 2011, equating to a net reduction in the number of households involved, as well as the total share taking part.

Trends in the total number of households raising livestock were not directly comparable between the census periods due to differences in the way that households raising different types of species were aggregated, with earlier census questionnaires also focusing on the total number of livestock across the island (see SPC et al, 2006, p. 39). However, the number of households involved in raising different types of livestock has been extracted from the raw census data, as shown in Table 9 below.

Table 9: Livestock raising over time by species (source: RON Census data)

Households with livestock	2002		2011		2021		'02-'21
Type of livestock	Share	Total HHs	Share	Total HHs	Share	Total HHs	Change
Raising Pigs	16.3%	270	12.3%	203	6.7%	136	↘
Raising Chickens	8.7%	144	10.0%	165	2.3%	46	↘
Raising ducks	3.2%	53	1.5%	24	0.0%	0	↘

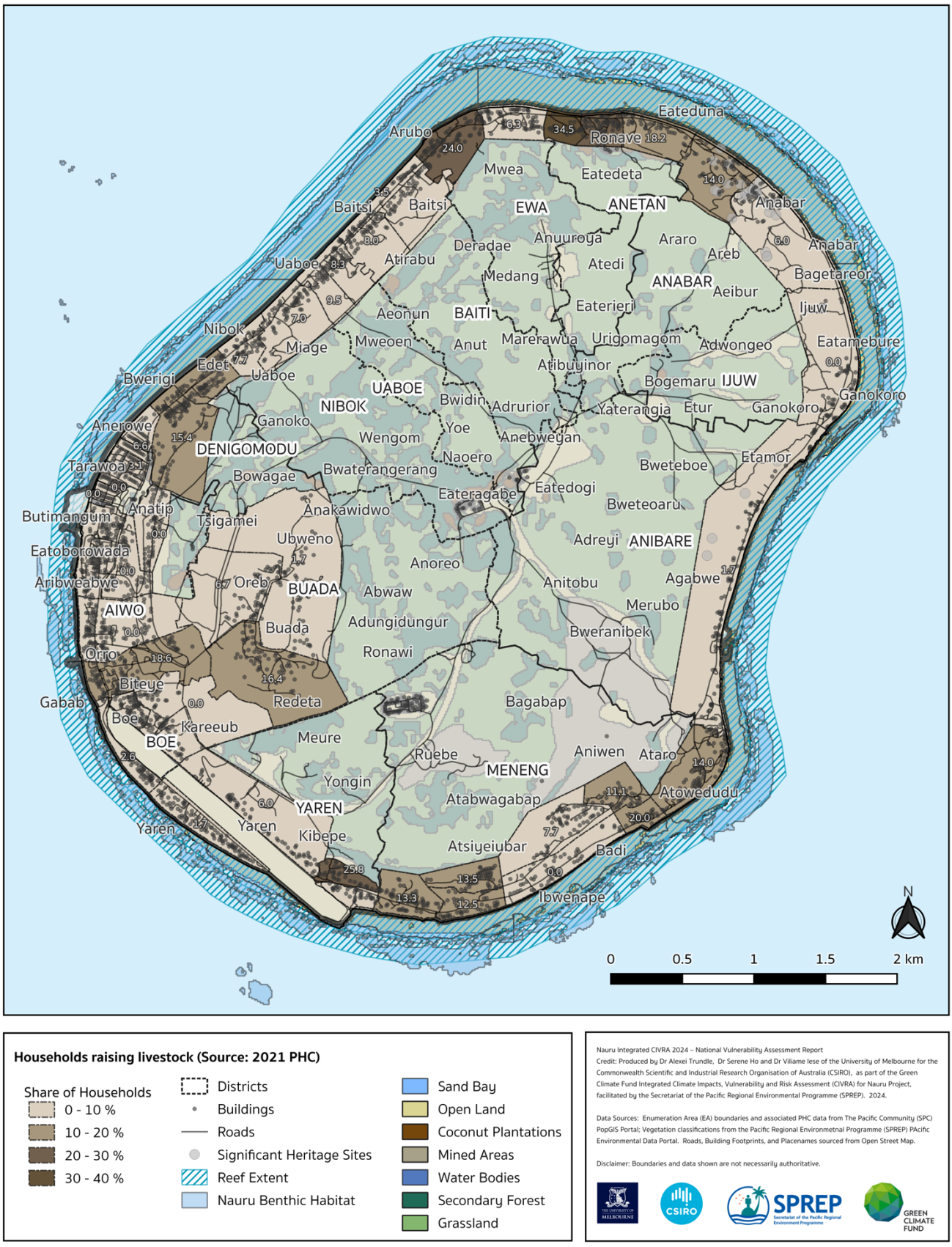


Figure 12: Households raising livestock – 2021

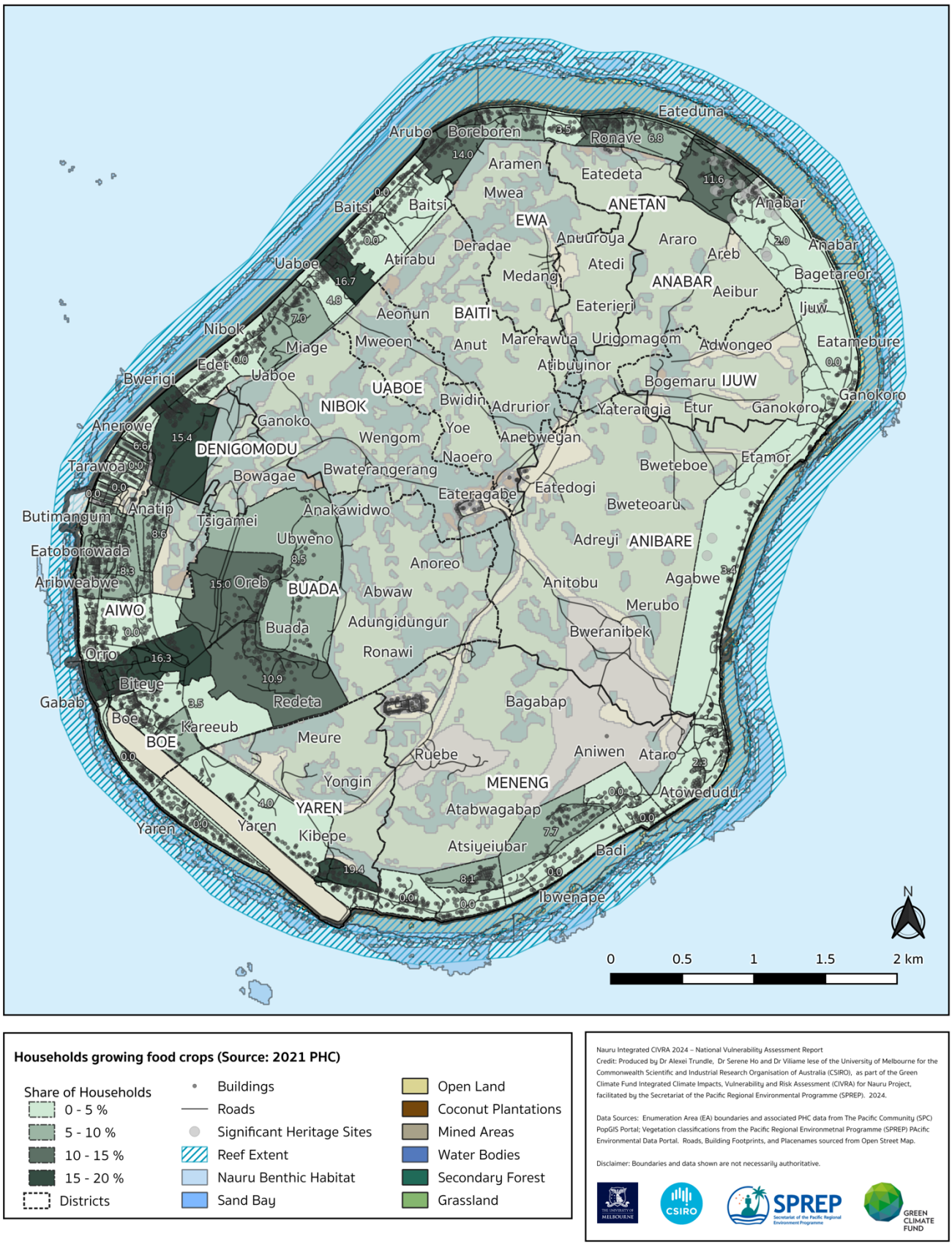


Figure 13: Households growing food crops – 2021

Across all categories there is a clear reduction in both the share and total number of households involved in livestock raising over the last decade. The number of households raising pigs has halved between 2002 and 2021, with the number of households raising chickens falling by two-thirds, whilst the raising of ducks has ceased entirely. This is despite several livestock promotion initiatives over that period, including the supply of 1,500 egg-laying chicken by the Taiwan Technical Mission in 2013, and efforts to establish small scale piggeries in 2009 (FAO, 2017).

It was noted during in-country consultations that the most recent drought caused mortality in breadfruit, pandanus and coconut plants, and many plants have not recovered. The Department of Agriculture imported coconut and breadfruit plants from Solomon and Marshall Islands to restore Nauru's stocks of these important food sources (Inception meeting, Pers Comm, July 2024). Water shortages may also have had an impact on livestock. The thermal comfort zone of adult pigs is 16–25 °C, young pigs 25–32 °C, and chickens 10–20 °C, with CSIRO *et al.* (CSIRO et al., 2024) noting that higher temperatures are likely to reduce productivity and potentially lead to livestock mortality.

Uncertainties & Externalities

In 2022 the Government of the Republic of Nauru, in partnership with the Pacific Community, released a National Climate Smart Agriculture Plan (NaCSAP), with the aims of increasing production of local food, building education around the importance of nutrition, and developing forms of local food production that are more resilient to climate impacts and change (GRN & SPC, 2021).

However, it is not clear whether this set of activities and initiatives has a clear funding pathway or the extent to which the projects set out within the plan have been funded since its inception in 2021, with the plan due to run until 2025. The NaCSAP's implementation is led by the Department of Commerce, Industry and Environment, with cross-governmental support from other Government of Nauru Agencies.

As noted above, the Higher Ground Initiative proposes a significant expansion of agriculture production across Nauru, constituting a wholesale transformation of nearly half of Topside into agriculture, including greenhouses, piggeries and aquaculture (Baches, Baches, Walters, et al., 2022).

Whilst this provides a formidable and commendable vision for Nauruan food systems, this long-term 'Island Master Plan' in its entirety has been noted to be potentially prohibitively expensive. The initial phase, for which detailed planning is already underway, is likely to provide an indication of overall remediation costs, although difference have been flagged between agricultural use rehabilitation and that of built up areas.

Critical to these efforts is a clearer understanding of both water storage strategies – beyond the reservoirs depicted in these plans – and interrelationship between these prospective forms of agriculture and water availability under a changing climate. Also critical is the willingness of the Nauruan population to engage in agricultural practices at a scale sufficient to support these initiatives, with land tenure complexities yet to be resolved outside of the initial subdivision, named Land Portion 230 (Baches, Baches, Rickersey, et al., 2022).

The relationship between local agricultural production and the food insecurity shown in Table 8 is not well understood, with a complex relationship existing between land availability for food production, household income, and more general availability of nutritious food (with the capacity to fish locally also a factor). These elements should be explored as part of any efforts to generate climate resilience and adaptation initiatives in the agricultural sector.

4.4 FISHERIES & MARINE RESOURCES

Fisheries and marine resources more generally are a critical sector for Nauru at multiple scales. Fisheries revenue underwrites government services, whilst local fishing for household subsistence (and, to a lesser extent, income) is significant in some areas. Wider structural support systems and adaptation pathways are contingent on reducing the current reliance on imported food goods, with local fish one of the most viable sources of protein, should this eventuate.

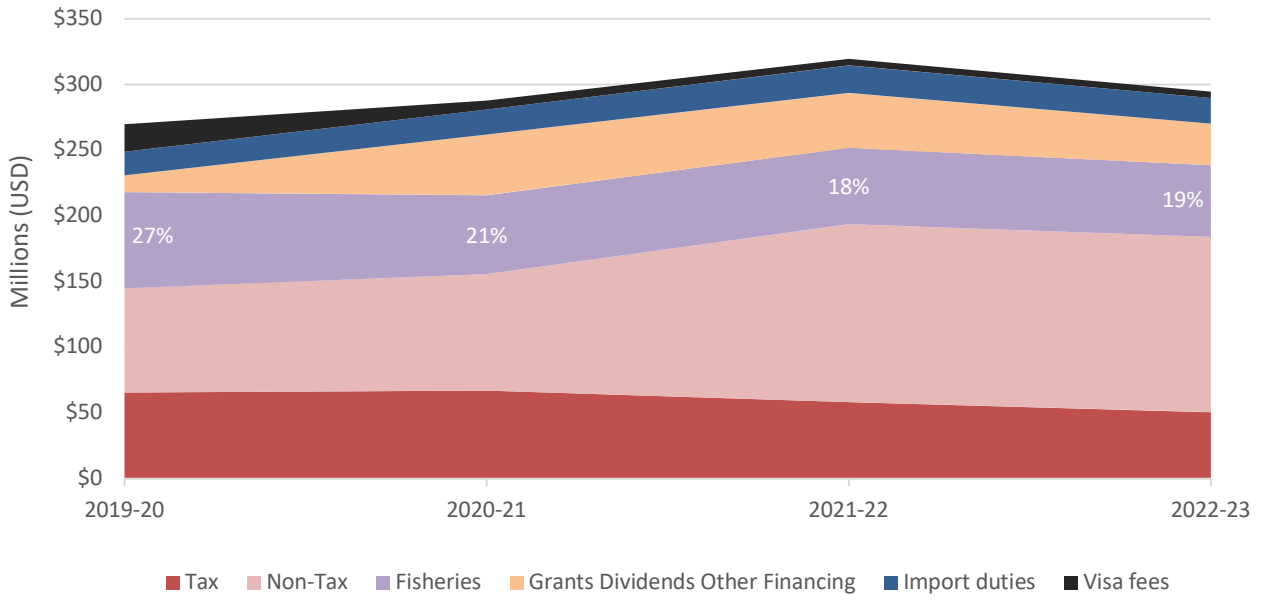
An overview of the sectors vulnerability assessment is provided in Table 10 below:

Table 10: Fisheries and Marine Resources Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	High	➢ Licenses ~20% of national revenue ➢ Key source of dietary protein - fish consumption ~52.3 kg/person/year ➢ Minor household income stream relative to comparable P-SIDS ➢ Low-quality of existing nearshore coral ecosystems & species diversity	• Nauru National Budget Papers (RON 2023) • Fishery & Aquaculture Profile – Nauru (FAO 2013) • SPC Reef Invertebrate Survey (Harris et al. 2016) • Tuna Indicators (FFA 2023)
Disaggregate Vulnerability	Extreme	➢ Key sections of the community are heavily reliant on a range of different subsistence fishing modes, from deep sea fishing to reef fishing by foot ➢ Localities with 100% rates of fishing and fish selling for income ➢ Nutritional deficits related to ~70% of households economically vulnerable ➢ Failure of previous efforts to establish local deep sea fishing business	• 2021 National Census – Households involved in Fishing (H46,47) • 2021 National Census – Households exhibiting food insecurity (H51a, H51b) • National Social Protection Strategy 2022-2023 (GoN) • Bell et al. (2021)
Trends & Future Disruption	Moderate	➢ Recent trend data suggests stable income from fisheries licensing ➢ Overfishing of tuna stock is a risk but is monitored regionally through FFA ➢ Possible increase in local fish consumption risks overfishing due to a lack of local controls ➢ Probable shift in tuna catch outside of Nauru's EEZ over time	• Nauru National Budget Papers (RON 2023) • Rethinking fisheries policy in the Pacific (Pretes & Petersen, 2004) • Yeeting et al. (2018) • CSIRO et al. (2024) Nauru Climate Impacts Report
Uncertainties & Externalities	Low	➢ Recent trend data suggests stable income from fisheries licensing ➢ FFA negotiations on revenue may be fraught as climate change shifts tuna fishing areas relative to EEZs ➢ Capacity to monitor / police illegal fishing is dependent upon ODA ➢ Shelf reef ecosystem quality currently limits resources, with potential for positive interventions	• Nauru National Budget Papers (RON 2023) • Yeeting et al. (2018) • Status of Coral Reefs in the South West Pacific (Lovell et al., 2004) • SPC Reef Invertebrate Survey (Harris et al. 2016)

Aggregate Vulnerability

The aggregate level of vulnerability of the fisheries sector to current day climate hazards that Nauru and its surrounding EEZ is assessed here as high, as a function of the key role that associated income and nutrition play at the national scale. Over the period 2015-2018 Nauru received the 5th largest share of annual tuna fishing access fees (an average of US$29.5 million per year) of any of the Forum Fisheries Agency signatory countries in the Pacific, accounting for 31.2 percent of government revenue over that same period (Bell et al., 2021, p. 901). Although other P-SIDS are more dependent upon purse seine fishing licensing revenue – tuna-fishing access fees account for 84.2 percent of government revenue in Tokelau, and 70.6 percent of government revenue in Kiribati (ibid) – limited alternative income streams leave Nauru vulnerable to any shifts in this income stream. The share of government revenue provided by purse seine fisheries licenses is shown in Figure 14, alongside other revenue streams over the period 2019-2022.



Source: Government of Nauru Budget Papers

Note: 2019-20 & 2021-22 Preliminary Actual Revenue, 2020-21 & 2022-23 Projected Actual Revenue

Figure 14: Government of Nauru Revenue 2019-20 to 2022-23

Fish provide 50–90 percent of animal protein towards the diet of coastal communities across the Pacific islands, with national average fish consumption per person more than 3–4 times the global average. Ocean acidification poses a threat to marine ecosystems. A loss of fisheries productivity and marine aquatic biodiversity would threaten national economies dependent on fisheries resources (CSIRO et al., 2024). Fish consumption by Nauruans has been estimated to be 52.3kg per person per year (FAO, 2017), more than 2.5 times higher than the global average (FAO, 2017). However, a significant share of consumed fish is imported, having been processed elsewhere in Asia and other Pacific Island Nations.

Total annual take from the Nauruan EEZ is estimated to be between 20,000 and 67,000 tonnes, of which more than 90 percent is tuna (FAO, 2017). In contrast, the total catch by local Nauruan flagged vessels in 2016 was estimated to be 530 tonnes in total (ibid).

Two longliner fishing vessels were previously operated by the Nauru Fisheries Trading Corporation, however this entity ceased operations in the mid-2000s (ibid). Although exact figures for the share of consumed fish that was purchased as processed food, compared with locally sourced catch, were not able to be obtained, this suggests a reasonably high proportion of fish consumption is sourced from Nauru's reef area and immediate surrounds.

Other critical considerations at the national scale include overfishing and depletion of near-shore fish stocks (as well as other marine resources), which correlates with a steady overall population increase over the last 3-4 decades, and a lack of implementation and enforcement of traditional or legislative constraints on reef takings.

Disaggregate Vulnerability

Following independence, the Government of Nauru provided a significant number of state-based services, such as utilities and education, either free or heavily subsidised to households, a phosphate mining subsidised safety net referred to by Connell as a "comprehensive welfare state" (2006, p. 50). However, the collapse of government revenue in the late 1990s and early 2000s led to failures across many of these service areas, highlighting the overall risk posed to social cohesion and potential for rising inequality should government revenue fall significantly.

This is particularly acute for those households already in poverty, with the proceeds of phosphate mining and land leases more generally unevenly distributed across households and tribal groups depending upon their status, location, and other factors.

The Government of Nauru classifies the national Basic Needs Poverty Line (BNPL) as AU$5,249 annual expenditure per adult, with those earning AU$5,249-AU$$7,873 classified as 'vulnerable' (GoN, 2022, p. 39). In 2013, one quarter of Nauru's population fell below the BNPL, with a further 44.2 percent of the population classified as 'vulnerable'.

The total share of the population falling below the BNPL in 2013 was a marked increase from the previous Household Income and Expenditure Survey in 2006, at which time 20.4 percent of the population, or 2,000 people, were classified as living in poverty (Olsson, 2012, p. 4).

Six of Nauru's 47 Enumeration Areas had more than half of their households involved in fishing, with the highest levels in three EAs in Location (EA1), Meneng (EA7), and Yaren (EA3). Even in the lowest decile in terms of participation more than one-in-ten households were regularly involved in fishing, suggesting a strong distribution of fishing activities across tribal and sociodemographic groupings (see Table 11). The distribution of households fishing in 2021 is shown in Figure 15.

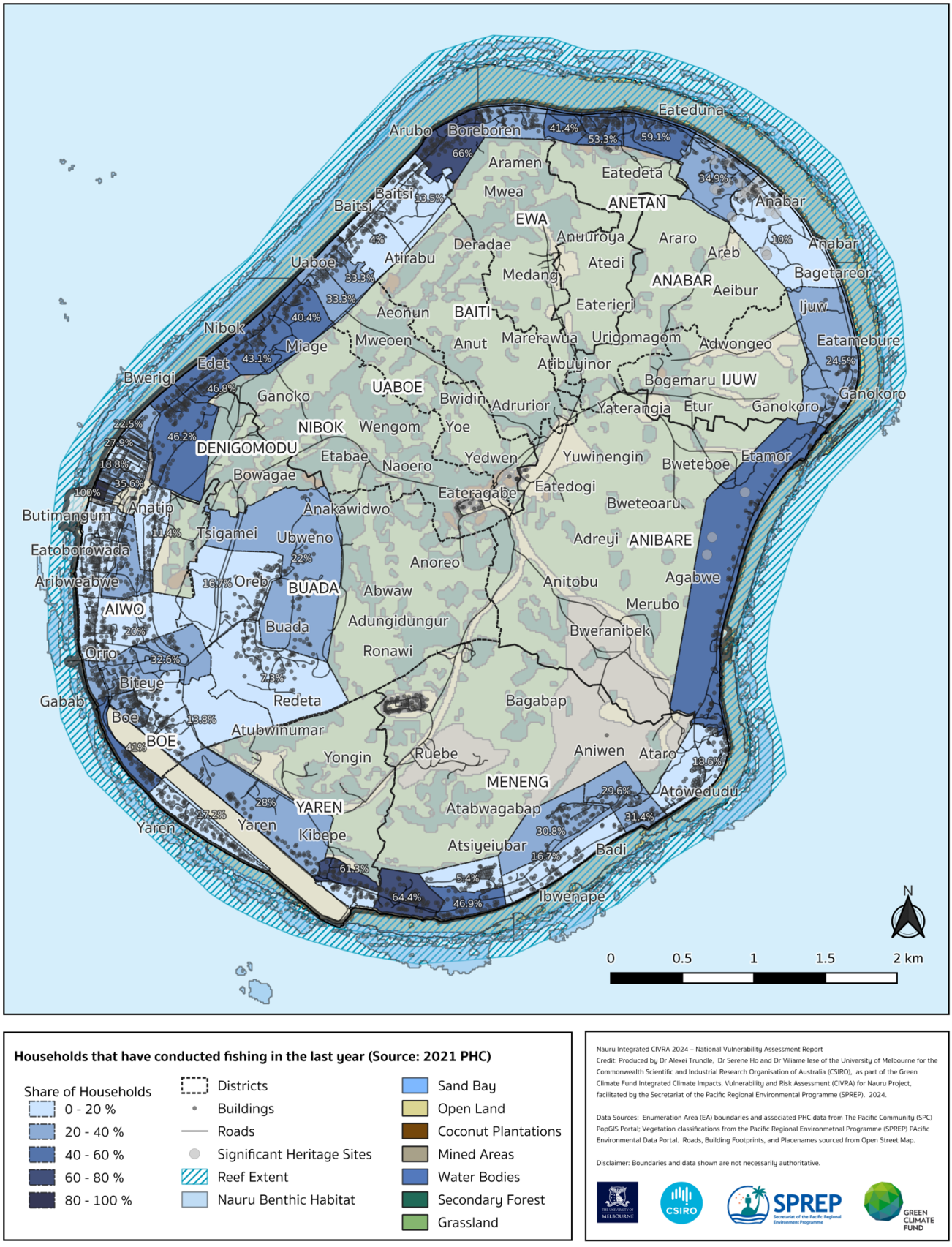
The number of households selling fish was significantly lower, with only 5.2 percent of households either occasionally or predominantly selling their catch. However, this subset of households was much more spatially clustered, particularly in localities within Meneng, Anetan, Ijuw, Location, and Uaeboe. This is reflected in nearly two-thirds of households within the highest decile selling fish, with as high as 100 percent of households in one Meneng EA selling produce, as shown in Table 11.

Data on marine resource use more widely – including sea cucumbers, giant clams, and other non-fish marine products – is harder to disaggregate. A recent comprehensive reef survey found most invertebrates were in low abundance and undersized, with giant clams to at risk of local extinction (D. Harris et al., 2016, p. 15).

Traditional resource management strategies have been argued to have fallen into disuse through the period of mining operations, resulting in subsequently unsustainable consumption patterns (ibid).

Table 11: Fisheries Data – Household Level Distribution and Trends (source: RON census data)

Census Data	National	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Trend
Households Fishing	29.6%	12.7%	56.2%	100%	Location (EA1)	49.0%	51%	29.6%	↘
Households Selling Fish	5.2%	0.0%	62.7%	100%	Meneng (EA6)	1.0%	-	5.2%	↗
Households Deep Sea Fishing	10.0%	1.9%	27.8%	33.3%	Meneng (EA7)	-	23%	10.0%	↘



Households that have conducted fishing in the last year (Source: 2021 PHC)

Share of Households
- 0 - 20 %
- 20 - 40 %
- 40 - 60 %
- 60 - 80 %
- 80 - 100 %

- Districts
- Buildings
- Roads
- Significant Heritage Sites
- Reef Extent
- Nauru Benthic Habitat
- Sand Bay
- Open Land
- Coconut Plantations
- Mined Areas
- Water Bodies
- Secondary Forest
- Grassland

Nauru Integrated CIVRA 2024 – National Vulnerability Assessment Report
Credit: Produced by Dr Alexei Trundle, Dr Serene Ho and Dr Viliame Iese of the University of Melbourne for the Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO), as part of the Green Climate Fund Integrated Climate Impacts, Vulnerability and Risk Assessment (CIVRA) for Nauru Project, facilitated by the Secretariat of the Pacific Regional Environmental Programme (SPREP). 2024.

Data Sources: Enumeration Area (EA) boundaries and associated PHC data from The Pacific Community (SPC) PopGIS Portal; Vegetation classifications from the Pacific Regional Environmetnal Programme (SPREP) PAcific Environmental Data Portal. Roads, Building Footprints, and Placenames sourced from Open Street Map.

Disclaimer: Boundaries and data shown are not necessarily authoritative.

Figure 15: Households that have conducted fishing in the last year – 2021

Trends & Future Disruption

Revenue relating to ocean fishing has been reasonably stable over the past 5-year period, as noted above, owing largely to the success of regional governance frameworks orchestrated through the Pacific Islands Forum Fisheries Agency (FFA). The FFA has been the implementing agency for the Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Interest, more generally known as the Nauru Agreement, since its inception in 1982, whereby eight PICs collectivised management of more than half of the western and central Pacific's tuna stock fisheries, equivalent to more than a quarter of the world's tuna supply (Yeeting et al., 2018).

At a regional scale, income has been similarly stable since 2015, prior to which a restructuring of purse seine licensing led to a rapid increase in revenue for the eight PICs party to the Nauru Agreement (FFA, 2023). The overall value of catch for foreign-flagged fishing fleets has fluctuated significantly over this time, however FFA flagged fleets have seen a steady increase in revenue, correlating to an increase in Pacific Islander employment across the sector. This represents a major economic opportunity for Nauru should the industry be localised after port upgrading works.

Table 11 above highlights changes in household-level fishing activity over the last two decades, including a significant decline in the number of households engaging in the activity in the most recent 2021 census, which fell from nearly half of all households in 2002 and 2011 to only 29.6 percent of households.

The number of households selling fish – while only a small share of the total population – also increased markedly over the last two decades, particularly when considering the nearly 10 percent increase in total population over that period. The decrease in households fishing beyond the near-shore reef also declined noticeably, although the reason for this change is unclear.

Uncertainties & Externalities

Significant concerns exist around the timelines of ocean heat and acidification impacts on near-shore reef fish stocks and other marine resources in Nauru, which are highly vulnerable due to the inadequacy of current management practices resulting in overfishing, as evidenced in Harris et al. (2016).

The potential for marine heatwaves having localised impacts is a key area of uncertainty in this sector. At the same time, the trends highlighted above that demonstrate a sharp decline in local fishing practice is an area that needs further research and exploration.

As elaborated on in CSIRO *et al.* (2024), under a high emissions scenario (RCP8.5) the consensus is that tropical tuna distributions in the Pacific are projected to shift eastwards with a 12.6 percent decrease in biomass in the Western Central Pacific Ocean and a concurrent 23.3 percent increase in biomass in the central Eastern Pacific Ocean by 2050.

Whilst this report does not consider future climate vulnerability, the shifting nature of tuna take, alongside the sensitivity of regional relations and the cohesion of CROP bodies upon which these negotiations rely (in the face of increasing geopolitical attention), presents a significant risk of future disruption (Koro et al., 2023; Nomura et al., 2024).

4.5 DISASTER MANAGEMENT

Disaster preparedness, response, and management is not conventionally understood as an economic sector or industry. However, the high prevalence disasters in the Pacific – along with the complex interaction of climate and non-climate hazards with climate change – elevates the importance of this domain at this regional scale. This section of this vulnerability assessment has also been used to directly consider adaptive capacity in a more holistic context, reflecting on key data relating to household and community capacities to response to climate-related shocks and stresses. Also incorporated is a wider consideration of emergency response services and capabilities as a function of national agencies and related alert systems. An overview of the climate vulnerability of the disaster management sector is shown in Table 12.

Table 12: Disaster Management Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	Moderate	➢ Current day climate impacts are the primary source of disaster exposure, particularly drought, which has widespread impacts across the island ➢ Adaptive capacity in relation to most disasters is low, with many households lacking resources or knowledge to deal with disasters ➢ Overall national impacts from disasters are low in terms of economic and other damage relative to overall revenue	• 2021 National Census: Household experience of disasters H36) • 2021 National Census: Household level post-disaster actions H37a) • DRR in Nauru Status Report (UNDRR, 2022) • RONAdapt (RON 2015) • Nauru Climate Risk Country Profile (World Bank 2021)
Disaggregate Vulnerability	High	➢ High frequency of food shortages with localities resorting to drinking unsafe water during drought ➢ Multiple communities where 100% of households have not taken preventative action post-disaster ➢ High localised levels of self-perceived lack of adaptive capacity	• 2021 National Census: Household experience of disasters H36) • 2021 National Census: Household level post-disaster actions H37a) • DRR in Nauru Status Report (UNDRR, 2022)
Trends & Future Disruption	Low	➢ Changes to existing disaster exposure over the short to medium term are largely within existing levels of variability, with gradual incremental change driven by sea level rise relative to disaster response timeframes / planning ➢ Stable underlying household adaptive capacity levels ➢ Resilience of existing sociocultural connections & fabric (e.g. language)	• CSIRO et al. (2024) Nauru Climate Impacts Report • DRR in Nauru Status Report (UNDRR, 2022) • Nauru Climate Risk Country Profile (World Bank 2021) • 2021 National Census: Household post-disaster action (H37a)
Uncertainty & Externalities	Low	➢ Well-structured and stable institutional environment for DRM ➢ Planned retreat inland further limits exposure to coastal hazards	• DRR in Nauru Status Report (UNDRR, 2022) • HGI Reports (Baches et al. 2022)

Aggregate Vulnerability

Overall vulnerability of existing disaster management processes and structures to climate change has been assessed here as being moderate, with formal governance approaches to a limited range of hazard exposures being viewed as generally effective and unlikely to be strained by significant rapid onset climate impacts.

This view is consistent with recent work by the United Nations Office for Disaster Risk Reduction, which recently completed a status assessment into Disaster Risk Reduction (DRR) in Nauru (UNDRR, 2022). This assessment noted that Nauru was ranked as being of 'low' risk in globally applied disaster risk comparative frameworks, such as the INFORM Risk Index, which ranked Nauru 109th, primarily as a function of its low range and levels of exposure to disasters. However, reduced household level adaptive capacity and evidence of a lack of post-disaster preparedness activities increase the overall rating provided here, as outlined below.

Disaster response in Nauru is managed by the Department of National Emergency Services (NES), which includes the relevant emergency agencies and incorporates the Nauru Disaster Risk Management Office (NDRMO). A National Emergency Operations Centre is also housed within the department. These arms of government were established out of a review into national disaster management law, supported by a range of humanitarian partners, that ran from 2015-2016, and resulted in the *National Disaster Risk Management Act 2016*, which was enacted in 2017 (ibid). The NES operate alerts for a range of hazards, including advice to limit water use in drought, via Facebook and mobile services (Inception meeting 2024, Pers Comm).

The NES also includes rescue and fire services, ambulance services, lifeguard services, and meteorological services. Nauru owns a total of four fire trucks – two for aviation, one for domestic purposes, and one additional tanker. The fire trucks use desalinated RO water, due to the salinity of groundwater affecting the trucks' machinery (Inception meeting, 2024). Much of the efforts to improve these services has been financed through development partners, with the Australian Government providing AU$15 million between 2018 and 2021 through the Nauru Infrastructure and Essential Services Initiative to improve these services, as well as other underlying aspects of Nauru's utilities-related infrastructure (UNDRR, 2022, p. 14). Additional finance has strengthened elements of health services, including emergency response.

Meteorological services have recently also been strengthened by the Secretariat of the Pacific Community, as part of a regional initiative titled 'Building Safety and Resilience in the Pacific'. This project funded new meteorological and hydrological equipment in support of disaster forecasting and included training and capacity building in partnership with the Australian Bureau of Meteorology (Depaune & Depaune, 2020). Meteorological and Hydrological Service and Fire Service now conduct awareness campaigns in schools, including annual fire and tsunami evacuations for all 10 schools, including the Able Disable Centre (Inception meeting 2024, Pers Comm).

Disaggregate Vulnerability

As the national economy is largely dependent upon international revenue sources (in the form of purse seine licensing, and funding for the Regional Processing Centre), local disaster impacts tend to be limited in global measures of lost GDP. At the same time, the slow onset and localised nature of current disaster impacts, along with the limited use of ecosystem services for food production, means other measures such as lives lost from reduced food production, are similarly difficult to quantify. Nonetheless, two-thirds of households across Nauru reported having been impacted by a natural disaster in the last decade at the 2021 census, as shown in Table 13 below.

As discussed in Section 4.1 and spatially depicted in Figure 8, drought is the most prevalently experienced disaster, having impacted 62.7 percent of households in the last decade (SPC & RON, 2023). Storm surges and king tides, as well as associated flooding, also have significant impacts on communities at the local scale as a function of differing geographies of household locations in relation to elevation and prevailing tides and winds.

Overall – as a measure of all hazards – only three Enumeration Areas had less than one-in-ten households that had been impacted; localities in Boe (EA4 & EA2) and Anabar (EA1). In contrast, multiple localities around the island had more than 90 percent of households having been impacted by a disaster: communities in Meneng (EA3), Location (EA2, EA3 and EA5), Aiwo (EA5), Nibok (EA1), and Uaeboe (EA2), as well as all households in three further areas (Anetan EA1 and EA2, and Location EA1).

Table 13: Disaster Management Data – Household Distribution and Trends (source: RON census data)

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Disaster Impacted Households – Last Decade									
Share of households affected by any disaster	66.5%	15.5%	97.3%	100%	Multiple	-	-	66.5%	-
Impacted Households not Adapting Post-Disaster	60.1%	19.3%	95.7%	100%	Multiple	-	-	60.1%	-
Rationales for Households Not Taking Preventative Measures:									
Lack of skills / knowledge	10.3%	0.0%	16.3%	53.5%	Anabar (EA2)	-	-	10.3%	-
Lack of money	7.7%	0.0%	12.6%	29.3%	Yaren (EA1)	-	-	7.7%	-
Believed there was nothing they could do	35.2%	2.2%	63.2%	84.6%	Meneng (EA3)	-	-	35.2%	-
Didn't know what should be done	20.0%	0.0%	32.4%	48.8%	Anabar (EA2)	-	-	20.0%	-
Believed adaptive action should be done by others	11.8%	0.0%	21.5%	79.3%	Anetan (EA1)	-	-	11.8%	-

In addition to these high localised levels of disaster exposure, responses to subsequent census questions suggested widespread low levels of adaptive capacity, with large numbers of households reporting that they were not taking preventative action following the impact of these disaster events to reduce their sensitivity to any recurrence of these shocks or stresses. As shown in Table 13, more than 60 percent of households that were impacted by disasters in the last ten years took adaptive or preventative action following these impacts, with this figure rising to 95.7 percent for the highest decile of localities.

This lack of adaptive action was widely spread across the island spatially, across diverse communities experiencing different types of hazards, as shown in Figure 16.

Reasons given for not taking action to prevent future impacts included:

- households believing that there was nothing they could do (35.2 percent of households);
- a lack of knowledge about what actions should be taken (20 percent);
- a belief that it was not the household's task or duty (11.8 percent);
- a lack of skills and / or knowledge (10.3 percent);
- a lack of money (7.7 percent); and
- a lack of other resources (7.2 percent).

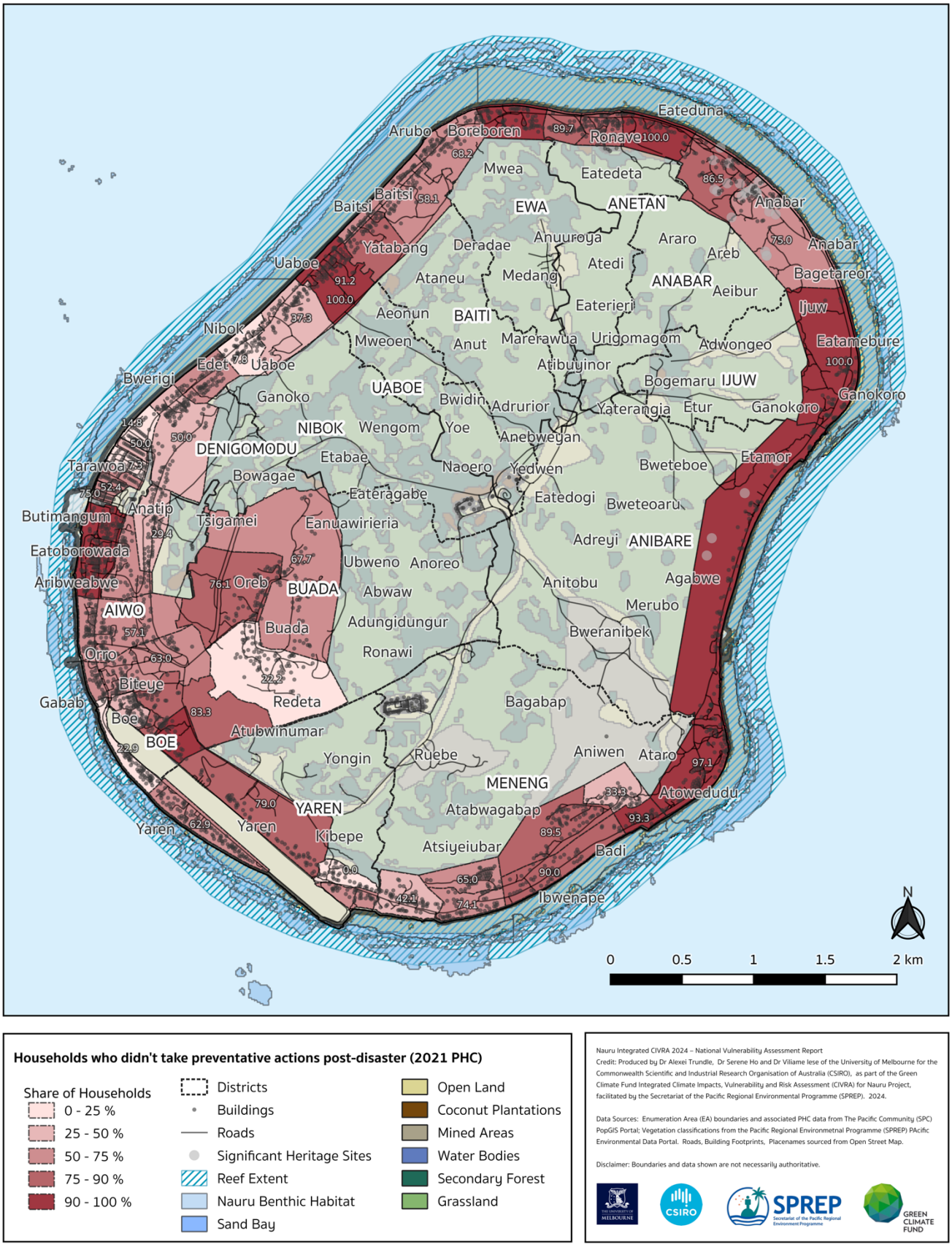


Figure 16: Households who didn't take preventative actions post-disaster – 2021

Trends & Future Disruption

As questions relating to disaster impacts, preparedness, and adaptive action have not previously been included in national censuses, assessment of sectoral trends is extremely limited in the case of disaster management. However, the increased resourcing, capacity building and staffing of disaster management over the last decade is likely to have strengthened the sector significantly.

More broadly the increase national GDP, as well as widespread access to internet services and telephony, over the last decade is likely to have enabled more effective disaster response and preparedness management, with one-third of households noting that they were receiving messages to raise awareness of climate change through the internet, the second most prevalent information source to family and friends (SPC & RON, 2023, p. 101) . In contrast, only one-quarter of all households reported having access to the internet in 2011 (SPC, 2012).

UNDRR's review of the status of disaster risk management in Nauru (2022) included recommendations for improvement in DRM in Nauru, which provides a template for likely future actions to enhance the sector. Priority 1 set out potential improvements in data management and integration, potentially building on SPC's POPGIS data visualisation portal.

Priority 2 noted the critical intersection between DRM and national adaptation planning, with a separate earlier review recommending that any future iterations of RONAdapt explicitly map to the Sendai Framework for Disaster Risk Reduction (Depaune & Depaune, 2020).Priority 3 noted the need for long-term investment in water security nationally, advocating for finance in support of the Nauru Sustainable and Resilient Urban Development Project (DCCNR, 2024). Priority 4 highlights ongoing efforts to mainstream climate science into infrastructure investments, such as the Sustainable and Climate Resilient Connectivity Project that is focused on improving port operations.

Uncertainties & Externalities

As noted above the lack of longitudinal data is one of the key areas of uncertainty in relation to the vulnerability of the disaster management sector, with existing data dependent upon recent experiences and environmental conditions (e.g. limited dependence on local food production). Although the focus on emergency management in education facilities is also positive, it is less clear whether other vulnerable demographics, such as the elderly and those with disabilities, are being engaged or planned for in emergency management processes and operations.

The emergence of extreme heat as a key climate-related hazard is an area that critically needs improved data, awareness raising, and household-focused community research. Although reports from in-country consultations highlighted some productivity impacts on airport staff, wider impacts in the community, as well as in other commercial enterprises and on workers and asylum seekers at the Regional Processing Centre facilities on Topside, also need further investigation.

Heat health alerts would also require calibration of local weather forecasting to identify measures for exposure thresholds, such as Extreme Heat Factor days, to be effective (M. E. Loughnan et al., 2013).

Most expected external impacts on the sector, such as the higher ground initiative, are likely to reduce overall susceptibility and sensitivity of Nauru's population to climate-related and other non-climate hazards. However, extreme heat impacts may worsen due to the lack of proximity to the ocean, whilst the interconnection between local food production and water availability requires rigorous analysis of rainfall variability. The dependence upon desalinated water remains the key weakness in national disaster mitigation planning.

4.6 COASTAL DEVELOPMENT, PROTECTION AND INFRASTRUCTURE

The coastal protection and infrastructure sector incorporates a wide range of built environment assets across Nauru, with a particular focus on commercial and public infrastructure of national importance, utilities related infrastructure and assets, and the built form of dwelling structures. A number of these key assets are depicted in the national vulnerability summary map in Section 3 of this report (Figure 7), many of which are directly exposed to coastal hazards to varying degrees. Much of this sector has also been primarily assessed elsewhere in this report (e.g. critical health infrastructure, such as the RoN Hospital, has been assessed within the Health and Wellbeing sector, reported on in Section 4.2).

In May 2024 the Government of the Republic of Nauru released an Integrated Infrastructure Strategic Plan (NIISP), incorporating all funded and unfunded public infrastructure focused development projects valued at AU$100,000 or more (GRN & PRIF, 2024). The NIISP includes a condition assessment of all public infrastructure assets, including economic value, service levels, and maintenance needs. Rather than replicating the highly detailed assessment conducted as part of NIISP process, this section of the CIVRA Climate Vulnerability Assessment focuses on detailing dwelling conditions not included within the NIISP process, whilst summarising the findings that relate to the nationally owned or controlled elements of coastal protection and infrastructure. A summary of these is set out in Table 14 below.

Table 14: Coastal Protection and Infrastructure Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	High	➢ Dwelling materials overall reasonably constructed, with minimal improvised/makeshift buildings; however, in disrepair (e.g. 1/3 of household guttering) ➢ Main ring road & curb assessed as being in generally 'fair' condition, with footpaths along sealed roads ➢ Seaport & single container vessel critical for import dependent economy (including food supply) ➢ Energy remains dependent on centralised diesel generators and household gas supply systems ➢ Limited access to refrigeration, significant lack of freezers	• 2021 National Census: Household guttering & downpipe condition (H09 & H10) • Nauru 2024 Integrated Infrastructure Strategic Plan • CSIRO et al. (2024) Nauru Climate Impacts Report • 2021 National Census: HH refrigeration & freezers (H32)
Disaggregate Vulnerability	Extreme	➢ High levels of current inundation exposure in Anetan and Anibar (up to 100 percent in some localities) ➢ External household cooking areas prevalent (>40%) in some localities ➢ Areas with 2/3 of households lacking freezers, ¼ lacking fridges ➢ Housing shortage across Nauru creating overcrowding issues & poor building quality in areas	• 2021 National Census: Household experience of disasters (H36), refrigeration access (H32) & kitchens (H24) • Higher Ground Initiative Purpose + Need Report • CSIRO et al. (2024) Nauru Climate Impacts Report
Trends & Future Disruption	High	➢ Increasing exposure to inundation related climate impacts ➢ Increasing extreme heat exposure ➢ Current upgrading of Seaport Facilities, RoN Hospital, water supply network, septic treatment & solid waste management ➢ Planned inland relocation of several services and upgrading of national infrastructure through HGI and Future NSRUDP Phases	• Nauru Coastal Risk Assessment (2023) • Nauru SRUDP Resettlement Plan (ADB 2024) • Nauru 2024 Integrated Infrastructure Strategic Plan • Higher Ground Initiative – Purpose + Need Report
Uncertainty & Externalities	Low	➢ Households without access to cooling (fans, A/C) unknown, with implications for heat exposure ➢ Land tenure complexities limit options for retreat & resettlement ➢ Possible impacts of private sea walls on adjacent shoreline areas	• 2021 National Census • HGI Land Tenure & Safeguarding Report (Baches et al. 2022) • Nauru Coastal Risk Assessment (2024)

Aggregate Vulnerability

Coastal protection is directly inter-related to the levels and types of exposure faced by coastal assets, implying an existing level of susceptibility to oceanic climate hazards. In the case of Nauru, most of the country's settlements, infrastructure, and other assets is proximal to the coastline. An estimated 38.4 percent of Nauru's population lives within 100 metres of the coastline, for instance, along with 40 percent of the country's total infrastructure replacement value (Kumar et al., 2020).

Here, coastal protection has been assessed in terms of infrastructure immediately adjacent to the shoreline impacted by hazards such as coastal inundation, erosion, and other impacts of wave action. Analysis conducted for SPC in 2023 identified that Nauru's coastline consisted of a limited patchwork of private and public sea walls, with the shallow reef flats providing some protection from wave action (Wandres et al., 2023). Existing coastal defences are primarily concrete structures and large boulders sourced from broken-down pinnacles, which are viewed locally as being highly durable and are easy to procure (Pers. Comm., 2024).

A survey from 2000 identified severe erosion along Anibare harbour, along with land adjacent to the airport runway (Wandres et al., 2023). It was noted that subsequent improvements to the airport's coastal defences may have mitigated this risk, with in-country consultations noting that the southern corner of the airport in the Yaren District does not appear to experience significant inundation from wave overtopping at present (CSIRO et al., 2024). However, land adjacent to the airport was observed to experience some inundation during large swells.

Coastal flooding was estimated through the Nauru Coastal Risk Assessment to be costing Nauruans an estimated US$1.3 million annually, with a '1-in-100 year' equivalent inundation event (100-year ARI) modelled to impact 54 percent of Nauru's population, flooding 9.2 percent of buildings and 3.6 kilometres of the island's road network (Wandres et al., 2023, p. 23). As noted in CSIRO *et al*. (2024), under current conditions, a 2.7 m king tide would expose only 13 residential buildings to inundation, with no impacts on commercial, industrial, or public buildings (Allis et al., 2020, p. 39). These impacts centre on the northern and southern coastlines of the island, with the former predominantly households and the latter national and commercial assets (GRN & PRIF, 2024).

The vulnerability of infrastructure more generally was found to be significantly higher than that of coastal protection, with the patchwork nature of coastal defences generally offset by relatively moderate hazard impacts (e.g. low-level inundation). However, the generally poor condition of housing, alongside complex and interdependent energy supply chains, coupled with limited household assets, significantly worsened national infrastructure vulnerability overall (A. K. McLennan, 2016; Morris, 2021). Additional elements of infrastructure vulnerability relating to water supply and sanitation are highly vulnerable but have already been assessed in Section 4.1.

As noted in the 2021 census, only one-in-ten Nauruan households currently use electricity for cooking, with most reliant on imported butane gas canisters (SPC & RON 2023, p. 93). Overcrowding is common, with many houses accommodating extended families in compact quarters. As of 2021 the average household size was 5.8 people, however 14.3 percent of households had more than ten inhabitants, despite less than 10 percent of dwellings having five or more bedrooms (ibid). Overall Nauru has the highest density of any Pacific country; 554 people per square kilometre, 1.5 times higher than Tuvalu which holds second place (ibid, p14). This is before accounting for the uninhabitable land that has been mined out on Topside, which increases the practical density of the country further.

Disaggregate Vulnerability

Analysis of current day exposure to coastal inundation conducted for the Higher Ground Initiative shows limited impacts beyond housing stock, with areas of roads exposed to the north of the island around Anetan and Anabar, with some further areas of exposure in Meneng to the island's south (Allis et al., 2020, p. 46). Household exposure to both storm surges and king tides was also included within the 2021 National Census questionnaire, with results showing which households had experienced either hazard in the last decade. Results of these two questions are shown in Figure 17 and Figure 18 below, which show significant spatial variation in household hazard exposure.

Storm surge impacts were almost universal across the communities at the western and eastern extents of Anetan District, with 96.5 percent and 100 percent of households respectively having been affected. Several households in Denigomodu on the country's central western coast – and the sub-district area of Location in particular – also reported being impacted by storm surges, with a quarter of all households experiencing direct impacts at some point in the last decade. King tides were reported as having impacted a smaller subset of households, however a similarly high number in the two localities of Anetan had been impacted, as shown in Figure 18.

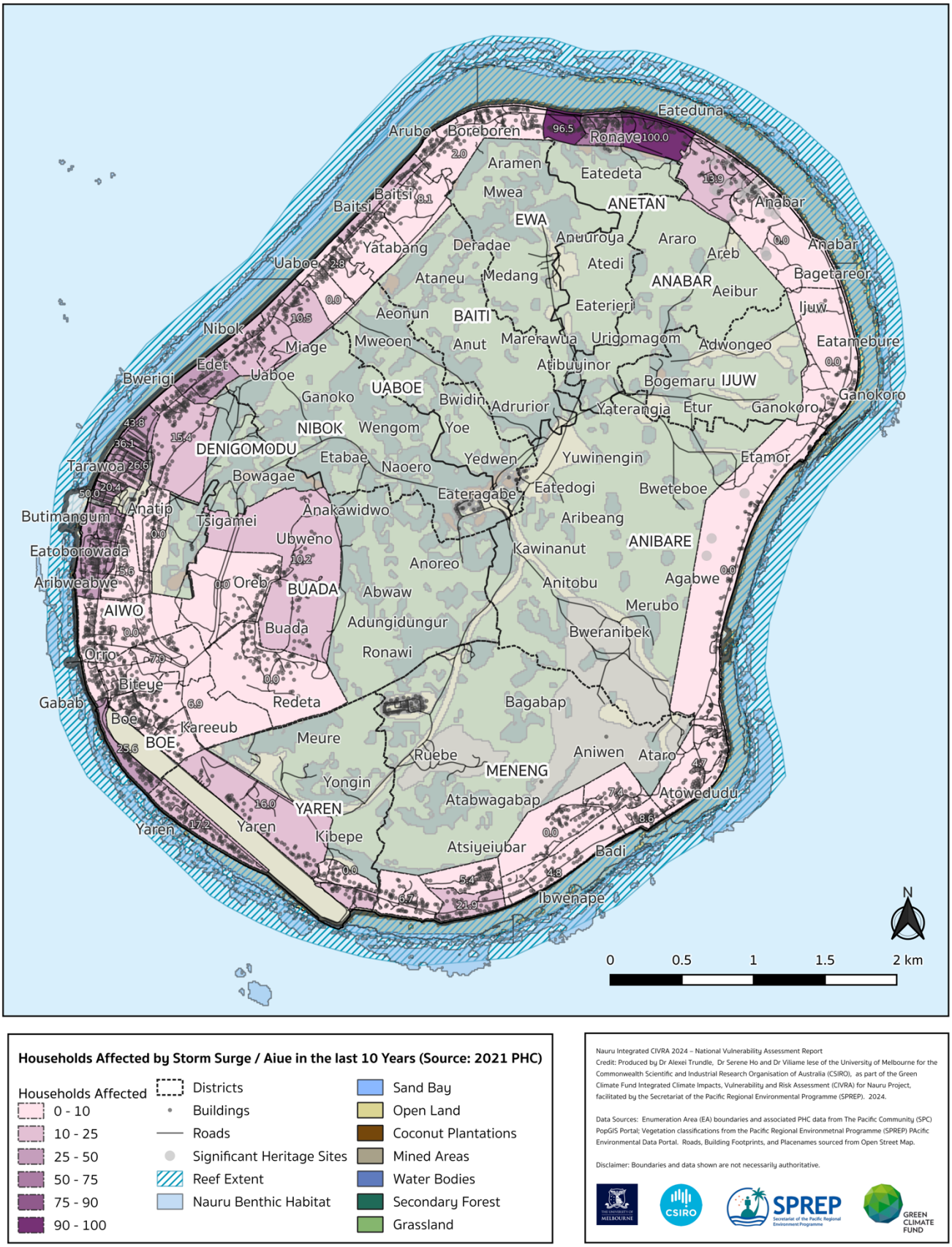


Figure 17: Households affected by storm surges in the last decade – 2021

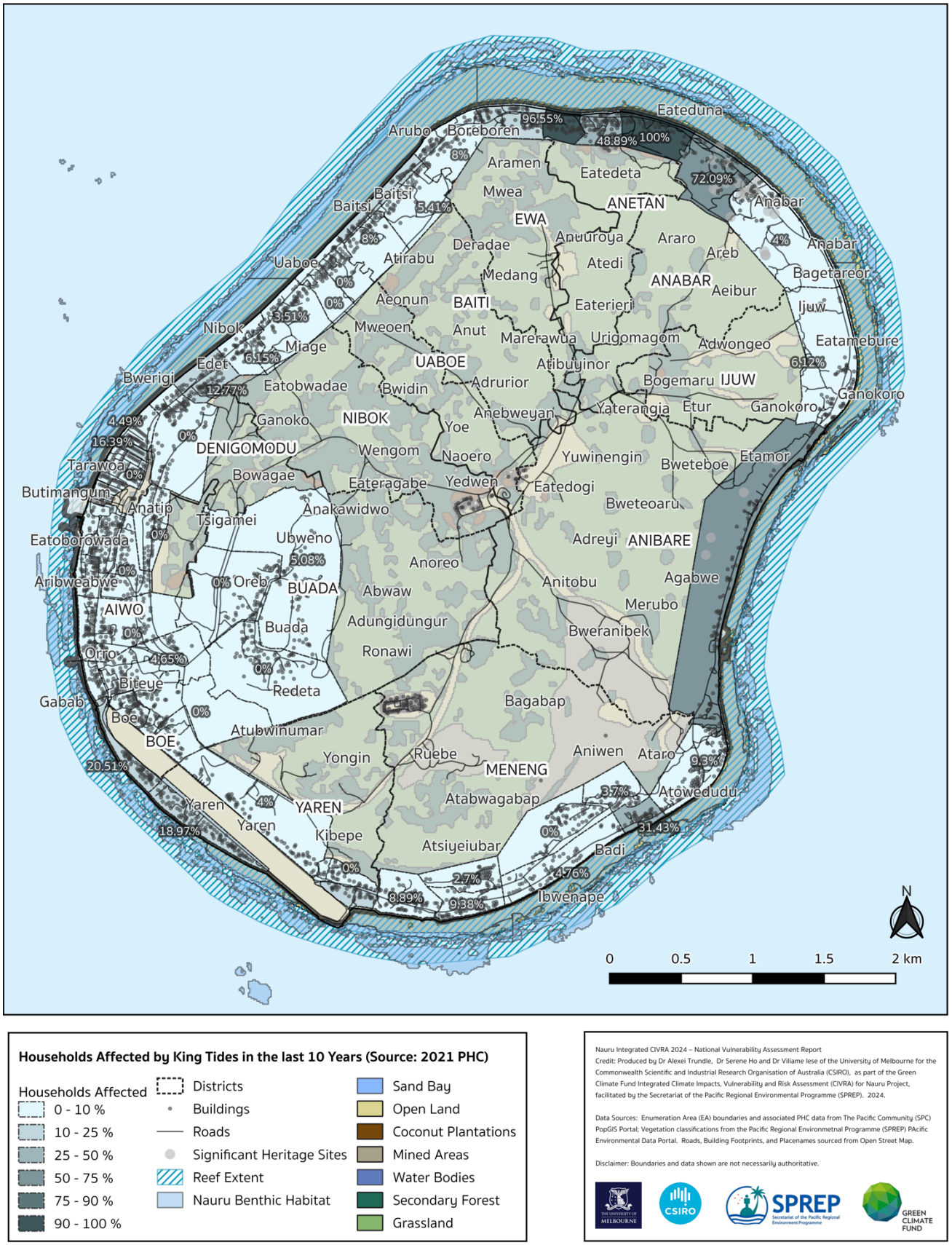


Figure 18: Households affected by King tides in the last decade – 2021

72 percent of households in the larger northern section of Anibare (EA1) reported impacts from King tides, potentially reflective of the deeper coastal bathymetry associated with Anibare Bay, which lacks the fringing reef that surrounds the rest of the island. As noted in CSIRO *et al.* (2024), recent storm surge events in January 2024 did impact construction works at the seaport, which related to a distant storm event. The resulting impacts were caused by infragravity waves, which differ from locally wind-driven storm surges. Smaller swells of 0.5m are unsafe for boat unloading, with potential impacts on the economy, food security, and livelihoods.

Dwelling attributes that impact climate vulnerability have been assessed at the household level, with disaggregated results shown by EA in Table 15 below. These variables have been grouped into three categories: household construction materials and configuration; utilities and services access; and appliances, goods and vehicles. Although in many ways all the variables within the housing component of the National Census have some relevance to infrastructure, the subset shown below is of most relevance to the vulnerability of residential infrastructure to climate impacts. Aspects relating to land management have been addressed separately in Section 4.8.

The construction materials and household configurations in Nauru are a key factor in the coastal protection and infrastructure sectors overall rating as having a high level of climate vulnerability, with the poor quality of housing driving susceptibility to heavy rainfall and inundation related hazards, and issues relating to overcrowding increasing the sensitivity of residents to health-related impacts. However, the typology of housing, as well as the materials used, differs significantly across Nauru, increasing the vulnerability of some communities significantly.

The higher density dwellings on the central western coast of Nauru are particularly distinct, with Location being constructed as a standalone and large complex of apartment-style accommodation for expatriate workers employed by the then British Phosphate Corporation that has subsequently been repurposed. The Location area within Denigomodu District has 72.3 percent of its population overall living in apartments, with some areas nearly entirely apartment-style accommodation (as shown in Table 15). Additional apartment complexes can be founded in Aiwo (EA3) and Meneng (EA1, EA2b, EA3, EA6, and EA7). Nationally 11.4 percent of households also share their house with one or more other households, particularly in Meneng (EA6), Yaren (EA1), Ewa (EA1) and Denigomodu (EA2). These configurations often limit adaptation options in terms of adjustments to built form; however, shared utilities and spaces can also offer more effective and efficient adaptation pathways and support community resilience and adaptive capacity.

Households with detached structures – such as toilets, kitchens, and animal pens – are sensitive and susceptible to climate impacts, such as extreme heat exposure and floodwater generated vector-bourne disease, in different ways.The total share of households with multiple detached structures in 2021 varied significantly spatially across Nauru, with the lowest decile having single attached structures only in its entirety, rising to more than one-in-three households having multiple detached structures in the highest decile. Anabar EA1 had as many as 86 percent of dwellings constructed in this way. Households with outside cooking areas were similarly prevalent but were more evenly distributed, with the highest share being in Anetan (EA3), at 40.9 percent, but a similar number of households doing so in localities in Denigomodu (EA1), Boe (EA3), Meneng (EAs 5 and 7), and Yaren (EA2).

Households with singular bedrooms, as noted earlier, do not necessarily correlate with smaller household sizes, with several likely to be indicative of overcrowding (Morris, 2021). Nearly half of all households in parts of Aiwo (EA3) had one or less bedroom, consistent with several of the households there being classified as ‘single quarter’ dwellings (rather than detached housing or apartments). 18.4 percent of households in Ijuw EA1 were classified as having no bedrooms; the highest figure nationally, followed by 8.3 percent in Buada EA1. In contrast, whilst less than 10 percent of households had more than five bedrooms, some had as many as eleven (SPC & RON, 2023). The largest clusters of these large households were in Nibok and Buada; districts which collectively accounted for nearly one-quarter of all dwellings with five or more bedrooms.

Dwelling construction materials have a substantive impact on the sensitivity of households to climate impacts, however the quality of housing across Nauru has undergone limited analysis despite the country’s steady population growth, high levels of density, and status as a 100 percent urbanised country (Trundle, 2020). Much of Nauru’s housing stock is also quite old, with 35.8 percent of houses constructed before national independence 50 years ago, and a further 21.7 percent more than 20 years old (SPC & RON, 2023, p. 80). The localities with the largest number of houses that are more than 50 years old are Location in the Denigomodu District (90.6 percent) and Uaboe District (60 percent), with the largest share of recent construction having occurred in Anibare and Buada (ibid).

Table 15: Coastal Protection & Infrastructure Data – Household Distribution and Trends (source: RON census data)

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Household construction materials & configuration									
Households with multiple detached structures	15.2%	0.0%	35.2%	86.0%	Anabar (EA1)	-	-	15.2%	-
Households with an outside cooking area	14.9%	2.6%	31.5%	40.9%	Anetan (EA3)	-	-	14.9%	-
Apartment dwellings	25.6%	2.4%	81.3%	98.3%	Location (EA2)	34.5%	22.0%	25.6%	↘
HHs with ≤1 bedroom	23.0%	9.6%	35.2%	48.5%	Aiwo (EA3)	11.9%	19.0%	23.0%	↗
HHs with 5+ bedrooms	9.9%	0.0%	28.1%	40.6%	Ewa (EA2)	5.6%	-	9.9%	↗
Households with sheet metal walls	4.5%	0.0%	10.1%	23.1%	Denigomodu (EA1)	4.1%	6.0%	4.5%	→
Households with asbestos roofing	1.1%	0.0%	1.8%	3.7%	Meneng (EA2b)	-	28%	1.1%	↘
HHs without guttering	35.9%	10.7%	59.3%	84.0%	Anibare (EA1)	-	30%	35.9%	↗
Guttering needs repair / replacement	34.8%	8.3%	45.1%	65.9%	Location (EA3)	-	31%	34.8%	↗
Household utility & services access									
HHs without septic or sewerage system	29.4%	0.0%	77.4%	92.3%	Meneng (EA3)	5.9%	55.0%	29.4%	↘*
HHs cooking w/ electricity	4.8%	6.6%	41.3%	51.4%	Aiwo (EA5)	96.1%	60.0%	4.8%	↘
HHs using the internet	80.7%	22.0%	100.0%	0.0%	Location (EA1)	-	27.0%	80.7%	↗
HHs with a mobile phone	98.4%	96.5%	100.0%	81.8%	Location (EA3)	-	89.0%	98.4%	↗**
HHs burning waste	2.3%	0.0%	8.0%	16.3%	Ijuw (EA1)	-	-	2.3%	-
Appliances, goods and vehicles									
HHs with generators	4.8%	0.0%	11.7%	0.0%	Multiple	0.8%	-	4.8%	↗
HHs with a refrigerator	72.6%	52.1%	91.8%	25.0%	Location (EA1)	70.6%	57%	72.6%	→
Households with a freezer	65.1%	51.8%	81.1%	36.1%	Location (EA5)	54.1%	48%	65.1%	↗
HHs with a motorboat	7.0%	0.0%	17.4%	23.8%	Uaeboe (EA1)	12.6%	6.0%	7.0%	↘
Households with a traditional canoe	0.9%	0.0%	2.7%	6.3%	Meneng (EA5)	9.4%	4.0%	0.9%	↘

** The exact wording of the question from the 2002 is unclear, suggesting this figure may exclude some pit latrines and other unsealed toilet facilities*

*** 2011 data includes landlines, suggesting that the number of households with access to mobile phones was lower at this time than shown above*

Sheet metal walls are generally reflective of poorer building quality, leading, for instance, to their occupants being more susceptible to higher levels of internal thermal stress than buildings with stronger insulative properties. The Denigomodu district had the highest share of sheet metal walled buildings (excluding the Location sub-zone), with nearly one-quarter of households in the EA1 locality being constructed in this way, significantly more than the national average of 4.5 percent. Although not shown in Table 15, asbestos was also a prevalent outer wall material, particularly in Meneng, Anetan, and Denigomodu Districts.

A lack of functional guttering heightens sensitivity to flooding, while also limiting the capacity to retain and use rainwater; a necessity given Nauru's propensity to drought. Although national averages show two-thirds of households have guttering, as discussed in Section 4.1, this number decreases to only 40.7 percent of households in one-in-ten localities. In Anibare, communities have as high as five-in-six households lacking guttering (EA1); a locality that also has one of the country's lowest levels of rainwater collection (with correspondingly high dependence on RO water tanker supply).

Many households that did state that they had guttering also noted that it was in a state of disrepair; even in the lowest decile 8.3 percent of households with guttering stated that it needed either repair or replacement. This was particularly the case in Location, where it rose to as high as two-thirds of households in some areas (EA3), while it was also high in parts of Aiwo (EA4) and Denigomodu (EA1 and 2). Outside of the housing sector the NIISP also noted widespread roofing leakages in buildings across both the education and health sector, including in some of the newer buildings in the RON Hospital complex (GRN & PRIF, 2024, p. 17).

Access to utilities is a critical factor in household level susceptibility to climate impacts. Localised exposure to sewerage was of particular concern, given the prevalence of flooding in some areas (as shown in Figure 19), and dependence on groundwater in others. Whilst some areas had low levels of associated vulnerability, with the lowest decile having 100 percent access to septic or sewerage systems, the converse decile lacking access averaged 77.4 percent of households, rising to as high as 92.3 percent of households in Meneng EA3.

Internet access (measured as use in the last week) was generally high, however some communities were isolated from this means of communication, particularly those households in Location EA1 (none), Anetan EA1 and EA3 (6.9 and 20.5 percent respectively), and Location EA2 and EA6 (roughly 18 percent).

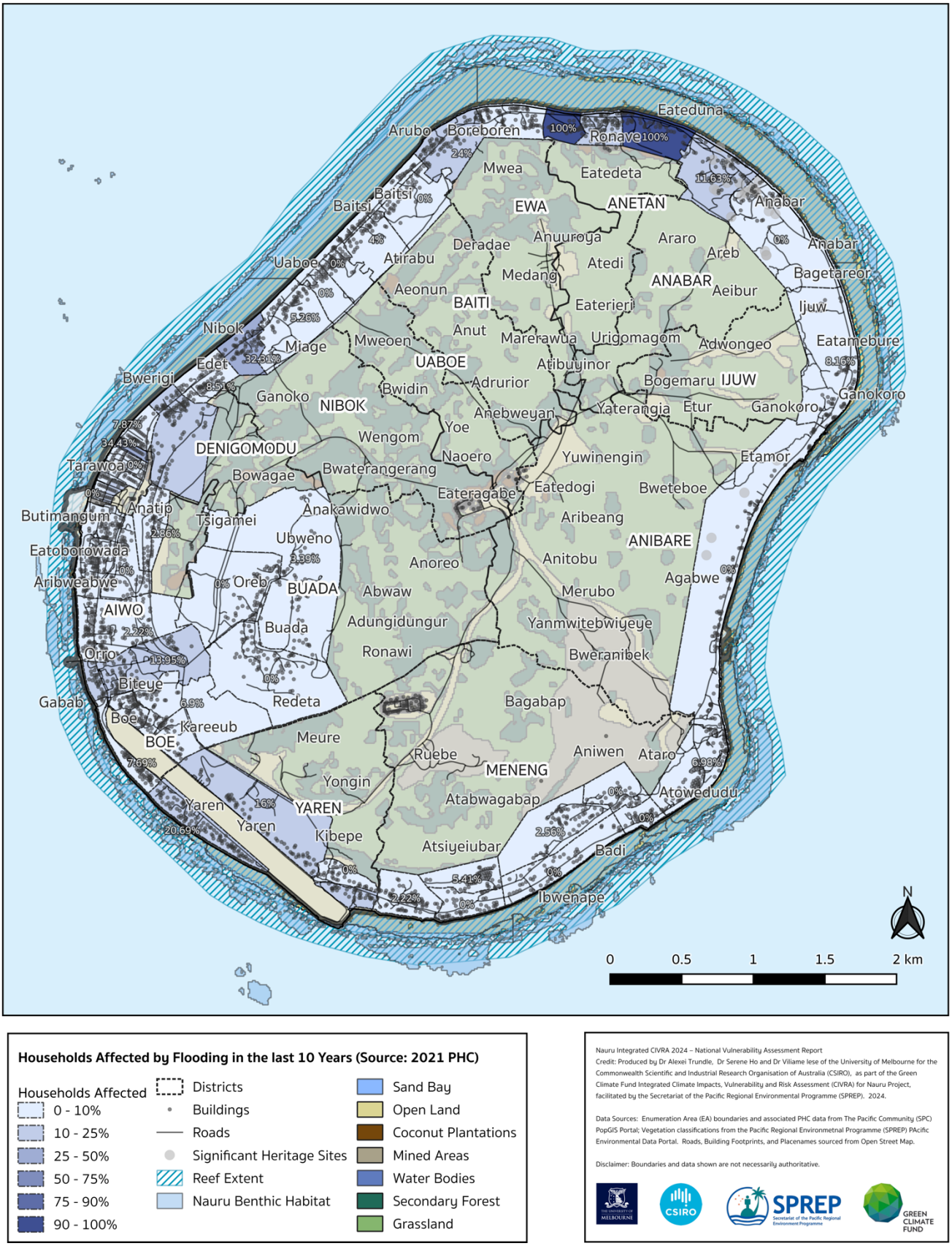
Despite nearly universal access to electricity, household capacities to store fresh food across Nauru are limited by highly variable ownership of refrigerators and freezers. When localities were divided by ownership levels, the lowest decile of EAs had rates of ownership of both appliances near 50 percent. The lowest levels of access were in Location, with only one-quarter (EA1) and one-third (EA5) of households owning their own refrigerator or freezer respectively within subdivisions of the highly compact settlement. Nearly five percent of households also owned their own generator, providing some redundancy in the event of power outages to the national grid.

The aforementioned patchwork of seawalls underwent a comprehensive assessment using satellite imagery in 2023 (including comparative analysis between 2014 and 2020) as part of the Nauru Coastal Risk Assessment (Wandres et al., 2023). Although the majority of Nauru's coastline is not protected by seawalls, this mixture of private and public investment is nonetheless significant, with some districts, such as Uaboe, undergoing rapid recent expansion in the area of coastline covered. Earlier seawalls are however in states of disrepair, with a reduction in coverage in districts such as Anibare and Anetan (ibid, p.17). Less well understood, however, are the impacts of seawalls on adjacent, unprotected, areas of coastline, where changes to wave action have the potential to worsen local vulnerability to coastal impacts.

Trends & Future Disruption

Changes to the variables discussed above are shown in Table 15, where comparable data is available from earlier census records. The ongoing shift in household configuration is particularly notable, with an increasingly wide distribution in number of bedrooms reflective of ongoing change at the household level as the population has grown over the last decade. This is particularly significant as between 2012 and 2020 there was a 50.9 percent increase in the number of buildings in Nauru, with the Anabar, Anibare, Ewa and Ijuw districts more than doubling in size over that time (Wandres et al. 2023).

The share of households with one or less bedroom over this period also more than doubled, increasing from 11.9 percent to 23 percent, whilst the share of households with five or more bedrooms also nearly doubled, from 5.6 percent to 9.9 percent.



Households Affected by Flooding in the last 10 Years (Source: 2021 PHC)

Households Affected
- 0 - 10%
- 10 - 25%
- 25 - 50%
- 50 - 75%
- 75 - 90%
- 90 - 100%

- Districts
- Buildings
- Roads
- Significant Heritage Sites
- Reef Extent
- Nauru Benthic Habitat
- Sand Bay
- Open Land
- Coconut Plantations
- Mined Areas
- Water Bodies
- Secondary Forest
- Grassland

Nauru Integrated CIVRA 2024 – National Vulnerability Assessment Report
Credit: Produced by Dr Alexei Trundle, Dr Serene Ho and Dr Viliame Iese of the University of Melbourne for the Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO), as part of the Green Climate Fund Integrated Climate Impacts, Vulnerability and Risk Assessment (CIVRA) for Nauru Project, facilitated by the Secretariat of the Pacific Regional Environmental Programme (SPREP). 2024.

Data Sources: Enumeration Area (EA) boundaries and associated PHC data from The Pacific Community (SPC) PopGIS Portal; Vegetation classifications from the Pacific Regional Environmetnal Programme (SPREP) PAcific Environmental Data Portal. Roads, Building Footprints, and Placenames sourced from Open Street Map.

Disclaimer: Boundaries and data shown are not necessarily authoritative.

Figure 19: Households affected by flooding in the last decade – 2021

In effect, planning for adaptation at the household level is increasingly requiring solutions tailored to a wider range of household typologies.

Household access to electricity across Nauru is extremely high, with 99.5 percent of households found to be connected to the national grid as of 2021 (SPC & RON 2023, p. 90). However, grid reliability in recent years has been variable, with diesel generators dating back to near the time of Independence having been only replaced in 2018 (ADB, 2019).

This largely accounts for the rapid reduction in household use of electricity for cooking purposes, which collapsed from 96.1 percent of households in 2002 to only 4.8 percent of households in 2021. This new reliance on butane gas at the household level presents a challenge for the country as it tries to shift to renewables and reduce its dependence on imported fuel for energy.

This is despite 50 percent of electricity in Nauru being due to be generated by solar power by mid-2024 (IMF, 2023). Earlier targets to reach 50 percent renewables by 2015 were overly ambitious, with Nauru having had no renewables installed onto its grid only a few years prior to its initial target end date (Dornan, 2014).

Another notable change over the last two decades is the now nearly universal household ownership of mobile phones. Mobile devices are now the primary mode of internet access, with wired access (using copper or fibre-optic cables) now accounting for less than one-in-five households nationally.

This has drastically increased the overall levels of internet access and usage, as Table 15 illustrates, which has increased from 27 percent to 80.7 percent between 2011 and 2021. This finding was particularly significant for disaster risk management (as discussed in Section 4.5), with 34.9 percent of households citing the internet as their primary source of awareness raising in terms of disasters and climate change (SPC & RON, 2023, p. 101).

Access to appliances, goods and vehicles appears to have fluctuated significantly between the three censuses analysed in this assessment, although declines in refrigeration and freezer access between 2002 and 2011 did not reflect a net loss of these assets (but rather, access did not keep up with population growth). Reductions in the ownership of motorboats and traditional outrigger canoes, however, did equate to a net decline between 2002 and 2021, in line with a reduction in the overall levels of involvement in fishing discussed in Section 4.4.

Uncertainties & Externalities

Both coastal protection and infrastructure assets more broadly are likely to change drastically over coming years, both because of ad hoc upgrading of dwellings and household purchasing patterns, as well as the large number of infrastructure projects currently being implemented or planned across Nauru.

Many of these major initiatives are discussed in earlier sections of this report, but a comprehensive list of current projects is included in the latest version of the Nauru Integrated Infrastructure Strategic Plan (GRN & PRIF, 2024). One example of these is the ongoing installation of a 6.5MW solar farm, inclusive of 5MW of battery storage, which will significantly increase the reliability of the national grid and reduce existing dependence on imported diesel.

The NIISP also includes a comprehensive forward-looking shortlist pipeline of national priority projects, developed by government agencies and vetted through a whole-of-government process. These range from relatively small procurements of new fire trucks, through to a $93 million upgrade to the RON Hospital, and incorporate initiatives mentioned elsewhere in this assessment, such as the Nauru Sustainable Urban Development Program.

Other significant initiatives include a $10 million coastal protection program, comprising construction and repair of sea walls across much of the island, a $20 million extension of the Meneng Farm, a $60 million water storage tank upgrade for NUC, and a Sealed Road Repair Program incorporating drainage upgrades for the island's main ring road (GRN & PRIF, 2024, p. 31).

Whilst efforts to reduce the prevalence of asbestos in residential buildings appear to be significantly reducing the prevalence of the dangerous material in dwellings across Nauru, surveys by SPREP show that Nauru has the highest total volume of asbestos containing material in non-residential locations in the Pacific, with 52,874 square metres identified (SPREP, 2015). Issues have also been identified with storage of removed material at the landfill site, presenting a localised hazard for workers and surrounding communities.

An estimated 32% of dwellings were suspected to contain asbestos in a survey by SPREP in 2015, comprising a significantly higher number of households than self-reporting in response to the census questionnaire, reflective of loss of built material knowledge over time. A material survey, including testing, of roofing materials must be explored thoroughly as part of any roll out of water storage and guttering upgrades nationally, should this occur.

4.7 BIODIVERSITY & ENVIRONMENT

As noted in Gale (2019), Nauru's pre-colonial biodiversity was distinctly improved from today. Topside, according to Manner *et al.* (1984), was likely to have been primarily two forms of forest: one, covering rocky outcrops and hillcrests, dominated by Polynesian banyan (*Ficus prolixa*), and the other, which Manner *et al.* approximated would have covered 90 percent of Topside, dominated by the oil-nut tree known as Tamanu (*Calophyllum inophyllum*), which has an average canopy height of 16 metres (ibid).

At the time of Manner *et al.*'s 1984 survey 50 indigenous species were found across the island, fourteen of which were identified in non-mined sites. Over the next few decades, most of these species were replaced by both exotic weeds (79 species), as well as by ornamental (261 species) and food plants (80 species) grown by Nauruans.

An overview of the vulnerability of Nauru's current environment and associated biodiversity attributes is shown in Table 16 below. Broadly, this is primarily a function of the degraded state of much of Topside resulting from near a century of phosphate mining. However, the steady increase in total population since World War II, coupled with inadequate environmental controls, ranging from sanitation to overfishing of the nearshore reef areas, has led to a wider range of impacts to marine and terrestrial flora and fauna.

Table 16: Biodiversity Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	High	➢ Remnant flora and fauna are in a highly disturbed state, despite high cultural and ecological value ➢ Groundwater systems show signs of saline ingress under current conditions and are highly sensitive to periods of drought ➢ Nearshore reef areas are in a degraded state, with most fish and marine invertebrates undersized, suggesting overfishing	• Nauru's Biodiversity Strategy & Action Plan (Onorio & Deiye, 2010) • Nauru's 2021 State of the Environment Report (SPREP, 2021b) • Fishery & Aquaculture Profile: Nauru (FAO 2013) • SPC Reef Invertebrate Survey (Harris et al. 2016)
Disaggregate Vulnerability	Extreme	➢ Some marine species likely at critical thresholds (giant clam, sea turtles) and lacking protection ➢ Several tree species are close to local extinction (e.g. Aidia racemosa), with cascading ecosystem service impacts (e.g. Bruguiera gymnorrhiza, which purifies nearby lagoon water)	• Nauru's 2021 State of the Environment Report (SPREP, 2021b) • Rapid Biodiversity Assessment of Nauru (SPREP 2014) • Fishery & Aquaculture Profile: Nauru (FAO 2013)
Trends & Future Disruption	High	➢ Ongoing issues with sanitation are likely to continue to pollute groundwater systems ➢ Evidence of recent coral deaths, correlating with populated areas, suggesting degradation since 2014 ➢ Reduced levels of fishing may decrease pressure on nearshore marine ecosystems	• CSIRO et al. Nauru Climate Impacts Report • Rapid Biodiversity Assessment of Nauru (SPREP 2014) • 2022 Nauru Water & Sanitation Master Plan • Census – Households Fishing in 2021 (H46,47)
Uncertainties & Externalities	High	➢ Permeability of groundwater lenses to saline ingress is uncertain, critical for sea level rise impacts ➢ Proposed biodiversity conservation areas	• Jacobson & Hill (1987) vs. Alberti et al. (2022) • Nauru Climate Risk Profile (WBG 2021)

Aggregate Vulnerability

The status of Nauru's biodiversity – being one already in a highly-disturbed state – makes assessment of its vulnerability to climate impacts complex, as in many ways the remanent ecosystems and habitats across Nauru have exhibited a high-level of resilience to a century of profound change, extraction, pollution, and material depletion. The rating of Nauru's environmental climate vulnerability as 'high' is considered from the basis of this current state as a baseline, albeit compared with other national contexts, particularly those within the Pacific.

As noted in CSIRO *et al.* (2024), Nauru's onshore fauna does not comprise any native terrestrial mammals, with domesticated dogs and cats, livestock species (pigs and chickens), and Polynesian rats being the prevailing species, all of which are introduced. Nauru does, however, have endemic insects, including moths and dragonflies, and reptiles (four species of gecko, three skinks, and a blind snake). The specific sensitivity of these species to climate impacts such as increasing temperatures and surface water availability has not been able to be analysed as part of this assessment and has not been documented elsewhere.

Nauru's bird diversity comprises 36 species, with seven resident species, including the endemic Nauru reed warbler *Acrocephalus rehsei* (SPREP, 2021b, p. 122). The latter species is believed to have adapted well to both the regenerating vegetation around the mined areas of Topside, as well as urban environments around the island's coastal urban areas (ibid).

The Micronesian Pidgeon (*Ducula oceanica*) also resides on Topside, along with Black and Brown Noddy's (*Anous minutus* and *Anous stolidus*). Lesser (*Fregata ariel*) and Greater (*Fregata ariel*) Frigate birds are also indigenous to the island, with both these and Noddy bird species hunted for sport and food, also being of cultural significance (as reflected in the presence of the Frigate bird on the Nauruan coat of arms).

Similarly to its fauna, Nauru's flora is dominated by introduced species, with a total of 573 species and cultivars identified in the Draft 2021 State of the Environment Report, of which only 63 are indigenous (SPREP, 2021b, p. 113). Of the island's four endemic plants, two are believed to be now extinct. The limestone forest tree *Aidia racemose*, known locally as enga, is also close to extinction, whilst several Topside forest trees such as *Cordia subcordata* (eongo) and *Erythrina variegate* (eora) exist only in small patches of remnant forest that have survived decades of phosphate mining. A detailed vegetation map of Nauru was most recently developed in 2008, building on a 2007 survey (see Thaman et al., 2009, p. 18)

Other species that provide important ecosystem services include*Bruguiera gymnorrhiza* (etõm or etam), a mangrove tree that purifies lagoon water, but is now rare, and *Thespesia populnea* (itira), a forest tree that was traditionally used for carvings and construction.

Hernandia nymphaeifolia (etiu), also known as 'Jack in the box', was used for canoe hulls however, as reflected in Section 4.9, this practice has all but ceased as the species is no longer easily harvestable. Another now-rare species is *Tournefortia argentea* (deren), which was traditionally planted to provide protection against coastal erosion and was also valued for its medicinal properties. The *Pisonia grandis* (yangis) forest tree also provides the main rookery habitat for Noddy birds on the island.

The biodiversity and condition of marine environments, particularly those contained within the nearshore reef shelf that surrounds Nauru, is of critical national importance, with much of the shelf area being less severely impacted than Nauru's terrestrial ecosystems, and due to its critical role in the provision of traditional sources of protein (as discussed primarily in Section 4.4).

A reef survey facilitated by SPC in 2015 identified that most marine invertebrates were in low abundance and undersized, with giant clams having been believed to be locally extinct as recently as 2005, before three were identified in the SPC study (D. Harris et al., 2016, p. 15). Sea cucumber species – a potential export industry – were also undersized, with the most prevalent including surf redfish (*Actinopyga mauritiana)*, lollyfish (*Holothuria atra*), and flowerfish (*Pearsonothuria graeffei*) (ibid).

An earlier 2005 survey also conducted by SPC included an assessment of fish species in the outer reef area, which identified 129 species, surveying a total of 45,043 fish through 50 reef transects. Identified fish were predominantly from the *Acanthuridae* (surgeonfish) and *Balistidae* (triggerfish) families, which accounted for 34 of the 129 species (ibid). Surgeonfish are herbivorous and thrive in the algae-dominated areas of the reef, while triggerfish were found more in seaward reef areas (being a species that feeds more on detritus and crustaceans, benefiting from the vigour of wave action).

Small-size schooling species of mullets, snappers and goatfishes were also identified as being commonly found behind the breaker zone. Other commercially targeted species were viewed as being primarily undersized, including groupers, snappers and

emperors, with species generally caught by spearing such as parrotfish also lower in density and size than expected.

Nauru's reefs cover a total of 7.4 square kilometres, with differing concentric bands of submerged environments – in differing conditions – characterising transects moving perpendicular to the shoreline on all sides of the island (SPREP, 2021b). As elaborated on in CSIRO *et al.* (2024), coral communities on the reef slope are sparse, particularly adjacent to population centres. Reef flats are primarily covered in turf algae, with 58 algal species identified within the benthic area. Beyond the reef flats subtidal coral cover is of much higher quality, with 51 hard coral species recorded, including several rare and threatened species (SPREP, 2021b).

Coral species diversity within the reef is, however, generally low, with phosphate mining, coral bleaching, and human activities and pollution all potentially contributing to the reef quality (or lack thereof). The distance from other islands also reduces the potential for natural mixing of coral species.

Disaggregate Vulnerability

Terrestrial environmental conditions can be, to some extent, disaggregated spatially using the land use map shown in Section 1 of this report (Figure 4), which differentiates baren mined areas from mined areas that are revegetating (classified as 'open' land), and that of the more established secondary forest. The area surrounding Buada Lagoon – as well as the lagoon itself – is also distinctive, albeit heavily modified by ongoing human practices (ranging from animal rearing, to agriculture, to aquaculture within the lagoon itself).

The 2013 Rapid Biodiversity Assessment proposed a series of priority terrestrial and marine sites for ecological conservation, which can be considered a spatial proxy for those environmentally significant sites most vulnerable to climate impacts (SPREP, 2014). Three marine areas are identified: a section of Nauru's north-eastern coastline adjacent to the districts of Anabar and Ijuw identified for its isolation from industry, runoff and harvesting; the Anibare Bay area; and the Meneng reef flats and ocean front, which was found to have a high density of coral and fish species.

Terrestrial conservation areas included: ten scattered clusters of unmined pinnacle outcrops across Topside, critical to lizard and invertebrates; regenerating scarp forest areas to the north of Buada Lagoon (through and beyond command ridge), and the Anabare wetland and forest area (of particular significance to birdlife).

Finally, the BIORAP identified clusters and individual specimens of five endangered species of coastal littoral trees, each of which had substantive cultural significance, with proposals to use them for seed harvesting and long-term species regeneration. These include:

- *Tournefortia argentea* (deren), which can primarily be found along the Anibare Bay shoreline and the north-eastern coast, as well as in a small cluster on Topside to the island's north;
- *Thespesia populnea* (itira), which is scattered throughout urban areas to the islands west, south, and north-east;
- *Hernandia nymphaeifolia* (etiu) and *Cordia subcordata* (eongo), both similarly found in coastal urban areas along the island's south and western fringe; and
- *Cerbera manghas* (dereiyongo), primarily located slightly further inland at Bottomside's inner extent to Nauru's south and west.

Trends & Future Disruption

Observed environmental trends, as well key measures of biodiversity, are comprehensively assessed in Nauru's 2021 State of the Environment Report, and are mixed, with most tracking poorly. Much of the continuing decline in ecological condition is driven by the continued pressures associated with population growth, weak environmental protection (including pollution and conservation controls), and increasing rates of material consumption (with biproducts including e-waste and chemical pollutants). However, as discussed in Section 4.4, declining levels of near-shore and off-shore fishing are likely to be significantly reducing pressure on marine ecosystems.

Nauru's bird diversity and population levels have been assessed variously in 1962, 2008, and 2015, showing a clear and continual decline in the country's avian population, transient and otherwise. Of note is the decline in species that are harvested for food, particularly the Noddy bird, with 194 households across the island engaging in 'Noddying' as of 2021, albeit a small a decline from 219 households in 2011 (SPC & RON, 2023; SPC, 2012).

The Micronesian pigeon, which is also hunted, has declined from an estimated 500 individuals in the 1960s to between 50-150 at the time of a survey in 2014 (SPREP, 2021b).

Reef surveys generally showed mixed change over time depending upon the characteristics of the location, differing further across even similar species. For instance, Harris *et al.* identified that surf redfish sea cucumbers had poor densities on the reef flats, but healthy densities on the shallow reef front (with an overall decline in density between 2005 and 2015) (2016, p. vii). The presence of two giant clams, thought locally extinct in two previous survey efforts, is also illustrative of the complexity of assessing the overall trends in marine biodiversity around Nauru. Hard coral cover showed some positive signs, averaging 48 percent in deeper water and 65.5 percent in shallow water (<11 m depth) in 2015. This is a significant increase in coral cover since 2005 when live coral cover was only 21 percent.

Uncertainties & Externalities

As discussed above, there are significant uncertainties, including environmental externalities, that have the potential to seriously impact the impacts of climate change on Nauru's biodiversity and natural environment. Continued uncertainty around the pollution of groundwater by both human sources and saline ingress – particularly in relation to the island's lagoon systems – is one such critical unknown with cross-sectoral implications, impacting upon water resources, agriculture, and human health and wellbeing, in addition to biodiversity and environmental conditions more generally.

Interconnectivity of transient marine and avian species with wider climatic changes and impacts abroad (such as storm events that can lead to mass seabird deaths) also confounds analysis of change in populations of some species over time. One such example is a fish kill even in 2005, which may have been caused by an algal bloom, prolonged elevated water temperature, or an upwelling of de-oxygenated water (CSIRO et al., 2024)

4.8 LAND MANAGEMENT & REHABILITATION

The dual consideration of land management practices, in a more general sense, and rehabilitation from the extensive phosphate mining operations across Nauru's Topside plateau is reflective of the intertwined functioning of these land matters at the national scale. The longstanding failure to rehabilitate mined areas, coupled with lost revenue from mining royalties, is also significant sectoral context. These earlier issues reflect ongoing difficulties in managing the country's limited land resources, with implications for any planned retreat as part of national adaptation strategies.

Whilst the prevalence of customary land ownership across Nauru, coupled with its legislative recognition, is undoubtedly a positive aspect of the island's land management processes, it is less clear that these systems have been adequately supported or harmonized at the institutional level.

The ongoing weakness of land use planning, lack of regulatory controls such as building codes, has instead been primarily beneficial to extractive industries, but less so to residents in terms of quality of life and the condition, sustainability, and quality of their built and natural environments, as discussed in several sections above. Table 17 provides a summary of this sector's vulnerability to climate impacts, reflective of the current levels of sensitivity, susceptibility, and adaptive capacity of land management and the mining rehabilitation processes.

As noted in the table, this sector suffers less from future uncertainties in climate impacts than potential reconfigurations of existing land tenure systems, which are yet to be successfully reconciled with visions of – and capacities to finance – rehabilitation of the now 80 percent of the island that is unusable

Table 17: Land Management and Rehabilitation Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	Moderate	➢ Exclusive Nauruan ownership of land, with 90 percent customary tenure (<10 percent state owned) enshrined in legislation ➢ Degradation of 80 percent of land; failure to enforce land remediation; and loss of compensatory revenue ➢ Lack of traditional or state systems for formal environmental control ➢ Lack of current/enforced strategic spatial planning and urban planning for built up areas	• Customary land and development in the Pacific (AusAID, 2008) • National Sustainable Development Strategy '19-2030 (RON, 2019) • National Env. Mgmt. Strategy (Thaman & Hassall, 1996) • OHCHR Nauru Review Joint Submission (NIANGO, 2011)
Disaggregate Vulnerability	High	➢ Significant inequality in land ownership between tribes, families, migrant populations & refugees ➢ Large spatial differentiation in both land degradation & compensation ➢ Inequality in access to remnant water resources & agricultural areas ➢ Undermining of traditionally matrilineal land systems by colonial powers and associated governance ➢ Localised land management issues (e.g. landfill, school sanitation)	• 2021 National Census – Persons who don't identify with a tribe (incl. unknown) (P17) • Land Ownership & Control in Nauru (Macsporran, 1995) • Nauru: Phosphate and Political Progress (Viviani, 1970) • 2022 Nauru Water & Sanitation Master Plan
Trends & Future Disruption	Low	➢ Shift from eldest daughter majority inheritance to equal siblings' rights ➢ Continued intergenerational disbursal / dilution of collective ownership complicating 'buy back' ➢ Potential for further fluctuations in remnant phosphate value shifting rehabilitation feasibility ➢ Home ownership steady as a percentage of households and increasing in net numbers	• Gender Equality Brief for Nauru (UN Women, 2022) • Land Ownership & Control in Nauru (Macsporran, 1995) • Nauru's 2021 State of the Environment Report (SPREP, 2021b) • 2002, 2011 & 2021 National Census Data

Uncertainty & Externalities	Moderate	➢ Water (wells), reef, and other natural elements (e.g. trees) were part of customary tenure but lack literary analysis, but are critical components of climate vulnerability ➢ Rehabilitation proposals such as the Higher Ground Initiative Master Plan require renegotiation of, and potentially constitutional amendment to, customary tenure systems to be implemented ➢ Households with insecure tenure (squatting) not published in 2021	• Land Ownership & Control in Nauru (Macsporran, 1995) • CSIRO et al. 2024 Nauru Climate Impacts Report • 2022 Nauru Water & Sanitation Master Plan • HGI Land Tenure & Safeguarding Report (Baches et al. 2022) • 2021 National Census (SPC & RON, 2023)

Aggregate Vulnerability

Land management in Nauru, as prefaced in Section 2, has undergone deep transformation over the last one-and-a-half centuries, as a function of inter-tribal warfare, colonisation, world wars, forced relocation, and the physical and economic disruptions stemming from phosphate mining.

Early records of land tenure systems and customary law are contested (Macsporran, 1995), however it is particularly notable that throughout this repeated disruption Nauruan's have sustained a unique form of customary land tenure. Critically, tenure in Nauru is understood to be intertwined with not only demarcated terrestrial space, but also features with both the land and seascape (Pollock, 2014). These rights, in their traditional form, were differentiated to include a range of ecosystem services, such as the collection of coconuts, hunting Noddy birds, and access water sources (Thaman & Hassall, 1996).

Collective, matrilineal, clan-based systems of land ownership that existed prior to colonisation were heavily disrupted during colonisation, during which an official register – the German Ground Book – was used to record land ownership based on senior men within each clan (AusAID, 2008, p. 115). Subsequent mass deportation and loss of life throughout the Japanese occupation during World War II, as discussed in Section 2 of this report, devastated Nauru's social structures.

However, many socio-cultural structures, including the Nauruan Council of Chiefs, survived this period, with, for example, one of its members, Chief Detudamo, having a seat on the council from the 1920s and residing as head chief from 1930 until his death in 1953 (Viviani, 1970, p. 96). Unlike much of the rest of the Pacific, ownership of land in Nauru has throughout living memory remained the exclusive domain of Nauruans, other than some inherited colonial-era infrastructure including a German radio station that were retained by the Nauruan Government after independence (Viviani, 1970, p. 124).

Land ownership in Nauru was traditionally determined by matrilineal chiefly class, with the oldest female child – *temonibe* – being the primary inheritor of land and associated decision-maker, with younger sisters – *engame* – secondary landholders (Thaman & Hassall, 1996, p. 218). Migrants and those who lost their land in intertribal warfare were classed as *itsio* and were required to work for the *engame* in exchange for food, productive trees, and/or smaller land portions (ibid). In this traditional, pre-mining, context, either 'coconut land' or 'pandanus land' could be inherited, with the former being associated with coastal housing areas of Bottomside, and the former the forested productive areas of Topside.

Both forms of land ownership have been incorporated into Nauru's modern land ownership and management systems. For land that had some level of existing use, particularly the built up areas of Bottomside, the ownership of these areas has been extensively surveyed and formalised through a cadastral demarcation process by the Nauru Lands Committee, with inheritances subsequently gazetted and contested through the Supreme Court (NIANGO 2011). In practice, however, this process – particularly in relation to the valuable 'phosphate lands' of Topside, as the pandanus land is now known, is highly contested, with multiple claimants having emerged during land determinations (Macsporran, 1995).

By the late 1990s there were a total of 630 tenured subdivisions across Nauru (ibid), with that figure having risen to more than 5000 portions today according to analysis for the Higher Ground Initiative (Baches, Baches, Rickersey, et al., 2022, p. 22). Thaman and Hassall note that in the modern era land rights are usually divided equally among siblings, irrespective of seniority or gender (1996). However, these rights have been allocated on a 'shareholder' basis, as a function of the rights generating a proportional share of phosphate royalties from the 'phosphate land' on Topside to which many of these landholding families hold ownership rights. It is these multiply-held land

titles, as much as the continued subdivision of land, that acts as a significant barrier to land development and management decisions. This is despite amendments to the *Lands Act 1976* allowing for the relevant Minister to override minority owner objections to a proposed lease if three-quarters of landowning 'shareholders' are in support of a proposal (Macsporran, 1995).

The Nauru-Australia Phosphate Lands Treaty that entered into force in 1993 effectively concluded in 2013 with the final AU$2.5 million payment of Australia's cash settlement, totalling AU$107 million, to "assist the Republic of Nauru in its preparations for its post-phosphate future" (Commonwealth of Australia, 1993, p. 2). As an outcome of this process, 15 experts were commissioned by the then Australian International Development Assistance Bureau to draft a "blueprint for rehabilitation including residual mining, pinnacle removal and crushing, the economical use of pinnacle rock and aggregate, reforestation, agricultural development, environmental protection, housing, and human resource development" (RON, 1999, p. 12). Known as the Rehabilitation and Development Feasibility Study, this seven-volume set of reports included development of a draft Master Land Use Plan (Thaman & Hassall, 1996).

This plan, however, was not endorsed, with limited progress on the feasibility study's proposed actions to date, two decades later (UNEP, 2019). As a result, Nauru does not have a legally operable national land use plan, with even the draft Rehabilitation Land Use Plan being general in its demarcation and land classification, failing to set out site specific controls, address topography, or, critically, account for existing customary land ownership structures. The NRC did attempt to finalise the draft 1994 Master Land Use Plan by establishing and Land Use Planning Committee in 2001, however this activity does not appear to be ongoing at the present time (UNEP, 2019, p. 28). Much of these efforts have shifted into the Higher Ground Initiative, which was instigated in 2019 and includes an island-wide Master Planning component, as discussed in more detail below.

Total mining revenue from independence in 1968 to 2001 was A$3.5 billion, with an estimated $1.75 billion being added to the Nauru Phosphate Royalties Trust (Quanchi, 2007, p. 254). This revenue – in addition to earlier holdings and other contributions – had declined from a reserve of A$1.3 billion in 1990 to a mere A$300 million by 2004, because of severe mismanagement and a lack of fiscal accountability (ibid). The failure to effectively invest these proceeds in national development and planning processes has limited the Nauruan government's capacity to self-finance expensive rehabilitation processes, with any future initiatives instead having to rely on development assistance and alternative revenue streams.

Complicating rehabilitation planning is both the estimated expenditure and physical materials needed to complete any restorative infill efforts for the mined-out areas of Nauru. The Nauru Rehabilitation Corporation (NRC) was established through the *Nauru Rehabilitation Corporation Act 1997 (Baines, n.d.)*. Mandated by the Nauruan parliament to coordinate the rehabilitation and development of the country's mined out lands that dominate Topside, the NRC's primary activities to date have comprised secondary and residual phosphate mining to fund future rehabilitation efforts (NIANGO, 2011). By 2020 it was reported that NRC had rehabilitated 5 hectares, with a further 6 hectares subsequently remediated for the installation of the now-complete solar farm in Meneng District (IMF, 2020, p. 12).

Disaggregate Vulnerability

Land management and rehabilitation's sensitivity and susceptibility to climate impacts are not able to be disaggregated in the same manner as many of the sectors addressed earlier in this report. Land requiring rehabilitation is almost exclusively located on Topside, away from Nauru's statistical Enumeration Areas, except for Buada Lagoon and its immediate surrounds. Land tenure documentation is also both sensitive and, in the case of Nauru, held primarily in paper-based records; a recording system that is itself a key vulnerability of the land management system. Nonetheless, some social and cultural characteristics can act as proxies for land management vulnerability at the household level.

Most pertinent amongst these is tribal connectivity, which, as set out above, is central to the determination of customary land rights. Conversely, those inhabitants of Nauru who don't have connectivity to a tribe are likely to have limited land ownership rights, with foreigners unable to own land altogether. A map showing the distribution of those persons who didn't identify with a Nauruan tribe at the 2021 census is shown in Figure 20. The total number of persons – 8.8 percent of the population – roughly correlates with the share of the population born overseas, however is more than twice the number of non-citizens in the country, most of whom were i-Kiribaiti and Fijians (SPC & RON 2023, p. 42).

As Figure 20 demonstrates, more residents located in the central western areas of Bottomside lacked tribal connections. This was especially the case in Location,

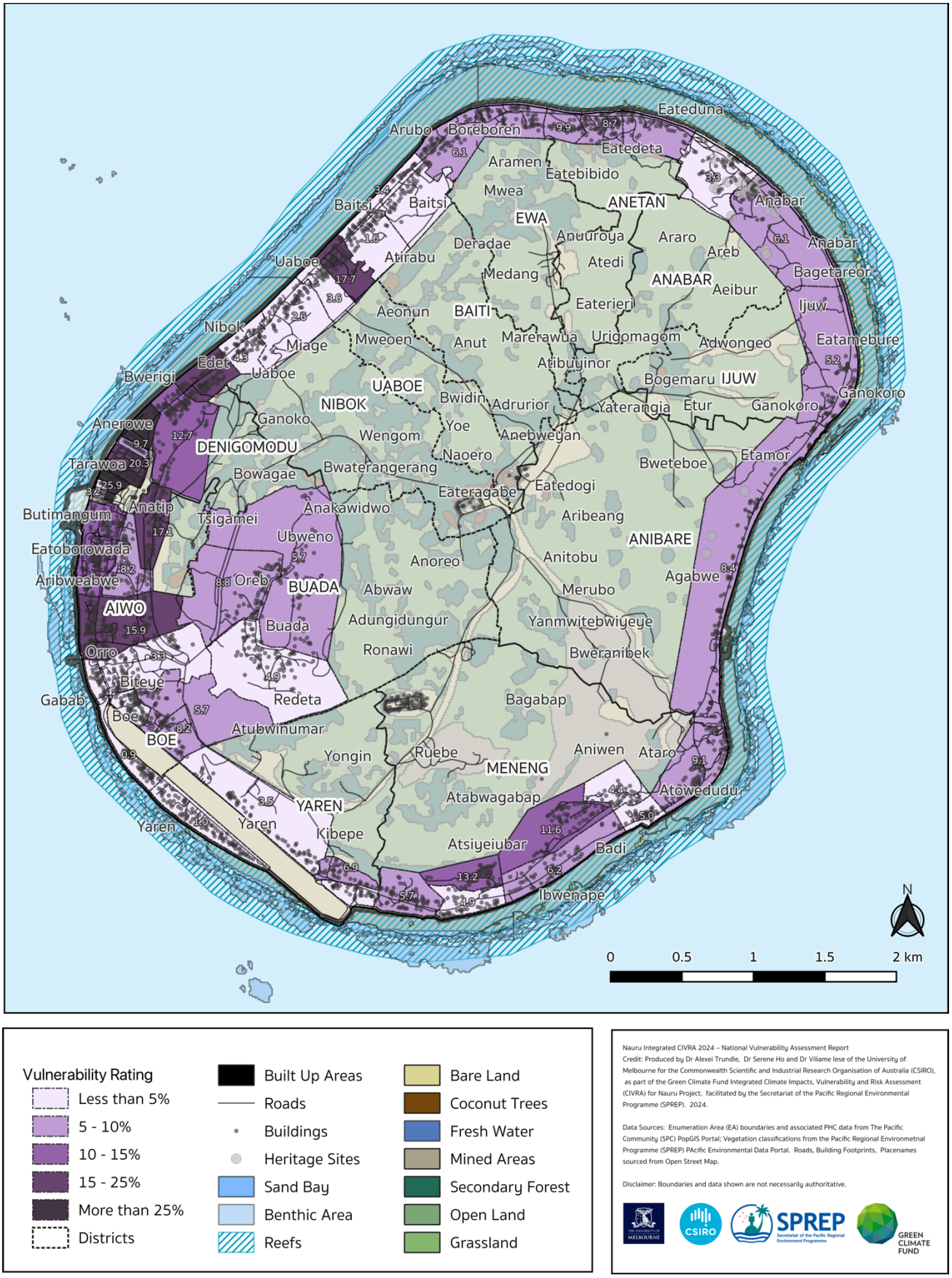


Figure 20: Persons not identifying with a Nauruan Tribe – 2021

A sub-area within Denigomodu District, where this figure rose to as many as one-third of inhabitants within Location EA2 and EA6.

Other localities with high levels of non-tribally identifying inhabitants included parts of Aiwo and Meneng District. Overall a higher number of men (10.6 percent) than women (7.7 percent) lacked tribal connectivity; a gender difference that was more distinct in several of these hotspot areas. These included Meneng EA6, where 22.1 percent of men lacked a tribal identity, but only 5.8 percent of women were similarly tribally agnostic. More men than women did not identify with a tribe in 86 percent of EAs.

Other household-level land management are evident in relation to other sectors elsewhere in this report but do not necessarily demonstrate or correlate with climate vulnerability within the land management sector. For example, although the growing of fruit trees and crops is assessed in Section 4.3, this does not directly demonstrate household level prohibition from agricultural land uses.

Trends & Future Disruption

As noted above, the ongoing fragmentation through both allotment subdivision and 'shareholder' land ownership inheritance is a critical trend in land management that complicates any efforts to address climate impacts through retreat, relocation, or large-scale infrastructure interventions. However, Nauru is a rare example in the Pacific of countries that have exhibited a steady rise in home ownership levels over recent decades, despite its fully urbanised status and ongoing population growth over this period, as shown in Table 18.

This is even more notable given the significant decline in government and employer provided housing since 2002, with a net increase in the number of households owning their own dwelling of more than 50 percent over the last two decades.

As discussed above, the extent to which individual home occupiers have immediate jurisdiction over their dwelling is, however, questionable, with the shared extended family system having been argued to limit investment in and potential upgrading of dwelling structures and associated infrastructure (Baches, Baches, Merril, et al., 2022).

UN Women notes that there appears to have been a decline in the role of women in land-related decision-making in recent times, despite matrilineal traditions centring on the role of women as custodians of Nauruan land (UN Women, 2022). This observation would be consistent with contemporary non-gendered and age inclusive approaches to allocating land inheritance discussed above, as well as wider male dominance of State-based decision-making processes and associated government positions (AusAID, 2008). Even within the team of 15 experts that drafted the 1993 Rehabilitation and Development Feasibility Study, only one was a woman (Pollock, 2014, p. 132).

Table 18: Changes in household tenure 2002 – 2021 (source: RON census data)

Dwelling Tenure	2002		2011		2021	
	Number	Percent	Number	Percent	Number	Percent
Total own	987	59.7%	1345	81.7%	1540	76.2%
Total rent	63	3.8%	100	6.1%	97	4.8%
Rent privately	*54*	*3.3%*	*92*	*5.6%*	-	-
Rent from NHA	*9*	*0.5%*	*8*	*0.5%*	-	-
Total occupied without payment	478	28.9%	176	10.7%	256	12.7%
Employers house	*283*	*17.1%*	*27*	*1.6%*	-	-
Government house	*128*	*7.7%*	*33*	*2.0%*	-	-
Squatters	*8*	*0.5%*	*53*	*3.2%*	-	-
Occupy in other way	*59*	*3.6%*	*63*	*3.8%*	-	-
Other / not stated	124	7.5%	26	1.6%	128	6.3%

The most substantive ongoing land remediation effort is the Higher Ground Initiative, a whole-of-government initiative led by the Department of Climate Change and National Resilience, the NRC, and the Ministry of Finance and Sustainable Development. HGI is led by a ministerial 'troika' constituting the leadership of these three portfolios, accompanied by a wider high level leadership committee (Baches, Baches, Rickersey, et al., 2022).

The initial scope of work is focused on Land Portion 230, a 10-hectare plot of government owned land on Topside within the Meneng District (Baches, Baches, Merril, et al., 2022). However, documents include the aim of expanding this initial 'pilot' township to extend towards Meneng's existing coastal housing area, described as the LP230 Expansion Plan, with the total expanded area having the capacity to accommodate the entirety of Nauru's current population (Baches, Baches, Walters, et al., 2022, p. 25).

A second component of HGI develops an 'infill' master plan for upgrading of the Location housing complex on the island's west coast; considered a priority due to the poor quality of the medium density housing in this area, as well as the site's proximity to the national port.

The longer-term Island Wide Master Planning component of HGI variously sets out agricultural areas, water reservoirs, forest regeneration and conservation zones, and commercial and industrial settings across Topside. Although more detailed than the 1994 Master Land Use Plan, these wider concepts remain high level and require consultation and agreement with customary landowners, legislative arrangements, and a yet-to-be-determined, but substantive, quantity of finance if this vision is to be implemented.

Uncertainties & Externalities

The 11 hectares of land that have been successfully remediated by NRC to date represent less than one percent of the mined-out land on Topside, with the first Phase of the Higher Ground Initiative – constituting the government-owned Land Portion 290 – covering an additional 10 hectares (Baches, Baches, Walters, et al., 2022).

Whilst these areas can provide some insight into wider remediation processes, there are several limitations to extrapolating elements such as costs and jurisdiction to elsewhere across the island.

It has been reported that costs of remediating the mined areas of Nauru to date have been in the range of AU$1-2 million per year, however, these figures are based on NRC efforts that draw on existing, limited, government resources, with progress currently occurring at a rate no faster than 2 hectares per year (Allis et al., 2020; Feary, 2010). As such, real costs for a larger scale rehabilitation effort may be significantly higher, with more complex requirements for remediation that is able to support building foundations, water reservoirs, and the infrastructure set out in the Higher Ground Initiative project documentation.

An additional consideration – both in terms of cost, and long-term land use and other risks, is procurement of 'fill' for the mined-out areas. Although much of the topsoil and waste product from these processes was retained following mining activities, more than 50 million tonnes of limestone rock from the topside pinnacles were used for upgrading of the airport runway, seaport, and other infrastructure initiatives (Inception meeting, Pers Comm, July 2024).

A stockpile of 100,000 tonnes of topsoil, removed from the mined areas, has been retained, but this would only be sufficient to cover 2.5 hectares of land before it was depleted. Importing of additional topsoil comes with additional risks, such as biohazards, and would need to be carefully managed.

The lack of legislative property taxation structures, coupled with the absence of a real estate market across Nauru, makes valuation of any land extremely difficult (Baches, Baches, Rickersey, et al., 2022). This is a source of significant uncertainty in any future land management interventions, beyond the remediation associated expenses outlined above. Any reform processes are likely to be highly contested and result in further unknown outcomes, particularly in relation to Nauru's cultural fabric and community structures, as discussed in the following section

4.9 Community and Culture

Nauruan community and cultural resilience are arguably self-evident in the persistence of traditional practices, customs, and language throughout the profound social, environmental, and economic upheavals that this small island nation has faced over the last 150 years, all of which is outlined in the background section of this report (see also Gale, 2019; Hoare, 2023; Morris, 2021; Tabucanon & Opeskin, 2011). However, this sector faces further upheaval throughout the 21st century, both as a direct result of climate change, and through a range of additional non-climate related external and internal shocks and stressors.

Sociocultural vulnerability in many ways cuts across all the other eight sectors, with cultural practices intertwined with land management (Section 4.8), Disaster Management (Section 4.5), Agricultural Practices (Section 4.4), to name but a few linkages. However, key features of community practice, infrastructure, and attributes, as well as those of more explicit cultural significance, warrant explicit, standalone consideration. These aspects of Nauru's community and cultural vulnerability to climate change are summarised in Table 19 below.

Table 19: Community and Cultural Vulnerability Summary

CVA Component	Rating	Description / Rationale	Key Evidence / Data
Aggregate Vulnerability	High	➢ Limited physical space and natural materials for conduct of cultural practices ('traditional work) ➢ No national register of sites of cultural significance or heritage ➢ Extensive loss of traditional knowledge across generations ➢ Legislated customary land tenure intertwined with cultural systems ➢ Very high levels of identification with Nauru's 12 tribal groups & linguistic fluency in Nauruan ➢ Complex relationship between cultural fabric, land & royalties ➢ Limited migration (net inward) ➢ Tertiary education levels are very low across adult population ➢ High dependence upon public service roles for employment	• Higher Ground Initiative – Purpose + Need Report • Nauru Coastal Risk Assessment (SPC 2023) • Nauru's 2021 State of the Environment Report (SPREP, 2021b) • 2021 National Census – Tribal Identity (P17) • OHCHR Nauru Review Joint Submission (NIANGO, 2011) • Nauru Integrated Infrastructure Strategic Plan 2024 • Nauru Demographic & Health Survey 2007 (NBS et al. 2009)
Disaggregate Vulnerability	High	➢ Women significantly under-represented in paid employment ➢ Areas with high levels of dependence on communal infrastructure (e.g. toilets) ➢ Percent of the population below BNPL ➢ Gini (inequality) coefficient up to 0.52 in 2014, from 0.34 in 2012 ➢ Localities with high numbers of persons with differing disabilities ➢ Parts of the island where large numbers of inhabitants lack tribal connection, incl. Nauruan citizens ➢ Traditional foods & ecosystem service use are endangered by limited source stock (fish, trees)	• 2021 National Census – Employment status by gender (P34) • 2021 National Census – Household toilet facilities (H20) • National Social Protection Strategy 2022-2023 (GoN 2022) • 2021 National Census – Persons who don't identify with a tribe (incl. unknown) (P17) • Pacific Food Systems Report (O'Meara et al. 2023)

Trends & Future Disruption	Extreme	➢ Increasing number of single (or no) bedroom households ➢ Reduction in number of persons born overseas other than in PICTs ➢ High levels of religious participation but with increasing fragmentation ➢ Rapid emergence of internet access likely to disrupt community and cultural practices, but also enable linkages to diaspora & new economic opportunities ➢ Potential for increased outmigration through seasonal worker migration and other associated medium-term migration programs ➢ Complex inter-relationship with proposed relocation / planned retreat initiatives and customary land governance	• 2021 National Census – # of Bedrooms (H06) • 2002, 2011 & 2021 Census comparison of place of birth (P01) • 2002, 2011 & 2021 Census comparison of religious affiliation • 2021 National Census – Households with internet access (H33b) • Nauru's 2021 State of the Environment Report (SPREP, 2021b) • Petrou & Connell (2023) • HGI Land Tenure & Safeguarding Report (Baches et al. 2022)
Uncertainty & Externalities	High	➢ Wider impacts of technological change, internet access & remote work may profoundly change community structures, migration patterns & cultural practices ➢ Government revenue (supporting key community services) is highly dependent upon three at-risk sources: refugee-related visas and ODA, purse-seine fishery licensing, and limited phosphate reserves ➢ Some positive prospects for revitalisation of traditional practices and livelihoods through the Higher Ground Initiative & enactment of biodiversity conservation measures	• Kant et al. (2018) • Nauru Coastal Risk Assessment (SPC 2023) • Context Assessment – Nauru (IMF, 2020) • OHCHR Nauru Review Joint Submission (NIANGO, 2011) • HGI Land Tenure & Safeguarding Report (Baches et al. 2022) • Nauru's Biodiversity Strategy & Action Plan (Onorio & Deiye, 2010)

Aggregate Vulnerability

Nauruan cultural traditions stem from twelve tribal groupings or clans, each named totemically and varying in descriptive meaning from animals and insects (such as *Eamwidara* – dragonfly), to more humanistic characteristics (e.g. *Eaoru*, translating as a destroyer or jealous type), with each having an origin in Nauruan mythology (Viviani, 1970, p. 7).

Contemporary descendants trace their familial origins matrilineally to a 'foundress' of each tribe. Chiefs of these tribes have been recorded as being either men or women, variously elected or appointed at different stages of the 20th century (Pollock, 2014). Tribal areas were not spatially delineated across the island, inter-related to "strictly kept" rules to not marry within one's own tribe (Viviani, 1970, p. 7).

When concepts of moving housing to Topside were proposed as part of the Rehabilitation and Development Study process in 1993/94, it was notable that in the words of one of the expert consultants, Dr Nancy Pollock, "[Nauruan] women were particularly concerned about their land rights, and voiced their concerns at each of the public meetings that the feasibility team convened. They are concerned that their government will put in place rehabilitation schemes that will necessitate the nationalization of land." (Pollock, 1996, p. 133)

This fear, as put by Pollock and others, is more than a self-serving interest due to the residual phosphate royalties, but rather should be viewed as a manifestation of the intertwinement of land rights, Nauruan community, and cultural longevity. As such, they should serve as a critical consideration for any future climate adaptation planning that requires similar inward migration to occur at scale.

Community leadership structures in Nauru have been more heavily disrupted by colonisation and Nauru's subsequent transition to a sovereign nation state. Initial German occupation was nominally at the behest of the Nauruan Queen, who in the late 1800s led the twelve Nauruan tribes (Pollock, 2014, p. 109). Although

twelve chiefs were initially recognised in line with the tribal/clan system, this became 14 at some point near the turn of the century when the German administration established the same number of districts across the island (Viviani, 1970, p. 24). Despite some disruption Nauru maintained a similar Nauruan Council of Chiefs (NCC) through the interwar period, with chiefs elected, and holding life tenure in office unless removed by the council (Macsporran, 1995). The NCC was replaced by the Nauru Local Government Council in 1951, with councillors elected for a four-year term from across the fourteen traditional districts of Nauru.

It is notable that although tribal identities have sustained at a familial level throughout the century of colonisation, the now defunct chiefly structures – which provided a key decision-making role over land ownership – were deeply changed, repurposed, and at times, as discussed in Section 2, manipulated for colonial gain. For example, in 1945, following severe depopulation and the relocation of both Nauruans to Truk (Chuuk in modern day Micronesia) and the forced in-migration of Gilbertese (now Kiribati), seven district chiefs were appointed by the Allied armed forces: three Nauruan and four Gilbertese (Viviani, 1970, p. 86). As surmised by Viviani, "family relationships and responsibilities were held more strongly than clan and class relationships by the Nauruans" (1970, p. 7). Community leadership in the current context is therefore viewed as being highly sensitive to climate and other impacts.

Community resilience, in terms of more direct capacity to adapt to and withstand climate impacts, was not able to be fully assessed as part of the CIVRA process, beyond the wider aspects of household-level disaster preparedness discussed in Section 4.5.

However, the 2021 National Census did include a question on climate change awareness raising, which provides some insight into the role of community in adaptive capacity and countering climate vulnerability more broadly. Nearly half of all Nauruan households stated that family and friends were the main source of information relating to climate change (49.2 percent), followed by the internet (34.9 percent), and radio (30.2 percent), with outreach workers and television also playing a role (SPC & RON 2023).

As with many Pacific Island Countries, the church plays a significant role in community and cultural fabric in Nauru. As shown in Figure 21, 98.2 percent of Nauruan inhabitants identified with a particular religious denomination in 2021, an increase from 2011 when 97.0 percent of inhabitants did so.

The Nauruan Congregational Church is the largest denomination in Nauru, a protestant congregationalist denomination with seven congregations across Nauru, counting 34.3 percent of Nauru's population within its membership. This is closely followed by the Roman Catholic faith, which is observed by just over one-third of Nauruans.

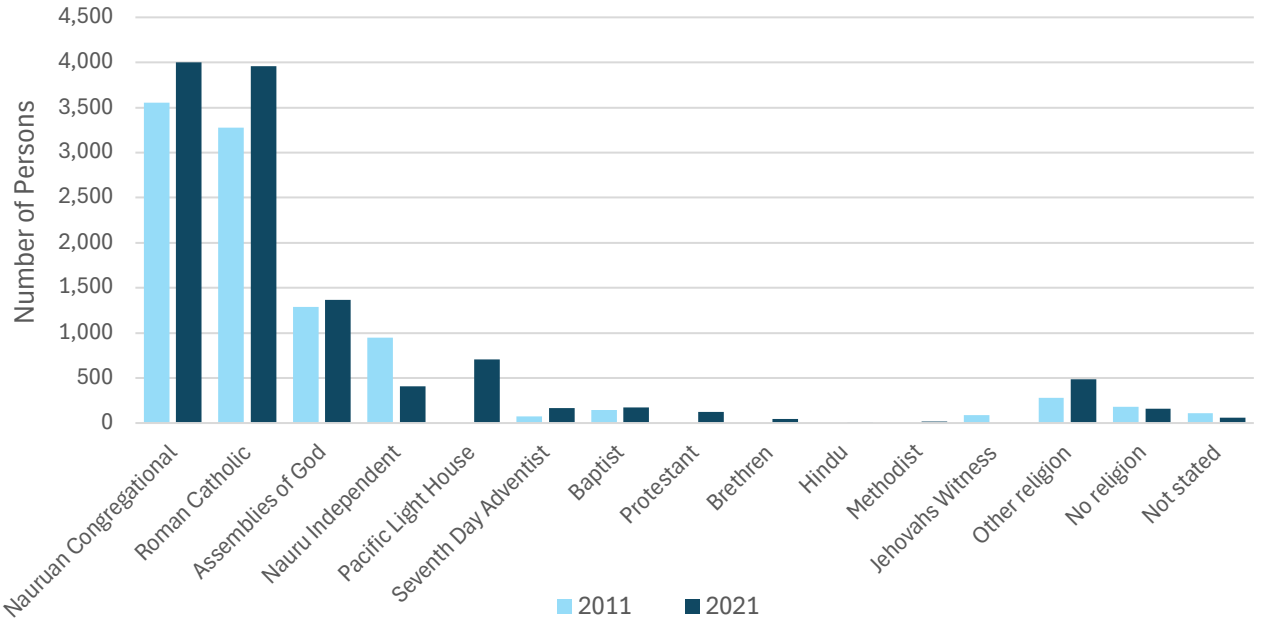


Figure 21: Nauruan Religious Observance 2011 to 2021 (source: RON census data)

Whilst several other faiths are recognised in the National Census data shown above, registration of new religious groups from a legal perspective requires several thresholds to be met, including having at least 750 enrolled members, land, a physical presence in Nauru, and leadership by a Nauruan member of the clergy (OIRF, 2022).

Registered religious groups are also able to operate private schools, with several in operation across Nauru. Only the Catholic Church, the Nauru Congressional Church, Assemblies of God, Nauru Independent Church, and Seventh Day Adventist Church are officially registered in Nauru as of 2022.

Also considered within this sector are national sites of cultural heritage and national significance, beyond the areas high biodiversity significance addressed in Section 4.7. At present, there is no national register of sites of national significance, although the *National Heritage Act 2017* provides for such a register, as well as the framework for establishing a National Heritage Office (SPREP, 2021b, p. 183).

Potential sites of significance include the Ara Pond, the Damamak Rock, and Nibok, which have significance in traditional lore (with the latter being the site where Nauruans are believed to have first come ashore) (ibid). Other potential heritage sites include the various World War remnants, including batteries, tunnels, and fortifications.

Other aspects of community and cultural practice include 'traditional work', which are considered in the census to include fishing, diving, noddying, gardening / agriculture, arts and craft (SPC & NBS, 2006). The former categories are largely addressed in earlier sections of this report (4.3 and 4.4), however handicraft production remains a significant 'own-account' activity for 2.9 percent of Nauruan households (SPC & RON, 2023, p. 69). These practices, however, remain dependent upon access to natural materials, particularly for wood carvings, which have been depleted due to phosphate mining. Knowledge of traditional medicines has been similarly impacted as elders who retain the knowledge pass on (SPREP 2021b, p. 193).

The continued fluency and regular use of Nauruan language by more than 94 percent of the population is a key cultural strength. Of those who spoke Nauruan at home slightly more than half – 52.4 percent – could both read and write in the language, with 355 persons able to read Nauruan fluently (SPC & RON, 2023, p. 58).

Disaggregate Vulnerability

Community and cultural climate vulnerability can be disaggregated in a multiplicity of ways, however National Census variables of relevance: household characteristics, the primary occupation of the adult population, and measures of cultural connectivity. The variables associated with each of these three categories are shown in Table 20, and are elaborated on below. A second set of attributes associated with persons with disabilities is also examined later in this section, with results collected by person, rather than household, also spatially disaggregated by gender.

Although discussed to some extent in Section 4.6 in the context of housing infrastructure, those households with one or less bedroom are also reflective of different levels of social connectivity within communities, as well as – conversely – overcrowded conditions which present additional risks related to extreme heat and vector-borne disease. The share of single bedroom households nationally is less than one-quarter of all dwellings but rises to as high as 48.5 percent in localities within Aiwo (EA3), with the highest decile of localities averaging at more than one-third of all households with one bedroom or less.

Less than one-in-six households had an exterior kitchen or cooking area: a feature likely to increase sensitivity to extreme heat, vector-borne disease, as well as present additional risks during severe storm events and strong winds. In the top ten percent of localities this figure rose to nearly one-third of households, reaching as high as 40.09 percent in one area of Anetan (EA3), closely followed by EA1 in Denigomodu District.

The lack of sealed and safe sanitation facilities is discussed in detail in Section 4.1; however, the use of shared toilet facilities is specifically examined here due to its importance in both household-level vulnerability, and the development of adaptation actions (where proposals to upgrade shared infrastructure can in some cases prove significantly more cost effective and be more socially acceptable).

Nationally, 29.7 percent of households primarily use a shared toilet facility. However, in several localities this figure rises to more than half of all households: Boe EA1 (69.2 percent); Uaeboe EA2 (66.7 percent); Nibok EA1 (61.5 percent); Aiwo EA2 (60 percent); Anetan EA2 (55.6 percent); Yaren Ea1 (53.5 percent); and Ijuw EA1 (53.1 percent). As the distribution of these areas demonstrates, these conditions are scattered widely across Nauru, with even the lowest decile of localities averaging 7.3 percent of households.

Table 20: Community and Cultural Data – Spatial Distribution and Trends (source: RON census data)

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Household characteristics									
HHs with ≤ one bedroom	23.0%	9.6%	35.2%	48.5%	Aiwo (EA3)	11.9%	19.0%	23.0%	↗
HHs w/ traditional canoe	0.9%	0.0%	2.7%	6.3%	Meneng (EA5)	9.4%	4.0%	0.9%	
HHs cooking outside	14.9%	2.6%	31.5%	40.9%	Anetan (EA3)	-	-	14.9%	-
Households using a shared toilet	29.7%	7.3%	55.7%	69.2%	Boe (EA1)	-	11.0%	29.7%	↗
Households using the internet in the last week	80.7%	22.0%	100.0%	0.0%	Location (EA1)	-	27.0%	80.7%	↗
Primary occupation (persons 15 years and older)									
Paid employment	30.8%	14.3%	40.1%	1.4%	Boe (EA4)	48.7%	43.7%	30.8%	↘
Women only	26.5%	11.1%	35.9%	0.0%	Location (EA1)	40.1%	32.7%	26.5%	↘
Men only	35.1%	19.3%	45.7%	1.2%	Boe (EA4)	57.6%	54.8%	35.1%	↘
Household duties	12.6%	8.9%	16.5%	20.0%	Denig. (EA1)	5.7%	17.4%	12.6%	↘
Women only	18.9%	15.4%	25.5%	27.4%	Baitsi (EA1)	9.1%	30.2%	18.9%	↘
Men only	6.5%	2.6%	11.8%	1.5%	Location (EA4)	2.2%	4.4%	6.5%	↗
Study	4.7%	2.2%	7.3%	8.5%	Baitsi (EA2)	2.3%	8.4%	4.7%	↘
Women only	5.1%	1.9%	8.4%	11.0%	Meneng (EA3)	2.5%	8.7%	5.1%	↘
Men only	4.3%	2.1%	7.1%	11.1%	Boe (EA4)	2.0%	8.1%	4.3%	↘
Share looking for work	2.8%	0.1%	5.2%	9.5%	Aiwo (EA1)	17.4%	14.7%	2.8%	↘
Women only	1.8%	0.0%	4.0%	11.4%	Aiwo (EA2)	20.3%	12.6%	1.8%	↘
Men only	3.8%	0.0%	8.2%	10.4%	Baitsi (EA1)	14.5%	16.9%	3.8%	↘
Self employed	6.6%	0.6%	16.6%	30.6%	Boe (EA4)	-	2.6%	6.6%	↗
Women only	5.8%	0.0%	14.7%	30.3%	Boe (EA4)	-	2.3%	5.8%	↗
Men only	7.5%	0.6%	18.6%	33.9%	Meneng (EA3)	-	2.8%	7.5%	↗
Cultural connectivity (persons 15 years and older)									
Not identifying with a tribe	8.8%	3.3%	17.4%	36.9%	Location (EA2)	6.3%	9.3%	8.8%	→
Women only	7.7%	1.0%	15.5%	38.5%	Location (EA2)	5.2%	7.8%	7.7%	→
Men only	10.6%	2.8%	21.5%	35.1%	Location (EA2)	7.5%	10.9%	10.6%	→
Persons fluent in Nauruan	94.2%	89.4%	98.3%	80.0%	Aiwo (EA5)	95.8%	95.3%	94.2%	→
Women only	94.7%	91.0%	99.6%	79.7%	Aiwo (EA5)	95.7%	96.1%	94.7%	→
Men only	93.7%	87.1%	98.7%	80.4%	Aiwo (EA5)	95.9%	94.6%	93.7%	→

Data on occupation is gathered in Nauru for all persons aged 15 years and older. Occupation has a range of implications for climate vulnerability; forms of employment face different levels of exposure to climate hazards, whilst those earning income through paid employment often have more ready access to capital to draw down upon in the event of a climate-related disaster. Those self-employed, however, are often more exposed to medium-term economic impacts due to the risk to their businesses.

Roughly one-third of working age Nauruans were engaged in paid employment at the time of the 2021 census, however there was a nearly 10 percent difference between women and men (with men being more heavily employed). Rates of paid employment were lowest in Boe, where only 1.4 percent of the population had payroll-based jobs. However, when disaggregated by gender this fell to zero percent of women in Location EA1.

Conversely, Boe EA4 had the highest number of self-employed persons (30.6 percent), including near gender parity between men and women, who were self-employed at a rate of 30.3 percent. This compared with a national average of only 6.6 percent of adults: 5.8 percent of women, and 7.5 percent of men.

The share of the adult population looking for work, or 'unemployed', in Nauru is relatively low nationally, at only 2.8 percent and an even lower rate of 1.8 percent for women. Whilst the lowest decile of localities had an effective unemployment rate of zero percent, irrespective of gender, the highest decile averaged at 8.2 percent of men and 4 percent of women. Aiwo had pockets of particularly high unemployment, with EA1 having 9.5 percent of persons looking for work, and EA2 11.4 percent of women. Baitsi EA1 was the locality with the highest share of men unemployed (10.4 percent).

Somewhat unsurprisingly a significantly higher proportion of women than men were primarily occupied with household duties, accounting for 18.9 percent of women and 6.5 percent of men nationally in 2021. The area with the highest overall share of persons occupied in this way was Denig EA1, where the share rose to as high as one-in-five adults. Baitsi EA1 was the locality with the highest share of women so occupied (27.4 percent), while Location EA4 had the lowest share of men (1.5 percent).

Cultural connectivity comprises the final set of variables disaggregated within Table 20, with tribal identity, or lack thereof, also depicted spatially across Nauru in Figure 20 in Section 4.8. Not assessed earlier, however, is the difference between men and women, with 2.9 percent more men than women not identifying directly with a Nauruan tribe. The highest decile of EAs differentiates further when separated by gender, rising to 15.5 percent and 21.5 percent of men and women respectively. In all cases, the locality with the highest share of non-tribally identifying individuals is Location EA2, where more than one-third of adults don't identify with one of Nauru's twelve tribes.

As noted above, the prevalence and persistence of Nauruan language is a key cultural strength, albeit with some variation in non-verbal literacy. As shown above there is very little variation in fluency across Nauru spatially, with less than 2 percent of people in the highest decile of EAs not fluent in Nauruan. Aiwo EA5 contains the highest share of non-speakers, with roughly one-in-five adult inhabitants not able to speak Nauruan fluently, irrespective of gender.

Whilst the aggregate analysis of this sector notes the differing (and diverse) communications mediums used for raising awareness about climate change at the household level, the localised nature of these different dissemination activities, broadcasts, and information sources is also of interest from both a vulnerability and an adaptation planning perspective.

This information was not available at an EA level, however the 2021 census report notes that the sourcing of climate change information from family and friends varied from two-thirds of households in Denigomodu, to only 2 percent of households in Ijuw.

Similarly, while community events received no responses in Ijuw, outreach workers were referred to as a source of climate change information by 79.6 percent of households there, while having little effect in Buada (10.9 percent) and Anabar (12.9 percent).

Household internet access – another key source of climate-related and other information nationally – was also very widespread but had a minority of localities where access was especially poor, as shown in Figure 22. In contrast to a national average of four-in-five households having used the internet in the last week in 2021, and 36 of Nauru's 47 Enumeration Areas having more than three-quarters of households with regular internet access, six localities reported less than one-quarter of households being internet users. This included Location EA1, where no households using the internet in the last week, while Anetan EA1 reported only 6.9 percent of households accessing the web.

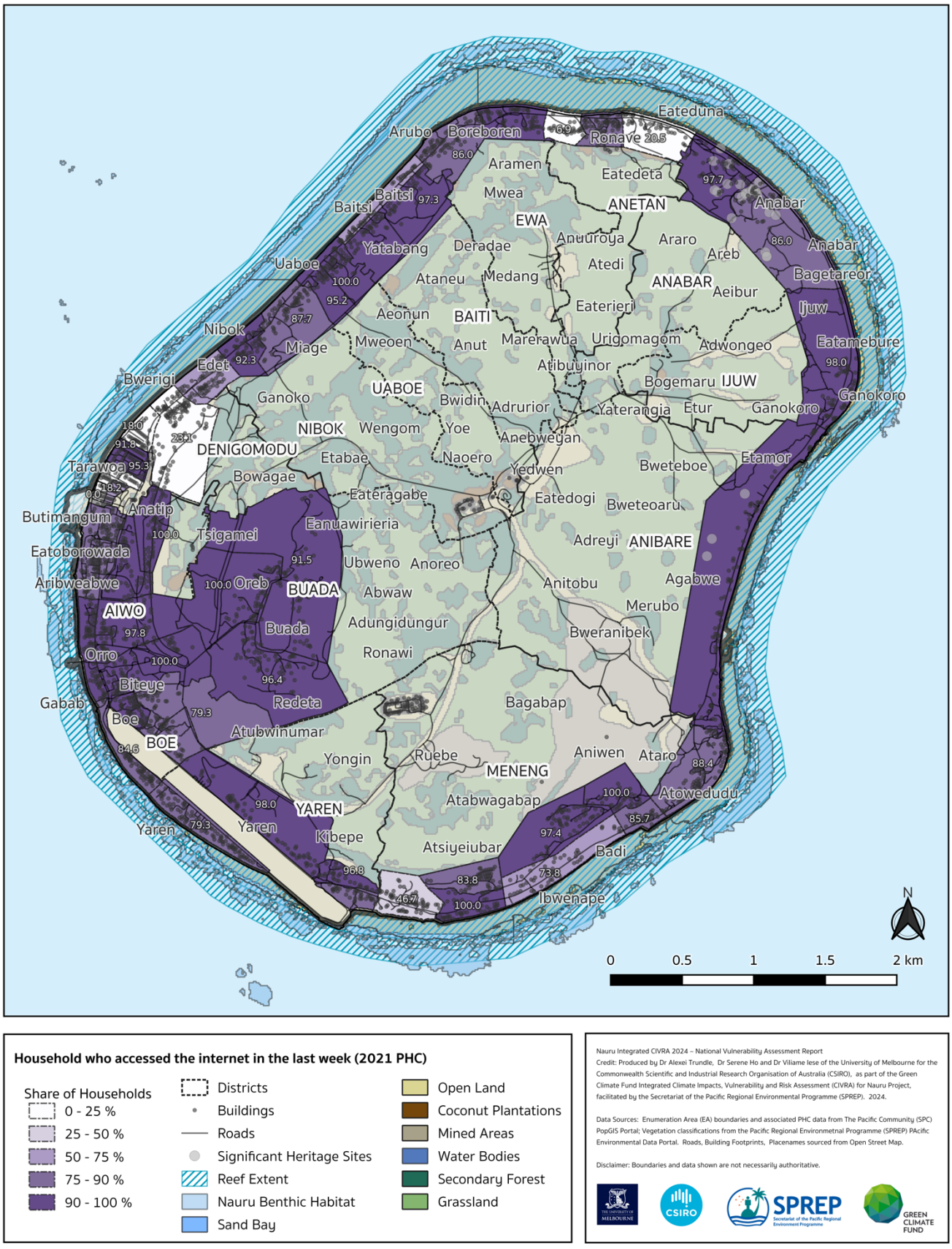


Figure 22: Households who accessed the internet in the last week – 2021

Disabilities have a significant impact on the sensitivity of community members to climate impacts, with special needs often required in disaster response (as discussed in Section 4.5), and several disabilities increasing the susceptibility of individuals to health-related impacts (as addressed in Section 4.2). Nauru has a universal disability allowance available for people with a disability, with the Nauru Disabled People's Association providing advocacy and support nationally.

The *Inclusion of Persons with Disabilities Act* was developed to give effect to the *United Nations Convention on the Rights of Person with Disabilities*, to which Nauru became a party in 2012. This Act provides for a Nauru Disability Coordinating Council, tasked with developing a National Disability Strategy. Additionally, the Act requires the development and maintenance of an official Register of Persons with Disabilities, with the former being currently formalised.In the interim, the 2021 census provides broad categories of persons with one or more disability, as shown in Table 21.

Women were overrepresented in seeing, hearing, mobility, and remember difficulties, with men only significantly more prevalent in the category of difficulties in communicating. As the number of persons in each locality was generally small, analysis of individual Enumeration Areas did not provide much insight on a per-category basis. However, both Location EA1 and Boe EA4 were overrepresented in multiple categories, despite the latter not being the highest ranked EA in any of the categories assessed in Table 21 below.

Table 21: Persons with Disabilities – Spatial Distribution and Trends (source: RON census data)

Census Data	Avg.	Lowest Decile	Highest Decile	Most Vulnerable EA		2002	2011	2021	Change
Persons aged 5 and over with at least some difficulties in:									
Seeing	2.7%	0.4%	2.7%	11.7%	Yaren (EA3)	-	-	2.7%	-
Women only	3.1%	0.0%	3.1%	14.8%	Aiwo (EA4)	-	-	3.1%	-
Men only	2.3%	0.4%	2.3%	9.3%	Yaren (EA3)	-	-	2.3%	-
Hearing	1.3%	0.0%	2.9%	6.0%	Boe (EA4)	-	1.4%	1.3%	→
Women only	1.5%	0.0%	3.9%	6.9%	Ewa (EA2)	-	1.3%	1.5%	↗
Men only	1.1%	0.0%	2.7%	9.1%	Location (EA1)	-	1.5%	1.1%	↘
Mobility	2.5%	1.2%	3.8%	7.0%	Aiwo (EA5)	-	1.9%	2.5%	↗
Women only	2.6%	0.8%	4.9%	8.5%	Aiwo (EA5)	-	2.0%	2.6%	↗
Men only	2.3%	0.6%	4.0%	5.4%	Aiwo (EA5)	-	1.9%	2.3%	↗
Remembering	1.5%	0.2%	3.1%	8.3%	Location (EA1)	-	-	1.5%	-
Women only	1.6%	0.0%	4.8%	7.7%	Location (EA1)	-	-	1.6%	-
Men only	1.4%	0.0%	3.8%	9.1%	Location (EA1)	-	-	1.4%	-
Self-care	1.5%	0.2%	3.1%	7.6%	Ewa (EA2)	-	-	1.5%	-
Women only	1.5%	0.0%	3.7%	6.2%	Meneng (EA7)	-	-	1.5%	-
Men only	1.6%	0.0%	3.8%	9.5%	Ewa (EA2)	-	-	1.6%	-
Communication	1.1%	0.0%	2.2%	5.2%	Denigo. (EA1)	-	0.8%	1.1%	↗
Women only	0.9%	0.0%	1.9%	7.1%	Denigo. (EA1)	-	0.8%	0.9%	→
Men only	2.7%	0.0%	2.7%	9.1%	Denigo. (EA1)	-	0.8%	2.7%	↗

Trends & Future Disruption

The volatility of Nauru's economy over the last three decades, coupled with rapid sociocultural upheaval, technological change, and significant population changes in the form of temporary residents within Nauru itself, has resulted in both ongoing and prospective future disruptions to the vulnerability of Nauru's community and its culture as being classified as extremely high. This is before factoring in wider externalities and uncertainties, which are discussed at length latter in this section of the vulnerability report.

One critical trend that underpins both community life and cultural practices is the total size of Nauru's population, including when distributed by age, which at present is especially dependent upon an anomalously high fertility rate. Although the average number of children per woman in Nauru fell steadily between 2011 and 2021, from 4.3 to 3.5, this remains the fourth highest in the Pacific, with the teenage fertility rate the highest in the region (SPC & RON, 2023, p. 117).

A sustained birthrate at current day levels with no migration would result in a Nauruan population of 14,006 by 2030 and 21,141 by 2050, a level that would result in a significant reduction of quality of life and significant additional environmental pressures. It should be emphasised that this hypothetical scenario is highly unlikely given both the declining levels of fertility and the capacity to migrate elsewhere, however it is illustrative of the complexity in assessing population trends.

Pollock noted in 1996, writing of the impact of mining on Nauruan women, that several Nauruan women "would like to use birth control methods to control their pregnancies, but the men and the government do not accept that view" (Pollock, 2014, p. 133). More recent projections of Nauru's future population, based on current rates of births and deaths in the country, suggest that there has been a significant cultural shift in the acceptance of birth control in Nauru. It is the declining levels of fertility, coupled with the potential for out-migration, that is provided as a rationale for UN projections of a leveling off of the country's population near current levels, as discussed in Section 2 (UN-DESA, 2018).

Rates of out-migration from Nauru saw a significant increase between 2000 and 2015, with an average of one in ten Nauruans migrating overseas over that period, primarily for education (51 percent of migrants), but also for labour schemes (21 percent) (Curtain & Dornan, 2019, p. 7). A UN survey of Nauruans in 2016 found that a significant number of Nauruans wanted to migrate between 2004 and 2012, but they were unable to do so, primarily because of a lack of financial resources (Campbell et al., 2016, p. 13). One-in-three households believed that migration out of Nauru would be a likely response if droughts, sea-level rise, or floods worsened (ibid).

Government-led formal social protection systems in Nauru have been strengthened over the last decade, with funding of social services – such as the disability benefit under the *Inclusion of Persons with Disabilities Act* – increasing by $13.9 million between 2014 and 2020, rising from 1.5 percent to 9.9 percent of GDP (GoN 2022, p. 17).Financial inequality in Nauru has, however, continued to worsen, with the national Gini coefficient – a statistical representation of income inequality – rising to 0.52 in 2013, up from 0.34 in 2021 (ibid). Despite Nauru's small size this level is now one of the highest in the Pacific.

Notable changes in the built environment evident in Table 20 are largely discussed in Section 4.6, however it is important to reiterate that the now more than one quarter of households one or less bedroom is an increase from only 11.9 percent in 2002 – is demonstrative of both overcrowding and also potentially a wider breakdown of extended family housing practices. Further analysis is needed to identify which of these two conditions is more prevalent, with some reports suggesting that houses are increasingly using external improvised spaces built from materials such as tarpaulins to cope with the housing crisis.

The rapid decline in engagement in agricultural and fishing practices over the last two decades is also discussed elsewhere (in Section 4.3 and 4.4 respectively) and is critical measure of the increasing vulnerability of associated cultural practices. However, the loss of non-edible cultural practices is also evident in areas such as the declining use of outrigger canoes, which were traditionally carved the now rare tamanu tree, *Calophyllum inophyllum*.

As shown in Table 20 the number of households with traditional canoes fell from roughly one-in-ten across Nauru in 2002 to less than one percent in 2021, suggesting that the remaining canoes were falling into disrepair and unable to be replaced or rebuilt.

The decline in seabird populations across Nauru is also problematic. 'Noddying', as discussed elsewhere, is a uniquely Nauruan hunting practice. Noddy birds also providing a key food source for the population. A loss of transmission of cultural knowledge from older to younger generations around skill for hunting and collecting traditional food has resulted in less awareness of cultural hunting and lay times and procedures (Inception meeting, Pers Comm, July 2024).

Uncertainties & Externalities

The complex societal changes that Nauruans have gone through over the last 150 years – driven almost exclusively by external pressures, monetisation, and capital goods – have had a profound and ongoing impact on sociocultural vulnerability in general, as well as in relation to climate-related shocks and stresses.

There is also significant uncertainty in the state of many of these community-level systems and structures, with limited research available outside of Nauru, and many practices and elements of the country's social fabric difficult to assess from the outside. As noted in Nauru's Draft 2021 State of the Environment Report, there is a need to document traditional knowledge, particularly that held by elders, as part of a process of engaging younger Nauruans in these cultural practices, if community resilience is to be sustained going forward

Other elements of community fabric have also undergone little analysis but play a critical role in disaggregating vulnerability information. For instance, Nauru's Disaster Risk Reduction status report notes that domestic and gender-based violence is a profound issue across the country, with 48 percent of women having experienced physical and/or sexual violence in intimate partner relationships at least once during their lifetime (UNDRR, 2022, p. 12). International studies have shown that instances of domestic violence often worsen during periods of extreme heat and disaster recovery more generally, but these elements have yet to be assessed in Nauru.

Constituent within the Nauruan community – and indeed its cultural milieu – are migrants, international workers, and expatriates, with varying degrees of climate vulnerability. Each of these groups has proved to be an extremely volatile – and in some cases, involuntary – component of the Nauruan community.

One such example is the nearly 4,000 i-Kiribaiti contract workers employed initially by the Pacific Phosphate Company, along with smaller numbers from China, Fiji, and elsewhere in the Pacific, almost all of which were repatriated in 2006 when primary mining operations ceased (Pollock, 2014, p. 116).

Another is the population of more than 1,200 asylum seekers who were sent to the Australian Regional Processing Centre, of whom many relocated, but a total of 120 resettled on the island upon successfully claiming asylum (Morris, 2021, p. 704). These latter numbers continue to fluctuate and will arguably increase further as climate change impacts further disrupt economies, livelihoods, and politics across Asia and the Pacific.

X. AREAS FOR FURTHER ANALYSIS & ADAPTATION PRIORITIES

As elaborated on in Nauru's climate vulnerability overview in Section 3, Nauru's level of existing exposure to climate-related hazards, as well as the relative severity of and exposure to projected climate changes over the medium term, are relatively moderate when compared with other Pacific Island Countries and Territories. However, across several key national sectors, and particularly when disaggregated down to the sub-national level, Nauru is extremely vulnerable to climate-related shocks and stresses. Aspects such as existing infrastructure deficits, as well as the wider structure of Nauru's economy and legacies of colonial and commercial exploitation of land, the biosphere, and traditional socio-cultural systems all contribute to its generally high level of climate vulnerability.

This viewpoint is broadly consistent with other socioeconomically derived measures of national vulnerability, such as the United Nations Multi-Dimensional Vulnerability Index (MVI), which ranks Nauru as the fourth most vulnerable country of all UN Member States, and the most vulnerable of all Pacific Small Island Developing States (United Nations, 2024, p. 45). Central to the MVI system is the coupling of structural vulnerability – a measure of underlying social, economic and environmental metrics – and structural resilience (or a lack thereof) – defined as the "inherent characteristics or inherited capacity of countries to withstand, absorb, recover from or minimize the adverse effects of shocks or stressors" (ibid, p. 19).

Nauru's 'Top 5' rating in the MVI index is accounted for primarily through its measured 'lack of structural resilience', in which it ranks first out of all assessed countries, followed by fellow Pacific Island Country Tuvalu (ibid, p. 45). Given these measures are primarily derived from proximity to global markets, availability of ecosystem services (ranging from forests to water sources) and arable land, and social measures such as economic productivity and even the share of population classified as refugees, Nauru's high global ranking is in many ways unsurprising.

However, as with many other areas of the Pacific, it has been more recently assessed that use of Western, capital-centric measures may underestimate the social connectivity, traditional knowledge systems, and other informal structures (economic and otherwise) from which the region continues to demonstrate highly effective and sustained forms of disaster response, management, and preparedness (Komugabe-Dixson et al., 2019; McEvoy et al., 2023). These endogenous forms of climate resilience, while not unique to the Pacific (see, for instance, L. M. Harris et al., 2017), are much more difficult to measure in global rankings, but are critical if localised, community level responses to climate change are to be developed.

Beyond these localised resilience qualities, several areas requiring further analysis are put forward throughout this report. Critical components, from a climate adaptation perspective, relate to the interconnected elements of water capture and storage (including within groundwater systems), changes to and severity of drought, and the impacts of sea level rise (particularly, saline ingress).

Rigorous understanding of both existing structures – ranging from rainwater tanks to the freshwater lenses under Nauru's lagoon systems – and also of the feasibility of prospective adaptation and development initiatives – such as the proposed network of reservoirs contained within the Higher Ground Initiative's Island Wide Master Plan – is crucial if Nauru is to invest sustainably in its future development pathways.

Gender disaggregation of the sectoral data presented in Section 4 is limited, with population level data able to be assessed, but little capacity to separate household level data in terms of the implications for vulnerability that are globally recognised to differ significantly between men, women, and non-binary persons. Assumptions on gender roles – for instance, the prevalence of women in home-caring duties – are a poor proxy and do little to improve understandings of different experiences of climate impacts, as well as capacities to adapt. A detailed gender-based adaptation assessment component would be beneficial within the National Adaptation Plan development process, beyond representation in consultations for development of the NAP.

Land tenure in Nauru is extremely complex, with cadastral information and associated tribal structures and distributions not included within this analysis. However, land rights are central to both the ongoing revenue from royalties, and the long-standing accumulation of wealth, by certain – but not all – family groupings across Nauru.

This interconnectivity with both capital accumulation (and associated adaptive capacity), as well as the ability to 'veto' large scale adaptation actions, must be clearly understood if Nauru's more substantive adaptation projects are to be successful. This extends to individuals and families who do not hold formal tribal land ties, with informal settlements – both 'squatters', but also those living in unsanitary or

overcrowded housing – not reflected in the most recent 2021 census, or any other government documentation.

Extreme heat impacts are increasingly being recognised to closely interrelate to a range of vulnerability measures that are physiological, behavioural, and environmental. In the case of Nauru, even general assessments of the effectiveness of dwellings to keep Nauruans within productive or even safe thermal ranges are highly inaccurate, with census records not differentiating households that *lack* cooling mechanisms but rather inventorying the number that have different forms of cooling devices (with unknown levels of overlap). This confounds inaccurate and incomplete diurnal and nocturnal temperature records, the coupling of which over multi-day periods is increasingly considered best practice for determining extreme heat risk.

Alternative measures of heat exposure, derived from hospital records of presentations, mortality and morbidity, were not able to be assessed as part of this report. Given the clear trajectory towards overall higher average temperatures, proportionate to rising heat extremes and increasing minimum temperatures (as reflected in CSIRO et al., 2024), this area should be prioritised in future adaptation planning processes.

The reduction in levels of nearshore fishing, coupled with surveys identifying undersized and depopulated reef fish stocks, present a particularly acute source of systemic vulnerability to both the Biodiversity and Environment and Fisheries and Marine Resources sectors.

It is unclear whether these changes are driven by adjusting social behaviour, or if the depletion of fish stock has reached critical thresholds that make fishing unproductive. Although analysis of these behavioural shifts is itself useful, any studies should also consider strategies to integrate traditional coastal management systems and 'taboos', which have been variously noted to have been used effectively within living memory but are no longer used or enforced.

Assessment of household food production shows a limited range of food crops are grown, with generally high levels of exposure to Nauru's highly variable levels of rainfall. Although several programs are currently in place to encourage local food production, including provision of seed stock through local nurseries, a better understanding of climatic thresholds and innovative growing techniques that minimise water loss (and maximise nutrients balance) would be beneficial.

As noted in various planning documents and technical reports, the overall quality of Nauru's housing stock is extremely poor, suffering from legacies of poor quality and even carcinogenic building materials, high costs for imported materials, and disincentivisation of building improvements due to the multiplicity of the land ownership system. A national housing strategy – drawing on low-cost, climate adaptive building designs, is urgently needed to improve the baseline resilience of Nauru's inhabitant population.

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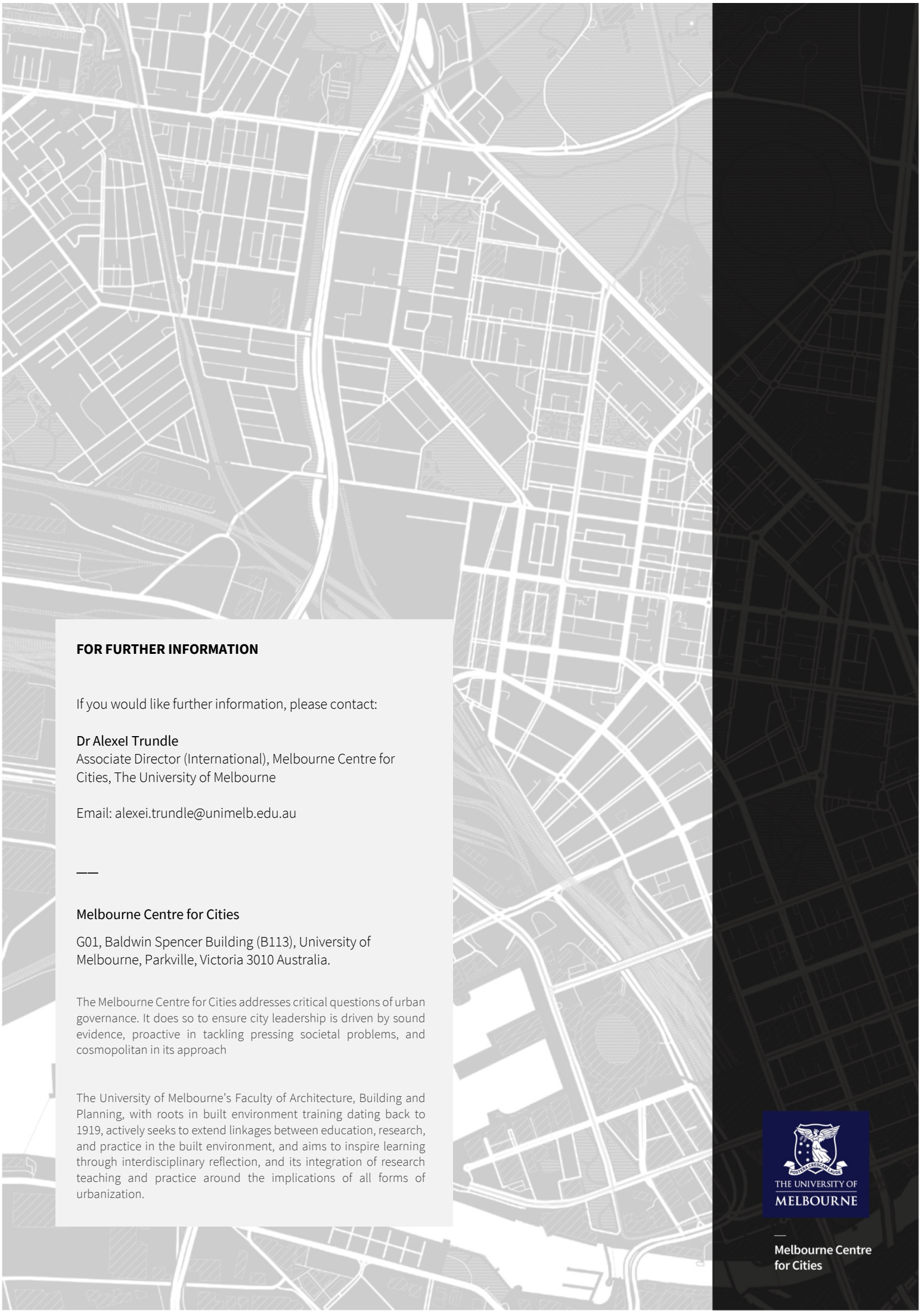

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